U.S. General Services Administration

P100 FACILITIES STANDARDS
FOR THE PUBLIC BUILDINGS SERVICE

May 2024

Figure 1(Cover): U.S. Courthouse
San Antonio, TX

Figure 2: U.S. Courthouse Interior
San Antonio, TX

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INTRODUCTION TO P100

Through its Public Buildings Service (PBS), the U.S. General Services Administration (GSA) contracts for the design, construction, and operation of federal civilian buildings. PBS provides workspace primarily with courthouses, land ports of entry, and federal office buildings. It ranks among the largest holders of real estate in the United States.

The *Facilities Standards for the Public Buildings Service* (P100) establishes mandatory standards and criteria for its owned inventory and lease construction facilities that the Government intends to own or has an option to purchase. P100 applies to many project types and sizes across the country and its users span the entire spectrum of building professional disciplines. P100 informs and regulates decisions made throughout a project's life. This document contains both performance-based standards and prescriptive requirements to be used in the programming, design, and construction of GSA buildings.

UPDATING P100

P100 is on a three-year update schedule which closely aligns with other codes and standards. Addendums may be issued in the interim to reflect new legislation, executive orders, or significant updates. A GSA Steering Committee is responsible for updating requirements and working with industry on new developments. The latest updates, guidance, and training are available at [www.gsa.gov/p100.](www.gsa.gov/p100) Change proposals are accepted through this form. Proposals will be reviewed for the next update or addendum. Questions about P100 or the update process can be directed to p100@gsa.gov.

Figure 3: Jonas Federal Building and U.S. Courthouse
Charlotte, NC

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GENERAL REQUIREMENTS

Figure 4: Jonas Federal Building and U.S. Courthouse Interior Charlotte, NC

The design team must review and show compliance with the building program and performance at each stage of the project, as required in Appendix A. This ensures that the requirements of the program, P100, and relevant codes and standards have been met and to guard against unplanned expansion of the program because of design and engineering choices.

All prospectus-level projects are required to follow the Design Excellence Policies and Procedures

1.1 PURPOSE OF THE FACILITIES STANDARDS

P100 is a mandatory standard. It is not a guideline, textbook, handbook, training manual, nor substitute for technical competence. P100 represents the current state of practice in designing facilities to meet GSA's commitments, maximize the efficiency of business processes, and comply with the requirements of law.

P100 must be used in conjunction with the governing standards referenced in this document, as well as the building program for each project. If conflicts exist between the facilities standards and a specific program or project requirements, contact the PBS Office of Architecture and Engineering for resolution.

Since 2014, P100 has moved to more performance-based requirements. A large portion of the standard now specifies levels of performance, allowing a project team and GSA's other professional partners to identify and implement the best strategies to meet those goals.

Design Excellence Policies and Procedures identifies the Regional Project Management Team (RPMT) as the primary contact for design and construction projects. The RPMT is made up of the regional project manager, the contracting officer, and the regional chief architect. The RPMT have many responsibilities related to the implementation of P100 and are referenced throughout for resolutions and access to certain information.

In general, four levels of performance are defined throughout P100 in matrices. It is the RPMT's responsibility to use the P100 Performance Matrix to document the "baseline" performance for their project. Different building types may have a higher starting threshold, and the Matrix attempts to identify these cases, but the program specific guides listed in P100 provide the final requirements. Each project may implement any combination of performance levels to prioritize opportunities that stem from climate, site, program, mandates, and other conditions. Performance goals must be validated at various phases of design with Design Excellence and through construction with total building commissioning.

Links to documents, websites, and other information are provided throughout P100 for convenience. It is the design team's responsibility to use the correct reference or information at the time of project solicitation.

1.2 APPLICATION OF P100

Once issued, P100 is required and must be listed in the initial contract for a project advertised after the issuance date. A new P100 is not retroactive to contracts that are already underway or to existing facilities, equipment, structures, or installations that have no projects.

P100 applies regardless of the funding source. Thus, P100 applies equally to projects funded through BA51 New Construction, BA54 Minor Repairs and Alterations, and BA55 Major Repairs and Alterations, BA61 Operating Funds (including work performed under operations and maintenance contracts), BA63 Energy Rebates, BA64 Historic Preservation, as well as customer-funded projects through BA80 Reimbursable Work Authorization and privately financed projects such as an Energy Savings Performance Contract. This document also applies to certain BA53 lease construction facilities.

1.2.1 REPAIRS AND ALTERATIONS

A repair is to restore an item to good working order or safe condition, to fix, or to improve a damaged condition. An alteration is any work that adds, removes, or replaces items to the building, systems, or equipment. Compliance with P100 is required for repairs including "in kind" and alterations to the extent the work is identified in the approved and funded project scope of work. A waiver is required for any deviations from P100.

Abandonment-in-place of unused elements is not permitted within the scoped work area of a repair or alteration. Further removal may be required by code.

1.2.2 LEASE CONSTRUCTION

Lease construction is new construction of a facility for Government use required by GSA's formal Request for Lease Proposals (RLP).

P100 must be included where GSA's formal Request for Lease Proposal (RLP) has an option for GSA to purchase the building at a future date. The requirements of P100 will be included in the RLP on a case-by-case basis, in consultation with the Chief Architect. Exclusion of P100 from lease construction facilities where GSA's formal RLP has an option for GSA to purchase the building requires Chief Architect written approval. In addition to the GSA-adopted nationally recognized codes and requirements, state and local government codes apply. If a conflict exists between applicable state and local government codes and the GSA requirements, the developer must identify these conflicts in writing and request a resolution from the GSA contracting officer.

1.2.3 TENANT IMPROVEMENTS

Tenant Improvements (TI) are the customized alterations GSA makes to configure the space for the needs of the tenant.

The GSA PBS Pricing Desk Guide (PDG) defines the policies used by PBS to price real estate and related services to federal customer agencies.

PDG sets policy for the entire PBS owned and leased portfolio, provides pricing direction for both cases and special circumstances. It is designed to guide PBS employees in the performance of their work and serve as a resource for Customer Agencies seeking a more thorough understanding of the PBS Pricing Policy and its application.

Utilize the latest PDG edition at the time of project solicitation. Coordinate Tenant Improvement alterations and renovations with the PBS P-120 cost and schedule management requirements.

1.2.4 DEVIATIONS FROM P100

1.2.4.1 WAIVERS

Deviations from P100 require an approved waiver except as noted below. Project teams seeking relief from requirements must establish the technical hardships that make compliance impossible. Alternatively, requests for waivers may demonstrate that non-compliance is life cycle cost beneficial. Budget and/or time constraints are not technical hardships and will not be considered as they do not ensure the life cycle cost benefits of GSA's real estate investments. Waivers must be requested in writing by the regional commissioner or designee and approved by the Office of Architecture and Engineering before the final concept submission is presented. The following deviations utilize other processes:

- Waivers for addressing the requirements in Chapter 7, Fire Protection, are not permitted. However, alternative, and equivalent compliance requests for deviations from the requirements in Chapter 7 require an approved alternative and/or equivalent compliance solution in accordance with the requirements in Chapter 1 Alternative and Equivalent Compliance. Such requests for alternative and/or equivalent compliance must also include a concurrence signature from the regional Fire Protection Program Office and follow a similar approval process as the waiver process.
- Waivers or modifications from the Architectural Barriers Act Accessibility Standard (ABAAS) must be approved by the Commissioner of PBS. The ABAAS process is explained in the "National Accessibility Program—Standards, Policies and Procedures"
- Metric Waivers—See GSA Metric Order, GSA Metric Program, for guidance.

1.2.4.2 ALTERNATIVE AND EQUIVALENT COMPLIANCE

GSA encourages the development of new and innovative building systems. The provisions of this document are not intended to prohibit the use of alternative systems, methods, or devices not specifically addressed by P100. The use of alternative systems, methods, or devices is permitted to meet the intent of the prescribed requirements in P100 were approved as being equivalent. All technical documentation for alternatives must be submitted and approved by the regional program office prior to final concept submission. Proposed alternatives must be equivalent or superior to P100 requirements concerning quality, cost, strength, effectiveness, fire resistance, durability, efficiency, and safety. All proposed alternatives must be accomplished within the project budget and schedule. The approved alternative will be recognized as being an equivalent design solution and compliant with P100. The use of an alternative and equivalent compliance method is not to be considered a waiver.

1.2.4.3 NEWER VERSIONS OF P100

Project teams may choose to apply a newer version of P100 to ongoing projects. If the design team determines benefits to the project from the newer version, they must document potential changes for the appropriate sections of P100 to submit to the RPMT. If approved, a copy of the documentation must be submitted to the central office P100 Waiver Program Manager.

1.3 FEDERAL LAWS, REGULATIONS, AND STANDARDS

The following are federal laws, regulations, and standards applicable to all projects.

1.3.1 PUBLIC BUILDINGS AMENDMENTS OF 1988

The Public Buildings Amendments of 1988, 40 USC §3312, require that each building constructed or altered by GSA, or any other federal agency must, to the maximum extent feasible, comply with one of the nationally recognized model building codes and with other applicable nationally recognized codes. These projects must consider local zoning laws and other local requirements. It also provides for state and local government consultation, review, and inspection and requires the agency to give due consideration to state and local government recommendations.

1.3.2 ENVIRONMENTAL PROTECTION

In addition to building-specific codes, GSA projects must comply with applicable federal, state, and local environmental, energy efficiency, and greenhouse gas emission laws, regulations, and executive orders if more stringent than P100. Project teams are advised to collaborate with the GSA regional environmental coordinator and the Office of Architecture and Engineering for assistance during the design process.

Among the key mandates is the National Environmental Policy Act (NEPA). NEPA requires that federal agencies consider and document the environmental impacts of proposed actions as part of their decision process. Although NEPA activity often takes place prior to design start, it is vital that project teams are aware of any assertions or commitments GSA made during the NEPA process, to ensure that these are adhered to during design. Depending on the outcome of the NEPA process, relevant commitments, or assertions as to the scope, strategy or scale of the project may be found in a Finding of No Significant Impact (FONSI), a Record of Decision (ROD), or even a Categorical Exclusion (CATEX). The project team must be aware of these legally binding commitments and must address them, as appropriate, in the project design.

1.3.3 ENERGY AND SUSTAINABLE DESIGN

Legislation directed toward energy efficiency and sustainability continues to increase.

Laws, regulations, and Executive Orders affecting the design and operation of federal buildings include:

- EO 14057 Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability
- EO 14008 Tackling the Climate Crises at Home and Abroad
- EO 13990 Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis
- Energy Act of 2020
- Energy Independence and Security Act of 2007 (EISA 2007)
- Energy Policy Act of 2005 (EPAct 2005)
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles)
- Resource Conservation and Recovery Act of 1976 (RCRA)

1.3.3.1 ENERGY REBATES (BA63)

Project teams must pursue utility rebate and incentive programs and any government grant or incentive programs at the local, state, and federal level. Project teams are encouraged to contact the local utility as early in the design process as possible to determine if the project qualifies for a financial incentive or rebate, as local utilities often offer “custom” or unadvertised rebates. Rebate checks must be submitted to GSA.

Examples of projects that are typically eligible for rebates or incentives include the following:

- Building envelope improvements (windows, roofing, doors, weather stripping)
- HVAC upgrades and new installations (boilers, chillers, VFDs, tune ups, controls, etc.)
- Lighting retrofits (LED upgrades, controls, etc.)
- Appliance purchases (cafeteria equipment, water heaters, etc.)

1.3.4 HISTORIC PRESERVATION

The National Historic Preservation Act (NHPA) of 1966 mandates that federal agencies use historic properties to the greatest extent possible and strive to rehabilitate them in a manner that preserves their architectural character, in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR §67).

Further, projects impacting historic properties must comply with NHPA's Section 106 process. This process often results in GSA making legal commitments to execute the project in a certain way. In most cases, the Section 106 consultation process, and any resulting agreement documents, should be completed prior to the issuance of a FONSI or a ROD. As with NEPA, the project team must be aware of these commitments and must address them in the project design documents. Project teams must consult with GSA's Regional Historic Preservation Officer for assistance.

1.3.5 THE ARCHITECTURAL BARRIERS ACT ACCESSIBILITY STANDARD (ABAAS)

GSA policy is to make all federal buildings accessible without the use of special facilities for persons with disabilities. The intent of this policy is to use standard building products set at prescribed heights and with prescribed maneuvering clearances to allow easy access by disabled employees and visitors. Building elements designated specifically for use by persons with disabilities should be kept to a minimum.

ABAAS is mandatory for all GSA projects. If local accessibility standards exist, the design team must follow the most stringent requirements between the local standards and ABAAS.

The criteria of this standard must be considered a minimum in providing access for persons with disabilities. Dimensions that are not stated as "maximum" or "minimum" are absolute. All dimensions are subject to conventional industry tolerances except where the requirement is stated as a range with specific minimum and maximum end points. The accessibility requirements of the I-codes can only be used if more stringent than ABAAS.

1.3.5.1 ACCESSIBLE PUBLIC ENTRANCES

All public entrances provided in accordance with Paragraph F206.4.1 (Public Entrances) of the ABAAS must have at least one entrance door complying with Section 404.3 (Automatic and Power-Assisted Doors and Gates) of the ABAAS. Where an accessible public entrance has a vestibule with exterior and interior entrance doors, at least one exterior door and one interior door must comply with Section 404.3.

1.3.6 OCCUPATIONAL SAFETY AND HEALTH REGULATIONS

The Department of Labor Occupational Safety and Health Administration (OSHA) does not directly regulate facility design; however, the construction, operation, and occupation of facilities must comply with OSHA regulations. The design team must ensure that facilities can be constructed in a manner compliant with 29 CFR §1926; the design must anticipate facility operations and maintenance and ensure they can be performed in compliance with 29 CFR §1910; and must not subject building occupants to conditions in violation of 29 CFR §1910.

1.3.7 RANDOLPH-SHEPPARD ACT

The Randolph-Sheppard Act provides qualified blind persons the opportunity to operate businesses on federal, state, or other property. The design team must coordinate design with the vending facility operators to meet the needs of vendors covered by the act.

1.3.8 BUY AMERICAN ACT

Only domestic construction materials must be specified in construction contracts performed in the United States except when a waiver to the Buy American Act is granted or per the requirements in FAR 25.2.

1.3.9 FACILITY DEFINITIONS

1.3.9.1 ESSENTIAL FACILITIES

The International Building Code (IBC) has defined essential facilities as “Any building and other structure that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquake". Buildings and other structures designated as essential facilities include but are not limited to: Group I-2 occupancies that have surgery or emergency treatment facilities, aviation control towers, or fire and police stations.

1.3.9.2 CRITICAL ACTION FACILITIES

The Department of Homeland Security Federal Emergency Management Agency has defined a facility as "Critical Action” when even a slight chance of flooding is too great. If critical action structures must be located within a 1-percent-annual-chance (also known as the 100-year), 0.2-percent-annual-chance (500-year) or the Federal Flood Risk Management Standard (FFRMS) floodplain (i.e., there are no practicable alternatives), critical infrastructure must be elevated above the applicable floodplain elevation. Critical actions include, but are not limited to:

- storage of irreplaceable records
- the production, use, or storage of highly volatile, flammable, explosive, toxic, or water-reactive materials
- hospitals and nursing homes, and housing for the elderly, which are likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during flood and storm events.

The critical action designation is established under the decision-making process outlined in the accompanying Desk Guide for GSA Order PBS 1095.8A, Floodplain Management. The U.S. Courts has determined that all new court houses are critical action facilities. Refer to Chapter 4, Flood Resistant Design Requirements.

1.3.9.3 MISSION CRITICAL FACILITIES

The tenant will determine this designation during project development. A mission critical facility contains any operation that, if electrical supply is interrupted, will cause a negative impact on business activities, ranging from losing revenue to jeopardizing legal conformity, and loss of life. Examples may include data centers, hospitals, laboratories, public safety centers, court houses, land ports of entry, research facilities, law enforcement, and critical file and payroll centers. See Chapter 1, Resilience, Chapter 3, Enclosure, Chapter 5, Wildfire Smoke Mode, and Chapter 6, Primary Distribution for requirements.

The Federal Data Center Enhancement Act notes a "growing need for Federal agencies to use data centers and cloud applications that meet high standards for cybersecurity, resiliency, and availability". The minimum requirements applicable to data centers will be documented and published by the IT Modernization Division (GSA). Please contact dccoi@gsa.gov for more information.

1.3.10 PROHIBITION OF FORCED OR CHILD LABOR

The Trade Facilitation and Trade Enforcement Act of 2015 (TFTEA), the Uyghur Forced Labor Prevention Act and FAR clauses prohibit products created with forced or child labor.

It is the design team's responsibility to specify products that do not use such labor. Utilize tools from Design for Freedom, Cradle to Cradle, B-Corp, SA8000 and others to select materials that comply with law.

1.4 NATIONALLY RECOGNIZED CODES AND STANDARDS

For all design and construction work that GSA performs on federal buildings, or those functions under GSA’s construction authority, GSA has adopted the technical requirements of the nationally recognized codes and standards referred to in this subsection. The technical requirements of these codes and standards are supplemented by mandates of federal laws and Executive Orders, as well as GSA and other federal agency criteria. The latest published edition of these codes and standards, in effect at the time of project solicitation, must be used throughout design and construction of the project.

All new work not identified in P100 is required to meet or exceed the applicable national codes and standards adopted by GSA. If a major portion of the building or an entire building component is being renovated, which affects/impacts multiple codes, the specific codes must be evaluated to determine if the building or component must be brought into compliance with those codes. Any questions or concerns must be discussed with the RPMT.

1.4.1 CONFLICTS BETWEEN CODES OR STANDARDS AND GSA REQUIREMENTS

To ensure flexibility, GSA’s policy is to make maximum use of equivalency clauses in the required codes and standards. If a conflict exists between GSA requirements and the GSA-adopted codes or standards, the GSA requirements take precedence. All such conflicts must be brought to the attention of the RPMT as appropriate for resolution.

1.4.2 ICC INTERNATIONAL CODES

GSA has adopted the technical requirements of the International Codes, or I-Codes published by the International Code Council (ICC). The International Green Construction Code (IgCC) is required as referenced in specific sections of P100. Exceptions to the I-Codes are noted below. Follow link to the ICC I-Codes.

1.4.3 NFPA LIFE SAFETY CODE

GSA has adopted the technical egress requirements of the National Fire Protection Association (NFPA), Life Safety Code (NFPA 101), in lieu of the technical egress requirements of the IBC. Follow link to The Life Safety Code.

1.4.4 NFPA NATIONAL ELECTRICAL CODE

GSA has adopted the technical electrical requirements of the NFPA, National Electrical Code (NFPA 70). Follow link to the National Electrical Code.

1.4.5 NATIONAL STANDARDS

Organizations writing voluntary national standards, including NFPA; the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE); the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA); the National Roofing Contractor Association (NRCA); the Institute of Electrical and Electronics Engineers (IEEE); and the American Society of Mechanical Engineers (ASME), publish standards on health, safety, welfare, and security that are recognized by GSA in various chapters of P100. Consistent with GSA's long-standing policy to comply with nationally recognized standards to the extent practicable, these standards must be used as indicated in P100. The latest edition of the nationally recognized standards herein, in effect at the time of project solicitation, must be used during design and construction.

1.4.6 WILDLAND URBAN INTERFACE

Each building must comply with the latest edition of the International Wildland-Urban Interface Code (IWUIC), promulgated by the International Code Council, if the building is at moderate or greater wildfire risk as defined in the IWIUC, using the USDA "The 2010 Wildland-Urban Interface of the Conterminous United States" map.

1.4.7 INTERAGENCY SECURITY COMMITTEE RISK MANAGEMENT PROCESS FOR FEDERAL FACILITIES

The Risk Management Process for Federal Facilities: An Interagency Security Committee Standard (ISC) (current edition) defines the criteria and processes that those responsible for a facility's security use in determining its security level. This standard provides an integrated, single source of physical security countermeasures and guidance on countermeasure customization for all nonmilitary federal facilities. The ISC standard incorporates several appendices (For Official Use Only - FOUO) that are not repeated here. Refer to the ISC standard for more information.

The Facility Security Committee (FSC), consisting of representatives of all federal tenants in the facility, the security organization (for example: Federal Protective Service (FPS) for General Services Administration (GSA) owned and operated facilities), and the owning or leasing department or agency, determines the Facility Security Level (FSL) for the facility.

In general, the FSC is responsible for addressing the facility-specific security issues addressed in the facility security assessment and approving the implementation of security criterion (aka countermeasures) and practices recommended by the security organization. The implementation may be a combination of operational and physical security measures based on the FSL, and the level of protection (LOP) that is deemed both appropriate and achievable. Physical security countermeasures may include architectural, interior design, landscape design, structural, mechanical, and electrical design requirements as part of the security criterion listed in the table below.

Table 1.1 Physical Security Countermeasures

Discipline	Security Criterion may include but may not be limited to: (Note: Where discipline specific security requirements are specified and/or guidance is available, the individual P100 technical chapters provide this information)
Structural	Blast Resistance - Windows Blast Resistance - Facade and Structure Blast Resistance - Progressive Collapse Blast Resistance - Under-Building Parking Burglary Resistance of Windows Walls and Non-Window Openings Windows in Critical Areas - Ballistic Protection Blast Resistance - Interior Public Spaces Blast Resistance - Mail Screening and Receiving Location Interior Windows
Mechanical	Protection of Air Intakes Isolated Ventilation Systems HVAC Control CBR Detection Technology Biological Filtration - General Building Biological Filtration - Lobbies and Mailrooms Chemical Filtration Security of Ventilation Equipment and Controls Location of Utilities and Feeders Protection of Water Supply
Electrical	Site Lighting Vehicle Screening lighting Location of Utilities and Feeders Separation of Emergency and Normal Power Distribution Emergency Generator Protection

Discipline	Security Criterion may include but may not be limited to: (Note: Where discipline specific security requirements are specified and/or guidance is available, the individual P100 technical chapters provide this information)
Architecture and Interior Design	Identification as Federal Facility Pedestrian Access to Site Vehicle Access Points Restricted Areas or Significant Areas and Assets Signage - Sensitive Areas Control of Parking Vehicle Access to Controlled Parking Vehicle Screening Pedestrian Access to Controlled Parking Areas Hazardous Materials Storage Receptacle and Container Placement Location of Utilities and Feeders Emergency Generator Protection Regulatory Signage Lobby Queuing Entrance Co-location Perimeter Doors & Door Locks Employee Convenience Doors Emergency Exit Doors Space Planning Access to Nonpublic Areas Security of Critical Areas Building Systems and Roof Access Publicly Accessible Restrooms Publicly Accessible Retail and Mixed-Use Space
Landscape Architecture	Landscape Design Site Layout Perimeter Security

Facility Security Level Determinations and Levels of Protection (LOP) must be determined by the FSC for all new construction, renovation and major modernization projects during the requirements definition process and approved security criterion incorporated into the program of requirements. The baseline for GSA buildings is to meet the ISC Risk Management Process (current edition) and Appendices for the given Facility Security Level (FSL). See the PBS, Office of Project Delivery Project Management Guide (PM Guide) for information on Security Requirements, links to the ISC standards and guidance for developing the project program of requirements.

1.4.8 ASHRAE 90.1

The U.S. Department of Energy (DOE)'s final rule on Federal agencies' use of ANSI/ASHRAE/IES Standard 90.1 is published at 10 CFR §433.

- GSA has determined that new building projects, must use the latest performance standard §433.100 and performance level determination as listed in §433.101, at the time of project solicitation, regardless of the start (effective) date listed by DOE.
- GSA has determined that all existing building projects must use the latest energy efficiency performance standard as listed in §433.100 (a)(5)(i) at the time of project solicitation, regardless of the start (effective) date listed by DOE.

1.5 STATE AND LOCAL CODES

Facilities built on federal property are exempt from state and local building codes. GSA recognizes that the national building codes are typically the foundation of state and local building codes, and that state and local codes represent important regional interests and conditions. In keeping with federal law (incl. the Public Buildings Amendments of 1988 and the Federal Urban Land Use Act of 1949), it is GSA's policy to comply with state and local building, energy, green, and construction codes to the maximum extent practicable if more stringent than P100 requirements. However, GSA has the final authority to accept or reject any recommendation from state and/or local government officials.

1.5.1 STATE AND LOCAL GOVERNMENT CONSULTATION AND REVIEW

The Public Buildings Amendments of 1988, 40 USC §3312, direct that GSA must consider all design requirements (except procedural requirements) of state or local governments, which would apply if it were not a building constructed by a federal agency before construction or alteration. This includes zoning as well as laws related to landscape, open space, building massing and orientation, and aesthetic considerations. To meet these requirements, GSA will consult in a timely manner with appropriate local officials in preparing plans for the building.

The RPMT must provide the appropriate state and/or local government officials the opportunity to review the project for compatibility with local planning, design objectives, and zoning compliance. Local reviews must occur early in project development so that the design can easily respond to appropriate recommendations. These reviews include, but are not limited to, the review of drawings and specifications, making recommendations for compliance with local regulations, compatibility with local planning goals, and alignment with first responder requirements. In most cases, collaboration with local officials required to meet these standards will be in addition to, and not a substitute for, NEPA consultation with local officials. The RPMT must inform state and local government officials that GSA and its contractors are not allowed to pay any fee for any actions taken by the state and/or local government officials in connection with local reviews or inspections. GSA will review all recommendations made by state and local government officials. Each recommendation will be carefully considered based on adequacy, cost, and nationally accepted practice. GSA has the final authority to accept or reject any recommendation from state and/or local government officials. The RPMT will maintain a record of all recommendations and comments from state and local government officials for the duration of the project.

The above requirements are also directed by the Federal Urban Land Use Act of 1949 (40 USC §901-905) and Executive Order 12072.

1.5.2 ZONING AND RELATED ISSUES

As noted elsewhere, federal law directs that GSA projects, to the greatest extent practicable, be consistent with the zoning, land-use practices, and development objectives of the local government. Further, GSA projects that impact the public realm must be executed only after due consideration of all requirements (other than procedural requirements) of zoning laws; laws relating to landscaping, open space, building orientation and massing, historic preservation, aesthetic qualities of a building; and other similar laws of state or local government which would apply to the project if it were not a building constructed or altered by a federal agency.

An exception to state and local codes requirements noted above are local regulations on the design of systems that have a direct impact on off-site terrain or infrastructure. GSA will incorporate these requirements into the project if more stringent than P100. These systems include, but are not limited to, fire protection services, storm water runoff, erosion control, sanitary sewers and storm drains, water, gas, electrical power, communications, emergency vehicle access, roads, and bridges.

Although federal law gives GSA latitude to determine what design strategies are practicable on each project, compliance with the letter and intent of these laws demands that project teams comply with the collaborative design requirements outlined in this document.

A P100 waiver would be required for designs that deviate from compliance with local zoning, design, and development objectives.

Finally, the project team must offer local officials a timely opportunity to review and comment on the GSA project plans for compatibility with local plans, zoning, and design guidelines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the RPMT must document this in the project file.

1.5.3 DESIGN REVIEW FOR CODE COMPLIANCE

The RPMT must provide the appropriate state and/or local government officials the opportunity to review the design for building code compliance. The RPMT will officially forward design submissions to the appropriate local officials.

1.5.4 CONSTRUCTION INSPECTIONS

If state and local government officials elect to perform code compliance construction inspections, the RPMT must include provisions in both the design team and the construction contract for coordination of the work with local officials. State and local government officials do not have the authority to reject, accept, or make changes to the work, and their inspections are done only to assist GSA in achieving code compliance.

1.6 PROGRAM-SPECIFIC GUIDES AND STANDARDS

In addition to P100, GSA and its customer agencies use several specific guides and standards that address program requirements. Use of these guides is mandatory. In case of conflicts between P100 and a specific building guide, the more stringent requirement will take precedence. If conflicts exist between the facilities standards and specific program and project requirements, contact the Office of Architecture and Engineering for clarification. Refer to the GSA Pricing Desk Guide for guidance on Tenant Improvements.

1.6.1 FEDERAL COURTHOUSES

The Office of Architecture and Engineering provides guidance on all levels of development of courthouse projects, including Congress, OMB, the Administrative Office of the United States Courts, and GSA serves as a liaison for all courthouse projects. See the RPMT for access and detailed descriptions of the publications listed below and their application:

- Capital Security Program Handbook
- U.S. Courts Design Guide

- U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space, Volumes 1-3, Publication 64

1.6.2 LAND PORTS OF ENTRY

GSA provides guidance on the management of the border station program, including strategic planning, budgeting, benchmarking, and design guidance. For more information:

- United States Land Port of Entry Design Standard, see RPMT for access

1.6.3 CHILD CARE CENTERS

Requirements for child care centers must be incorporated early in the design and planning process. The references below provide guidance on such topics as site design, emergency evacuation, food services, safety, security, mechanical, electrical, and plumbing:

- Child Care Center Design Guide (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)
- Interagency Security Committee Appendix C: Child Care Level of Protection Template (FOUO)

1.6.4 HISTORIC PRESERVATION

Performance requirements for projects affecting historic properties must be incorporated into qualification requirements, project scopes of work, and construction contracts. Project teams undertaking feasibility studies, repairs, alterations, or new construction within or adjoining historic properties must include a historical architect, architectural conservator, or preservation specialist, as applicable, who meets U.S. Department of Interior Professional Qualification Standards and GSA Qualification Requirements.

Projects affecting historic properties, including landscape modifications and infrastructure work involving ground disturbance, must follow the Secretary of the Interior's Standards for the Treatment of Historic Properties in accordance with GSA ADM 1020.3 Procedures for Historic Properties, as directed by GSA's Regional Historic Preservation Office. The performance level to be met within the standards will be determined by the historical architect or preservation specialist, who must be integrally involved in the design and analysis of all alternatives affecting restoration or rehabilitation zones as defined in the Building Preservation Plan (BPP) or Historic Structure Report (HSR). The minimum standard treatment is rehabilitation with viable design alternatives that avoid adverse effects on historic spaces and materials. Each study and design submission must include a Section 106 Compliance Report documenting the development and analysis of preservation design alternatives in photographs, detail drawings, and project descriptions explaining how the recommended solutions address preservation issues raised by the project. Designs must follow applicable GSA Technical Guidelines and requirements for historic buildings in P100.

Contract documents for repair, cleaning, restoration, or alteration of historic building materials must include GSA technical competency requirements for work requiring specialized skills required to meet preservation standards.

1.6.5 FIRST IMPRESSIONS

The First Impressions program extends the vision of Design Excellence into public lobbies of federal buildings. These are the areas that shape a visitor's "first impression" of the Federal Government. Lobby security is a critical part of these public spaces, and visitors should be able to seamlessly navigate these areas without delay or confusion. The goal is to provide guidance for creating world-class lobbies. Five action points form the foundation of the First Impressions program. These action points are applicable across projects of all scopes and funding levels.

- Reduce Clutter—A place for everything and everything in its place.
- Consolidate Functions—Cluster amenities by function, creating centrally located business centers.
- Unify Signage—A unified signage system is critical to access.
- Streamline Security—Security should not be intrusive or intimidating.
- Transform your image—The result of integrating architectural, graphic, security, and signage design.

See the First Impressions Program Guide for more information.

1.6.6 SMART BUILDINGS

GSA leads the Government in owning and operating smart buildings. Utilizing the latest technology, building systems, and programs such as GSAlink, GSA can optimize energy usage and operations. There are several Smart Building guidance documents including, but not limited to, the GSA Smart Building Program Guide, the GSA Smart Building Implementation Guide, and the GSA Data Normalization for Building Automation Systems. Please reference the GSA Smart Buildings Program Guide for guidance on developing Smart Building projects and selecting smart building attributes. The GSA Smart Buildings Implementation Guide must be referenced for guidance in specifying the smart building attributes. The GSA Data Normalization for Building Automation Systems document must be utilized for GSA standard data point naming conventions and tagging within building systems.

All these guides can be found through the RPMT at Public Buildings Service Technology Guidance InSite.

1.6.7 DESIGN GUIDE FOR OPERATIONAL EXCELLENCE

The Operational Excellence program aims to ensure the long-term durability, maintainability, and efficiency of new or renovated facilities and that operation and maintenance costs are considered as part of Design Excellence. Operational Excellence goals and objectives include:

- Eliminating or minimizing negative impacts to the building's long-term durability, maintainability, efficiency, and utility consumption.
- Considering building spaces and systems in terms of their accessibility, durability, reliability, maintainability, and cleanability.
- Ensuring services contracts staff, including operations and maintenance, janitorial, elevator/escalator maintenance, landscape maintenance, and snow removal can safely and efficiently perform their functions.
- Taking advantage of opportunities to reduce or minimize periodic maintenance operations.

- Consulting with Property Management regarding maintenance and operations implications, as well as service-enhancing and labor-reducing features that are explored and evaluated as design alternatives.
- Providing adequate training after commissioning for mechanical, electrical, plumbing, building automation, lighting control, and fire protection systems as appropriate to relevant staff.

Use of the Design Guide for Operational Excellence is required.

1.6.8 OTHER GUIDES AND STANDARDS

- GSA National Business Space Assignment Policy
- PBS P-120, Public Buildings Service Cost and Schedule Management Policy (P-120)
- Metric Design Guide (see GSA Metric Order, GSA Metric Program, for guidance)
- GSA Order on Controlled Unclassified Information
- GSA Commissioning Guide

1.7 SAFETY AND HEALTH RISK REDUCTION

Most facility safety and health risks are adequately controlled through adherence to current building codes and regulations. However, codes and regulations only provide a minimum standard of care and generally do not address unique designs or optimize safety and health risks over the facility life cycle. It should also be noted that building codes tend to focus on facility design with an emphasis on structural and fire safety issues while safety and health regulations (such as those promulgated by OSHA) are primarily employee or operationally oriented and usually do not regulate building design. Therefore, GSA requires designers take a systems approach to facility safety and health risk management to eliminate or mitigate facility life-cycle risks.

1.7.1 LOSS CATEGORIES

The following categories, potential exposures and losses must be considered:

- Occupants. Facility designs must consider the intended or potential occupancy and be designed to prevent or minimize workplace injuries and illnesses to those occupants during such occupancy or use.
- Visitors and the General Public. Facility designs must consider expected use and unintended use by visitors and the public and be designed to eliminate or mitigate injury to such parties and liability to GSA.
- Contractors. Facility designs must not present an unreasonable risk to GSA operations, maintenance, custodial, construction, or other contractors. Facility designs must, to the extent practical, incorporate safety considerations into the design.
- GSA Assets. Facilities must be designed to minimize susceptibility to property damage and loss due to fire, water damage, structural failure, and other causes.
- Business Continuity. Facilities must be designed for maximum availability and mission continuity.

1.7.2 SPECIAL EXPOSURES

- Construction. Constructability reviews must consider and address the risk of injury to personnel on or affected by the job site, and potentially exposed building occupants, other contractors, visitors, and the public. The review must also consider potential loss or damage to GSA, other federal agencies, or private property. The review must consider measures for extreme heat, cold, or other weather-related events.
- Maintenance, Repair, and Custodial Operations. Facility components that use or require the use of hazardous materials, work at elevation, entry into confined spaces, ergonomic stress, access to energy sources (electrical, mechanical, pressure, thermal), or access to other dangerous locations can present significant risks to the trades and GSA inspectors as well as increase costs when personal protective equipment and special procedures are required. Therefore, these hazards must be designed out or mitigated to the extent feasible. Refer to NIOSH Prevention through Design (PtD) or USGBC Pilot Credit 93 (PtD) for guidance.

1.7.3 ORDER OF PRECEDENCE

Designers must mitigate safety and health risks in accordance with the following ANSI Z10 order of precedence:

1. Hazard elimination. Elimination of the hazardous condition must be the primary objective of safe design.
2. Engineering controls. If the hazard cannot be eliminated, reduce the associated risk to an acceptable level through isolation or substitution with a lower risk hazard.
3. Warning devices. If the hazard cannot be engineered to an acceptable level of risk, provide cautions and warnings. Provide detection and warning systems where required to alert personnel to specific hazards.
4. Procedures and training. As a last resort, risks may be reduced to an acceptable level through the incorporation of special procedures and training.

Mitigation with preferred methods generally requires higher initial cost; however, these methods provide the most effective protection, often with lower life-cycle costs. Where preferred methods are too costly, less preferred recommendations may be combined to provide redundant or overlapping solutions. For high consequence hazards, avoid using warning, caution, or other written advisories as the only risk reduction method.

1.7.4 SPECIFIC HEALTH AND SAFETY REQUIREMENTS

1.7.4.1 ASBESTOS

1.7.4.1.1 ALTERATIONS

Alterations of occupied spaces must include the removal of all asbestos-containing material (ACM) that has the potential for future disturbance, and which can no longer be safely managed in place through repair, maintenance, enclosure, or encapsulation. A State Licensed Asbestos Project Designer must prepare the scope of work for all aspects of the project where asbestos containing materials will be disturbed.

1.7.4.1.2 ASBESTOS PRE-ALTERATION ASSESSMENTS

The OSHA Construction Standard, 29 CFR §1926.1101, mandates that surfacing and thermal systems insulation in buildings constructed before January 1, 1981, are to be presumed to contain asbestos unless proven otherwise. GSA considers materials replaced by non-asbestos alternatives after January 1, 1981, as exempt from this OSHA requirement, provided that such replacements are properly documented. While buildings constructed after 1980 are not subject to specific regulations, OSHA obliges building owners to exercise due diligence in identifying any potentially asbestos-containing materials.

Moreover, the United States Environmental Protection Agency (EPA), National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR §61 Subpart M) necessitates a thorough inspection of the affected facility, where demolition, repair, or alteration work will occur, before commencing such activities. It is noteworthy that the NESHAP does not address the construction date of the building. Despite a significant decline in the use of asbestos-containing building materials over the past few decades, it is imperative to recognize that asbestos has not been entirely banned. Presently, asbestos may still be found in certain products like drywall mud and flashing cement. Hence, before designing a demolition, repair, or alteration project, an evaluation must be conducted to ascertain the presence of asbestos in the project area. This assessment involves reviewing any available asbestos surveys and consulting with GSA regional environmental, health, and safety offices.

A pre-alteration assessment must be conducted on the portion of the facility that will be affected by the renovation or demolition operation to inspect and evaluate the presence and condition of asbestos-containing materials to determine whether and to what extent asbestos may be disturbed (41 CFR §102-80.15). Presumed and suspected asbestos must undergo sampling and testing or be treated as asbestos-containing. In areas that are not readily accessible but will be impacted by the project, destructive samples must be collected and tested, or presumed to contain asbestos.

Projects with the potential to disturb asbestos must implement controls to safeguard the construction contractor, building occupants, the public, and the environment. GSA adheres to state and local asbestos regulations where applicable, in addition to the Federal NESHAP, including notification requirements. Designers must seek guidance from GSA regional environmental, health, and safety offices for specific instructions.

Refer to the EPA compliance advisory titled Federal Facility Compliance with the Asbestos NESHAP for more information.

1.7.4.2 LEAD-BASED PAINT

OSHA regulates the disturbance of paint that contains any detectable concentration of lead. Paint must be tested for lead content for buildings constructed prior to 1978, whenever alterations or demolitions require disturbance of painted surfaces (e.g., sanding, burning, welding, scraping, etc.). Paints being disturbed and found to be lead-containing must be managed and disposed of in accordance with 29 CFR §1926.62, and 40 CFR §260. Lead-containing paint that is intact and in good condition need not be abated unless required for alteration or demolition. Lead-containing paint, (over 0.5% or 1mg/cm^2 lead content) must be abated in childcare centers. Refer to PBS-P140 for specific details. Construction waste containing lead must be considered hazardous waste unless testing proves otherwise.

1.7.4.3 CONFINED SPACES

The designer must avoid the creation of confined spaces except where required as part of a system (e.g., tanks, pits). Confined space is defined in 29 CFR §1910.

1.7.4.4 FALL PROTECTION

All locations, both indoor and outdoor, where routine work is expected to be performed at elevations above four (4) feet must be addressed for the feasibility of including permanent work access and platforms in the design. Typical work locations include but are not limited to luminaires, mechanical equipment, window glass, and roofs, especially green roofs. Inspection and testing are exempt from the work platform requirement. Specific detail is provided in the appropriate technical chapters, especially Chapter 3, Suspended Access to Elevated Locations.

1.8 GENERAL PROCEDURES

1.8.1 CONSTRUCTION SIGN

Construction signs are to be constructed of a rigid, durable, weather-resistant material, properly and securely framed, and mounted. The sign will be black with white lettering and mounted at least 1,200 mm (4 ft.) above the ground. The sign must include the official GSA logo no less than 165 mm (6.5 in.) wide. The lettering, graphic style, and format should be compatible with the architectural character of the building.

Construction signs must provide the following information:

- Building for the People of the United States of America
- (Name of) Federal Building
- Constructed by (general contractor)
- U.S. General Services Administration–Public Buildings Service
- (President’s name), President of the United States
- (Administrator’s name), Administrator, GSA
- (Name), Commissioner, PBS
- (Regional Administrator’s name), Region (Region Number) Administrator

Figure 5: Construction Sign Example

1.8.1.1 NEW CONSTRUCTION SIGN

New construction signs are to be 3,600 mm by 1,800 mm (12 ft. by 6 ft.) and must include the name of the architect and general contractor. The sign may contain an artist's rendering or photograph of the model of the building under construction.

1.8.1.2 REPAIR AND ALTERATION PROJECT SIGN

Signs at prospectus-level repair and alteration project sites may range from 1,220 mm by 1,440 mm (4 ft. by 8 ft.) to 3,600 mm by 1,800 mm (12 ft. by 6 ft.) depending on the significance of the project. The sign must include the name of the architect and/or engineers for the major systems work (e.g., structural, mechanical, electrical), in addition to the name of the general contractor.

1.8.2 SPACE MEASUREMENT AND BUILDING EFFICIENCY

The design team must design to the area included in the approved prospectus and delineated in the program of requirements. The area must be confirmed at each phase of design and is to be measured in accordance with the GSA National Business Space Assignment Policy dated May 2009 or current edition, including any addendums or other clarifications. Projects that exceed the area included in the prospectus will need to be redesigned.

GSA's National Business Space Assignment Policy establishes current PBS practices for the assignment of space within the federally owned and leased inventory. It provides the methodology and information necessary for the correct assignment of space.

Additionally, this policy document provides details and illustrations of how PBS uses the commercial ANSI and Building Owners and Managers Association International (BOMA) Standard Method for Measuring Floor Area in Office Buildings (ANSI/BOMA Z65.1) as the foundation for space measurement and assignment.

PBS's measurement and assignment principles are not 100 percent compliant with ANSI/BOMA measurement standards. For example, PBS uses a PBS-specific category in conjunction with ANSI/BOMA's categories. This document provides the details and illustrations showing how PBS's assignment and measurement processes relate to and differ from ANSI/BOMA processes.

Space efficiency is defined as the minimum necessary space for the desired functions to be properly accommodated, with minimum "waste" between usable area and gross area. The target for the usable-to-gross ratio in new building construction is 80 percent. The National Business Space Assignment Policy established the definition of usable and gross area. In all building types, space efficiency must be balanced against effectively achieving space requirements and desired aesthetics.

The plan configuration, floor-plate depth, planning module, and circulation patterns together determine the space efficiencies of a building. The historic character of a building can create major inefficiencies where the primary circulation is typically wider and thereby affects the amount of usable space available. However, a building's historic value or design aesthetics must not be compromised to achieve greater space efficiencies.

Plan configuration describes the geometry of a typical floor within a building. A square or rectangular plan with a single central core will be inherently more efficient than a plan that is highly irregular, with distributed service cores. Building types other than office buildings, like courthouses and Land Ports of Entry, will likely have lower usable to gross ratios based on numerous special requirements that are addressed in their design guides. When efficiency ratios fall, the floor plan is likely to have more irregularities that, in turn, will increase space utilizations per full-time equivalent (FTE) and restrict furniture and tenant space planning. Configuration of space is an important consideration when selecting a new building design or comparing one with another.

1.8.3 BUILDING INFORMATION MODELING (BIM)

BIM is now both an industry-standard method of design and an essential means of project delivery for complex building projects in the United States. GSA has required the use of BIM in design and construction in various ways since the 2009 P100.

The primary goal of the GSA BIM program is to capture digital representations of our building inventories as needed and use this information to better manage our investment over the entire facility lifecycle: From design, through construction, to space allocation and measurement, and on to facilities management, operations, and repair.

We encourage the use of Virtual Reality and other imaging and presentation techniques during the initial concept phases to allow all our partners to understand the qualities and benefits of a particular design. After concepts are approved, we require that BIM must be used to organize the elements, materials, spatial qualities, and asset information in the creation of construction documentation. The completed BIM models and information contain critical information used after construction in space management and facilities operation after project turnover. GSA now uses BIM information to power GIS mapping, space allocation, building documentation, and digital twin software to utilize and transfer building data across our business lines.

All new-construction, major repair and alteration projects are required to submit BIM deliverables throughout the project period, at multiple milestone points, specified in the project schedule. BIM also applies to lease-construction facilities where GSA's formal Request for Lease Proposal (RLP) has an option for GSA to purchase the building at a future date. Energy Savings Performance Contract (ESPC) projects and other alternate methods of building investment must also provide their information digitally in BIM so that we can incorporate this work into our management systems.

The design team’s deliverables are outlined in the P100 Submittal Matrix, while construction-phase BIM deliverables are outlined in the P100 Appendix. Generally, submissions must include all the individual files of the entire Native BIM model, an Industry Foundation Classes conversion of the native model files, associated data files, required quality control reports, and data and spreadsheet exports (i.e. Construction Operations Building Information Exchange (COBie) and Spatial-Data) from the model files for GSA needs.

In design-bid-build projects, the designer is responsible for the creation of Design BIM and Record BIM models. The construction contractor is responsible for developing fabrication BIM models, coordination BIM models, and for providing their record of construction as an As-Built BIM model. All content included in the models must comply with the GSA BIM Standard, and the 2024 GSA Common Data eXchange and COBie Playbook (CDX), as applicable. In alternate delivery methods (i.e. Design-Build or CMc) a single contractor may be required to deliver all information.

1.8.4 TOTAL BUILDING COMMISSIONING

Total Building Commissioning (TBC) is a systematic process of ensuring by verification and documentation, from the design phase to a minimum of one year after construction, that facility systems perform interactively in accordance with the design documentation and intent and in accordance with the owner’s operational needs to include preparation of operation personnel.

TBC recognizes the integrated nature of all building systems’ performance, which affects sustainability, workplace productivity, occupant safety, and security. All GSA construction projects must employ and comply with the commissioning practices and requirements outlined in the GSA Commissioning Guide. The commissioning agent must be an independent commissioning provider contracted by GSA, or by a firm subcontracted by the Construction Manager as Advisor (CMa), but not solely by the construction contractor itself.

See Chapter 7, Fire Protection, for additional information on commissioning the fire protection and life safety systems.

1.8.5 BUILDING OPERATIONS AND MAINTENANCE

Long-term operations and maintenance costs are significantly higher over time than first costs. Systems must be designed for ease of operation and cost-effective maintenance and repair. System accessibility is a critical consideration in building design. The design team must anticipate the means and methods expected for testing, inspection, adjustment, cleaning, maintenance, repair, replacement, and upgrades of building components.

1.8.5.1 WORKER ACCESS

All building components that require routine inspection, adjustment, cleaning, maintenance, repair, and replacement must be so located, oriented, or otherwise designed to allow for safe and unencumbered access by building maintenance personnel. Access must include both the route to the component and clearance. Access to components must be addressed for each maintenance task and must accommodate an anthropometric range of a 5th percentile female worker to a 95th percentile male worker based on MIL-STD-1472.

1.8.5.2 REMOVAL AND REPLACEMENT

Components must be located and oriented to allow the removal and replacement of such components, or parts thereof, without the need for special rigging, removal of non-related components or equipment, or requiring special safety precautions.

1.8.5.3 VERIFICATION

Worker access and component removal/replacement must be demonstrated in the BIM model. Animation is not required, and verification may be provided through static "clash" modeling. All components that require routine inspection, adjustment, cleaning, maintenance, repair, and replacement must be modeled. The RPMT may exclude components where adequate access and removal/replacement is obvious without modeling.

1.8.5.4 TURN-OVER

The design team must specify that operation and maintenance manuals be provided in electronic format (MP4 files) with training for O&M staff and videos for the startup and maintenance of all major equipment. Training videos must include the detailed instruction of all operational and maintenance aspects of any new Building Automation System software. See the GSA Commissioning Guide for additional information.

At the conclusion of design, the design team must provide an electronic document describing the design intent for all building systems. These instructions must be developed during the design phase and incorporated into the comprehensive training for operations and maintenance personnel.

1.9 SUSTAINABILITY

Sustainability is the conditions under which humans and nature can exist in productive harmony, and that permit fulfilling the social, economic, and other requirements of present and future generations. Sustainable design seeks to ensure that future generations are not disadvantaged by the depletion of natural or nonrenewable resources by the current generation.

1.9.1 SUSTAINABLE PERFORMANCE TABLE

1.9.1.1 Energy		
Energy Net-Zero		
Baseline		New construction and major modernization project designs must be Energy Net-Zero ready to the maximum extent technically feasible on a source energy basis with onsite renewables that are designated on the plan for future installation including pathways, conduits, or other means of getting the power in the building. See Chapter 1, Conservation, Efficiency, Renewables
Tier 1		Baseline with 25% onsite renewables installed and the remainder designated on the plan for future installation. At a minimum, comply with IgCC-Section 7.4.1.1 On-Site Renewable Energy Systems, without Exception.
Tier 2		Tier 1 + 50% onsite renewables installed.
Tier 3		Tier 1 + 100% renewables installed.
M & V		Report the projects ongoing energy performance in a sustainability benchmarking platform
Plans & Specs		Y
Calculations & Analysis		Provide ASHRAE 90.1 Appendix G energy model and calculations for proposed and installed renewable energy.
References		
Basis of Design		Show project is energy net-zero ready, on a source energy basis, and achieves actual annual delivered energy less than or equal to the on-site and/or proposed renewable exported energy.
Construction Verification		CxP to confirm installed renewables supply the required power to meet the high-performance tiers.
1.9.1.2 Water		
Water Net-Zero		
Baseline		New construction must be Water Net-Zero Ready with 15% potable water reused or infiltrated on site. Recycled water, either sourced from a municipal entity or produced onsite with systems listed or labeled in accordance with NSF/ANSI 350, may be used to meet these requirements. All projects must meet current policy including EISA section 438.
Tier 1		Meet baseline and increase new construction to 40%. Major modernization projects must be Water Net-Zero Ready with 15% potable water reused or infiltrated on site.
Tier 2		Meet baseline and increase new construction to 75% and major modernization to 40%.
Tier 3		Meet baseline and increase new construction to 100% and major modernization to 75%.
M & V		Report the project's ongoing water performance in a sustainability benchmarking platform.
Plans & Specs		Y
Calculations & Analysis		Provide calculations for water-use baseline. Show all methods of water conservation, reuse, and the amount of water returned to the original water source.
References		EPA REUSExplorer Tool
Basis of Design		Provide written narrative showing how water baseline is offset by proposed and installed water saving or reuse measures.
Construction Verification		CxP to confirm proper system functioning and staff are trained with operational manuals.
1.9.1.3 High Performance Building Technologies		
GSA Pilot to Portfolio		

Baseline		Designs must incorporate two Pilot to Portfolio (P2P) technologies that demonstrate deployment potential for GSA.
Tier 1		Designs must incorporate four P2P technologies that demonstrate deployment potential for GSA.
Tier 2		Designs must incorporate five P2P technologies that demonstrate deployment potential for GSA.
Tier 3		Designs must incorporate six P2P technologies that demonstrate deployment potential for GSA.
M & V		
Plans & Specs		Identify technologies utilized from the P2P program.
Calculations & Analysis		
References		
Basis of Design		Provide written narrative showing how the P2P technologies will be utilized.
Construction Verification		CxP to confirm GPG technologies are appropriately installed.

1.9.1.4 Fenestration

Daylight and Views		
Baseline		50% or more of the total floor area of the referenced spaces must have a direct line-of-sight. The line-of-sight distance to view fenestration must not exceed 40 ft.
Tier 1		60% floor area and 40’ distance
Tier 2		70% floor area and 30’ distance
Tier 3		75% floor area and 25’ distance
M & V		
Plans & Specs		
Calculations & Analysis		
References		Training Rooms, general conference rooms, breakroom, offices, and reading areas. Refer to 1.9.2.7 Designing for Daylight
Basis of Design		
Construction Verification		

1.9.2 SUSTAINABILITY PERFORMANCE ATTRIBUTES

1.9.2.1 ENERGY NET-ZERO

During conceptual design, evaluate the project's anticipated energy usage. Once a baseline is established, determine how much renewable energy is required. Renewable energy comes from unlimited, naturally replenished resources, such as the sun, tides, and wind. On a plan, provide the baseline and the calculation of renewable energy required. Show where the renewable energy could be installed and in what quantities. Consider the renewable energy design at a conceptual level including pathways for conduits, access into the building, and other design elements that may be impacted by the future installation of renewables. As the budget allows, incorporate renewables as designated on the plan.

1.9.2.2 WATER NET-ZERO

The National Blue-Ribbon Commission for Onsite Non-potable Water Systems defines water reuse, also known as water recycling, as the process of intentionally capturing wastewater, stormwater, or graywater and cleaning it as needed for a designated beneficial purpose such as drinking, cooling, toilet flushing, and irrigation. Recycled water may be produced onsite at federal facilities or by water or wastewater utilities. Utilize the EPA REUSExplorer Tool to determine regulations in each state.

Refer to Chapter 2, Rainwater Catchment Systems.

1.9.2.3 GSA'S PILOT TO PORTFOLIO

GSA's Center for Emerging Building Technologies (CEBT) annually evaluates emerging and sustainable technologies through the Green Proving Ground (GPG) and Applied Innovation Learning Lab (AILL) programs. The GPG and AILL Programs evaluate the merits of next generation building technologies in real-world operational settings, recommending the most promising for deployment within GSA's Pilot to Portfolio (P2P) Program. By discovering best-of-breed innovative technologies early in their development and placing them strategically within federal properties, the CEBT ensures GSA's leadership position within the commercial building industry and contributes to GSA's sound investment decisions and high-performance buildings, which greatly benefit the American taxpayer.

Those technologies recommended for broad deployment within P2P have demonstrated cost-effective real-world performance, tenant and facility operator acceptance, and maintainability. They are ready for installation in GSA's existing buildings, as well as incorporation into GSA's new construction, repair and alteration, and end-of-life replacement projects. To learn more about these technologies and their savings, go to the CEBT website.

1.9.2.4 DESIGNING FOR DAYLIGHT

The project team is responsible for developing a daylighting strategy to meet the daylighting requirements and manage glare. Components of the daylighting design will be part of the base building, including blinds or shading devices. The project team must also coordinate their design with the requirements of the users and their design guides.

Views to daylight must originate at a height of not more than 42 inches (1.0 m) above the floor, to view fenestration. The glazing area must not be less than 6% of the floor area required to have exterior views. Views into interior atria may be used to meet up to 30% of the required area.

1.9.3 SUSTAINABILITY REQUIREMENTS

Sustainable designs follow an integrated, synergistic approach, in which all phases of the facility lifecycle are considered. Following sustainable design principles improves building performance, promotes the health and comfort of building occupants, minimizes environmental impacts, and supports natural resource availability. The result must be an optimal synergy of cost, environmental, societal, and human benefits while meeting the mission and function of the intended facility or infrastructure.

GSA's essential principles of sustainable design and development are:

- Employ Integrated Design Principles
- Optimize Energy Performance
- Protect and Conserve Water
- Enhance the Indoor Environment
- Reduce the Environmental Impact of Materials
- Assess and Consider Building Resilience

- Grid Stewardship via Load Optimization
- Design for reuse
- Value ecosystem services

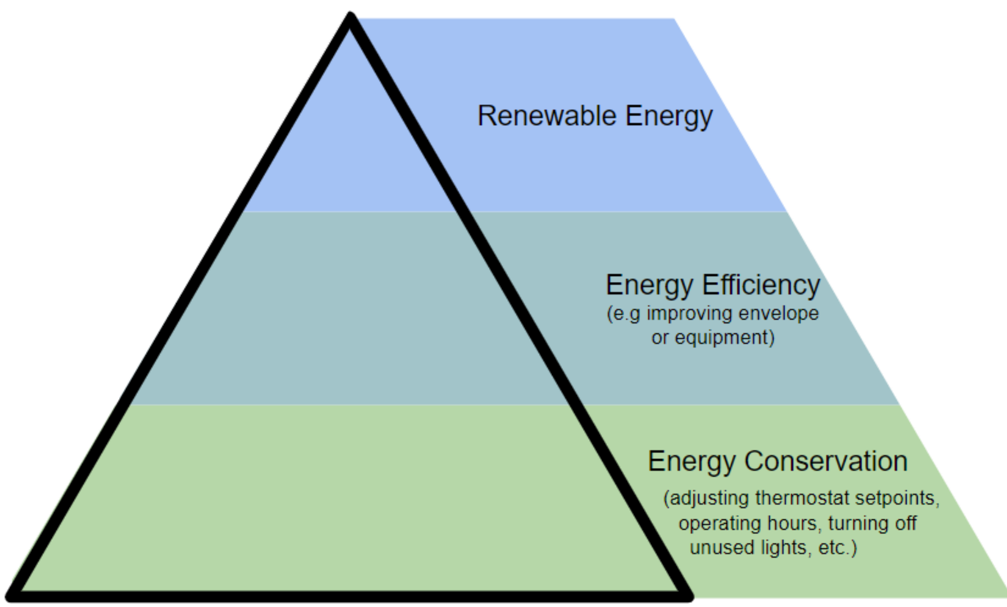
These principles must be applied to every project scope.

Applicable strategies and opportunities to improve sustainable performance must be included in all projects. New construction, major repairs, and alterations of GSA buildings, as well as applicable work in existing GSA buildings, must comply with the Guiding Principles for Sustainable Federal Buildings. Strategies to meet the Guiding Principles are included in each appropriate chapter of P100. See the latest guidance on implementing the Guiding Principles.

1.9.3.1 CONSERVATION, EFFICIENCY, RENEWABLES

The energy pyramid sets the basic principles for designing a sustainable building at a reasonable cost. All designs must start at the broad base of conserving energy, move to using energy efficiently, and ultimately consider how much renewable energy can be installed. By focusing on the first two, this ultimately reduces how much energy the building needs to operate, lowering the load and allowing for the least amount of renewable energy to be installed to meet the building's mission.

- Energy Conservation - The act of using less energy has many options for all building types and locations from designing daylight that uses less artificial lighting, adjusting set points for the HVAC systems, and designing effective building enclosure systems.
- Energy Efficiency - Using technology to maximize the benefit of the energy that you do use and includes installing smart LED lights to operating ground source heat pump systems.
- Renewable energy – Using energy produced from sources like the sun and wind that are naturally replenished and do not run out.



1.9.3.2 GUIDING PRINCIPLES FOR SUSTAINABLE FEDERAL BUILDINGS

All GSA capital projects (projects above the current prospectus threshold) must use GSA's Kahua Sustainability App to report scope details, anticipated energy and water performance, and total/diverted tons of construction and demolition waste.

Project teams delivering new construction or major repair and alteration projects which involve the comprehensive replacement or restoration of virtually all major systems, interior finishes, and building features must additionally use GSA's Sustainable Design Checklist. The checklist is composed of Sustainable Design Criteria, or SDCs (see Appendix B.1) and must be used throughout design and construction. This Checklist tracks compliance with the Council on Environmental Quality's Guiding Principles for Sustainable Federal Buildings, and leverages LEED certification. Statuses are reported via GSA's Kahua Sustainability App. If requirements cannot be met, a P100 waiver is required.

1.9.3.3 LEED CERTIFICATION

Through integrative design and application of sustainable design principles, all BA51 (new construction) and BA55 (major repairs and alterations that include work to a majority of the engineering systems) funded projects must achieve, at a minimum, a Gold rating through the Leadership in Energy and Environmental Design (LEED) version 4 or 4.1 BD+C of the U.S. Green Building Council. Other projects must achieve a LEED rating at the level and system type (i.e. BD+C, ID+C, Core and Shell) identified during prospectus development by the Office of Architecture and Engineering. GSA uses LEED to measure and quantify building performance achievements in relation to its mandates and goals. Pursue LEED credits that align with the Guiding Principles for Sustainable Federal Buildings and are appropriate to the goals of GSA and to the type of project being designed. For more information, see GSA's Sustainable Design Checklist.

Renewable Energy Credits may be used to achieve certification but must be paid for with project funds and must meet GSA's requirements for Carbon Pollution Free Electricity (CFE).

1.9.3.4 DECARBONIZATION

Decarbonization, or the process of achieving a net-zero emissions building or portfolio, requires eliminating scope 1 and scope 2 GHG emissions from building operations by prioritizing energy efficiency and electrification. It may also refer to actions or decisions related to the embodied carbon of materials and carbon sequestration. Project teams must evaluate ways to decarbonize their project. Careful consideration must be given to the use of high embodied carbon items like concrete and steel and alternate materials should be considered that have lower embodied carbon such as wood and other biobased materials. See the Carbon Smart Materials Palette.

New construction and major modernization projects must also:

- Target at least a 20% reduction in the project's whole-building embodied carbon from materials, compared to a conventional standard baseline building of the same project type (e.g. modernization or new construction)
- Calculate and compare carbon footprints for at least the structure and enclosure of a standard baseline building and the proposed design using a GSA-approved embodied carbon estimation tool.
    - Earn at least one Building Life-Cycle Impact Reduction LEED BD+C: New Construction point, using LEED credit Option 2 "Whole-Building Life-Cycle Assessment" (WBLCA) to

conduct a cradle-to-grave life-cycle assessment of the project's structure and enclosure and

- Meet ASTM E2921's Standard Practice for Comparing WBLCAs, except as regards reference service life. Pursuant to the LEED Building Life-Cycle Impact reduction credit, the service life of the baseline and proposed buildings must be the same, and at least 60 years, to account for maintenance and replacement.

- Provide a whole-building life-cycle assessment summary during concept design. Finalize whole-building LCA at design completion (design drawings). The analysis must:
  - include total Global Warming Potential (GWP) converted to kgCO2 equivalent/ guided by TRACI (North American LCIA method);
  - include carbon life cycle stages A1-A3; and
  - report results in kgCO2 equivalent per square meter of the project as defined by the Project Boundary. Consider using tools such as EPIC for early phase estimates.

All GSA projects that use at least 10 cubic yards of a concrete or asphalt mix must use GSA's Low Embodied Carbon Concrete and Environmentally Preferable Asphalt standards listed in Chapter 1, Sustainable Materials.

1.9.3.5 ELECTRIFICATION

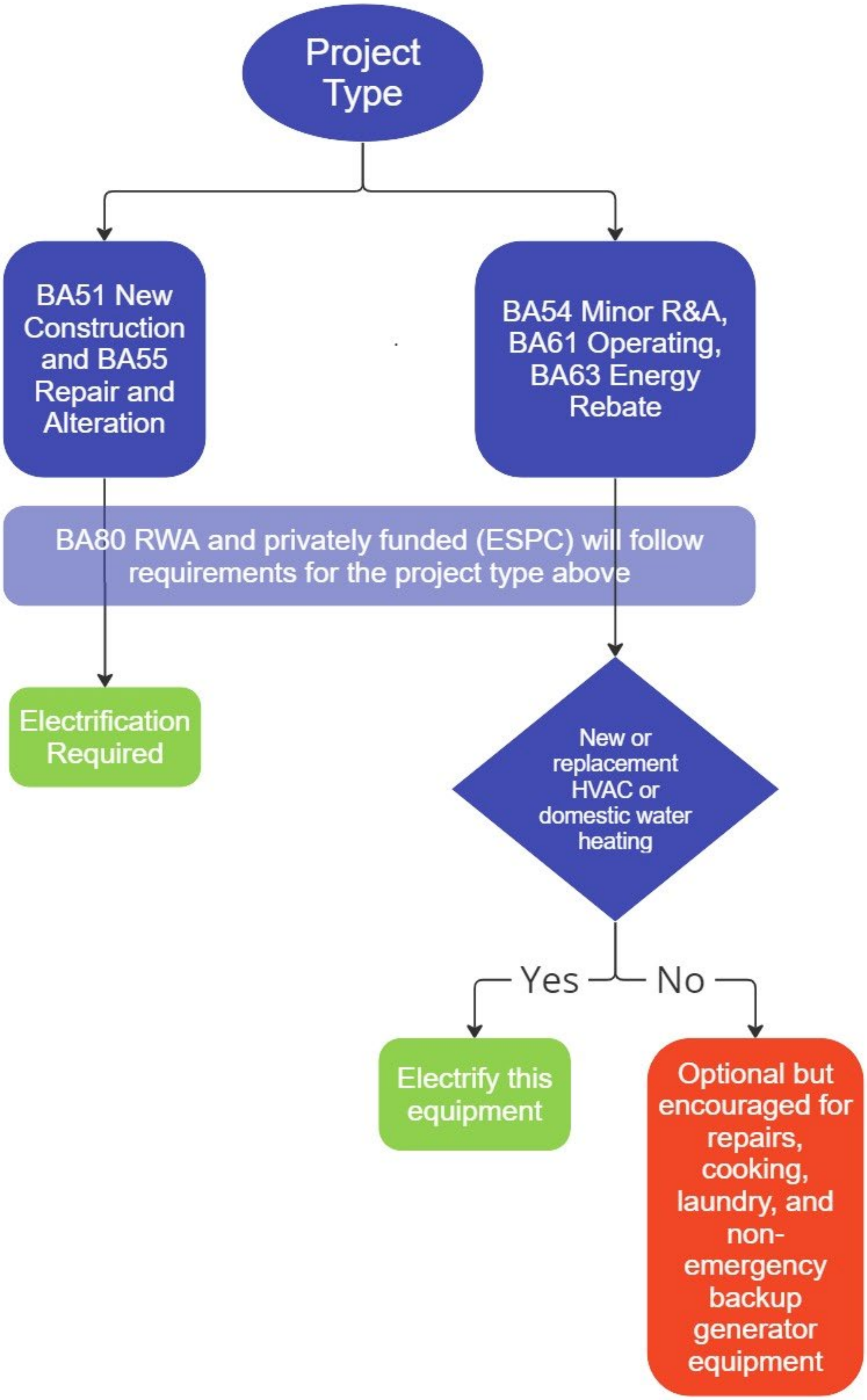
GSA defines building electrification of its owned inventory as the elimination of emissions generated directly by heating, ventilation, and air conditioning (HVAC), and by domestic water heating, cooking, laundry, and demand-response generators powered on site. Fossil fuel–powered emergency backup generators are not included in electrification requirements regarding these scope 1 emissions.

HVAC and domestic water heating system electrification analyses of alternatives must include Life Cycle Cost Analyses (LCCA) and operational (scope 1 and 2) greenhouse gas emissions of each alternative. Reference A.6 Life Cycle Cost Analysis Requirements. These analyses and LCCAs must include heat pump technologies. These selected systems may not use fossil fuels (per Table 1.2) and must be life cycle cost effective for implementation (including electric resistance heating).

Table 1.2 Electrification

Project Type Per Funding Code	BA51 New Construction and BA55 Repair and Alteration projects	BA54 Minor Repairs and Alterations, BA61 Operating Funds, and BA63 Energy Rebate Projects	Other funding legislation or sources including BA80 Reimbursable Work Authorization and privately funded projects (e.g. ESPCs)
Electrification	Required	Required for any new or replacement HVAC or domestic water heating equipment. Optional but encouraged for repairs, cooking, laundry, and non-emergency backup generator equipment.	Follow the electrification requirements for the project type (e.g. major R&A or limited scope) that aligns with funded scope

1.9.3.5.1 ELECTRIFICATION DECISION FLOWCHART



1.9.3.5.2 EXCEPTIONS

The following equipment must have an approved P100 waiver:

- Fossil fuel–burning equipment where Table 1.2 requires electrical equipment, including via O&M contracts
- Equipment that uses steam, hot water, or chilled water from a primarily fossil fuel–burning source, irrespective of whether that source is on- or off-site, or a district utility (i.e., scope 1 or 2 emissions)
- HVAC and domestic water heating equipment that is not the most life-cycle cost effective all-electric option

The waiver must include:

- A Life Cycle Cost Analysis (LCCA) including at least one heat pump system option for system types where air-, water-, or ground-source heat pump options are commercially available (e.g., HVAC and domestic water heating systems)
- Confirmation the project will not exceed the maximum allowable fossil fuel-generated energy consumption limits established in 10 CFR 433 Subpart B (Reduction in Scope 1 Fossil Fuel-Generated Energy Consumption), regardless of Subpart B's project cost and design start date thresholds

GSA encourages the electrification of all building systems, even when not required. GSA also recognizes that some projects in existing buildings located in ASHRAE climate zones 6, 7, and 8 may require supplemental fossil fuel for peak heating in extreme weather conditions.

1.9.3.6 ENERGY USAGE

Buildings must be designed to comply with the energy performance requirements of EPAct 2005, EISA 2007, and GSA Sustainable Design Criteria. Although there may be an energy target contractually supplied, the project team must make an early determination of a life cycle cost effective energy use intensity (EUI) target for their project and update GSA as the design progresses.

The attribute of energy performance considers the whole building synergistically and measured with respect to both energy utilization (consumption) and carbon emissions (total or source) on an annual basis.

The related attribute of energy cost is required to be reported for LEED certification, and this may be a driving requirement in terms of systems selection, particularly thermal storage, and demand peak shaving/load offset.

Energy software used to demonstrate compliance must be compliant with ASHRAE Standard 140.

1.9.3.6.1 EPACT 2005 BUILDING DESIGN ENERGY COMPLIANCE

EPAct 2005 requires new buildings to be designed to be at least 30 percent more efficient if life cycle cost effective than the energy model baseline design required by ASHRAE 90.1.

1.9.3.6.2 GUIDING PRINCIPLES CRITERIA FOR "OPTIMIZE ENERGY EFFICIENCY"

Major repairs and alterations that have significant energy savings opportunities must utilize the most stringent option of those provided, even if previous alterations meet one of the criteria. All designs that improve HVAC systems must include recommissioning of the entire HVAC system.

1.9.3.6.3 ENERGY MODELS

Design Performance Modeling: A model used during early concepts for rapid and iterative exploration, generally before engineering systems are selected, that informs decision-making by predicting project performance.

Building Energy Modeling: A robust, comprehensive model that predicts annual energy performance based on Typical Meteorological Year data that is compared to a baseline condition.

Project teams are encouraged to use the performance model during the early stages of concepts. A building energy model must be provided with the final concept to prove that the design is moving forward with a life cycle cost effective EUI. See appendix A for deliverables for different delivery methods.

Project teams are encouraged to utilize the Future Typical Meteorological Year (fTMY) in their energy model for the midpoint and end of service life. Coordinate model with Chapter 1, Resilience.

1.9.3.7 LIFE-CYCLE COSTING

Federal facilities must be designed to achieve the lowest life-cycle cost. A project's design must comprehensively define reasonable scope and performance requirements within the appropriated budget and approved prospectus for design and construction. Consistent with these constraints, building design alternatives, proposed systems and features must be analyzed and selected to achieve lowest life-cycle cost below the baseline building or system life-cycle cost per the requirements of the P120 and P100 Appendix A.6 Life Cycle Cost Analysis Requirements.

Life-cycle costing (LCC) must be used when selecting a system from several alternative systems or components for a project. LCC is the economic analysis method required by 10 CFR §436, Subpart A, "Methodology and Procedures for Life Cycle Cost Analyses." OMB requires this methodology, through the Federal Energy Management Program, to evaluate the cost effectiveness of systems that use energy and water. Examples of building systems that affect energy and water use are the building thermal envelope, passive solar features, fenestration, HVAC, domestic hot water, onsite water recycling and reuse, building automation, and lighting. LCC compares initial investment options and operating and salvage costs over the life of the equipment and identifies the least costly alternatives.

Many established guidelines and computer-based tools that effectively support present-value LCC analyses are available. The National Institute of Standards and Technology (NIST) has prepared the Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135) and annually issues real growth energy price indices and discount factors for life cycle cost analysis. As a companion product, NIST has also established the Building Life Cycle Cost (BLCC) computer program to perform LCC analyses. The latest versions of the BLCC program not only structure the analysis but also include current energy price indices and discount factor references. These NIST materials define all required LCC methodologies used in GSA design applications. The design team may obtain the NIST BLCC software and updates.

The project team must complete the LCC analysis for all project phases, from the preliminary concept phase through the CD Final phase.

1.9.3.8 GRID-INTERACTIVE EFFICIENT BUILDINGS

Grid-interactive efficient buildings (GEBs) provide an integrated approach for energy efficiency, renewable energy, storage, and smart technologies to coordinate building loads for cost reductions, continuous demand management and grid responsiveness. Many electrical loads in buildings can be operated in a more flexible manner, and through advanced controls, can be managed to operate at specific times and at different output levels. By optimizing end uses like HVAC and lighting as well as PV, EVSE, and electrical energy storage, the building benefits in ways that maximize financial value with the project's utility. This flexible control paired with continuous demand management can provide solutions to peak demand issues, which are becoming increasingly important to utilities in providing grid stability. See SFTool Grid-Interactive Efficient Buildings.

GEB measures that have potential for load shed, load shift, and demand response and grid-level services that should be considered, but are not limited to:

- Advanced HVAC system controls and thermostats
- Water heaters with grid connected controls
- Solar with smart inverter controls
- Electric storage (batteries) with smart controls
- EVSE with smart charging controls
- Lighting controls
- Controls for plug loads and other misc. loads
- Thermal energy storage with controls
- Shading and dynamic building envelope with controls
- Building Automation Systems and Energy Management Systems

Based on the content in the ASHRAE Grid Interactive Buildings for Decarbonization: Design and Operation Resource Guide, incorporate the following into the design process:

- Identifying and quantifying the GEB value proposition today and within 5 years
- Specifying GEB functionality with system design
- Engage the local utility during the design process to identify immediate and future opportunities to capture and enhance the value proposition of GEBs and to coordinate technical functionality of GEBs

Controls are an essential element of a successfully grid integrated building. Measures within the building that offer flexibility should have sufficient levels of submetering and control such that the project's local utility can confirm the reliability of the flexibility. The functionality of these systems must meet any requirements established by the project's utility to participate in demand response, real-time pricing and/or time-of-use rates.

When considering adding renewable generation, especially at a large scale, carefully evaluate the current and forecasted system load trends for the project's utility region and discuss options with the project's electric utility. Drawbacks from adding excess renewable generation can be partially or entirely mitigated by adding electrical energy storage. The opportunities for electrical storage within the project should be discussed with the project's local utility.

BA51 New Construction and BA55 Major Repairs and Alterations modernization projects that include complete HVAC and controls are required to achieve LEED EA credit: Grid Harmonization with at least 2 points.

1.9.3.9 WASTE NET-ZERO

A net-zero waste federal building is operated to reduce, reuse, recycle, compost, or recover solid waste streams (except for hazardous and medical waste), thereby resulting in no waste disposal to landfills or incinerators. Develop a solid waste management plan and design that shows: the building's waste collection and storage locations by waste stream; methods to maximize waste reduction and reuse (through interior construction and design); to collect, separate, and divert waste (reuse, recycle, compost, waste to energy); and locations within the building for the anticipated management and final collection points of the waste streams to maximize waste reduction and diversion. Provide appropriate ventilation rates for collection areas per ASHRAE 62.1. For more information, go to the DOE Net Zero Handbook.

1.9.3.10 SUSTAINABLE MATERIALS

Prioritize the use of materials with a long lifespan, durability, and low maintenance requirements. Choose materials that are recyclable or made from recycled content. Choose materials that can be easily uninstalled, relocated, deconstructed in a non-destructive fashion at the end of their first use. Additionally, to the extent consistent with law, including the Trade Agreements Act of 1979 and implementing regulations in FAR part 25, opt for locally sourced materials to reduce transportation emissions and costs, and seek out local marketplaces within the region to source these materials.

1.9.3.10.1 HOLISTIC APPROACH OF REGENERATIVE MATERIALS

Regenerative materials are safe for humans, ecosystems, and sequester carbon emissions from the atmosphere, while focusing on social health and equity. By considering all aspects of the creation and use of materials with a common language in all impact areas, project teams can reduce the negative embodied impacts of materials holistically to solve larger challenges, scale transparency, and optimization. Ultimately, reversing the embodied impacts of the built environment through our collective material choices.

Project teams must evaluate materials and products to support the following criteria:

- Human Health - to support and foster life and seek to eliminate the use of hazardous substances
    - Considerations: Substances, VOCs, Company Human Health Impacts
- Social Health & Equity - to support manufacturers that secure human rights in their own operations and in their supply chains by positively impacting their workers and the communities where they operate
    - Considerations: Company Workspace, Supply Chain, Community
- Ecosystem Health - to support and regenerate the natural air, water, and biological cycles of life through thoughtful supply change management and restorative company practices
    - Considerations: Pollution, Product Water Footprint, Company Water Footprint, Biodiversity and Conservation, Life Cycle Impacts

- Climate Health - to reduce carbon emissions and ultimately sequester more carbon than emitted
    - Considerations: Embodied Carbon, Company Carbon
- Circular economy - reusing and improving buildings and by designing for resiliency, adaptability, disassembly, and reuse, aspiring to a zero-waste goal for construction activities
    - Considerations: Sourcing, End-of-Life, Packaging, Waste, Company Circularity

1.9.3.10.2 SALVAGED MATERIALS

A reused, salvaged, reclaimed, repaired, refurbished, or remanufactured material/product is a material with substantially lower embodied greenhouse gas emissions if used to displace a new material. Explore partnerships with suppliers and contractors who embrace circular economy principles and can provide/take materials and services that align with these goals. Engage stakeholders and experts in circular economy practices.

Provide a salvage assessment for demolition projects. Any revenue from recycling/ scrap proceeds will be retained by the contractor, and factored into their bids with GSA, to reduce the government's contract cost.

1.9.3.10.3 LOW EMBODIED CARBON CONCRETE

All GSA projects that use at least ten (10) cubic yards of a concrete mix must:

Provide a product-specific cradle-to-gate Type III environmental product declaration (EPD) for each concrete mix design specified in the contract and used at the project, using NSF International's product category rule for concrete. Send EPD(s) with each concrete mix batch design (including type [e.g. standard or lightweight mix] and volume) to embodiedcarbon@gsa.gov and upload the submittals into GSA's project management information system.

Provide low embodied carbon concrete that meets the global warming potential (GWP) limits of the table below, for concrete of the mix type and strength class.

Table 1.3 Low Embodied Carbon Concrete

	Maximum Global Warming Potential Limits for GSA Low Embodied Carbon Concrete (kilograms of carbon dioxide equivalent per cubic meter - CO2e kg/m3)		
Specified compressive strength (f'c in PSI)	Standard Mix	High Early Strength	Lightweight
up to 2499	242	314	462
2500-3499	306	398	462
3500-4499	346	450	501
4500-5499	385	500	540
5500-6499	404	526	N/A
6500 and up	414	524	N/A
These numbers reflect a 20% reduction from GWP (CO2e) limits in proposed code language: "Lifecycle GHG Impacts in Building Codes" by the New Buildings Institute, January 2022.			

If it is not feasible to meet GSA's EPD requirement or GWP limits, submit a P100 waiver with the following information:

Outline and provide evidence of the specific circumstances that make compliance infeasible. For example, the only concrete suppliers within the maximum transport range for the mix design:

- are small businesses that have not yet invested in EPDs; or
- do not yet offer mixes that meet GSA's GWP limits, e.g. because lower-carbon materials are unavailable, or do not meet specific client-driven performance requirements.

Waivers for GWP limits must include the strategies, if any, that will be used to reduce GWP to the extent feasible. Such strategies include, but are not limited to, the use of alternative cements, supplementary cementitious materials, or alternative aggregates.

Any requests for a waiver from the EPD requirement must include a GWP estimate generated with a tool such as the Federal Highway Administration's LCA Pave Tool, NRMCA Concrete Carbon Calculator, Athena Pavement LCA, Athena Impact Estimator for Buildings, or ZGF's LCA Calculator.

1.9.3.10.4 ENVIRONMENTALLY PREFERABLE ASPHALT

All GSA projects that use at least ten (10) cubic yards of an asphalt mix must:

Provide a product-specific cradle-to-gate Type III environmental product declaration (EPD) for each asphalt mix specified in the contract and used at the project, using version 2 of the National Asphalt Paving Association's product category rule for asphalt mixtures. Send EPD(s) to embodiedcarbon@gsa.gov, and upload EPD(s) into GSA's project management information system.

Provide environmentally preferable asphalt. Send each asphalt mix batch design (including type, volume, and a description of the proposed techniques) to embodiedcarbon@gsa.gov and upload the submittals into GSA's project management information system. Environmentally preferable asphalt is defined in this context as material manufactured or installed using at least two (2) of the following techniques:

- 21% or higher reclaimed asphalt pavement (RAP) content (specify percentage, and whether in-place or central plant recycling is used)
- Warm mix technology (reduced onsite mix temperature)
- Non-pavement recycled content (e.g. roof shingles, rubber, or plastic)
- Bio-based or other alternative binders
- Improved energy/ carbon efficiency of manufacturing plants or equipment (e.g. using natural gas or electric to heat materials)
- Other environmentally preferable features or techniques (please specify)

If it is not feasible to meet GSA's EPD requirement or to implement at least two of the listed environmentally preferable requirements, submit a P100 waiver with the following information:

- Provide evidence of the specific circumstances that make compliance infeasible. For example, the only asphalt suppliers within the maximum transport range for the mix design:
    - are small businesses that have not yet invested in EPDs
    - do not yet offer mixes that use at least two environmentally preferable features or techniques while meeting specific client-driven performance requirements

- Provide a GWP estimate generated with a tool such as the Federal Highway Administration's LCA Pave Tool or Athena Pavement LCA embodiedcarbon@gsa.gov.

1.9.3.10.5 SUSTAINABLE WOOD – RESPONSIBLE SOURCES

The project team must provide documents that wood used in the project meets responsible sources per ASTM D7612-21. Responsible sources of forest products are non-controversial sources together with certified procurement systems or from forests managed using responsible practices.

Design teams should consider low risk wood utilizing tools like the Nature, Economy and People Connected sourcing hub, where the country has scored 80 or higher based on a low rating for both the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and Protected Sites and Species Sub-categories, and laws in at least 13 additional Sub-categories, including one law in each of the five Legal Categories. Nature, Economy and People Connected tool.

1.9.3.10.6 PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

PFAS chemicals are regulated by the EPA and state agencies as chemicals of special concern and hazardous substances under various environmental statutes, including the Emergency Planning and Community Right-to-Know Act (EPCRA). Design teams should avoid specifying interior finishes, construction materials, and products that contain regulated PFAS substances and require disclosure of such substances by suppliers (e.g., safety data sheets, product declarations, standards, and certifications). Additionally, PFAS substances are prohibited from use in fire suppression systems, including portable handheld fire extinguishers.

1.9.3.11 SUSTAINABLE CONSTRUCTION

Sustainable construction is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction.

Figure 6: Construction at U.S. Department of Transportation Volpe Center Cambridge, MA

1.9.3.11.1 CONSTRUCTION SITE DECARBONIZATION

As GSA moves to lower carbon emissions, the construction site must be reviewed for its contribution. Contracts must be required to comply with the Building Green Contractor's Commitment for their GSA work at a minimum of the GOOD level.

1.9.3.11.2 OFF-SITE CONSTRUCTION

GSA encourages the increased use of off-site construction to reduce project waste, costs, and community disruption while enhancing job site safety. Utilize ICC/MBI Off-site Construction Standard 1200: Planning, Design, Fabrication, and Assembly and Off-site Construction Standard 1205: Inspection and Regulatory Compliance to provide a consistent process for assuring off-site construction meets design requirements.

1.9.3.11.3 CONSTRUCTION AND DEMOLITION WASTE

Divert at least 50% of total non-hazardous construction and demolition (C&D) waste materials per IgCC Section 9.3.1 Construction and Demolition Waste Management and Section 10.4.5 Construction and Demolition Waste Management. Where feasible, aspire to divert 75% or higher, per EO 14057 section 207's goal to divert 75% by fiscal year 2030. See the Whole Building Design Guide’s Construction Waste Management page for more information.

See Chapter 1, Salvaged Materials to assess material reuse. Incorporate a dedicated storage area for salvaged materials as needed. Explore reuse partnerships with local organizations or re-suppliers.

1.9.3.11.4 GREEN CREDENTIALED CONSTRUCTION PERSONNEL

GSA encourages certification of contractor construction personnel to high-performance builder voluntary consensus standards such as Green Advantage.

1.10 RESILIENCE

1.10.1 MANAGEMENT OF CLIMATE RELATED AND EXTREME WEATHER RISKS

Historic climatic design data is less illustrative of the current and long-term climatic conditions. GSA must integrate both the observed and expected changes in climate and extreme weather for the intended asset service life when planning and designing capital investments.

Management of climate-related risks ensures that federal investments can continue to reliably perform and ensure life safety in the face of changing trends and extremes.

Safeguarding Assets is part of a qualitative, iterative risk management process. It addresses the risks and opportunities of plausible incremental climate–related risks, as well as extreme weather for the asset service life. It also addresses adaptations to the design, operation, and maintenance of a project considering its vulnerabilities. This aspect of risk management must be prioritized for projects that have sites with existing vulnerabilities, house mission-critical/mission-dependent functions (e.g. land port of entries, data centers), have an intended asset life beyond 30 years or are designated as a historical/cultural resource.

Some projects may require energy and water surety in the event of extended utility disruption. In short, detailed assessment and design must establish these criteria on a case-by-case basis, as informed by a partner agency's mission, sensitivity to interruption, and other variables.

Designers for new construction, modernizations, major repairs, and alterations must:

- Integrate climate information into designs per the GSA provided climate profile and statement of work for those prioritized project types listed above
- Develop professional recommendations and designs for the service life of the asset. Parts of a project may be designed for reliable performance throughout a building's lifespan; others may be adapted as conditions change.
- Exercise professional judgment in the context of preparedness and climate change adaptation for climate-related risks and an evolving professional standard of care in architectural, engineering design services as well as construction and asset management activities.
    - Under risk management activities, document for the project risk record any decisions/trade-offs reflecting the risk tolerance/risk acceptance of the climate informed professional recommendations and the extent to which the climate informed professional recommendations were integrated into the project design
    - At each phase of project delivery and design milestone document how design updates for this asset are able to adapt to changing conditions for the identified impacts including but not limited to thermal comfort (cooling and the ability to handle temperature extremes), construction (structural stability above grade, weatherproofing, detailing, durable materials), managing (shortage and inundation) , and managing the migration of wildfire smoke and include indicators or thresholds to monitor this asset.
    - Avoid maladaptation.

For more information, see Safeguarding Assets.

Refer to Chapter 4, Flood Resistant Design Requirements. See Chapter 5, Wildfire Smoke Mode.

1.10.2 THERMAL RESILIENCE

For some customers with Mission Critical Facilities, thermal resilience supports mission continuity in both observed and expected extreme climatic conditions. Dependent on customer criteria and location, specific spaces in a project or all a project may require thermal autonomy and passive habitability for heat and/or cold in duration. Leverage an integrated design to optimize the performance of the enclosure, mechanical systems, and controls. Provide a basis for a thermal autonomy analysis to measure the time which the space or project can passively (no active energy inputs) maintain comfort criteria. Measure the time that a space or a project can passively remain habitable during extended interruption of power.

2

COMMUNITY PLANNING AND LANDSCAPE DESIGN

Figure 7: Landscape at U.S. Courthouse
San Antonio, TX

2.1 COMMUNITY PLANNING PERFORMANCE TABLE

2.1.1 Sustainable Locations		
Site Uses Existing Local Infrastructure Resources and Preserves Natural Resources		
Baseline		Site selection process meets GSA responsibilities under directives described in Chapter 2, Community Planning Performance Attributes, incl GSA ADM 1097.1 and consults with local officials. Site's immediate prior use was not a public park or designated open space. Project earns 1pt under Sensitive Land Protection, LEED v4.
Tier 1		The site meets the Baseline requirements, AND: Site is a previously developed infill site served by existing water and sewer infrastructure. Proposed development on this site is designated by local planning officials as advantageous to local infrastructure and development goals.
Tier 2		The site meets the Baseline requirements, AND: Site is an officially designated brownfield site and has been remediated to the satisfaction of the designating authority OR Site is officially designated for priority redevelopment and earns 1 pt. under Priority Designation under High Priority Site, LEED v4
Tier 3		N/A
M & V		Map, documents, project design narrative, and related materials.
Plans & Specs		Site Acquisition and Design Concept materials
Calculations & Analysis		N/A;
References		EOs 12072, 13006, 14057, 14091; 41 CFR §102–83; Federal Urban Land Use Act of 1949, as amended (40 USC §901–905)
Basis of Design		LEED v4; SITES Silver
Construction Verification		Verify relevant design elements from approved Concept presentation
Site Supports Neighborhood Connectivity, Walkability, and Transportation Access		
Baseline		Project's main entrance and all frontages are linked to surrounding sidewalk and crosswalk network, extending out in a 1-mile radius from entrance. Project is within ¼ mile walkable distance of 4-7 diverse uses, as defined under Surrounding Density and Diverse Uses, LEED.
Tier 1		The site meets the Baseline requirements, AND: Project is served by qualifying transit routes and stops for bus, streetcar, light rail, etc. such that it earns at least 3 pts under Access to Quality Transit, LEED.
Tier 2		The site meets the Baseline requirements, AND: Project is served by qualifying transit routes and stops such that it earns 5 pts under Access to Quality Transit, LEED.
Tier 3		The site meets the Baseline requirements, AND: Project is within a 200-yard walking/bicycling distance of a designated bicycle network, connecting diverse uses, employment centers, and transit stops as defined under Bicycle Facilities, LEED
M & V		Map detailing connectivity around site, retail and other diverse uses within specified radius or buffer. Project teams are encouraged to use LEED documentation.
Plans & Specs		Site Acquisition and Design Concept materials
Calculations & Analysis		Calculations based on source material from vetted information service or GSA provided data.
References		EOs 12072, 13006, 14057, 14091; and 41 CFR §102–83; Federal Urban Land

		Use Act of 1949, as amended (40 USC §901–905)
Basis of Design		LEED v4; SITES
Construction Verification		Resubmission of previously specified maps using updated data as of time of substantial construction completion.

2.1.2 Collaborative Design Process

Design Process Considers Input of Local Officials		
Baseline		For new construction or other projects with significant impact on the public realm (e.g., landscape, facades, perimeter security): Prior to design start, GSA project team (incl. AE or others as appropriate) meets with local officials, shares general project information, gathers officials' input, and reviews local plans. Based on meetings with local officials and other research, the project team completes a community stakeholder analysis (CSA) and a community engagement plan (CEP) to inform its design process. At first Peer Review, the project team presents input it has collected from local stakeholders and explains how the project's developing design strategy is informed by both the stakeholder analysis and community engagement plan. Areas that present potential concerns or opportunities are to be highlighted. At Final Design Concept presentation for Commissioner's approval, the project team presents local input, outlines responding design strategy, and details the relevant building and landscape design elements that demonstrate meaningful response to community engagement. Outstanding issues or challenges in this regard should also be presented to enable GSA leadership's full consideration of the proposed concept.
Tier 1		Meets Baseline performance requirements, AND: Prior to approval of the Final Design Concept, project team must share the relevant elements of the proposed design strategy with local officials and address their feedback in the Final Design Concept presentation.
Tier 2		Meets Tier 1 Requirements AND: Project development must be based upon a Feasibility Study that includes input from local officials on relevant design elements.
Tier 3		Meets Tier 2 Requirements AND: Project design and development must be informed by a neighborhood planning or charrette process that was conducted in partnership with local officials.
M & V		OAE Review of Design Narrative and presentation at relevant reviews
Plans & Specs		Design Concept materials
Calculations & Analysis		N/A
References		Applicable policies: EOs 12072, 13006, 14057, 14091; and 41 CFR §102–83; Federal Urban Land Use Act of 1949, as amended (40 USC §901–905); Public Buildings Amendments of 1988 (40 USC §3312);
Basis of Design		
Construction Verification		Verify relevant design elements from approved Concept presentation.

2.1.3 Design for Public Use

Design for Public Use - INTERIORS		
Baseline		Assembly areas in the base building program (e.g., auditoriums, atria, jury assembly rooms) are designed to allow for manageable public access for after-hours use.
Tier 1		Meets Baseline Requirements AND: Assembly areas within the base building program are positioned in relation to public entries and other building amenities to enhance their visibility and utility and to encourage public interest in their use.
Tier 2		Meets Tier 1 Requirements AND: Assembly areas for appropriate public use includes at least one contiguous space that provides a minimum of 2,000 SF.
Tier 3		Meets Tier 2 Requirements AND: Project design and development must be informed by a neighborhood planning or charrette process that was conducted in partnership with local officials.
M & V		OAE Review of Design Narrative and presentation at relevant reviews
Plans & Specs		Design Concept materials
Calculations & Analysis		N/A
References		Public Buildings Cooperative Use Act of 1976 (40 USC §601a)
Basis of Design		
Construction Verification		Verify relevant design elements from approved Concept presentation, and submission of completed form 3453, when appropriate
Design for Public Use - EXTERIORS		
Baseline		Design provides clear vision for how all exterior public areas are meant to be used, whether for circulation, passive use, or programmed public use. Design narrative must include ratio of provided site seating to expected building population (i.e. seats/person, assuming 2’ linear per seat).
Tier 1		Meets Baseline Requirements AND: Onsite seating (2’ linear per seat) provided for at least 5% of daily building users. Seating meets standards outlined in SITES credit HHWB C6.4. If not provided under construction contract, site furnishings (benches, etc.) are selected and located by the project designer, priced, and sourced for later acquisition, and installed upon project opening
Tier 2		Meets Tier 1 Requirements AND: Site design includes a publicly accessible plaza space that provides for occasional programmed public use and includes electrical service to support it. Gathering areas are equipped with publicly accessible ‘‘guest” Wi-Fi to support use by building occupants and visitors.
Tier 3		N/A
M & V		OAE Review Project teams are encouraged to use appropriate documentation materials they’ve prepared for LEED/SITES.
Plans & Specs		Design Concept materials
Calculations & Analysis		Design Concept materials
References		Public Buildings Cooperative Use Act of 1976 (40 USC §601a); the Public Buildings Amendments of 1988 (40 USC §3312)
Basis of Design		SITES
Construction Verification		Resubmission of previously specified documents using updated data as of time of substantial construction completion.

2.2 COMMUNITY PLANNING PERFORMANCE ATTRIBUTES

GSA has the responsibility to leverage its federal real estate actions in ways that support local community planning goals, and advance regional economic and sustainability objectives while also meeting client agency needs, wherever possible. This derives from several laws and executive orders (E.O.) including the Federal Urban Land Use Act of 1949 (40 USC §901-905); the Public Buildings Cooperative Use Act of 1976 (40 USC §581(h)); the Public Buildings Amendments of 1988 (40 USC §3312); and E.O. 12072, E.O. 13006, E.O. 14057 and E.O. 14091. These requirements are in addition to and must be coordinated with the local consultation required under NEPA.

The goal of designing a federal building that responds to its site, to the surrounding neighborhood design and plans, and its potential for interactions with the public is leveraging federal investment in support of local plans in ways that improve neighborhood design and experience. Achieving this level of design quality requires that attention be paid to sustainably locating the facility near transit and in pedestrian-friendly neighborhoods, to involving local officials collaboratively in the design process, and to designing the building for maximum potential public use of the exterior and interiors.

Note that as with other sections of the IgCC, requirements for sustainable sites are encouraged, but not required for P100 compliance. Requirements related to sustainable sites and landscape development are found in Chapter 2.

2.2.1 SUSTAINABLE LOCATIONS

Constructing federal facilities in sustainable locations can lessen the cost burden on local infrastructure, provide transportation choice to reduce congestion, support access to jobs and services, conserve natural resources, and advance federal and local sustainability goals. Sustainably locating a federal facility requires consideration of several factors in addition to mission requirements. These factors include access to transit, walkability, proximity to neighborhood amenities, and maximization of existing road, sewer, and other infrastructure through infill and other efficient development opportunities.

2.2.2 COLLABORATIVE DESIGN PROCESS

In many localities, the construction and renovation of a federal facility may be one of the more significant real estate investments in the community. While GSA must meet client needs first, where feasible it also must look for ways for its federal investment to support local planning, sustainability, economic, and equitable development goals. This responsibility derives from the Federal Urban Land Use Act of 1949 (40 USC §901-905); the Public Buildings Amendments of 1988 (40 USC §3312); and Executive Orders. 12072,13006, 14057, and 14091, among others.

To meet this responsibility, the project team must understand local stakeholders, plans, and conditions, and meet the requirements outlined in the previous matrix and below. The project team also must develop community engagement plans to effectively solicit local stakeholder input during the design process and incorporate that feedback into its work. This aligns with applicable SITES certification elements, including factor 2.2 (Pre-Design Site Assessment) and C2.4 (Engage users and stakeholders), and relevant Federal directives.

The community stakeholder analysis (CSA) mentioned in the performance matrix must include key local or tribal governments, businesses, residential associations, and other relevant stakeholders, including those who may have environmental justice concerns or who have substantial interest in the project's outcome and impacts. Note: further guidance is available from the Center for Community Planning + Design in GSA's Office of Architecture and Engineering.

2.2.3 DESIGN FOR PUBLIC USE

The Public Buildings Cooperative Use Act of 1976 (40 USC §581(h)) requires GSA to encourage the location of commercial, cultural, educational, and recreational facilities and activities within GSA public buildings and sites, and to encourage the public use of these properties for cultural, educational, and recreational activities. Although much of this responsibility falls to how GSA manages and makes such space available, the design of the spaces–both interior and exterior–is fundamental.

Federal buildings are inherently public buildings, but their design determines how successfully the public can access and use the building interior and exteriors. This is especially true given current security requirements and project budgets.

Buildings that are highly successful maximize public investment by both meeting the federal space need and by enabling public use. Key factors in a successful project include the design's ability to support flexible passive or programmed use in gathering spaces, the shaping and orientation of the building program to encourage such use, and, where appropriate, the expansion of the building program to take advantage of site-specific public use opportunities.

All public areas of the project site, regardless of scale, should take a deliberate and proactive approach to providing a positive usable space for facility users and, where possible, the local community.

2.3 COMMUNITY PLANNING, DESIGN, AND SITE REQUIREMENTS

2.3.1 PROCESS CRITERIA

To fulfill the consultation and community design requirements of the P100 and its underlying Federal directives, the project team must consult with relevant local planning officials and other local stakeholders, as appropriate. The intent is to have a fully informed design process that maximizes opportunities for Federal investment to support local development and urban design goals and that minimizes negative impacts.

While project teams are invited to employ those collaborative design strategies that they believe will be most effective in this regard, for projects impacting the public realm (including new construction projects and those involving significant site work), design teams are required to submit a Community Stakeholder Analysis (CSA) and Community Engagement Plan (CEP), as described elsewhere in this document. Questions should be directed to GSA's Office of Architecture and Engineering and its Center for Community Planning and Design.

2.3.2 DESIGN CRITERIA

2.3.2.1 EXTERIOR CONNECTIONS AND GATHERING SPACES

All outdoor pedestrian pathways must connect building entrances safely and contiguously to the means of transportation identified in consultation with client agency and local officials, described above, including transit stops off-site. For new construction projects, standard practice must be for the GSA project to replace public sidewalks and curbs and add passenger loading zones where feasible on the perimeter of the site (e.g., between curb and building construction footprint) and those impacted by construction activity [41 CFR §74.565-580; 40 USC §589]. The design must consider street connections to transit stops, passenger loading zones, and to primary neighborhood corridors.

Building approaches, pathways, and plazas must be oriented toward primary pedestrian access points to the site. This orientation must consider street connections to transit stops, when appropriate, and to primary neighborhood corridors.

The project team must demonstrate in design drawings how plazas and other gathering spaces allow for several different active and passive uses (such as farmers markets, seated assemblies, and employee breaks and lunches). Project teams must consider current best practices in public space design. For example, isolated bench seating, seating without shade, and gathering spaces not visible from building entrances or along primary pedestrian pathways are not likely to be used regularly.

Design drawings must demonstrate consideration of human scale in the exterior design by showing building perspectives at eye-level from designed pedestrian pathways (such as sidewalks adjacent to the buildings).

2.3.2.2 INTERIOR SPACES AND ASSEMBLY AREAS

Assembly areas designed for flexible public use both during and after business hours must have direct and clear wayfinding from building entrances.

The project team must demonstrate in design drawings how, when designed for public use, atriums, jury assembly rooms, and other gathering spaces allow for several different public uses, such as a standing reception, a seated dinner, an awards ceremony, or similar use.

2.3.2.3 ZONING AND LOCAL REVIEW

As described in Chapter 1, Environmental Protection, federal law requires that, to the greatest extent practicable, GSA projects must be consistent with the zoning, land-use practices, and development objectives of local government. Projects that impact urban design elements must be executed only after due consideration of all requirements of zoning laws and similar design requirements of state or local government. Local regulations must be followed without exception in the design of systems that have a direct impact on off-site terrain or infrastructure. Deviation from local regulations must be approved by GSA through the P100 waiver process.

Per the Public Buildings Amendments of 1988, in preparing plans for the facility, the project team must consult with appropriate officials of the local government. The project team must offer local officials an opportunity to review and comment on the design concepts for compatibility with local plans, zoning, and design guidelines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the RPMT must document this in the project file.

2.3.2.4 FIRST RESPONDER AND EMERGENCY ACCESS.

Provide fire department vehicle access in accordance with the requirements of the ICC International Fire Code.

2.3.2.5 FIRE APPARATUS ACCESS ROADS

The design team must design the emergency vehicle access in accordance with the specific requirements of the local fire department. At a minimum, the fire department must be consulted regarding the surface material of the access roadways, minimum width of fire lanes, minimum turning radius for the largest fire department apparatus, weight of the largest fire department apparatus, and minimum vertical clearance of the largest fire department apparatus.

2.3.2.6 AERIAL APPARATUS ACCESS

For buildings or portions of buildings exceeding 9 meters (30 ft.) in height, from the lowest point of fire department vehicle access, provide access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines must not cross the access roadway.

2.3.2.7 SITE SIGNAGE

A well-designed site uses as few signs as possible. Signs must make the site wayfinding clear to the first-time user by identifying multiple site entrances, parking, and the main building entrance.

Generally, graphics and style of site signage should be consistent with signage used inside the building. Signs integrated with architectural elements can also be very effective. Signage must be consistent in font, style, and color as well as with any directional symbology used in site and building signage. Signage placement can be an important detail element of the building design whether prominently displayed and tooled into the exterior building wall materials or as a freestanding component near the entrance to the facility. Exterior signs identifying permanent rooms and spaces must comply with ABAAS (see ABAAS Section F216).

2.3.2.8 SITE WAYFINDING

Minimize the number of wayfinding signs on the site. For complex sites with multiple buildings or other destinations, consider developing a wayfinding plan for review by the RPMT and users.

Obtain approval of local authorities for entrance signs in the public rights-of-way.

Use variable message signs for high-volume areas where entrance patterns need to be altered.

2.3.2.9 FLAGPOLES

A ground-mounted flagpole, located preferably at the left of the entrance (facing the building), must be provided for new federal buildings. If ground-mounted poles are not feasible, a roof-mounted pole is permissible; or, if roof mounting is not suitable, an outrigger pole may be used. Generally, only one flagpole is needed for a complex of buildings on a common site. Exceptions may include particularly large campuses with multiple entrances or buildings where there is a need to fly multiple flags (e.g., U.S. flag and U.S. cabinet department flag). In those cases, flags should be grouped at key locations. In all instances, flags must be illuminated, and the light controlled with a seasonally adjustable time clock, photocell, or the BAS system.

Table 2.1 Approved Flagpole Heights and the Corresponding Flag Sizes	
Flagpole Height	Flag Dimensions
20 ft.	3 1/2 by 6 2/3 ft.
30 ft.	5 by 9 1/2 ft.
40 ft.	5 by 9 1/2 ft.
50 ft.	8 2/3 by 17 ft.
60 ft.	8 2/3 by 17 ft.

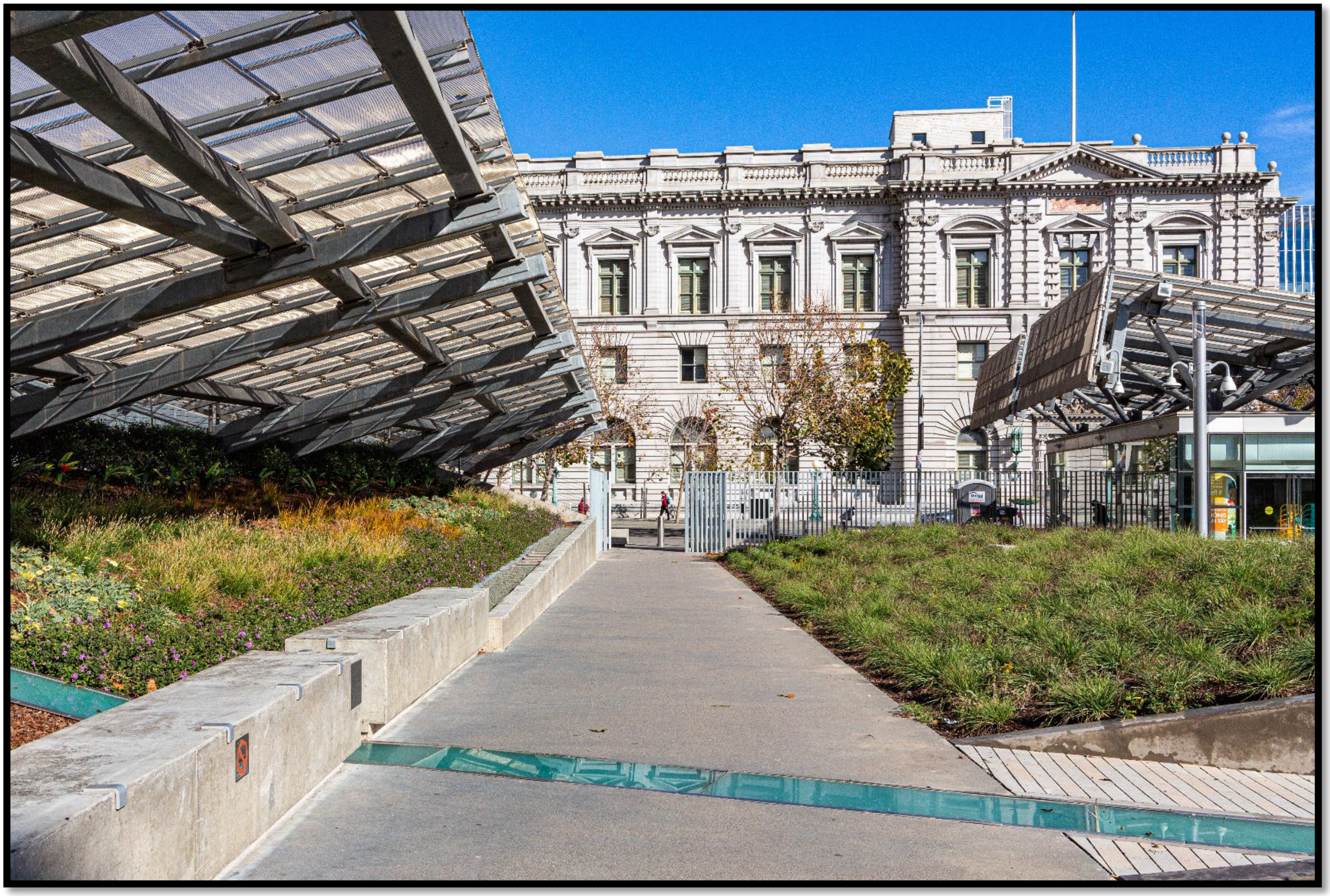


Figure 8: Nancy Pelosi Federal Building Landscaping
San Francisco, CA

2.4 LANDSCAPE PERFORMANCE TABLE

2.4.1 Site Performance		
Site Materials		
Baseline		Only use wood products per Chapter 1, Sustainable Wood. Use recycled content materials. Use regional materials.
Tier 1		Baseline plus maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste.
Tier 2		Tier 1 plus design for deconstruction and disassembly. Use adhesives, sealants, paints, and coatings with reduced VOC emissions.
Tier 3		Tier 2 plus reuse salvaged plant material.
M & V		Yes. Employ the Sustainable Sites Initiative (SITES) Definitions.
Plans & Specs		Yes
Calculations & Analysis		Provide a species list of all proposed wood products and threatened/endangered status. High performance: Provide a narrative with existing site materials and quantifications, including plants, and how it will be reused on site versus how much will enter the waste stream.
References		SITES section 5: SITE DESIGN – Materials Selection
Basis of Design		Describe proposed approach to site materials that achieves both visual and performative goals responding to project particulars
Construction Verification		Verify all site materials meet project performance requirements.
Site Soils		
Baseline		Option 1- Locate 70% of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance per site assessment. OR Option 2- On all areas with healthy or minimally disturbed soil limit disturbance to: a. 50 feet beyond the building perimeter, b. 15 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 20 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d. 30 feet beyond constructed areas with permeable surfaces that require additional staging areas to limit compaction in constructed areas. (SITES prerequisites 2.1 and 4.1)
Tier 1		Option 1- Locate 80 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance per site assessment. OR Baseline Option 2
Tier 2		Option 1- Locate 90 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance per site assessment. OR Option 2-On all areas with healthy or minimally disturbed soil limit disturbance to: a. 40 feet beyond the building perimeter, b. 10 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 15 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d. 25 feet beyond constructed areas with permeable surfaces that require additional staging areas to limit compaction in constructed areas. (SITES prerequisites 2.1 and 4.1)
Tier 3		Option1- Locate 100 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance per site assessment. OR Tier 2 Option 2

M & V		Yes. Employ the SITES Definitions.
Plans & Specs		Yes, and Provide Soil Management Plan
Calculations & Analysis		Provide comparative l analysis covering geotechnical, agricultural and drainage soil properties to establish the reference site soil condition and the proposed soil import/condition.
References		SITES section 4: SITE DESIGN - Soil and Vegetation
Basis of Design		Describe proposed site zoning and corresponding, phasing, lay-down, and sequencing for all areas affected by the construction process that respond to project particulars. Describe engineering controls for restoring site disturbance.
Construction Verification		Verify all imported soils and engineered soils meet project performance requirements.
Vegetation		
Baseline		Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible, preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements. Comply with IgCC-Section 5.3.2 Predesign Site Inventory and Assessment and5.3.3.1 Invasive Plants.
Tier 1		Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible, preserve, all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements.
Tier 2		Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify and preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements.
Tier 3		Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify, preserve, and reuse plant communities and special status vegetation native to the eco-region of the site to contribute to regional diversity of flora and provide habitat for native wildlife. Use vegetation to minimize building climate control requirements.
M & V		Yes. Employ the SITES Definitions.
Plans & Specs		yes
Calculations & Analysis		Tier 1, 2 and 3: provide an Invasive Species Management Plan. Tier 2 and 3: Biomass Density Index
References		SITES prerequisites and credits4.2/4.3/4.4/4.5 4.6/4.7/4.8/4.9/4.103
Basis of Design		Describe proposed distribution of plant communities throughout the site that respond to soil, topography and drainage responding to project particulars.
Construction Verification		Verify all plant materials meet project performance requirements
Pollinators		
Baseline		Foraging: Consider primary aspects of the planting design for adequate site foraging capacity for target pollinators. 1. Bloom Value, 2. Bloom Diversity of Form and Color, 3. Material Size and Structural Diversity, and 4. Pollinator-positive Plant Quantity. (Please see prescriptive requirements for resources). Plant a minimum of 3 different plant species for each viable blooming season. Pursue a non-mandatory 20% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. If a 20% target cannot be achieved provide written justification. All plants must be adapted to the site's eco-region. Tree and shrub canopy diameter at maturity must be considered for the purpose of plantable area calculation.
Tier 1		Baseline + Plant a minimum of 5 different plant species for each viable blooming season. Design to a mandatory 30% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. General signage must be provided on the site that identifies the pollinating-positive environment and the donor-recipient relationship and importance of pollinators
Tier 2		Baseline + Plant a minimum of 7 different plant species for each viable blooming season. Design to a mandatory 40% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. General and specific signage must be provided on the site that identifies the pollinating-

		positive environment and the donor-recipient relationship and importance of pollinators, and particular planting strategies and maintenance methods.
Tier 3		Baseline + Plant a minimum of 9 different plant species for each viable blooming season. Design to a mandatory 50% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. General and specific signage must be provided on the site that identifies the pollinating-positive environment and the donor-recipient relationship and importance of pollinators, and particular planting strategies and maintenance methods.
M & V		Field Verified -Post Construction by CM
Plans & Specs		Provide a planting plan for approval during schematic design and construction documents that identifies both the pollinator foraging species included, a bloom table representing the period of bloom, and proposed site locations. Bloom value, quantity, and percentage of total must be identified in the notes.
Calculations & Analysis		Provide a brief pollinator vegetation management plan as part of the maintenance plan. This plan will simply identify how the pollinator zones are intended to be managed as are noted in the "Supporting the Health of Honeybees and Other Pollinators."
References		Supporting the Health of Honeybees and Other Pollinators, October 2014, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes, October 2011, 2. USDA Pollinator Plant list, 3. Xerces Society Bloom Quality Plant list. 4 sWS-Pollinator Portal, 5. Pollinator Partnership
Basis of Design		
Construction Verification		Verify all plant materials meet project performance requirements.

2.5 LANDSCAPE REQUIREMENTS

All proposed site designs must meet baseline compliance with all applicable federal, tribal, state, and local regulation and/or guidance and the most stringent requirements take precedence. This includes all elements of work performed under the scopes of the landscape architect, architect, civil engineer, and geotechnical engineer. The applicable regulations must be determined on an individual project basis.

2.5.1. INTEGRATIVE DESIGN

Agency Subject Matter Experts including Landscape Architects, Civil Engineers, and Stormwater experts are available to assist projects and the consultants in determining design approaches that will meet the intent of the Facility Standard and whether a given scope of work is of sufficient scale and scope to pursue Sustainable Sites Initiative (SITES) v2 certification.

All major capital projects, with a scope of site work exceeding 5,000sf, must follow an Integrative Design process, equivalent to the format described in SITES prerequisite 2.1 and other Agency standards outlined in the P100. This process structures and promotes a collaborative effort between all relevant project team members and stakeholders involved in the planning, design, construction and includes operational phase considerations to deliver a more effective, resilient, and durable facility.

2.5.2 REGULATIONS, STANDARDS AND GUIDANCE

ALL project teams working on major capital projects with sufficient related site-civil scope of work are required to identify all relevant regulations, standards, and guidance applicable to the project. Examples of such criteria include but are not limited to:

2.5.2.1 SECTION 438 OF THE ENERGY INDEPENDENCE AND SECURITY ACT (EISA) & TECHNICAL GUIDANCE

The sponsor of any development or redevelopment project involving a federal facility with a footprint that exceeds 5,000 square feet must use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property regarding the temperature, rate, volume, and duration of flow.

For roof repair and renovation projects at existing building facilities, reference P100 Section 3.3.7.2 for clarity on GSA policy enhancement to EISA Section 438 compliance. These project scope areas would count towards the EISA Section 438 computation of the 5,000 sf threshold. Refer to GSA memorandum "Compliance with Section 438 (Stormwater) Requirements of the Energy Independence and Security Act of 2007" early in the project planning phase. For projects meeting the criteria described in the regulation and the GSA memorandum, compliance with EISA section 438 is required by law and cannot be waived.

Supplemental reference includes the EPA Technical Guidance , EPA 841-B-09-001, Dec 2009 and SITES credit 3.3 to 'Manage precipitation beyond baseline' for 6 points.

2.5.2.2 NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) OF THE CLEAN WATER ACT (AS DELEGATED TO THE STATES)

NPDES is a permitting program that applies to all activities resulting in water pollution discharges, including construction projects of certain sizes. Obtaining such a permit typically requires the development of an Erosion and Sediment Control Plan, and a Stormwater Pollution Prevention Plan (SWPPP). Minimum requirements are developed by the EPA and delegated to the individual states. The states often add additional performance requirements; therefore, state-by-state compliance is required.

2.5.2.3 COMMISSIONING OF DYNAMIC LANDSCAPE FEATURES

All major capital projects, with a scope of site work exceeding 5000sf, must follow a standard total building commissioning process, aligned with the Agency standard, and adopted in 2006, to verify and measure performance and train operators of site-based dynamic systems. The measurement, performance verification, and staff education of complex site systems provided through this established process is critical to help lower a facility's life cycle and operational costs. This process can protect the physical, operational, and human capital investment and deliver effective design that addresses major and minor construction errors prior to project turn-over.

A list of site-related systems must be developed and evaluated early in the project development process for potential inclusion in commissioning-related activities. As is standard with the commissioning of building systems, many site-based systems are dynamic and could utilize a commissioning process to measure and verify performance and train the operators on the systems operation. Discussions regarding this evaluation must be included in the development of the Owners Program of Requirements, and if deemed appropriate, refined, and implemented throughout the project development process.

Dynamic site-based features and systems include, but are not limited to, the following:

- Water harvesting systems (tanks, pumps, controllers, water quality systems)
- Stormwater storage systems (collection, conveyance, and filtering elements).
- Stormwater drainage systems and structures
- Vegetative Roofs (drainage, irrigation)
- Irrigation systems

- Dynamic site perimeter security features
- Snowmelt systems
- Exterior lighting
- CCTV systems
- Weather station(s)

2.5.2.4 SITES CERTIFICATION

All major capital projects, with sufficient related site-civil scope of work, must achieve, at a minimum, a SITES silver rating through Green Business Certification Inc (GBCI)of the U.S. Green Building Council. GSA's use of the SITES framework allows its land-based projects to better protect ecosystems and enhance the mosaic of benefits they continuously provide to our communities, such as climate regulation, carbon storage, and flood mitigation. Pursue SITES credits appropriate to the goals of GSA and to the type of project being designed.

During the development of a capital project, a SITES certification scorecard must be provided to GSA, at each submission stage, that encapsulates the most current direction of the design represented in the documentation being shared for review. This process of submitting a SITES scorecard with other design proposal documentation should begin during the conceptual design phase. Project teams should utilize the USGBC's 'SITES-LEED Synergies' 2016 publication and the 'LEED to SITES Readiness Tool' to the maximum extent feasible when framing early phase (concept, schematic, design development) project design proposals. Such a coordinated and integrated approach will encourage the most program-responsive and resource-effective solutions for achieving both certifications at a best value to the government.

For projects seeking SITES certification, compliance with prerequisite credits is required. Project teams must evaluate all project prerequisites during the earliest phases and analysis of the project.

2.5.3 WATER

2.5.3.1 PRECIPITATION

All major capital projects, with a scope of site work exceeding 5000sf, are required to comply with the equivalent of SITES credit 3.3 to 'Manage Precipitation Beyond Baseline' for 6 points. The goal of this credit is to capture and manage the equivalent of the 95th percentile precipitation event as is required by EISA section 438. Sufficient scope of work (the threshold) for this credit to be pursued, is identified in the federal law, and equates to the modification of more than 5000sf of a site area. Utilize resilient nature-based solutions to manage runoff in lieu of traditional gray infrastructure whenever possible. Where SITES certification is not being pursued, but compliance with EISA Section 438 is required, design submissions are to follow SITES certification documentation procedures, and Agency design-phase guidance identified in:

GSA memorandum "Compliance with Section 438 (Stormwater) Requirements of the Energy Independence and Security Act of 2007" early in the project planning phase.

Additionally, project locations that receive significant solid-state precipitation (e.g. snow) require project teams to provide liquid-to-solid state precipitation equivalencies, calendar year totals, and design features, such as meltwater forebays and pools, that aim to protect receiving water bodies from impairment.

CxP to confirm installed features are functioning as per design and Facility Managers are trained to monitor, manage, and recognize underperforming site features that have been created or installed to manage runoff.

2.5.3.2 WATER USE

All major capital projects, with a scope of site work exceeding 5000sf, are required to comply with the equivalent of SITES prerequisite 3.2 to 'Reduce Water Use for Landscape Irrigation' and credit 3.4 to significantly 'Reduce Outdoor Water Use' for a minimum of 5 points. The goal of this requirement is to protect and conserve water. Where SITES certification is not being pursued, design submissions must follow SITES certification procedures for approach and documentation of this element.

Rainwater catchment and harvesting systems from architectural rooftops must comply with ARCSA/ASPE/ANSI Standard 63-2020: Rainwater Catchment Systems, while systems harvesting sidewalk, plaza, and/ or parking lot runoff must comply with ARCSA/ASPE/ANSI 78: Stormwater Harvesting System Design for Direct End-Use Applications. In addition to the above, capital projects may use recycled water sourced from a centralized treatment facility to meet these requirements. Testing of the recycled water must be conducted to determine if the chemistry is compatible for sustaining the proposed plant palette.

Utilize EPA REUSExplorer Tool for State and local requirements for water reuse.

CxP to confirm installed features are functioning as per design and Facility Managers are trained.

2.5.4 SOIL AND AGGREGATES

2.5.4.1 PRIMARY AREAS OF WORK

The primary areas of work include:

- Creating a soil management plan
- Minimizing soil disturbance in design and construction.

Soil impacts described within are intended to manage impacts associated with major construction activities, not minor landscape improvements. In cases where topsoil needs to be improved to provide an enhanced growing environment, such dimensional restrictions may not apply. Consult with an Agency Regional Landscape Architect or appropriate SME to confirm an alternative approach by providing a coherent plan to manage soil as a valuable resource.

2.5.4.2 SOIL MANAGEMENT

All major capital projects, with a scope of site work exceeding 5000sf, are required to comply with the equivalent of SITES prerequisites 2.3 to 'Designate and Communicate Vegetation and Soil Protection Zones' and 4.1 to 'Create and Communicate a Soil Management Plan.' The goal of these processes and resulting documentation is to maximize ecosystem services; support effective drainage; sustain and/or improve the health of vegetation; and increase efficiency regarding site and landscape maintenance.

Limit disturbance of healthy soil to protect soil horizons and maintain soil structure, existing hydrology, organic matter, and nutrients stored in soil. Develop and communicate to construction contractors a soil management plan prior to construction to limit disturbance, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones.

2.5.4.3 AGGREGATES

Gravel, crushed stone, non-wood mulch, or other aggregate types being proposed as a loose surface material in publicly accessible landscape areas are prohibited from specification in the following sizes, due to potential use as a thrown projectile: #1, #2, riverstones over 2" diameter, and rip rap less than 6”. Boulders, rip rap larger than 6”, and all other size stones bound in place or adequately contained in gabion wall systems are permitted. Very small stone chips and stone dust pose minimal risk and are also permitted.

2.5.5 VEGETATION

2.5.5.1 MANAGING EXISTING SITE VEGETATION

2.5.5.1.1 DOCUMENTING EXISTING VEGETATION

In assessing the site, project teams must follow a Certified Arborist Report (CAR) that clearly demonstrates the size, species, and condition of all existing trees and shrubbery on site. Existing site vegetation has significant economic, environmental and ecosystem value and must be assessed and included in the project development during the early project phases as such. Existing mature trees should be prioritized for preservation whenever possible as they provide a myriad of benefits not expeditiously replaced such as carbon sequestration, stormwater interception and transpiration, soil stabilization, cooling shade, and wildlife habitat. Before a tree removal decision is made, a certified arborist must determine if targeted pruning of tree canopy and/ or root mass can be utilized to accommodate the project program and preserve trees in lieu of removal.

In assessing the site, project teams should follow guidance provided within IgCC-Section 5.3.2 which addresses ‘Predesign Site Inventory and Assessment’ and 5.3.3.1 which addresses the management of ‘Invasive Plants.’

The documentation and management of invasive plant species present on site during survey must be comprehensively addressed through the proposed design drawings and associated specifications, to meet or exceed the equivalent of SITES prerequisite 4.2 to ‘Control and Manage Invasive Plants.’

2.5.5.1.2 INCORPORATING EXISTING VEGETATION INTO A PROPOSED PROJECT

Detailed plans must be provided for those plants that will be impacted and/or removed for the impacted site. For all new construction projects, this includes identifying proposed new tree locations and quantities, as well as the protection plan for existing trees during the construction activity. Further, all proposed grade changes affecting the protected site trees must be identified.

2.5.5.1.3 DEFINING THE TREE PROTECTION ZONE

The Tree Protection Zone is defined as the area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

For trees, the locations of all Critical Root Zones (CRZs) are defined as the area for each tree that contains the estimated minimal amount of both structural and feeder roots that must be protected to minimize tree damage and retain structural stability. The CRZ for each tree is calculated based on the Tree Species Tolerance to construction impacts and age class, as outlined in the International Society of Arboriculture's Best Management Practices: Managing Trees During Construction, Third Edition (N. Matheny, T. Smiley, R. Gilpin, R. Hauer, 2023).

Although CRZs will differ by species and tree age, zones range from ½ foot per one inch DBH (diameter at breast height) to 1½ foot per one inch DBH. If the species tolerance is unknown, then the 1½ foot per one inch DBH standard is assumed. Mixed groupings of trees will base the required area of protection on that area which is required for maintaining the health of the most sensitive individual species composing the cluster. The 1½ foot standard applies unless sufficient information detailing the contrary is provided and a lesser area is approved. For large shrubs and groups of shrubs a protection area must be provided equivalent to 1.5 times the diameter of the massing itself, unless otherwise indicated.

2.5.5.1.4 TREE REPLACEMENT

Every effort should be made during the design process, and in coordination with the Certified Arborists Report, to preserve all 'Special-Status' and 'Heritage' vegetation located on site. Design proposals must provide a stage-by-stage inventory comparing proposed tree loss with all proposed new trees for the site. Where city, county, or other jurisdictional standards have been adopted for tree replacement, projects must follow those local replacement ratios to recompense for project-driven tree removal.

2.5.5.2 INTRODUCING NEW VEGETATION TO THE SITE

All major capital projects, with a scope of site work exceeding 5000sf, are required to comply with the equivalent of SITES prerequisite 4.3 to 'Use Appropriate Plants' when identifying species and varieties to be included in new installations. Proposed vegetation must consider hardiness as it relates to phenology and climatic flux. Appropriate vegetation must include near-term considerations, such as nesting and forage for migratory birds and critical pollinators as well as longer-term concerns related to plant health, maintenance, and durability.

Native tree, shrub, vine, and herbaceous species must be prioritized over non-natives. Perennial plants with long bloom cycles should be selected wherever possible. Cultivate a landscape with diverse flower colors, shapes, sizes, and bloom times, with a goal of providing host and forage opportunities for pollinators throughout each specific growing on the site. Consider plant layout for both environmental and cultural opportunities.

For lists of high wildlife value plant species to support local food webs, reference the National Wildlife Federation Keystone Plants by Ecoregion. As many perennials are first selected for aesthetics rather than ecological function, a bloom value must be identified for each species proposed. See the Xerces Society for Invertebrate Conservation website for more information.

2.5.6 POLLINATORS

The intent of this section is to provide opportunities for pollinators to thrive through the intentional design and management of federal landscapes.

During early project planning stages, all major capital projects, with a scope of site work exceeding 5000sf, must identify known pollinators in their immediate subject area and pollinators native to or likely to inhabit their region and climate zone, and identify design strategies for creating and preserving viable foraging and nesting areas to the maximum extent feasible.

Supporting the Health of Honey Bees and Other Pollinators, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes can provide specificity for 1) Procedures, 2) Education, 3) Pollinator Profiles, 4) Resources, and 5) Case Studies for project-specific use. This requirement is intended to make actionable intents set forth in the June 20, 2014, Presidential Memorandum promoting the health of pollinators.

2.5.6.1 POLLINATOR NESTING

Each project must identify viable pollinator nesting sites on the immediate project site or adjacent sites by 1) researching existing resources managed by both federal agencies and Institutions interested in promoting pollinator health and 2) by conducting a field inspection identifying the presence of pollinators. (Field inspection must be conducted during an active [non-dormant] pollinator season.)

Because birds and insects are often the predominant pollinators of concern in this measure, they should always be strongly considered and designed for in the absence of observed or known pollinators during the field inspection or background research. Whenever the existing pollinator nesting is identified and located on the project site during field inspections, the nesting site must be evaluated for preservation/protection to the maximum extent feasible. If nesting sites are located off-site, proposed foraging areas should be located to benefit the target pollinators, within the maximum foraging range if known. If observed nesting areas will be impacted through construction processes, landscape features must be considered that will meet nesting requirements of the impacted target species. If no nesting is known or observed, the design must consider, through site maintenance identified in the maintenance manual, providing overwintering/nesting opportunities for target and/or general species.

If native bees are a critical pollinator on site, identify areas of limited to no ground disturbance during construction operations to preserve current or future pollinator nesting habitats. These areas must be fenced during construction and identified as outside of project cut/fill zone impacts. Consider providing minor sand pits for future use of ground-nesting bees. Targeted bee nesting and foraging areas must be located away from entrances and other areas regularly visited by building occupants and visitors.

If butterflies are a critical pollinator on site, identify requisite plant species ranges for egg development and caterpillar and butterfly foraging areas, and through management allow likely nesting sites to remain intact for the purpose of over-wintering. See associated pollinator foraging section.

If bats are a critical pollinator on site, identify species nesting requirements such as tree vs. cave nesting, and preserve site nesting features to the maximum extent feasible. If nesting cannot be preserved, opportunities for new nesting areas should be explored.

2.5.6.2 POLLINATOR FORAGING

Bees, butterflies, and other beneficial insects need abundant nectar and pollen sources throughout the growing season. Select native plants with long bloom cycles wherever possible. Cultivate a landscape with diverse flower colors, shapes, sizes, and bloom times, with a goal of providing foraging opportunities throughout the specific sites' growing seasons. As some ornamental plants have been selected for aesthetics rather than ecological function, bloom value must be identified. See the [Xerces Society for Invertebrate Conservation]() website for more information.

Criteria for selecting flowering plants include:

- Material size and structural diversity—Native trees, shrubs, and herbaceous materials must be selected with a preference for pollinator-beneficial material. Trees and shrubs offer much of the critical habitat for pollinators and should not be overlooked. Pollinator foraging areas must be in areas adjacent to nesting sites to provide rich "nectar corridors" for pollinator access. See the Pollinator Partnership website for more information.

- Bloom diversity—Diverse plant species must be provided for each viable growing season, such as early spring through late fall in the northeastern United States. These plant species must be appropriate for targeted pollinator species, if known, or general pollinators if not, to ensure sufficient bloom time and material. See USDA Plants Pollinators webpage for more information.
- Bloom value—Beneficial plant species must be provided for each growing season that constitutes high-bloom value for target pollinators. See the Xerces Society for Invertebrate Conservation website for more information.

The U.S. Department of Agriculture NRCS, The Xerces Society, and the Pollinator Partnership, and others, all manage "Pollinator Conservation Resource" websites. These resources cover: 1) principal pollinators, 2) plant lists, 3) pesticide guides, 4) nesting guides, 5) plant nurseries, and 6) identification and monitoring resources.

2.5.7 EXTREME HEAT

Provide extreme heat mitigation and plan for thermal comfort in both urban form and remote sites, especially on projects within existing or projected urban heat islands. Assess and provide methods and strategies that consider urban and site morphology. Consider material selection, surface albedo, and extent of tree or structured shade, but also allow for natural ventilation flow across the site. For plazas, streetscapes, outdoor pedestrian queuing areas, and other expanses of hardscape, consider pursuing SITES credit 4.9 to 'Reduce Urban Heat Island Effects' and for parking lots reference Chapter 2, Parking Lots for prescriptive shading requirements.

2.5.8 OPERATIONS AND MAINTENANCE

2.5.8.1 SUSTAINABLE SITE MAINTENANCE

All major capital projects must be designed to support Facility Managers in implementing Integrated Pest Management (IPM) standards and must comply with SITES prerequisite 8.1 to 'Plan for Sustainable Site Maintenance' to ensure that special purpose plants, other site features and environs are managed effectively. Developing short- and long-term maintenance plans that support regular monitoring and documentation of site elements, features and systems is intended to ensure efficient, effective, lasting performance and to facilitate targeted adaptation when necessary. Facility Managers, preferably stationed at or with knowledge of the project site and surroundings, must be involved in the development of short- and long-term maintenance plans to ensure viability.

2.5.8.2 DESIGN FOR THE MAINTENANCE AND ACCESSIBILITY OF LANDSCAPE FEATURES.

Access requirements for dynamic landscapes and landscape features requiring routine weekly, seasonal or annual maintenance, such as infiltration features, cisterns, swales, green roofs, and other stormwater management practices require clear identification and supporting annotation within the mid-phase design documentation, 50% Design Development or equivalent, that address both the safety features required to inspect and maintain the feature (confined space/fall protection) and required spatial access (personnel/equipment). These design considerations for access and safety are paramount and must be presented to the Design, Construction and Facility Management staff for review and concurrence of approach.

Maintenance plans for dynamic landscape features and other site elements must be developed as part of the design process meeting the requirements described in SITES prerequisite 2.1. All relevant professionals (e.g. Landscape Architect, Civil Engineer/Stormwater SME, Commissioning Agent, Property Management) should be included to the extent available in the creation of a site-specific maintenance plan. Maintenance plans must include schedules for all specific training related to dynamic landscape features that will be needed by Facility Managers to oversee and monitor the effective operations of such features.

2.5.9 PARKING LOT DESIGN

The applicability of standards for Parking Lots is a frequent source of inquiry. The intent of this section is to provide initial clarification for questions frequently asked about these features. This section is not intended to, nor can it, provide complete guidance for all possible circumstances or conditions that may be relevant to the Landscape Prescriptive Requirements. All major capital projects, with a scope of site work exceeding 5000sf, must consult with the GSA Office of Architecture and Engineering, a GSA Regional Landscape Architect, Regional Stormwater SME, or other allied SME to clarify and confirm applicability of requirements.

2.5.9.1 PARKING LOTS

- If a parking lot is to be sealed, coal tar sealants are prohibited.
- All open parking areas with 18 spaces or more, or 6,000 square feet that front upon a street, must be screened by a perimeter landscaped area at least seven feet in width measured perpendicular to the street line.
- Perimeter landscaped areas may be interrupted only by vehicular entrances and exits; and select walkways that are providing a direct connection between a public sidewalk and walkway within or adjacent to the parking field.
- Where parking stalls are paved with permeable materials, rooting area computations can incorporate area located below the certified permeable system. Where such an approach is undertaken, sufficient trunk protection must be provided for any proposed trees that include provisions for full prospective tree growth, including buttresses and expanded trunk growth. Further wheel-stops and average car overhang dimensions must allow for the tree to safely reach maturity.
- The perimeter landscape area surface must typically include living plant material. On water challenged sites, non-paved mineral surfaces may be substituted for living plant materials on a qualitative basis. See aggregate size requirements in Chapter 2, Aggregates.
- The open parking area must be graded to allow stormwater runoff to drain into all required perimeter landscaped areas and/or planting infiltration islands.
- Proper stormwater drainage rates must be attained, if required, through underdrains that are connected to detention storage that meet/exceed local/regional drainage and flow requirements. Computations are required. If underdrains are not provided, soil boring tests must be conducted by a licensed engineer to ensure that ponded surface water can drain in at least 24 hours.
- To allow for adequate drainage and promote water infiltration, proposed catch basins placed in the planting infiltration areas must be elevated above adjacent grade to promote ponding and infiltration without posing a public nuisance or maintenance hardship for facility managers.

- One three-inch caliper shade tree must be provided for every 1,250sf of parking area. This is roughly equivalent to one tree for every 8 parking spaces. Each tree must have a minimum planting zone of 150sf of pervious area. Any space less than 2' in width must not contribute to the square footage requirement of the trees requisite planting zone.
- In regions where water is scarce and therefore establishment of a tree would be burdensome or consumptive of a dwindling resource, a shade structure with or without solar PV can be proposed in lieu of trees to shade the interior parking lot. The structure is expected to provide shade that is equivalent to the shade that would be provided by an open-grown mature shade tree grown under similar conditions in the region. Provide documentation showing the equivalency. The use of a shade structure in lieu of trees would not eliminate the need for islands to reduce the horizontal scale of the parking area, provide pedestrian refuge, and manage stormwater. Computations are required.
- Planting island soil depths must be measured to be at minimum 30" from the finished elevation of adjacent parking lot, or as required to support sufficient root development. Design details are required.

2.5.10 PUBLIC OUTREACH

To promote knowledge and dialogue about ecosystem services related to the project site, all major capital projects, with a scope of site work exceeding 5000sf, must identify and implement site- and/or community-specific outreach to communicate distinctive site features and/or systems whenever possible. Strategies and media may be based on SITES credits 9.1 to 'Promote Sustainability Awareness and Education; 9.2 to 'Develop and Communicate a Case Study'; and/or may include other strategies developed through the Integrative Design process.

3

ARCHITECTURE AND INTERIOR DESIGN

Figure 9: U.S. Department of Transportation Volpe Center Cambridge, MA

3.1 ENCLOSURE PERFORMANCE TABLE

3.1.1 Envelope – Natural Hazard		
Seismic Resistance		
Baseline		Life Safety
Tier 1		Reduced Damage
Tier 2		Immediate Occupancy
Tier 3		Operational
M & V		Performance Mockup Testing
Plans & Specs		Provide Connection details and complete load path information
Calculations & Analysis		IBC, ASCE 7, ASCE 41, ASTM E 2026, Project team Calculations & Inspection
References		
Basis of Design		Describe seismic resistance design assumptions
Construction Verification		
Windborne Debris Resistance		
Baseline		Comply with IBC
Tier 1		Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade
Tier 2		Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade. No breach in envelope for wind zone.
Tier 3		Site Specific Risk Assessment (Tornado Hazard)
M & V		ASTM E 1996/1886, Wind Tunnel Testing & Projectile Impact Testing
Plans & Specs		
Calculations & Analysis		ICC/NSSA 500, FEMA 361, ASTM E 1996, Project team Calculations & Inspection
References		
Basis of Design		Describe windborne debris resistance design requirements
Construction Verification		Witness mockup test when provided

3.1.2 Envelope - Serviceability		
Wind Resistance		
Baseline		Deflection within code limits. Deflection limit to be selected by project team to result in 8/1000 probability of breakage at design load.
Tier 1		Deflection less than code limits. Deflection limit to be selected by project team to result in 4/1000 probability of breakage at design load
Tier 2		N/A
Tier 3		N/A
M & V		ASTM E 330, ASTM E 1300, Wind Tunnel Testing & Performance Mockup Testing
Plans & Specs		
Calculations & Analysis		IBC, ASCE 7, Project team Calculations & Inspection
References		

Basis of Design		Describe envelope wind resistance design requirements
Construction Verification		

3.1.3 Water Penetration Resistance

Fenestration		
Baseline		6.24 psf Design Pressure
Tier 1		10 psf Design Pressure, Minimum Design - ASCE 7 105 mph+ Locations
Tier 2		15 psf Design Pressure, Minimum Design - facilities as defined under 1.3.9, Highrise, or ASCE 7 115 mph+ Locations
Tier 3		18 psf Design Pressure, Minimum Design - ASCE 7 140 mph+ Locations
M & V		ASTM E331, ASTM E1105, AAMA 501.1, ASTM E2268, AAMA 501.2, No reduction allowed for water infiltration field testing
Plans & Specs		Yes, Water Leakage = Uncontrolled Water Penetration, Delete Test Pressure Upper Limits from AAMA 101
Calculations & Analysis		ASCE 7, AAMA 101
References		
Basis of Design		Describe fenestration water penetration resistance level utilized in the design.
Construction Verification		CxP to witness Performance Mock-Up Test outlined in ASTM E331, E1105 as applicable

Roofing and Horizontal Waterproofing-Membrane System		
Baseline		Do not use roof surface for Storm Water Retention (Blue roof) or allow water to otherwise pond. Highly resistant to physical and chemical damage, e.g. cover board or equivalent, protected walking paths Designs that prohibit entrapment of water, minimum 1/4" per 1’-0” slope Fully Reinforced Membrane System
Tier 1		Baseline AND Adhered roofing membrane; including but not limited to torched materials or adhesives
Tier 2		Tier 1 AND Monolithic/Seamless Membrane, including hybrid assemblies (e.g. heat-welded or liquid applied membrane over 2-ply modified bitumen)
Tier 3		Tier 2 AND System Protected from Temperature and Ultraviolet Radiation. Inverted Membrane Roof Assembly (IRMA)
M & V		NRCA Roofing Manual and NRCA Waterproofing Manual, current editions., Single Ply Roofing Institute (SPRI), AAMA 501.2, ASTM C1153, ASTM C1521, ASTM D4138, ASTM D4541, ASTM D4787, ASTM D5957, ASTM D6132, ASTM D7234, ASTM D7240, ASTM D7877, ASTM 8231
Plans & Specs		Yes
Calculations & Analysis		Yes
References		
Basis of Design		Describe roofing and horizontal waterproofing membrane water penetration resistance construction. Any facility or space identified in Chapter 1, Facility Definitions must use a Tier 1 or better system. Membrane longevity must meet or exceed longevity of the equipment installed above it (e.g. photovoltaic systems).
Construction Verification		CxP to verify installation and witness integrity testing. Refer to The NRCA Waterproofing Manual, current edition, for guidance regarding quality assurance inspection and membrane integrity tests

Roofing and Horizontal Waterproofing-Minimum Slope		
Baseline		International Building Code, Section 1507
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		IBC, Section 1507
Calculations & Analysis		Yes
References		
Basis of Design		Describe roofing and horizontal waterproofing minimum slope used in design.
Construction Verification		CxP to verify installation and witness integrity testing. Refer to The NRCA Waterproofing Manual and SPRI, current editions, for guidance regarding quality assurance inspection and membrane integrity tests
Roofing and Horizontal Waterproofing- Drainage		
Baseline		International Plumbing Code, Section 1106 for 100 yr. max., 1-hr rainfall design
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		IPC, Section 1106 for 100 yr. max., 1-hr rainfall design
Calculations & Analysis		IPC, Section 1106 for 100 yr. max., 1-hr rainfall design
References		
Basis of Design		Describe basis for designing the roofing and horizontal waterproofing drainage.
Construction Verification		CxP to verify installation and witness integrity testing. Refer to The NRCA Waterproofing Manual, current edition, for guidance regarding quality assurance inspection and membrane integrity tests
Roofing and Horizontal Waterproofing-Green Roof (Vegetative Systems)		
Baseline		Tier 3 requirements of Roofing and Horizontal Waterproofing Membrane System AND IBC compliant minimum roof slope AND Tier 1 For Roofing and Horizontal Waterproofing Drainage AND Tier 1 for Roofing and Horizontal Waterproofing Testing and Monitoring
Tier 1		Baseline AND Tier 2 For Roofing and Horizontal Waterproofing Drainage
Tier 2		Tier 1 AND Tier 3 For Roofing and Horizontal Waterproofing Drainage AND Tier 2 for Roofing and Horizontal Waterproofing Testing and Monitoring
Tier 3		Tier 2 AND Tier 3 for Roofing and Horizontal Waterproofing Testing and Monitoring
M & V		Yes
Plans & Specs		Yes

Calculations & Analysis		Yes
References		
Basis of Design		Describe vegetative roofing systems water penetration construction, minimum slope, and basis for sizing drainage
Construction Verification		CxP to verify installation and witness integrity testing. Refer to NRCA Manual Guideline: 'Quality Assurance and Water Test.'
Roofing and Horizontal Waterproofing-Testing & Monitoring		
Baseline		Flood testing is not required and discouraged. Conduct integrity testing of the primary membrane under non-hydrostatic conditions. Utilize Electronic Leak Detection (ELD) or alternate methods that pinpoint breach locations in the membrane without reliance on water passage through the breach during construction. Testing agency confirmation of the suitability of using non-destructive test equipment (unit type and field protocol) must be established prior to proceeding with field test activities. Controlled water flow testing using a water nozzle similar to AAMA 501.2 must be performed on all roof detailing not included in ELD testing or where ELD testing is not effective due to the conductivity of the membrane. The conductivity of the membrane may determine which ELD method is utilized. A conductive primer may be required. ELD must be performed on the membrane before any placement of overburden.
Tier 1		Baseline AND Includes integration of ELD into a maintenance plan for periodic testing. Membrane must be exposed during future testing, not for applications with overburden.
Tier 2		Tier 1 AND Requires integration of ELD into a maintenance plan for regular testing and the integration of sensors for continuous monitoring with a connection into the Building Management System (BMS). Provide a maintenance plan including monitoring at regular intervals as determined. Membrane must be exposed during future testing, not for applications with overburden.
Tier 3		N/A
M & V		AAMA 501.2, ASTM C1153, ASTM D4787, ASTM D5957, ASTM D7240, ASTM D7877, ASTM D8231
Plans & Specs		Yes
Calculations & Analysis		N/A
References		
Basis of Design		Describe roofing and horizontal waterproofing testing requirements and leak monitoring system, when used.
Construction Verification		CxP to review Testing & Monitoring procedures proposed by contractor CxP to verify BMS system interface to leak detection in conjunction with balance of systems, if applicable CxP to verify installation and witness testing.
Ground Water Control		
Baseline		Active Ground Water Control
Tier 1		Passive Ground Water Control with emergency back-up pump, as required.
Tier 2		N/A
Tier 3		Select a location, site, or building design that allows for ground water table to remain a minimum of 600mm (2 feet) below the lowest level of the structure.
M & V		N/A
Plans & Specs		IBC, Section 1805.1.3
Calculations & Analysis		IBC, Section 1805.1.3

References		
Basis of Design		Describe method of ground water control when required.
Construction Verification		CxP to test emergency back-up pump, where applicable.
Below Grade Waterproofing		
Baseline		Relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain. Membrane waterproofing must be fully bonded to the substrate and seamless. Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection drainage and protection course.
Tier 1		Baseline AND Tier 1 designation in Ground Water Control Provide a system that does not rely on unpredictable or difficult to control site conditions to develop and maintain a water-tight installation. Complete “Bathtub” waterproofing in the presence of water table to mitigate demand on dewatering system. May require foundation modification. System must not rely on compression to maintain the performance criteria, allowing construction activities and future earthwork without compromising the system.
Tier 2		Tier 1 AND Includes redundant below grade waterproofing systems, such as a water repellant additive to the concrete masonry foundation walls.
Tier 3		Tier 2 AND Include secondary drainage layer within below-grade horizontal concrete slab assemblies.
M & V		ASTM E1643, ASTM E1745, ASTM E1993
Plans & Specs		IBC, Section 1805
Calculations & Analysis		IBC, Section 1805
References		
Basis of Design		Describe waterproofing system for below grade waterproofing and test method proposed.
Construction Verification		CxP must witness below grade waterproofing test.

3.1.4 Moisture and Condensation Control

Moisture Control Opaque Assemblies		
Baseline		Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160, Criteria for Moisture Control Design Analysis in Buildings, is an acceptable basis of design. Provide a vapor barrier directly beneath all concrete slab-on-grade construction or where concrete structures separate conditioned from unconditioned spaces.
Tier 1		Baseline AND Provide continuous exterior insulation for roof, wall, and below-grade walls containing conditioned space. Provide analysis of project specific assemblies and exposures. Provide for the placement of a portion of the thermal control layer to the exterior of the air and moisture control layers to reduce thermal bridging and move the moisture potential toward the exterior.
Tier 2		Tier 1 AND Provide thermal controls to the exterior to maintain conditions within the assembly below a 30-day running average of 70% RH when the temperature is between 5°C (41°F) and 40°F C (104°F).

		Provide monitoring of "vulnerable" exposures of the assemblies that alerts the building staff to approaching conditions that may be harmful to the assembly or the occupants.
Tier 3		Tier 2 AND All thermal controls are outboard of the air and vapor control layers of the assembly. Monitoring of moisture content of assemblies tied to BMS for each exposure and cladding type.
M & V		ASTM C1601, ASTM C1193, ASTM E1643, ASTM E1745, ASTM E1993
Plans & Specs		Yes
Calculations & Analysis		ASHRAE 160
References		
Basis of Design		Document requirement in basis of design
Construction Verification		CxP to witness tests outlined in ASTM C1601, if applicable
Condensation Resistance Fenestration		
Baseline		Condensation resistance of fenestration is required to ensure no condensation occurs on uncontrolled surfaces based on project-specific interior and exterior design criteria using National Fenestration Rating Council (NFRC) 500 Thermal Analysis and Modeling
Tier 1		Baseline AND AAMA 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections to verify no condensation on uncontrolled surfaces at project-specific interior and exterior design criteria.
Tier 2		Tier 1 AND Testing on project specific extrusion profiles and assemblies, including typical anchors to verify no condensation on uncontrolled surfaces at project-specific interior and exterior design criteria.
Tier 3		Tier 2 AND Provide a modified AAMA 501.5, Test Method for Thermal Cycling of Exterior Walls to include thermal couples of a full-scale, project specific laboratory mock-up to verify the NFRC 500 analysis.
M & V		NFRC 500 NFRC 102 AAMA 1503 AAMA 501.5 ASTM E2190 IgCC/IGMA Certification
Plans & Specs		NFRC 500 Testing and Modeling to show that no condensation occurs on uncontrolled surfaces based on the interior and exterior design criteria
Calculations & Analysis		NFRC 500
References		
Basis of Design		Document requirement in basis of design
Construction Verification		NFRC 500 and NFRC 102 (test procedure) are intended for the laboratory for establishing ratings, not field testing, so there is no CxP witness activity

3.1.5 Air Tightness

Fenestration		
Baseline		CW30 Minimum Performance Class

		Curtain wall, window wall and storefront, < 0.3 L/s*m (0.06 cfm/ft) @ 75 Pa (0.3" wc) Performance and durability testing of fenestration assemblies and interface conditions or documented.
Tier 1		Baseline AND Punch windows, AW40 Minimum Performance Class, fixed < 0.5 L/s*m (0.10 cfm/ft) @ 300 Pa (1.2" wc), operable < 1.5 L/s*m (0.3 cfm/ft) @ 300 Pa (1.2" wc) Curtain wall, window wall and storefront, < 0.3 L/s*m (0.06 cfm/ft) @ 300 Pa (0.3" wc) Required for facilities as defined under 1.3.9, Highrise locations, or at locations ASCE 7 115 mph+ Durability Testing as required for Performance Class or as appropriate for the systems anticipated use, whichever is greater.
Tier 2		N/A
Tier 3		N/A
M & V		ASTM E283 ASTM E783 Failure protocol = retest +1 additional sampling per failure.
Plans & Specs		AAMA 101 NAFS
Calculations & Analysis		AAMA 101 NAFS
References		
Basis of Design		Document requirement in basis of design
Construction Verification		CxP to witness Performance Mock-up Test outlined in ASTM E783 and ASTM E283.
Enclosure Airtightness (All Six Sides of the Building)		
Baseline		0.875 L/s/M2 (0.17 cfm/ft2) @ 75 Pa (0.3" wc). Comply with IgCC Section 10.6 Building Envelope Airtightness
Tier 1		5+ stories or non-combustible, 0.55 L/s/M^2 (0.11 cfm/ft^2) @ 75 Pa (0.3" wc). All other buildings, 0.40 L/s/M^2 (0.08 cfm/ft^2) @ 75 Pa (0.3" wc). Comply with Phius 3.1.3 Air Tightness Requirements
Tier 2		N/A
Tier 3		N/A
M & V		ASTM E779 ASTM E1827 ASTM E1186 ASTM D4541 ASTM E3158
Plans & Specs		Yes
Calculations & Analysis		No
References		
Basis of Design		Provide requirements for enclosure airtightness performance and describe measures designed to provide a continuous air barrier.
Construction Verification		CxP to witness Blower Door Test outlined in ASTM E1827. Conduct testing before air barrier is concealed by completed construction.

3.1.6 Thermal Performance

Thermal Performance

Baseline		ASHRAE 90.1, Section 5.5 and where section 5.5 is referenced
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		ASHRAE 90.1, IECC
Plans & Specs		Yes
Calculations & Analysis		ASHRAE 90.1
References		ASHRAE 1365 RP, BETB Guide, Low TEDI Guide
Basis of Design		Provide thermal performance characteristics of the enclosure assemblies. Increased R-values over and above code may be considered when life cycle cost benefits can be demonstrated.
Construction Verification		CxP to perform HVAC system testing per ASHRAE Guideline 1.1 (Guideline 30 was integrated into Guideline 1 in 2007)

3.1.7 Building Enclosure Commissioning

Building Enclosure Commissioning		
Baseline		Fundamental Building Enclosure Commissioning per ASTM E2813
Tier 1		Baseline plus Enhanced Building Enclosure Commissioning per ASTM E2813; facilities as defined under 1.3.9, Facility Definitions, projects located in high-risk or volatile weather locations, or with untested enclosure assemblies
Tier 2		Tier 1 plus increased performance testing as required by OPR. Refer to ASTM E2813, Table A2.1, for possible testing.
Tier 3		N/A
M & V		ASTM E2813, Table A2.1 ASTM E2947 ASHRAE 202 ASHRAE Guideline 0
Plans & Specs		ASTM E2813, Table A2.1 ASTM E2947 ASHRAE 202 ASHRAE Guideline 0
Calculations & Analysis		ASTM E2813, Table A2.1 ASTM E2947 ASHRAE 202 ASHRAE Guideline 0
References		
Basis of Design		Provide any special testing requirements anticipated during commissioning.
Construction Verification		CxP inspection and verification to be performed as outlined in ASTM E2813. Confirm air, vapor, and thermal continuity during construction, including via ISO 6781-23, ASTM C1060, ASTM C1153, ASTM E1186, and ASTM C1153

3.1.8 Enclosure Acoustic Control

Acoustic Control Assuming NC-35 interior		
Baseline		Comply with IgCC-Section8.3.3 Acoustical Control
Tier 1		N/A

Tier 2		N/A
Tier 3		N/A
M & V		ASTM E90, E366 & E966.
Plans & Specs		Classification by E1332
Calculations & Analysis		No
References		
Basis of Design		Provide enclosure sound control performance requirements.
Construction Verification		Testing witnessed by the CxP per ASTM E1124
3.1.9 Enclosure Service Life		
Walls (In years to replacement/major rehabilitation)		
Baseline		50/25
Tier 1		75/30
Tier 2		100/40; required for facilities as defined under 1.3.9
Tier 3		150/50
M & V		No
Plans & Specs		Review deliverables to confirm. Provide building enclosure commissioning.
Calculations & Analysis		No
References		
Basis of Design		Describe expected service life for each enclosure wall type proposed.
Construction Verification		CxP must confirm through submittal review.
Roofs (Replacement)		
Baseline		20
Tier 1		30
Tier 2		40; required for facilities as defined under 1.3.9
Tier 3		50
M & V		Manufacturer’s warranty certificate.
Plans & Specs		Review deliverables to confirm. Provide building enclosure commissioning
Calculations & Analysis		No
References		
Basis of Design		Describe expected service life for roof type proposed. Replacement includes labor and materials warranty.
Construction Verification		CxP must confirm through submittal review.
Fenestration (years to frame replacement / IGU + gaskets and seals replacement)		
Baseline		30/15
Tier 1		40/20
Tier 2		50/20; required for facilities as defined under 1.3.9
Tier 3		75/20

M & V		ASTM E2188, ASTM E2190, ASTM E218
Plans & Specs		Review deliverables to confirm. Provide building enclosure commissioning.
Calculations & Analysis		No
References		
3.8.4		Describe expected service life for each fenestration assembly proposed.
Construction Verification		CxP must confirm through submittal review.

3.2 ENCLOSURE PERFORMANCE ATTRIBUTES

3.2.1 NATURAL HAZARDS

3.2.1.1 SEISMIC RESISTANCE

This section refers to design earthquake shaking as defined in the International Building Code and ASCE 7

This attribute relates to building enclosure performance levels in terms of extent of damage and continuity of operations following a design basis earthquake with a 10 percent probability exceedance in 50 years (500-year return period). Seismic demands on the enclosure follow from deformation of the structure as characterized by peak transient inter-story drift and acceleration forces.

- Baseline: This performance level is characterized as Life Safety. Baseline performance anticipates serviceability degradation (e.g., glass breakage, weather seal damage, frame distortion, increased air, and moisture infiltration) of the enclosure system. Controlled deformation of the enclosure system anchorage is accepted, but catastrophic failure is not allowable. The building structural system remains stable and has significant reserve capacity; hazardous nonstructural damage is controlled. Occupancy not expected after the event until repairs are performed.
- Tier 1: This designation is characterized as Reduced Damage. This performance level anticipates moderate damage to the enclosure system. Ability to provide weather protection is locally compromised. Glass damage may occur, but breakage is mitigated. The building remains safe to occupy; structural and nonstructural repairs are minor.
- Tier 2: This designation is characterized as Immediate Occupancy. This performance level anticipates negligible structural and nonstructural damage with minimal damage to cladding components. Seals remain intact. Gaskets maybe loosened but remain functional. No glass breakage is expected.
- Tier 3: This designation is characterized as Operational. This performance level anticipates that no serviceability degradation of the enclosure system occurs because of a 500-year design basis earthquake.

3.2.1.2 WINDBORNE DEBRIS RESISTANCE

The attribute considers windborne missile impact and cyclic pressure loading resistance requirements in high wind zones and defined windborne debris regions.

- Baseline: This performance level for windborne debris resistance serviceability references the IBC. Windborne debris resistance must be implemented in zones specified by IBC. In non-windborne debris zones, protection is not required at the baseline level.
- Tier 1: This performance level incorporates windborne debris impact provisions designed to mitigate breaches of the enclosure system. The enclosure fenestration system is designed to resist large and small missile impacts and cyclic pressure loading per American Society of Testing and Materials (ASTM) E 1996/1886 as referenced in ASCE 7.
- Tier 2: This designation addresses a perceived increased level of windborne debris risk and decreased allowable impact compared to Baseline. This performance level requires that the building envelope has no breach for wind zone.
- Tier 3: This performance level is governed by criteria specified for building enclosure resistance to the impacts of tornado windborne debris and wind-induced loads. Risks associated with tornado hazards must considered as a separate item where applicable under a site-specific assessment and where high performance is desired. Recommended tornado design wind speed is 250 mph (3-second peak gust). Protection of plant function and occupants is desired for critical facilities.

3.2.1.3 FLOOD RESISTANT DESIGN AND CONSTRUCTION

Refer to Chapter 4, Flood Resistant Design Requirements.

3.2.2 SERVICEABILITY

3.2.2.1 WIND RESISTANCE (SERVICEABILITY)

This attribute relates to the serviceability of the building enclosure system in response to wind loading. Wind speed and design wind load requirements must be determined in accordance with applicable ASCE-7 prescriptive methods or wind-tunnel testing procedures. Wind-tunnel testing should be considered for large buildings or structures, including those with an unusual form, those with unique construction methodology, those subject to extreme weather and those surrounded by unusual terrain. The applicability of wind-tunnel testing to optimize design should be evaluated by the project team as early as practical in the design process.

3.2.3 WATER PENETRATION RESISTANCE

3.2.3.1 FENESTRATION

Fenestration water penetration resistance requires calculation or wind tunnel testing to determine the project-specific design pressure (DP) and water penetration test pressure. Requirements must be communicated to the contracting parties in the construction documents. Water penetration resistance can be confirmed with product testing, laboratory mock-up testing, field mock-up testing, and in-situ field testing. Consideration must be given to prescriptive minimum sampling requirements based on the type of test and number of assemblies to be included. Typically 2 samplings per condition is the minimum, but the design team may determine more are appropriate. Proposed fenestration systems without prior satisfactory testing results must include air and water infiltration testing.

- The maximum limits provided in AAMA 101 have been removed to allow higher test pressures as warranted by the project conditions. "No Uncontrolled Water Penetration" is also a departure from the AAMA 101 definition and does not allow water penetration on any interior surface that is not drained to the exterior or otherwise controlled.

- The 1/3 reduction of test pressure for water infiltration field testing referenced in AAMA 503 have been removed. Test pressures referenced in Table 3.1 apply to field tests, as representative of the performance of the delivered final condition to the owner. Team may elect to perform laboratory tests at a higher pressure.

3.2.3.2 ROOFING AND HORIZONTAL WATERPROOFING MEMBRANE SYSTEM

A roofing and horizontal waterproofing membrane system requires a high resistance to physical damage, including impact resistance, and prohibits the entrapment of water within the assembly including insulation, protection, and drainage layers.

Systems must prevent the retention of storm water or other accumulation or ponding of water on the membrane surface.

Construct roofing in accordance with the recommendations of the National Roofing Contractor Association (NRCA) Roofing Manual, current edition.

Construct waterproofing in accordance with the NRCA Waterproofing Manual, current edition.

Roof assemblies must be pre-tested in accordance with UL580, ANSI-FM 4474, or TAS 114 to withstand wind pressures at the design wind speed.

3.2.3.3 ROOFING MINIMUM SLOPE

Minimum slope is intended to eliminate the potential confluence of construction tolerance, creep, and other factors that may result in ponding or reduce the rate of water flow from the membrane surfaces.

- Comply with the minimum code requirement as per the International Building Code in which various minimum slopes are identified based on the type of roof covering system intended for use.
- Where seamless roofing products are adhered to the structural deck in satisfaction of Tier 3 roofing requirements, and where roof slope will not be built-up, the structural deck must be designed with a minimum of 1/4" per foot slope to ensure positive drainage.

3.2.3.4 ROOFING DRAINAGE (SIZE OF CONDUCTORS, LEADERS, AND DRAINS)

The intent of this requirement is to build redundancy into the drainage system and render the facility more resilient. Redundancy in the roof drainage system is intended to mitigate ponding in the event of reduced evacuation of water from the membrane surfaces due to blockages, and to increase the longevity and performance of the membrane and the drainage systems. Roofing drainage must comply with the requirements of the International Building Code, which provides exceptions for new roof drainage at existing buildings where the existing roof drainage system can accommodate expected precipitation volumes. All primary roof drains and secondary overflow drains must be set in sumps to ensure proper drain elevation and positive drainage.

3.2.3.5 GREEN ROOFING SYSTEMS

A Green Roof (Vegetated Roof, Rooftop Garden, Landscaped Roof), intensive or extensive, must be designed and constructed in accordance with ASTM E2777-14, Standard Guide for Vegetative (Green) Roof Systems and ASTM E2400M, Standard Guide for Selection, Installation, and Maintenance of Plants for Vegetative (Green) Roof Systems. Project teams must reach out to a regional or central office landscape professional for guidance and approval on appropriate soil media types/ depths, assemblies, and plant palettes to ensure long term health of the living system with reasonable maintenance requirements. Media depth must be greater than 3”.

Access to green roofs must be accomplished by a safe permanent means, and not by ladder, through non-full height windows, or by use of temporary devices such as hoists or lifts. Use 29 CFR §1910.29 Fall Protection Systems and Falling Object Protection criteria and practices to ensure adequate considerations for maintenance access and personnel safety. Access must consider the spatial environment available that is necessary for the efficient transfer of organic material generated by the landscape. If adequate clearance for common tools and the transfer of waste cannot be provided, including both on the roof itself and within the circulation access to the roof, then the green roof should not be considered viable and should not be proposed for the project. Refer to the GSA Preventive Maintenance Guide to ensure the proposed design meets the requirements of Facility Management staff and budget.

Green Roofs must also be installed and maintained in accordance with the requirements in the ICC International Fire Code (IFC) to ensure access and safety.

Blue roof systems for the purpose of water storage and controlled release are prohibited from use.

3.2.3.6 TESTING AND MONITORING OF ROOFING AND HORIZONTAL WATERPROOFING

Testing and monitoring are required to evaluate the water-tight integrity of new horizontal waterproofing and roofing surfaces. To detect moisture beneath existing roofing and horizontal waterproofing, use non-destructive testing methods, including electronic leak detection, capacitance testing, infrared thermography, and nuclear meter testing.

3.2.3.7 GROUND WATER CONTROL

Ground water control requires active removal of ground water by means of pumping from the lowest level of the structure. Active systems consume energy and should not run on more than rare occasions.

3.2.3.8 BELOW GRADE WATERPROOFING

Below grade waterproofing requires the relief of hydrostatic pressure on the structure’s walls and provision for water to drain to daylight or a storm water management system.

3.2.4 MOISTURE AND CONDENSATE CONTROL

3.2.4.1 MOISTURE CONTROL OPAQUE ASSEMBLIES

Where unique or custom opaque assemblies are proposed, analyze the performance and exposures to ensure the control of moisture and to mitigate the risk of condensation and uncontrolled moisture migration. Implement tools such as two-dimensional or three-dimensional thermal and hygrothermal simulation tools early in the project cycle to evaluate condensation risk. See ASTM E3054.

Condensation risk may be evaluated using dew point calculations following the Glaser Method outlined in the ASHRAE Handbook of Fundamentals under design conditions. For scenarios where transient/dynamic conditions are required, such as changing environmental conditions, moisture storage within materials, impact of thermal mass, one-dimensional or two-dimensional transient hygrothermal simulations with software (e.g. WUFI) may be required. These hygrothermal simulations must follow the ASHRAE 160 standard requirements.

For assemblies where thermal bridging may impact local surface temperatures within the assembly, condensation risk may be evaluated using thermal simulations under design conditions. Condensation risk analysis using thermal simulations must be performed with either two-dimensional or three-dimensional finite element heat transfer analysis and follow applicable simulation standards such as ISO 10211 or CSA Z5010, or follow the approach outlined in ASHRAE 1365 RP.

3.2.4.2 CONDENSATION RESISTANCE–FENESTRATION

Condensation resistance in fenestration is required to ensure no condensation occurs on uncontrolled surfaces based on the interior and exterior design criteria. Condensation resistance may be determined using two-dimensional or three-dimensional thermal simulations. These simulations must include sections of the fenestration and opaque assembly since connection details between the two assemblies may impact the surface temperatures of the fenestration. Thermal simulations must be evaluated following NFRC-500 for fenestration and ISO 10211 or CSA Z5010 for fenestration to opaque assembly details. Three-dimensional thermal simulations may be required for details with highly conductive materials such as aluminum framing or with discrete thermal bridges to evaluate surface temperatures at critical locations such as corners where vertical framing intersects with horizontal framing (e.g. window corners).

Include in the analysis project spandrel panel size and conditions, adjacent assemblies (e.g., transparent vision glazing sections, non-spandrel opaque assemblies), intermediate floor attachments and anchorages, spandrel construction (e.g., backpan configuration, insulation type, cladding type, interior wall construction), and airflow in and around the spandrel assembly. Do not rely on a single interior film coefficient factor.

3.2.5 AIR TIGHTNESS

3.2.5.1 AIR TIGHTNESS–FENESTRATION

Air tightness in fenestration is required to control air leakage in windows, doors, curtain walls, and skylights.

3.2.5.2 ENCLOSURE AIR TIGHTNESS (ALL SIX SIDES OF THE BUILDING)

Enclosure air tightness is critical to ensuring the performance of the building enclosure and HVAC systems. The construction of a continuous air barrier is required. Construction documents must demonstrate constructability and clearly illustrate the entire continuity of the air barrier system.

Consider illustrating air and thermal barriers in a separate diagram or other clearly understandable methodology.

Confirm the compatibility of specified products to ensure barrier life cycle performance.

Enclosure air tightness on all six sides of the building must be tested and verified.

Consider improving the building envelope for load reduction, in concert with HVAC optimum sizing, as the initial step towards Net Zero Energy Ready.

For major modernization or projects involving significant building enclosure work, obtain ASTM E779 blower door and ASTM E1186 test results of existing buildings as a prerequisite during the project planning phase to quantitatively and qualitatively measure existing enclosure performance and appropriately guide enclosure improvement scope. May be performed in conjunction with or as part of initial studies (e.g., BER (Building Evaluation Report), BCS (Building Conditions Survey), PDS (Program Development Study).

Where a garage door is integral to air or thermal barriers, include that component in energy calculations; and improve component performance if necessary.

3.2.6 THERMAL PERFORMANCE

Thermal performance is critical to ensuring occupant comfort and the energy efficiency of the building. Thermal performance must comply with requirements of section 5.5 of ASHRAE 90.1, which includes the impact of thermal bridging.

Where possible, provide continuous exterior insulation to move the dew point outboard of the drainage plane. Mitigate cold spots or locations within the assembly that may be below the dew point caused by thermal bridging with:

- thermal breaks,
- use low thermal conductivity materials,
- closer alignment insulation/thermal control layers between adjacent assemblies,
- convert continuous thermal bridging components (e.g. Z-girts) to discrete components (e.g. clips),
- provide insulation around structural thermal bridging details such as beam and column penetrations.

Spandrel assemblies that are part of unitized systems such as curtain wall and window wall assemblies are opaque assemblies and must be evaluated as such. NFRC thermal analysis is only applicable for fenestration.

Where unique or custom opaque assemblies are proposed, analyze their performance and exposures to ensure the control of moisture and to mitigate the risk of condensation and uncontrolled moisture migration.

- Pre-calculated thermal bridging details with linear and point transmittances can be found in the Building Envelope Thermal Bridging Guide (thermalenvelope.ca)
- Identify high impact thermal bridging details by performing whole building enclosure thermal bridging calculations following the method outlined in the Building Envelope Thermal Bridging Guide

Account for the tested or calculated aged thermal performance at the midpoint of assembly service life, assembly service life duration defined in Table 3.1. Design towards any thermal migration, performance when wet and the expected thermal performance throughout the full range of seasonal temperatures.

For work performed on existing buildings, consider measuring the actual enclosure performance prior to and after work, to obtain qualitative and quantitative data of the improvement.

3.2.7 BUILDING ENCLOSURE COMMISSIONING

Use ASTM E2813, Standard Practice for Building Enclosure Commissioning (BECx) for BECx. BECx is part and parcel to Total Building Commissioning. The BECx provider must demonstrate a minimum of five (5) years of experience delivering BECx in accordance with this standard and must provide documentation demonstrating compliance with the minimum core competencies outlined in ASTM E2813. The Owner's Project Requirements (OPR) must be developed in accordance with ASTM E2813 based upon the performance objectives established for the project and further refined as appropriate using the best practices established in ASTM E2947, Standard Guide for Building Enclosure Commissioning.

- BECx must be performed before interior finish materials are installed or may need to be removed to obtain clear visual access.
- The BECx plan must include a failure protocol, established before construction of the building envelope begins.
- No water pressure 1/3 reduction of onsite testing pressures allowed, described in AAMA 503.
- Mission-critical or project locations at extreme weather-prone locations default at water infiltration in situ testing pressure of 15lb/sf or greater. GSA test pressure requirements are for delivered, installed enclosure assemblies, including the contiguous moisture and air barriers.
- BECx results valid for 6 months after substantial completion
- Mock-ups are strongly recommended for new or atypical enclosure or curtainwall assemblies

3.2.8 ACOUSTIC CONTROL

Comply with IgCC-Section 8.3.3 Acoustical Control.

3.2.9 ENCLOSURE SERVICE LIFE

Two targets for each performance level have been identified: the full-service life and the time between major rehabilitation. Where successful tests or reliable methods of predicted service life do not exist, use proven industry best practices. The most important tools are material selection based on experience and design reviews by third parties who have experience and knowledge related to durability. Designers must recognize the differential durability of materials, products, and assemblies when attempting to realize maximum service life.

Enclosure service life must meet those listed in table 3.1 and be designed robust and resilient enough to guard against the potential for deferred maintenance.

3.3 ENCLOSURE REQUIREMENTS

3.3.1 MOISTURE CONTROL

Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160, Criteria for Moisture Control Design Analysis in Buildings, is an acceptable basis of design. Demonstration of the transient hygrothermal behavior of the various multi-layer building components for all critical building enclosure systems must be confirmed through modeling.

Construction documents must clearly depict all drainage and air passages. Illustrate details in three dimensions where practical, indicating critical corner terminations, the interfaces of all differing systems, proper sealant methods, etc.

3.3.2 BELOW GRADE SYSTEMS

3.3.2.1 GROUND WATER CONTROL

The drainage mat and soil filter must relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain. Pipes must not slope less than 1:200. Subsurface drainage should discharge into the storm drain, by gravity if possible. Cleanouts must be provided at grade to facilitate washing out the system.

3.3.2.2 WATERPROOFING

Membrane waterproofing must follow the recommendations of the National Roofing Contractors Association (NRCA) Waterproofing Manual –, current edition.

3.3.2.3 MEMBRANE PROTECTION

Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection mat to shield the waterproofing membrane from deleterious effects of construction activities, ultraviolet radiation, or aggressive vegetation.

3.3.2.4 WATERSTOPS

Waterstops must be used at construction joints in below-grade walls, footings, and other elements where a waterproof system is required. Wherever possible, use level changes to create a redundancy with the substrate in the event the water barrier fails.

3.3.2.5 UNDERSLAB INSULATION

Provide insulation under concrete slabs on grade where a permafrost condition exists, where slabs are heated, and where they support refrigerated structures.

3.3.2.6 UNDERSLAB VAPOR BARRIER

Provide an impermeable vapor barrier immediately beneath concrete slabs on grade and where structural concrete slabs separate conditioned from unconditioned space. Do not place sand, gravel, or other materials between the vapor barrier and the concrete slab.

3.3.3 SUBSTRUCTURE

Reference the Guiding Principles for Sustainable Federal Buildings, 4.4 Radon Mitigation, and comply with IgCC- Section 10.3.1.9 Soil-Gas Control.

When soil radon or contaminant levels are present per the GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT, a substructure depressurization system must be provided. If a passive system is designed, it must have the capability to accommodate future active depressurization.

3.3.4 WALL SYSTEMS

3.3.4.1 CONNECTIONS, FASTENERS, AND MISCELLANEOUS METALS EXPOSED TO WEATHER

Products of carbon steel that are directly or indirectly exposed to the weather must have corrosion protection consisting of a galvanic -zinc coating of at least 460 grams per m^2 (1.5 ounces per sq. ft.) of surface or other equivalent corrosion protection. Where possible, use stainless steel connections and fasteners. Specify SAE 316 or higher performance grade for use in marine environments. Marine/naval brass, aluminum-bronze and silicon-bronze are also acceptable marine grade metals; aluminum and copper may be acceptable in limited applications. Separate dissimilar metals with a gasket to prevent galvanic action.

3.3.4.2 MATERIALS WITH ORGANIC CONTENT

Type II interior wall covering is prohibited from use on any surface where it could function as a vapor barrier and trap moisture within a wall assembly. On mass storage walls where water may penetrate the wall, avoid interior finishes made from paper-faced gypsum sheathing or other highly processed organic materials that may promote mold growth.

3.3.4.3 AIR AND MOISTURE BARRIER SYSTEM

Air and moisture barriers are required of all new construction and should be employed wherever possible during remediation of existing exterior envelopes. The air barrier system is:

- A continuous element or combination of elements designed to control the movement of air and moisture through an exterior enclosure system.
- Continuous in three dimensions from roof to wall to foundation (all six sides).
- Consisting of materials and components that are, either individually or collectively, sufficient in stiffness and rigidity to resist air pressure differentials across the exterior wall assembly without permanent deformation or failure.
- Sufficiently durable to withstand the construction process including exposure to the elements.

The interior and exterior air pressures across an air barrier system that need to be examined include, but are not limited to, pressures caused by wind, stack effect, and mechanical systems. Air barriers may be located at different locations within a wall system, and the placement of the air barrier needs to be indicated by the designer on the drawings. The designer must carefully consider placement of the air barrier when the air barrier material(s) will act both as an air barrier and as a vapor retarder to determine if the drying of the enclosure system will be inhibited by the location of this material within the assembly. Portions of the air barrier may require regular maintenance, and an allowance should be made within the design to accommodate this work.

A continuous plane of air tightness, herein called the air barrier system, must be installed as part of the building enclosure (both above- and below-grade) to effectively separate all conditioned spaces from outdoor and polluted spaces.

The air barrier system must be shown on the drawings as continuous through all section drawings of the enclosure. The air barrier materials and components of each assembly must be clearly identified and labeled as "Air barrier" on construction documents, and detailed at all penetrations, joints, and transitions. The pressure boundary of the air barrier system(s) and the zone(s) to be tested must also be shown on the drawings.

The air barrier material of each assembly must be joined and sealed to the air barrier material of adjacent assemblies with sufficient flexibility to allow for the relative differential movement and with sufficient strength to resist expected peak air pressure differences.

Penetrations of the air barrier system must be sealed to the air barrier system in an airtight manner. These penetrations include, but are not limited to lighting fixtures, wiring, conduit, gas lines, cable services, windows, doors, ducts, fire protection standpipe connections, and plumbing pipes. Where possible and prudent, consolidate penetrations to improve constructability and the performance of waterproofing to reduce the risk of premature failure leading to water infiltration.

The air barrier system (and all materials and components comprising it) must last the anticipated service life of the enclosure system or allow for easy maintenance, repair, and/or replacement. Confirm the compatibility of products used to ensure system life cycle performance.

Parking garages (attached to or under buildings), other structures connected to the building, including those connected via tunnels, walkways, service conduits, etc., and any storage with contents that can negatively affect indoor air quality must be separated from all other conditioned spaces by an air barrier system. Access to such spaces must be provided by doors in airtight vestibules or airtight hatches at building access points.

Boiler rooms not using sealed combustion equipment must be separated from the rest of the building space by an air barrier system and provided with make-up air for combustion.

Additional equipment and other items required for testing the building's airtightness are to be installed by the contractor as specified by the testing agency in accordance with the Commissioning Plan. This may include indoor-to-outdoor pressure taps at various locations across the air barrier system, air flow and pressure measuring stations in air conveyance and handling systems, and tight-sealing dampers on all ducts carrying air across the air barrier.

3.3.4.4 SEALANTS

Sealants have become an increasingly vital component of the enclosure assembly, including water and air infiltration lines, especially in barrier type assemblies. Because it is a maintenance item, often with a service life lower than adjacent components within the assembly, design towards limiting the reliance on sealants to the greatest extent possible. Design for redundancy, never relying on sealants as the sole line of defense. Refer to ASTM C1193 for sealant design, application, and installation guidelines. Refer to ASTM D4541 for sealant adhesion testing. Provide redundancy and continuity in designs to prevent water intrusion and air infiltration. Provide a 2-stage sealant strategy in exterior wall assemblies that rely on sealant in a barrier methodology, including wall-to-fenestration, wall-to-roof, and wall-to-foundation interfaces.

3.3.5 MASONRY AND CONCRETE MATERIALS

Brick masonry design must follow the recommendations of the Brick Institute of America contained in the publication, Technical Notes on Brick Construction.

Concrete ready mix and site mix must meet GSA's Low-Embodied Carbon Concrete standard listed in Chapter 1, Sustainable Materials. This helps GSA prioritize greater use of recovered mineral content in cement or concrete projects, per EPA's Comprehensive Procurement Guidelines established under RCRA § 6966.

Concrete masonry design must follow the recommendations of the National Concrete Masonry Association contained in the publication, TEK Manual for Concrete Masonry Design and Construction. Concrete specifications will be performance-based, e.g. specifying the required properties such as compressive strength, number of days to strength achievement, shrinkage, exposure class as described in ACI 318 durability requirements, and, where applicable, modulus of elasticity. Specifications must not prescriptively describe concrete in terms of content of constituent materials such as cement content, water-cement ratio, supplementary cementitious material (SCM) content, or aggregate gradation. Specifications must allow ASTM C150, C595, and C1157 cements that meet ACI 318.

Architectural precast concrete design must follow the recommendations of the Precast Concrete Institute (PCI) contained in the PCI publication, Architectural Precast Concrete, Current Edition. Use a 2-stage sealant design as described in PCI. Follow ASTM C1193 for any joint sealants within the system.

Exterior limestone design must follow the guidelines of the handbook published by the Indiana Limestone Institute of America.

Marble and marble veneer design must follow the recommendations in Exterior Marble Used in Curtain or Panel Walls, published by the Marble Institute of America. Extreme care must be used in the design and selection of marble veneers to prevent thermal hysteresis.

Design alterations and additions to minimize damage to or concealment of historic walls. Clean historic masonry prior to repointing or color matching new materials intended to blend with historic stone, brick, terra cotta or concrete.

Service life of fenestration must meet that listed in table 3.1 and be designed robust and resilient enough to guard against any potential deferred maintenance.

3.3.6 FENESTRATION SYSTEMS

If full fenestration system replacement is not possible for retrofits of buildings in cold climates with single pane windows, consider window upgrades such as highly insulating commercial secondary glazing systems (window inserts, secondary storm windows), vacuum insulating glazing (VIG), low-e films, and insulating shades.

In single pane windows, significant thermal losses also occur at the frame (since these are typically non-thermally broken). For poor thermally performing curtain wall, replacing aluminum with non-metal (polyamide, fiberglass) pressure plates can improve thermal performance without replacing the frame.

Full fenestration replacement (frame and glass) will have the most impact on the final thermal performance. Where full fenestration replacement is feasible and for new construction, consider fenestration with high-thermal performance frames (wide thermal breaks) and insulating glass with a double or triple silver low-e coating (depending on solar control needs) using inexpensive improvement strategies such warm-edge spacer and argon gas-filling. A fourth surface low-e coating can also be used to increase performance further before moving to even higher thermal performance strategies such as triple pane insulating glass or a dual-pane hybrid vacuum insulating glass system.

Service life of fenestration must meet that listed in table 3.1 and be designed robust and resilient enough to guard against any potential deferred maintenance. At interface conditions between facade and fenestration, follow the more stringent service life requirement.

Fenestration must be rated by NFRC (National Fenestration Rating Council) or AERC (Attachments Energy Rating Council)

3.3.6.1 WINDOWS

Aluminum windows must meet the requirements of ANSI/AAMA Standard 101-17, but not less than fenestration performance requirements listed elsewhere within P100. Only optimal performance classes may be used.

Metal windows other than aluminum must meet the requirements of Steel Window Institute's (SWI) Specifier's Guide to Steel Windows for the performance class required.

Wood windows must meet the requirements of ANSI/NWMA Standard I.S. 2-87, Grade 60 and AAMA/WDMA 101/I.S.2/NAFS. AW Architectural Class.

Replacement windows in historic structures should exactly match original frame and muntin profiles, and consideration given to including highly insulating commercial secondary windows (also known as window inserts, low-e panels, or interior storm windows), vacuum insulating glazing (VIG), low-e films, insulating shades, and automated blinds and shades. Glazing installed in historic sashes must meet applicable safety glazing standards for the installation location, as well as any other project-specific safety and security requirements. See Upgrading Historic Building Windows for more information.

3.3.6.2 WINDOW FRAMES

Aluminum frames must be thermally broken as defined by NFRC 600 in climate zones 2-8. In climate zones 0 to 1, aluminum frames must be at least thermally improved as defined by NFRC 600. At curtainwalls, window mullions must be coordinated with the floor-planning grid to permit the abutment of interior partitions.

3.3.6.3 ENTRANCE DOORS

Entrance doors may be aluminum and/or glass of heavy-duty construction. Glazed exterior doors and frames must be steel and meet the requirements of SDI Grade III with a G-90 galvanic zinc coating. Vestibules are desired to control air infiltration and reduce stack effect. Sliding automatic doors are preferred over the swinging type. Motion detectors and push plates are preferred over mats as actuating devices. Historic entrance doors must be retained and upgraded with care to preserve the original appearance of the building. Where missing, replicas of the original doors should be installed. All door assemblies installed in the means of egress must meet the requirements of the National Fire Protection Association (NFPA), 101 Life Safety Code. Follow service life fenestration requirements listed under table 3.1. See additional requirements in table 3.5 All Glass Entrances.

3.3.7 ROOF SYSTEMS

3.3.7.1 ROOFING DESIGN

Roofing designs must follow the recommendations of the National Roofing Contractors Association (NRCA) Roofing Manual–, –current edition. Additionally, follow the recommendations of the NRCA Roofing Manual–to coordinate the design of metal flashing, trim, etc., with roofing terminations. The Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Manual is a trusted resource for the design, fabrication, and installation of sheet metal roofing accessories. All roof assemblies and rooftop structures must meet the requirements in the IBC and the IFC.

Where there is a likely ability [solar, physical constraints] to implement solar panels within the intended service life of the roof, include provisions in the roofing design to be solar-ready.

Consider performing a hygrothermal analysis prior to selecting a roofing membrane system

3.3.7.1.1 COOL ROOFS

Cool roofs are designed to reflect more sunlight than a conventional roof, which saves energy by lowering air conditioning demands. ASHRAE 90.1 sets minimum requirements for cool roofs but exempts steep-slope roofs and the requirements only apply in climate zones 0-3. GSA buildings must follow the requirements in ASHRAE 189.1, section 5.3.5.3 and 5.3.5.4, which set a minimum performance requirement for steep-slope roofs and require cool roofs in climate zones 4A and 4B. Buildings in other climate zones should assess cool roofs when considering design options; summer cooling energy savings are typically greater than the “heating penalty” caused by reduced solar heat gain in winter months.

Buildings in climate zones 1-6 must meet a mandatory initial solar reflectance or 0.85 and a 3-year solar reflectance of 0.75.

3.3.7.2 RE-ROOFING

Full replacement of roofing including insulation is the preferred approach to restoring the integrity of the enclosure system and realizing life cycle cost benefits; unless it can be demonstrated that the prior insulation used has an expected service greater than the re-roofing membrane specified and complying with table 3.1 service life; and that it maintains its original thermal, structural and edge integrity. Where full replacement is not feasible, roof recovery or partial replacements are permitted to restore the integrity of the roofing system, protect the asset, and ensure continuity of operations. Where new roofs are installed over existing roofing, comply with the IBC and prevailing local code requirements.

Survey and investigate the condition of the existing substrate to acquire warranties from the manufacturer and installer. Substrate must be determined structurally adequate before the new roofing assembly is applied. The new roofing system must not be of greater weight than the old roofing system, unless a structural analysis shows that the building can carry the additional weight. Ensure the integrity of the building enclosure system takes precedence over less critical repairs or alterations. See the technical guidelines for Historic Building Roofing for guidance on repair, replacement, and modification of roofing on historic buildings.

Re-roofing projects at existing buildings must evaluate the capacity of the roof drainage system to accommodate predicted future precipitation volumes. Re-roofing projects must also address requirements for fall protection and safe suspended access.

3.3.7.3 ACCESS TO THE ROOF

An interior permanent stair must be provided to permit access to roof-mounted equipment. Permanent access to all roof levels must be provided to facilitate recurring inspection and maintenance. Include appropriate signage for authorized access.

3.3.7.4 INSULATION

Install continuous roof insulation in a manner that minimizes thermal bridging. Where board insulation is installed in multiple layers, offset the boards in adjacent layers so that the joints are not aligned. When making insulation type selections, consider the long-term thermal performance characteristics (e.g. thermal migration and thermal aging), sustainability effects (e.g. harmful blowing agents), and thermal performance if wet. Thermal calculations must account for insulation performance characteristics because of expected thermal migration at the midpoint of assembly service life, determined in table 3.1/service life. Account for the performance across the entire expected range of temperatures, and performance when damp or wet.

Consider ultra-high performing insulation products, especially for historic properties requiring low-profile roofs. Consider the expected structural and edge durability and service life of roofing insulations. Consider the likelihood or accommodations of future penetrations when selecting some insulations.

3.3.7.5 ROOF MOUNTED EQUIPMENT

Penthouses and screen walls on roofs must be integrated into the architectural design and constructed of materials compatible with those used elsewhere in the building exterior. Some roof-mounted equipment, such as antennae, lightning rods, flagpoles, etc., does not have to be screened, but these elements must be integrated into the building design. Roof-mounted equipment must be elevated as recommended in The NRCA Roofing Manual: Membrane Roof Systems, current edition. Set equipment back from the roof edge to minimize visibility.

Penetrations through the roof to support equipment are vulnerable to leaks. Flashing details must be studied to ensure the continuity of the waterproof barrier. Do not use pitch pockets as part of the roof design.

No building element may be supported by the roofing system except walkways. Provide protective walkways on the roof along routes to and around equipment for maintenance.

Before installing rooftop photovoltaic systems, a meeting must occur with the RPMT, the contractor, GSA facility manager, GSA fire protection engineer, GSA safety specialist, local power utility company, and local fire official to ensure the proposed photovoltaic system design and layout is acceptable to all parties. See Chapter 6, Photovoltaic Systems.

3.3.7.6 EXTERIOR SOFFITS

Design exterior soffits to resist displacement and rupture by wind uplift. Design soffits to provide access to void space and concealed equipment where maintenance must be performed. Design soffits to be moisture resistant. Provide expansion and contraction control joints at the edges and within the soffit. Spacing and configuration of control joints must be in accordance with the recommendations of the manufacturer of the soffit material.

Operating equipment or distribution systems that may be affected by weather must not be located inside soffits. Where it is necessary to insulate the floors above soffits, the insulation must be attached to the underside of the floor construction so that the soffit void may be ventilated to prevent the formation of condensation.

3.3.7.7 SKYLIGHTS AND SLOPED GLAZING

Skylights are defined as prefabricated assemblies shipped ready for installation, while sloped glazing is field assembled. Skylight design must follow the guidelines of AAMA Standard 1600. For the design of sloped glazing, two AAMA publications are available: Glass Design for Sloped Glazing and Structural Design Guidelines for Aluminum Framed Skylights.

Where manufactured skylight systems are specified, do not deviate from the manufacturer’s proven standard details. Where the design intent or field conditions do not allow for the use of tested skylight assemblies, and where modifications to a manufacturer’s standard details or a custom design is required, develop a rigorous course of design- and construction-phase testing as part of the BECx plan to assure quality and performance.

Skylights and sloped glazing must use low emissivity glass. Placement should be calculated to prevent glare or overheating in the building interior. Provide a controlled path for condensate. Condensation gutters and a path for the condensation away from the framing must be designed.

Consideration must be given to cleaning of all sloped glazing and skylights, including access and equipment required for both exterior and interior faces.

Skylights must be guarded for fall protection or meet OSHA structural requirements.

3.3.7.8 ROOF FALL PROTECTION

Roofs designed for access must include edge fall protection such as parapets or railings. Edge fall protection includes the roof's outer edge and all unprotected sides and edges of inboard roof openings that could result in a fall to a lower level. Edge protection must be at least 42 inches in height with no openings exceeding 19 inches across the least dimension. Consult 29 CFR §1910 Subpart D for specific requirements.

Where parapets or railings are not feasible, the designer must include other means of fall protection appropriate to the operations and maintenance access and work anticipated. Systems include, but are not limited to, warning lines when distance allows, and personal fall protection systems such as personal fall arrest, travel restraint, or positioning systems. Consult 29 CFR §1910 Subparts D, F, I, and the International Building Code for specific requirements.

Equipment must be located away from roof edges and oriented with access panels inboard of the roof edge.

Roof replacement projects must include a review of the existing roof fall protection by a qualified consultant as defined in paragraph 3.3.12.5. Where such protection is deemed inadequate or unsafe, the design and installation of necessary fall protection systems, equipment, and components must be included in the roof replacement project.

Fall protection must be coordinated with historic preservation provisions.

3.3.8 QUALITY ASSURANCE

3.3.8.1 MOCK-UPS

Many architectural designs require full scale, laboratory, and/or on-site mock-ups of critical portions of the building facade. Mock-ups confirm expected system performance and establish acceptable standards of workmanship. The testing of a laboratory mock-up almost always informs the final design solution. Performance mock-ups typically allow the builders to discover the proper sequence of the work that leads to successful completion. Mock-ups must be constructed by the same team that will construct the facade. While in situ mock-ups are sometimes acceptable, separate, free-standing mock-ups are preferred to eliminate the risk of accepting substandard work. Testing, verification, and approval of mock-ups must occur prior to proceeding with final installations. Refer to the GSA Commissioning Guide (September 2020) for additional guidance.

3.3.8.2 AIR BARRIER TESTING

For new construction, demonstrate performance of the air barrier system for the building enclosure. Comply with IgCC-Section 10.6 Building Envelope Airtightness. Prior to testing, verify that the continuous air barrier system has been installed as per the design in accordance with the specifications. Incorporate the use of infrared (IR) and smoke pencil tools (ASTM E1186) into regular inspections throughout completion of the air, water and thermal lines of facade and roof construction sequencing, preferably before interior finishes are installed. This quickly validates the continuity of each. Testing must occur during construction and prior to the installation of insulation and exterior cladding materials that could impede access to the air barrier and prevent the identification of failures and required repairs.

3.3.9 SUN CONTROL DEVICES

Where operable or fixed sun control devices are installed, design for ease of maintenance, repair, and replacement. If automated sun control devices are provided, commission their performance as a requirement of the BECx plan. Window washing systems used for the facility must also be compatible with any sunscreens or sun control devices.

3.3.10 WINDOW CLEANING

The facility must have provisions for cleaning the interior and exterior surfaces of all windows, skylights, and other glazed openings. The design team must demonstrate that cleaning and maintenance of interior glazing surfaces can be achieved without extraordinary means and methods. Submit this information with the construction documents.

3.3.11 PROVIDING ACCESS TO MAINTAIN EQUIPMENT IN ATRIUMS

The design team must demonstrate that maintenance of equipment (e.g., lighting, smoke detectors, and other systems that are mounted within atrium spaces) can be achieved without extraordinary means and methods. Submit this information with the construction documents.

3.3.12 SUSPENDED ACCESS TO ELEVATED LOCATIONS

Suspended access primarily applies to vertical surfaces that cannot be feasibly reached from ground-based equipment. Typically, these surfaces are exterior facades and interior atria. Access must be designed for maintainability and safety. The following key factors influence design for suspended access:

- The need for access, frequency of access, and type of work depends on the maintenance and cleaning requirements of the vertical surfaces and associated equipment and components. Access includes, but is not limited to, window washing, facade inspection, facade maintenance, and access to lighting and security cameras.

- The architectural configuration of the building is a primary factor affecting access. Negative-sloped facades, appurtenances that project into the vertical plane, visual shields that block access to anchorages, and other architectural complexities can make access design challenging, compromised, or sometimes infeasible.
- The roof and penthouse (if applicable) structure affect anchorage and other access equipment installations. The design of the building structure should anticipate the location of anchorage connection locations to produce an integrated design.
- The layout of mechanical, electrical, plumbing, and other systems on the roofs of buildings may make the location of access systems difficult or may limit coverage. The design team must coordinate the design of rooftop systems with anchorage connection locations to produce an integrated design and ensure access.

Roof replacement projects must review the adequacy of access to vertical surfaces from roofs. Where such access is deemed inadequate, the design and installation of necessary access systems, equipment, and components must be included in the roof replacement project.

3.3.12.1 ANCHORAGE

Technically the building structure is considered the *anchor* and the component installed to allow the connection of equipment or a worker to the structure is an *anchor connector*. However, the term “anchor connector” is also used to describe equipment components that attach to building anchor connectors. The term “anchorage” is used herein to describe the anchorage connector that is permanently attached to the building. The following are the three primary anchorage types:

- *Support Anchorages* are used to carry the load of a worker and equipment in a rope descent system. A variation of a support anchorage is a "tie-down" anchorage. This component is used to counter the moment of portable outriggers that are not counter weighted.
- *Tie-back anchorages* are used as secondary safety connections for portable outriggers.
- *Lifeline anchorages* are used as secondary safety connections for worker protection. Each worker must be "tied off" to an independent lifeline anchorage.

3.3.12.2 ROPE DESCENT SYSTEM (RDS)

A Rope Descent System (RDS), also called a controlled descent system, is a suspension system that allows a worker to descend in a controlled manner and, as needed, stop at any point during the descent. The system typically consists of a roof anchorage, support rope, a descent device, carabiner(s) or shackle(s), and a chair (seatboard or “boatswain’s chair”).

3.3.12.3 POWERED PLATFORM

A powered platform is equipment used to provide access to the vertical surface of a building consisting of a suspended power-operated working platform, a suspension means, and the requisite operating and control devices. A powered platform may also be called a suspended scaffold, swinging scaffold, or swing stage.

3.3.12.4 DESIGNER TASKS

During the concept development phase of the project, the design team must retain the services of a qualified consultant to:

- Determine the type of access needed for the expected cleaning, inspection, and maintenance tasks for the proposed facility
- Recommend means and methods, equipment, and anchorage locations to accomplish such tasks in a safe, cost effective, and sustainable manner

The consultant must consider local trade availability and the ability to provide and operate the proposed system design in these recommendations. Anchorage connection locations must be coordinated with the building structural design.

During design development the consultant must design the system and specify the installation including requirements for quality assurance, maintenance, and periodic inspection and testing. The consultant must provide a written certification that the anchorages meet the load requirements specified in paragraph 3.3.12.10.

3.3.12.5 DESIGNER QUALIFICATIONS

The consultant must meet the following minimum criteria:

- The consulting firm must be registered as a professional engineering firm and not be a manufacturer, distributor, installer, or supplier of access systems, anchors, anchorages, or anchorage connectors.
- The lead consultant(s) must be dually licensed professional engineer(s) and certified safety professional(s).
- The consultant(s) must demonstrate an understanding of current industry best practices, as well as applicable regulations and standards, including OSHA regulations and ANSI standards.
- The consultant(s) must have a minimum of five (5) years of industry-specific experience in fall protection, including challenging work at structures of historical and architectural significance.

3.3.12.6 PERMANENT VS. PORTABLE EQUIPMENT

While anchorages are permanent components attached to the building, GSA allows for flexibility in choosing other access system components that are permanent or portable. Generally, GSA prefers that access equipment needed for each cleaning or maintenance task be contractor-furnished (portable) to the greatest extent possible. Exceptions to this preference include the following:

- Building configurations that render the use of portable equipment infeasible, and
- Permanent access designs that have a lower Life Cycle Cost (LCC) or Total Cost of Ownership (TCO) than utilizing portable equipment. If such permanent systems are considered, a detailed LCC/TCO analysis must be performed that includes costs for periodic inspection, testing, maintenance, and re-certification of the permanent equipment.

3.3.12.7 SYSTEM PREFERENCES

The following order of preference must be considered in matching an access system (or systems) to the proposed building design:

3.3.12.7.1 ROPE DESCENT SYSTEMS

Where buildings are less than 300 feet above grade, contractor-supplied rope descent systems are the preferred means for access. Rope descent systems are generally the most efficient system for window washing and facade inspections. However, these systems generally are not feasible for facade work that requires equipment, heavy tools, or materials. OSHA limits rope descent systems to heights less than 300 feet above grade unless other means are not feasible or pose a greater risk than a rope descent system. Work to be completed at elevations above 130 feet requires intermittent, continuous or workstation (suction cup) stabilization.

3.3.12.7.2 GROUND-RIGGED POWERED PLATFORMS

When it is anticipated that a powered platform will be needed, contractor-supplied ground-rigged platforms and portable outriggers (generally counter-weighted or tie-down) are preferred. The designer must consider the risk of damage to roofing during set-up and relocation caused by portable outriggers. For heights above 130 feet, continuous horizontal stabilization is required. The use of portable outriggers is limited to heights less than 300 feet. (29 CFR §1910 subpart f)

3.3.12.7.3 ROOF-RIGGED POWERED PLATFORMS

Ground-rigged platforms are generally not practical at elevations greater than 300 feet and cannot be used with intermittent stabilization. For these situations, roof-rigged powered platforms are generally the system of choice. Regarding suspension supports, it is generally not feasible to roof-rig a powered platform from a portable outrigger. This typically requires the installation of GSA-owned suspension structures such as swingable davits. Also, portable outriggers are prohibited above 300 feet. If contractor-supplied powered platforms are anticipated, the building design must provide adequate roof access (e.g., freight elevator) to transport the platform to the roof.

3.3.12.7.4 PERMANENTLY INSTALLED POWERED PLATFORM SYSTEMS

Permanently installed systems are designed for dedicated building applications. GSA will consider such systems when simpler systems are not feasible or when a Life Cycle Cost (LCC) or Total Cost of Ownership (TCO) analysis shows a permanent system to be the best option.

3.3.12.8 STABILIZATION

For heights above 130 feet, horizontal stabilization is required to prevent lateral movement of a chair or platform due to wind loads. This stabilization is generally accomplished in three ways:

- Work Location Stabilization. This stabilization typically consists of suction cups placed on the glazing and is generally limited to window washers utilizing rope descent systems.
- Intermittent Stabilization. Intermittent stabilization consists of small anchorage points generally at every second floor. Intermittent stabilization can only be used with roof-rigged descents.
- Continuous Stabilization. These systems consist of channels or other sliding systems that run continuously along the vertical surface. These systems allow ground-rigging. However, it should be noted that continuous stabilization can be problematic architecturally, structurally, and functionally. The channel may affect the building aesthetics, the supporting structure (such as a mullion) must be capable of resisting the horizontal load, and the stabilization channels/rails must align smoothly at joints.

3.3.12.9 BUILDING ATTACHMENTS

Designs that utilize cornice hooks, roof hooks, roof irons, parapet clamps, or similar devices are prohibited unless approved by the GSA Office of Architecture and Engineering.

3.3.12.10 ANCHORAGE DESIGN

Anchorage must be designed to support a 5,000-pound ultimate load in all directions expected in use. Where feasible, anchorage must be located to facilitate routine inspection, load testing, and maintenance.

3.3.12.11 REFERENCES

All components, equipment, and systems permanently installed on or in GSA buildings must comply with the following references:

- ANSI/ASSE Standard Z359 Fall Protection and Related Systems
- ANSI Standard A120.1, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance
- NGA/IWCA 01-0116 Proper Procedures for Cleaning Architectural Glass Products.
- 29 CFR §1910 Subpart D: Walking—Working Surfaces
- 29 CFR §1910, Subpart F: Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms (OSHA)

Figure 10: Land Port of Entry
Derby Line, VT

3.4 GENERAL ARCHITECTURE

3.4.1 CORNERSTONE

A cornerstone is required for all new buildings as a part of the exterior wall. The cornerstone must be a cut stone block or similar long lasting material meeting table 3.1 Enclosure Service Life tier 2 or better having a smooth face of size adequate to present the following incised letters:

UNITED STATES OF AMERICA
(PRESIDENT'S NAME), PRESIDENT
GENERAL SERVICES ADMINISTRATION
(ADMINISTRATOR'S NAME), ADMINISTRATOR
(YEAR OF CONSTRUCTION START) – (YEAR OF PROJECT COMPLETION)

The words UNITED STATES OF AMERICA should be in letters 50 mm (2 in.) high and other letters should be proportionally sized by rank.

The names must be of the President in office at the time the construction contract was awarded, as well as the name of the confirmed GSA Administrator in office at the time the construction contract was awarded. If a confirmed GSA Administrator was not in office at the time the construction contract was awarded, the name of the confirmed GSA Administrator in office at the time closest to the date that the construction contract was awarded through to project completion must be included on the cornerstone. If a confirmed GSA Administrator was not in office at any time from the date the construction contract was awarded through to project completion, the cornerstone must not include the name of any GSA official, but instead will include "General Services Administration". The cornerstone must also include the year construction began and the year of project completion. A confirmed GSA Administrator may include an Acting Administrator who subsequently, without any break in service, becomes confirmed.

3.4.2 REGISTRY OF DESIGNERS AND BUILDERS

A plaque or electronic interface that names the individuals of the project team may be placed inside the building. Listed individuals are members of the GSA project team, consultant architects and engineers, on-site construction managers, and construction workers who have completed at least 200 hours of service to the project. The list encompasses office staff and on-site workers.

The RPMT will provide the specifications for the design and construction of the plaque or electronic media.

3.4.3 PROMOTE THE USE OF STAIRS

GSA encourages employees, tenants, and visitors to step up to a healthier lifestyle and consider taking the stairs. Regular physical activity, such as stair climbing, can help reduce the risk for several diseases and health conditions such as heart disease, high blood pressure, and obesity. Consider stair and circulation space design so they are readily accessible, easy to find, and desirable to use.

3.4.4 VERTICAL TRANSPORTATION

The goal of GSA's Vertical transportation program is to ensure code compliance on all new and modernization installations of both elevators and escalators, thereby improving overall building safety related to vertical transportation. The primary goal is the safety of the riding public and to protect from accidents or injury related to vertical transportation, while ensuring the cost effective and accurate installation of vertical transportation equipment.

The GSA Regional Vertical Transportation Subject Matter Expert (SME) must participate in each phase of the project from concept through design, construction, final acceptance, and occupancy to ensure all ASME A17 codes, as well as IBC and NEC code requirements, are incorporated into the project. The GSA Regional Vertical Transportation SME must review design plans, specifications, and related information; review contractors' submittals for compliance with contract documents; witness acceptance testing and commissioning of the Vertical Transportation systems; and upon successful completion of commissioning and acceptance of tested systems, will issue certificates of operation (or temporary certificates of operation). The GSA regional Vertical Transportation SME is the Authority Having Jurisdiction (AHJ) for the Regional Vertical Transportation program and for technical requirements in this chapter. As the AHJ, the GSA Vertical Transportation SME has the right to revise the specific requirements within this chapter based on a technical evaluation and analysis of the project's specific needs.

All new and altered elevators and escalators must comply with ASME A17.1. All new and altered lifts must comply with ASME A18.1, Safety Standard for Platform Lifts and Stairway Chair Lifts. (See Chapter 7, Fire Protection for specific requirements related to elevator systems)

The selection of type and quantity of conveying systems, such as elevators, escalators, and wheelchair lifts, must be made in conjunction with a thorough vertical transportation traffic analysis of the facility.

3.4.4.1 VERTICAL TRANSPORTATION/ELEVATOR TRAFFIC ANALYSIS

The elevator traffic analysis must be performed by an independent consultant to determine the type, quantity, capacity, and speed requirements of elevators. Separate calculations must be performed for each elevator classification.

The criteria by which the traffic analysis calculations should be judged are "average interval" and "handling capacity."

Average interval is defined as the calculated time between departures of elevators from the main lobby during the morning up-peak period. Calculated intervals during the up-peak period should not exceed 30 seconds for a typical elevator bank.

Handling capacity is defined as the number of persons the elevator system must move in any given 5-minute period of up-peak traffic used to measure the average interval. GSA buildings must always be designed for a 12 percent handling capacity, even if the building is designed as a multi-tenant facility.

Elevator cab sizes must be in accordance with the standards established by the National Elevator Industries, Inc. (NEII). Elevator cabs must be designed to reflect the architectural character of the building design.

3.4.4.2 ELEVATORS

If no separate freight or service elevator is provided, one passenger elevator must be designated as a service elevator with pads to protect the interior wall surfaces of the cab. The passenger elevator designated as a service elevator must not be considered as one of the elevators required by the traffic analysis.

A minimum ceiling height of 2,700 mm (9 ft.) is required in service elevator cabs. Freight elevators must have a ceiling height of not less than 3,700 mm (12 ft.).

In large or high-rise GSA buildings, the number of freight elevators provided must be determined by the elevator traffic analysis. The use of more than one freight elevator will provide better freight service for the tenants as well as provide redundancy for normal maintenance and during times when repair work is conducted.

Where equipment penthouses are provided, service elevators or freight elevators must provide access to that level. An elevator must service all maintenance floors.

Trap doors and hoist beams must be provided at the elevator machine rooms for traction elevators where the machine room is not served by a freight or service elevator for removal of equipment for service and repair.

3.4.4.3 ELEVATOR CLASSIFICATIONS

Passenger: Passenger elevators must be sized to qualify for the disabled. Capacities of 1,590 kg to 1,810 kg (3,500 to 4,000 pounds) must be used for passenger elevators.

Service: A passenger elevator designed to meet the ASME A17.1 Code requirements for "Carrying Freight on Passenger Elevators" is required. The minimum rated load must be based on the inside net platform area for passenger elevators. See Figure 8.2.1.2 ASME A17.1 ñ 2007. The car doors must be horizontal sliding type. The car platform must be designed to the applicable freight class loading.

Freight/Service: A passenger elevator designed to meet the ASME A17.1 Code requirements for "Carrying Freight on Passenger Elevators" qualifies for freight purposes.

Security: Security or specific purpose elevators are designed to transport designated groups of people such as judges, cabinet members, or prisoners. These will be custom designed to meet specific program requirements.

Shuttle: Typically, a passenger elevator that services a limited number of landings, e.g., parking garage to main lobby.

3.4.4.4 MACHINE ROOM-LESS (MRL)

A machine room-less elevator is an elevator with the drive machine, governor, and other related components located in the elevator hoistway. Hydraulic machine room-less elevators are prohibited. Traction machine room-less elevators require specific Government approval by the GSA regional elevator/transportation SME. The elevator must have a metal belt and the control system must be located outside of public and high-security areas to facilitate safe maintenance procedures. The MRL must meet the following minimum requirements:

- Main line disconnect switches must be installed within 18 inches of the strike jamb of control room door
- The car position, movement, and direction must be able to be determined from the control room
- Provide HVAC in the control room so that the temperature does not go below 50 degrees or above 90 degrees
- Access to the governor must be provided from outside the hoistway
- The suspension means must be manufactured for elevator use only and be constructed from steel only

3.4.4.5 ESCALATORS

Due to their high operation and maintenance costs, use escalators only where necessary. Their use must be justified by the vertical transportation analysis. Escalators may be installed as supplements to elevators when vertical transportation is required for a large unpredictable volume of public traffic. They should be used where the first floor is not large enough to contain the high public traffic so that the interval for elevators can be calculated with accuracy. Escalators should be located to be visible from the building entry and convenient to the areas they serve.

3.4.4.6 WHEELCHAIR LIFTS

Wheelchair lifts must comply with the current edition of ASME 18.1 Safety Standard for Platform Lifts and Stairway Chairlifts. Proper design of accessible routes in new construction must not require the use of wheelchair lifts. In repair and alteration projects, ramps are preferred to wheelchair lifts.

3.4.5 FAMILY/SINGLE OCCUPANCY RESTROOMS

All new federal buildings must provide one or more combined purpose family/single occupancy restroom on each accessible floor. This restroom is in addition to, and preferably collocated with Male/Female building restrooms. For partial floor alterations, provide the family/single occupancy restroom when alteration area is equal to or exceeds 50% of that floor’s total rentable area. This restroom must be sensitive to historic features.

The physical characteristics of the family/single occupancy restroom must:

- Provide a lockable door with dead-bolt type occupancy designation.
- Provide door signage to indicate the following features:
    - International Symbol of Accessibility per ABAAS 703.7.2
    - Designations for family, single use and non-gender specific occupants
    - Presence of Adult (Universal) or /Infant changing station
- Provide minimum clear floor areas and accessible routes to all restroom features following ABAAS standards.
- Provide all elements of an accessible restroom to include but not limited to:
    - one accessible sink
    - one accessible toilet with accessible toilet accessories and grab bars
- Provide one accessible changing station as follows:
    - Infant Changing Station - Provide one infant changing station. The station may be fixed at +30” above finished floor or a powered height adjusted table with a range from +17” to +34” above finished floor and hold a weight of no less than 50 Lbs.
    - Adult (universal) Changing Station - In buildings where the main floor can accommodate a public area with fifty or more occupants, exchange the infant changing station on that floor with one adult (universal) changing station. The station may be fixed at +30” above finished floor or a powered height adjusted table with a range from +17” to +34” above finished floor and hold a weight of no less than 300 lbs with minimum dimensions of 25” in width by 70” in length.
- Provide finishes appropriate for ease of maintenance and in line with specific Building Design Standards.

3.4.6 LACTATION ROOMS

Consistent with Section 4207 of the Patient Protection and Affordable Care Act (P.L. No. 111-148), and 29 USC §218d, federal agencies are required to provide a reasonable break time for female employees to express breast milk as needed for their nursing child for 1 year after the child's birth. Federal agencies must provide their employees a place for lactation, other than a bathroom, that is shielded from view and free from intrusion from coworkers and the public.

The Fairness for Breastfeeding Mothers Act of 2019 (P.L. No. 116-30) requires that certain public buildings that are open to the public and contain a public restroom provide a lactation room, other than a bathroom, that is hygienic and is available for use by members of the public to express milk.

As such, all federal buildings must provide facilities to meet these requirements. Lactation rooms must be provided according to Table 3.2. When feasible, separate lactation space for employees and the public are recommended to mitigate accessibility and safety issues.

Room size:

- For a single station lactation room, minimum footprint is 5 feet by 7, as it allows for a 5-foot radius circle with an accessible 20-inch-deep X 30 inch wide counter.
- For a multi-station lactation room, at least one station must meet accessibility requirements. Non-accessible stations must be a minimum of 4 feet X 4 feet.
- In multi-station lactation rooms, provide visual partitioning for each station.
- Determine the number of lactation stations according to Table 3.2 below. If the number of female employees is unknown, assume half of the number of employees to be female.

Minimum requirements:

- A lockable door. In single station lactation rooms, the lock should have an occupancy indicator.
- A comfortable chair and a work surface sufficient for lactation equipment.
- A small utility-type sink with adjacent counter. In a multi-station lactation room, provide a minimum of one sink per three stations.
- Storage for cleaning supplies and paper towels.
- Provision for towel dispenser and trash receptacle.
- A mirror.
- Well-placed GFCI electrical outlets for each lactation station and near the sink if in a multi-station room.
-
- Hard or resilient flooring suitable for regular mopping and sanitizing.
- Signage to identify that it is a Lactation Room.
- Accessibility must be met for all common features of an accessible room.

Employee only additional requirements:

- A bulletin board.
- Well-placed GFCI electrical outlet for refrigerator
- Milk storage – install lockable refrigerator, sized sufficiently for the number of users for employees only

Location

- Public Lactation rooms should be in a safe area accessible to the public and near, or adjacent to, a family restroom or health unit. Consideration should be given to acoustics with respect to adjacent occupancies.
- Employee Lactation rooms should be near or adjacent to restrooms or health unit.

HVAC and Lighting

- Provide HVAC and lighting in accordance with Chapter 5 and Chapter 6, respectively.
- While existing conditions vary, below are preferable, particularly in new construction and substantial renovation:
    - A thermostat for user adjustment. Air ventilation and filtration: Consult Chapter 5 tables to determine optimal solutions.
    - Noise control to reduce sound intrusion and attenuation. Consult Chapter 5 tables to determine optimal solutions. STC 45 is recommended as a minimum.
    - Non-glare lighting fixtures are preferred. A dimmer switch is strongly recommended. Consult Chapter 6 tables to determine optimal solutions.
    - Electrical loads accommodating refrigerators, milk pumps, personal phones and computers are recommended at a minimum.

Fire Protection

- See Chapter 7 Fire Protection.

Table 3.1 Lactation Stations

Number of Total Employees	Number of Stations Needed
Under 200	1
Approximately 500	2
Approximately 1000	3
Approximately 1500	4
Approximately 2000	6
For every additional 2000 total employees	6 additional stations
At least one lactation station must be accessible to the public.	

3.4.7 BIRD-SAFE BUILDING DESIGN

All BA51 (new construction) or BA55 (major repairs and alterations) projects affecting the glazing of the envelope meet the following (historic buildings must make a determination with the RHPO):

- All glass, from ground level to a minimum of 75 feet above grade must have a Threat Factor rating of 30 or less

- All glass, adjacent to a green roof or partial green roof and up to three floors above, must have a Threat Factor rating of 30 or less
- All glazed corners, fly-through conditions, glazing adjacent to courtyards, skywalks, building connectors, railings, noise barriers, wind barriers (including in parking structures, transportation and weather shelters, gazebos, external booths, atria, and any other free-standing glass, plexiglass, or other clear, transparent, or highly reflective free-standing structure must have a Threat Factor less than or equal to 25

See The American Bird Conservancy Threat Factors product database and Prescriptive Rating Option.

All projects should consider bird friendly design per the American Bird Conservancy for Bird-Safe Building Design and the National Glass Association's Best Practices for Bird-Friendly Glazing Design.

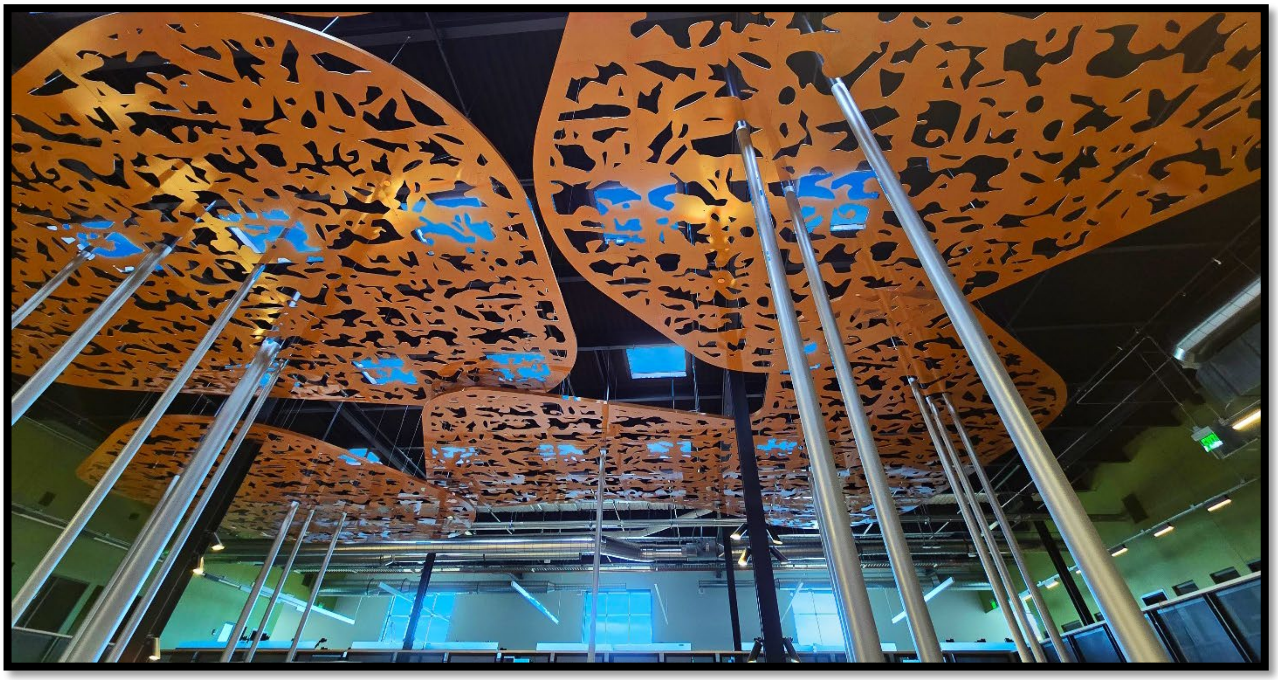


Figure 11: Building 48 Interior
Denver Federal Center
Denver, CO

3.5 INTERIOR CONSTRUCTION PERFORMANCE TABLE

3.5.1 Solid Core Wood Doors		
Construction		
Baseline		Bonded stave core; AWI Custom Grade; 5-ply; Field applied paint
Tier 1		Bonded particle board core; AWI Custom Grade; 5-ply; Hardwood veneer; Field applied finish
Tier 2		Bonded structural composite core; AWI Premium Grade; 5-ply; Factory finish
Tier 3		N/A
M & V		N/A
Plans & Specs		WDMA I.S-1. A; AWI Standards
Calculations & Analysis		N/A
References		
Basis of Design		Describe door construction.
Construction Verification		Verify door construction through shop drawing submittal and product submittal information.
Durability		
Baseline		25 Year Warranty
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Manufacturer's Warranty
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify warranty through product submittal information.
Hardware		
Baseline		Grade 1, Bored Locks
Tier 1		Grade 1; Standard duty mortise locks
Tier 2		Grade 1; Heavy duty mortise locks; solid stainless steel or bronze
Tier 3		Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission
M & V		N/A
Plans & Specs		BHMA A156 Series (door hardware)
Calculations & Analysis		N/A
References		
Basis of Design		Describe door hardware requirements.
Construction Verification		Verify hardware submittal during construction to verify compliance.

Frame		
Baseline		Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated
Tier 1		N/A
Tier 2		Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized
Tier 3		Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout
M & V		N/A
Plans & Specs		ANSI/SDI 250.4
Calculations & Analysis		N/A
References		
Basis of Design		Describe door frame construction.
Construction Verification		Verify through shop drawing submittal and product submittal information.
Security		
Baseline		No Rating
Tier 1		N/A
Tier 2		Time Rated
Tier 3		Forced Entry, Ballistic Resistant
M & V		N/A
Plans & Specs		UL 752
Calculations & Analysis		Required for FE and BR ratings
References		
Basis of Design		Describe UL 752 door rating level (1-8) when applicable.
Construction Verification		Verify through shop drawing submittal and product submittal information.

3.5.2 Hollow Metal Doors

Construction		
Baseline		Level 2; 0.042" (1.0mm)/untreated; Field applied paint
Tier 1		Level 3; 0.053" (1.3mm)/untreated; Field applied paint
Tier 2		Level 3; 0.053" (1.3mm)/untreated; Shop applied paint
Tier 3		Level 4; 0.067" (1.7mm)/galvanized; Electrostatically applied paint
M & V		N/A
Plans & Specs		ANSI/SDI 250.4 & ANSI/SDI 250.8
Calculations & Analysis		N/A
References		
Basis of Design		Describe door construction.
Construction Verification		Verify door construction through shop drawing submittal and product submittal information.
Durability		
Baseline		Heavy Duty

Tier 1		Extra Heavy Duty
Tier 2		N/A
Tier 3		Maximum Duty
M & V		N/A
Plans & Specs		ANSI/SDI 250.4 & ANSI/SDI 250.8
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify warranty through product submittal information.
Hardware		
Baseline		Grade 1; bored locks
Tier 1		Grade 1; Standard duty mortise locks
Tier 2		Grade 1; Heavy duty mortise locks; solid stainless steel or bronze
Tier 3		Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission
M & V		N/A
Plans & Specs		BHMA A156 Series (door hardware)
Calculations & Analysis		N/A
References		
Basis of Design		Describe door hardware requirements.
Construction Verification		Verify hardware submittal during construction to verify compliance.
Frame		
Baseline		Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated
Tier 1		N/A
Tier 2		Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized
Tier 3		Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout
M & V		N/A
Plans & Specs		ANSI/SDI 250.4 & ANSI/SDI 250.8
Calculations & Analysis		N/A
References		
Basis of Design		Describe door frame construction.
Construction Verification		Verify through shop drawing submittal and product submittal information.
Security		
Baseline		No Rating
Tier 1		N/A
Tier 2		Time Rated
Tier 3		Forced Entry, Ballistic Resistant, UL Level 3

M & V		N/A
Plans & Specs		UL 752
Calculations & Analysis		Required for FE and BR ratings
References		
Basis of Design		Describe UL 752 door rating level (1-8) when applicable.
Construction Verification		Verify through shop drawing submittal and product submittal information.

3.5.3 Glazed Aluminum Doors

Construction		
Baseline		1/8" (3mm) extruded aluminum; mill finish
Tier 1		1/8" (3mm) extruded aluminum; Class II anodic finish
Tier 2		1/8" (3mm) extruded aluminum; Class I anodic or fluoropolymer paint finish
Tier 3		3/16" (5mm) extruded aluminum; Class I anodic or fluoropolymer paint finish
M & V		N/A
Plans & Specs		AAMA 101/I.S.2/A440
Calculations & Analysis		N/A
References		
Basis of Design		Describe door construction.
Construction Verification		Verify door construction through shop drawing submittal and product submittal information.
Durability		
Baseline		Standard Warranty
Tier 1		N/A
Tier 2		N/A
Tier 3		5 Year Warranty
M & V		Manufacturer's Warranty
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify warranty through product submittal information.
Hardware		
Baseline		Offset pivots, BHMA Grade 2
Tier 1		Offset pivots, BMHA Grade 1
Tier 2		Center pivots, BMHA Grade 1
Tier 3		Center pivots, BMHA Grade 1
M & V		N/A

Plans & Specs		BHMA A156 Series (door hardware)
Calculations & Analysis		N/A
References		
Basis of Design		Describe door hardware requirements.
Construction Verification		Verify hardware submittal during construction to verify compliance.
Glazing		
Baseline		1/4" (6mm) clear safety glass
Tier 1		1/4" (6mm) clear safety glass
Tier 2		1" (25mm) clear insulating laminated glass
Tier 3		1/2" (13mm) laminated clear or decorative glass
M & V		N/A
Plans & Specs		ASTM C 1048
Calculations & Analysis		N/A
References		
Basis of Design		Describe glazing system proposed in glazed aluminum doors.
Construction Verification		Verify glazing in glazed aluminum door submittal during construction to verify compliance.
Security		
Baseline		Lock Set Only
Tier 1		N/A
Tier 2		N/A
Tier 3		Electronically Controlled Access
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe security requirement for glazed aluminum doors.
Construction Verification		Verify through shop drawing submittal and product submittal information.

3.5.4 All Glass Entrances

Construction		
Baseline		All glass with stainless steel or chrome plated top and bottom rails or patches.
Tier 1		All glass with polished stainless steel, brass or chrome plated top and bottom rails or patches.
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		NGA with GANA Heavy Glass Door Design Guide

Calculations & Analysis		N/A
References		
Basis of Design		Describe construction of all glass entrances.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Durability		
Baseline		Standard Warranty
Tier 1		Standard Warranty
Tier 2		3-year warranty
Tier 3		N/A
M & V		Manufacturer's Warranty
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe warranty period.
Construction Verification		Verify warranty through product submittal information.
Hardware		
Baseline		Grade 1 top and bottom pivots. Concealed floor or overhead closer.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe door hardware requirements.
Construction Verification		Verify hardware submittal during construction to verify compliance.
Glazing		
Baseline		Clear safety glass, 1/2" (13mm) thick.
Tier 1		N/A
Tier 2		Clear safety or decorative glass, 1/2" (13mm) thick.
Tier 3		N/A
M & V		N/A
Plans & Specs		NGA with GANA Heavy Glass Door Design Guide
Calculations & Analysis		N/A
References		
Basis of Design		Describe proposed glazing for all glass entrances.

Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Security		
Baseline		Provided by lock function.
Tier 1		N/A
Tier 2		Electronically controlled access.
Tier 3		N/A
M & V		N/A
Plans & Specs		NGA with GANA Heavy Glass Door Design Guide
Calculations & Analysis		N/A
References		
Basis of Design		Describe security requirements for all glass entrances.
Construction Verification		Verify through shop drawing submittal and product submittal information.

3.5.5 Borrowed Lights

Glazing		
Baseline		Tempered, laminated or some other form of safety glass.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C1048
Calculations & Analysis		N/A
References		
Basis of Design		Describe proposed glazing for borrowed lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.

3.5.6 Wood Framed Interior Lights

Construction		
Baseline		Field fabricated and finished. Painted birch, poplar, or clear softwood. AWI Custom grade.
Tier 1		Shop fabricated with field applied clear or tinted stain. Oak, maple, cherry, walnut, or similar hardwood. AWI custom grade.
Tier 2		Shop fabricated and finished with clear or tinted stain. Oak, maple, cherry, walnut, or similar hardwood. AWI premium grade.
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		

Basis of Design		Describe construction of wood framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Glazing		
Baseline		1/4" (6mm) clear safety glass
Tier 1		N/A
Tier 2		Insulating glass or two 1/4" (6mm) lights of laminated glass with 1/2" (13mm) gap for reduced sound transmission.
Tier 3		Decorative laminated glass, 1/2" (13mm) think.
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe proposed glazing for wood framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.

3.5.7 Hollow Metal Framed Interior Lights

Construction		
Baseline		Untreated, field painted.
Tier 1		Galvanized for installation in wet areas, shop applied painted finish.
Tier 2		Galvanized for installation in wet areas and electrostatically applied painted finish.
Tier 3		Galvanized for installation in wet areas and electrostatically applied painted finish.
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe construction of hollow metal framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Frame		
Baseline		Knock-down hollow metal frame, 0.042" (1.0mm) thick.
Tier 1		Welded hollow metal frame, 0.053" (1.3mm) thick.
Tier 2		Welded hollow metal frame, 0.053" (1.3mm) thick with custom profile.
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe frame construction of hollow metal framed interior lights.

Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Glazing		
Baseline		1/4" (6mm) clear safety glass
Tier 1		1/4" (6mm) clear safety glass
Tier 2		Insulating glass or two 1/4" (6mm) lights of laminated glass with 1/2" (13mm) gap for reduced sound transmission.
Tier 3		Decorative laminated glass, 1/2" (13mm) thick.
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe proposed glazing for hollow metal framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.

3.5.8 Aluminum Framed Interior Lights

Construction		
Baseline		Manufacturer's standard profile: mill finish
Tier 1		Manufacturer's standard profile; Class II anodic finish
Tier 2		Manufacturer's standard profile; Class I anodic or fluoropolymer paint finish
Tier 3		Custom profile; Class I anodic or fluoropolymer paint finish
M & V		N/A
Plans & Specs		AAMA 101/I.S.2/A440
Calculations & Analysis		N/A
References		
Basis of Design		Describe construction of aluminum framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Frame		
Baseline		1/8" (3mm) extruded aluminum
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		AAMA 101/I.S.2/A440
Calculations & Analysis		N/A
References		
Basis of Design		Describe frame construction of aluminum framed interior lights.

Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.
Glazing		
Baseline		1/4" (6mm) clear safety glass
Tier 1		N/A
Tier 2		1" (25mm) clear insulating laminated glass
Tier 3		1/2" (13mm) laminated clear or decorative glass
M & V		N/A
Plans & Specs		ASTM C 1048
Calculations & Analysis		N/A
References		
Basis of Design		Describe proposed glazing for aluminum framed interior lights.
Construction Verification		Verify through mockup, shop drawing submittal and product submittal information.

3.5.9 Metal Stud Partitions

Construction		
Baseline		3-5/8" x min. 25 ga. metal studs @ 24" o.c., 5/8" gypsum board, each side (max. deflection L/240)
Tier 1		N/A
Tier 2		3-5/8" x min. 16 ga. light gage metal framing studs @ 16" o.c., 2 layers 5/8" gypsum board, 9 ga. wire mesh between studs and gypsum each side (max. deflection L/360)
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C 645, ASTM C 1396,
Calculations & Analysis		N/A
References		
Basis of Design		Describe partition construction.
Construction Verification		Verify compliance through design submittals, shop drawings and product submittal information.
Durability (Impact Resistance)		
Baseline		Standard
Tier 1		N/A
Tier 2		High
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe impact resistance requirement, when applicable.

Construction Verification		Verify compliance through product submittal information.
		Height
Baseline		Deck to Ceiling with plenum barrier
Tier 1		Deck to Slab or Deck to Ceiling with plenum barrier or Deck to Deck Above
Tier 2		Deck to Slab or Deck Above
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe partition height requirements.
Construction Verification		Verify compliance through design submittals.
		Security
Baseline		No Rating
Tier 1		N/A
Tier 2		SCIF
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		Required for FE and BR ratings
References		
Basis of Design		Document security requirement.
Construction Verification		Verify compliance through design submittals and shop drawings
		Environmental
Baseline		Standard for Sustainability for Gypsum Boards and Panels. GREENGUARD Gold certification or Indoor Advantage Gold Certification; product-specific Type III environmental product declaration (EPD).
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		
Basis of Design		N/A
Construction Verification		Verify compliance through product submittal information

3.5.10 Masonry Partitions

Construction		
Baseline		6" CMU, 1-5/8" metal studs @ 16" o.c. and 5/8" gypsum board, each side
Tier 1		8" filled and reinforced CMU, 9 ga. wire mesh one side, 1-5/8" metal studs @ 16" o.c. and 2 layers 5/8" high impact resistant gypsum board, each side
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C 129, ASTM C 645, ASTM C 1396
Calculations & Analysis		N/A
References		
Basis of Design		Describe partition construction.
Construction Verification		Verify compliance through design submittals, shop drawings, and product submittal information.
Durability (Impact Resistance)		
Baseline		Standard
Tier 1		High
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe impact resistance requirement, when applicable.
Construction Verification		Verify compliance through product submittal information.
Security		
Baseline		Moderate
Tier 1		High
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		Required for FE and BR ratings
References		
Basis of Design		Document security requirement.
Construction Verification		Verify compliance through design submittals and shop drawings
Environmental		

Baseline		Standard for Sustainability for Gypsum Boards and Panels. GREENGUARD Gold certification or Indoor Advantage Gold Certification; product-specific Type III EPD.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		
Basis of Design		N/A
Construction Verification		Verify compliance through product submittal information

3.5.11 Demountable Partitions

Construction		
Baseline		Standard Panel Width Prefinished Panels
Tier 1		Custom panel widths with Prefinished Panels
Tier 2		Custom panel widths with Prefinished Panels. Provide transoms and borrowed lights.
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe partition construction.
Construction Verification		Verify compliance through product submittal information.

Environmental		
Baseline		GREENGUARD Gold certification or Indoor Advantage Gold Certification
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		
Basis of Design		N/A
Construction Verification		Verify compliance through product submittal information

3.5.12 Operable Walls

Construction

Baseline		Steel or MDF/Vinyl/3" (75mm) thick
Tier 1		Steel or MDF/vinyl, fabric, or veneer/3" (75mm) think
Tier 2		Steel or MDF/vinyl, fabric, veneer, or marker board/3" (75mm) thick. Gasketed at top, bottom, and panel joints.
Tier 3		Steel, MDF, or gypsum/vinyl, fabric, veneer, or marker board/4" (100mm) thick. Gasketed at top, bottom, and panel joints.
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe partition construction.
Construction Verification		Verify compliance through product submittal information.
Operation		
Baseline		Single panels or hinged pairs, manual
Tier 1		N/A
Tier 2		Continuously hinged panels, motorized
Tier 3		Hinged pairs, manual
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe operable wall operation type.
Construction Verification		Verify compliance through product submittal information.

3.5.13 Millwork and Cabinets

Construction		
Baseline		Particle Board with Plastic Laminate Veneer
Tier 1		Particle Board with Wood Veneer on exposed to view surfaces.
Tier 2		N/A
Tier 3		Solid Wood, Custom Detailed Molding and Trim
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe construction and document any environmental (temperature/humidity) limits, if any.
Construction Verification		Verify compliance through product submittal information.
Durability		

Baseline		Moderate
Tier 1		N/A
Tier 2		Extended Life
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe anticipated service life.
Construction Verification		Verify compliance through product submittal information.
Quality		
Baseline		AWI Custom grade, factory standard products. Grade 2 hardware, plated finish.
Tier 1		AWI Custom grade, shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, plated finish.
Tier 2		AWI Premium grade, shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless steel, brass, or bronze. Provide AWI QCP Labels/Certificates.
Tier 3		N/A
M & V		N/A
Plans & Specs		AWI Standards
Calculations & Analysis		N/A
References		
Basis of Design		Describe quality of millwork and cabinets.
Construction Verification		Verify through shop drawing submittal and product submittal information.

3.5.14 Countertops

Construction		
Baseline		Particle Board, Plastic Laminate Top and Edge
Tier 1		Particle Board, Exterior Glue, Solid Surface Material Top and Edge
Tier 2		Exterior Grade Plywood with Stone Top and Edge
Tier 3		Exterior Grade Plywood with Chemical Resistant or stainless-steel top and edge
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe countertop construction.
Construction Verification		Verify compliance through product submittal information.
Durability		

Baseline		Limited
Tier 1		Moderate
Tier 2		Extended Life
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe anticipated service life.
Construction Verification		Verify compliance through product submittal information.
Quality		
Baseline		AWI Custom grade
Tier 1		AWI Premium grade
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		AWI Standards
Calculations & Analysis		N/A
References		
Basis of Design		Describe quality of countertops.
Construction Verification		Verify through shop drawing submittal and product submittal information.
Environmental		
Baseline		GREENGUARD Gold certification or Indoor Advantage Gold Certification
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		
Basis of Design		N/A
Construction Verification		Verify compliance through product submittal information

3.6 INTERIOR CONSTRUCTION PERFORMANCE ATTRIBUTES

Interior construction is described in two categories: construction products and materials and finish materials. Construction products and materials are the elements that are built to create functional spaces, and finish materials, are the products that are applied to the construction products to conceal, protect, or enhance the appearance of construction products or to provide wearing surfaces.

Construction Products and Materials include doors, windows (borrowed lights), permanent partitions, demountable partitions, operable partitions, and millwork. Each product is evaluated based on its applicable characteristics. Products are evaluated for construction, durability, acoustic properties, security, operability/flexibility, and other characteristics that reflect the functional requirements of the product under consideration.

3.6.1 CONSTRUCTION PRODUCTS AND MATERIALS

The baseline performance characteristics described are commercial quality products and would be suitable for use in most applications.

3.6.1.1 SOLID CORE WOOD DOORS

Wood doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors must be fabricated in accordance with WDMA I.S.-1.A, Architectural Wood Flush Doors, and DHI A115-W, Wood Door Hardware Standards, Hardware Preparation. Hardware must comply with BHMA A156 series requirements. Hollow metal frames must be fabricated to meet requirements of ANSI/SDI 250.4, Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors. All doors and frames must be factory prepared for hardware installation. Hollow metal frames must be factory primed. Use of local hardwoods is preferable.

3.6.1.2 HOLLOW METAL DOORS

Hollow metal doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors and frames must be fabricated to meet requirements of ANSI/SDI 250.4, Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors and ANSI/SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100). Hardware must comply with BHMA A156 series requirements. All doors and frames must be factory primed and prepared for hardware installation.

3.6.1.3 GLAZED ALUMINUM DOORS

Aluminum doors are typically fully glazed. They are constructed as aluminum entrances or part of a storefront system even though they are for interior use and are usually installed in aluminum frames. Doors and frames must be fabricated in accordance with AAMA101/I.S.2/A440, North American Fenestration Standard/Specification for Windows, Doors, and Skylights. Safety glass in compliance with ASTM C1048, Standard Specification for Heat Treated Flat Glass, must be used. Sound transmission can be reduced with insulating glass. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Finishes must comply with AAMA 611, Specification for Anodized Architectural Aluminum, or AAMA 260, Specification for Pigmented Organic Coatings.

3.6.1.4 ALL GLASS ENTRANCES

All glass entrances are installed without traditional frames. They are not available as fire rated assemblies or forced entry resistant. They may be considered in and of themselves to be higher performance than any of the above door types because of their cost and appearance. Glass must be either laminated or tempered in compliance with ANSI Z97.1, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes.

3.6.1.5 BORROWED LIGHTS

Borrowed lights are used to allow daylight to penetrate interior spaces or to allow visual connection between adjacent spaces. Borrowed lights include sidelights, transoms, and openings in other wall construction. Borrowed lights in corridors and sidelights are required to be glazed with tempered, laminated, or some other form of safety glass complying with ASTM C1048, Standard Specification for Heat Treated Flat Glass.

3.6.1.6 WOOD FRAMED INTERIOR LIGHTS

Wood framed borrowed lights cannot be fire rated.

3.6.1.7 HOLLOW METAL FRAMED INTERIOR LIGHTS

Hollow metal framed borrowed lights may be fire rated if dimensions comply with the requirements for required rating and glazed with appropriate material.

3.6.1.8 ALUMINUM FRAMED INTERIOR LIGHTS

Aluminum framed borrowed lights are typically fabricated from storefront or curtainwall framing systems. Finishes must comply with AAMA 611, Specification for Anodized Architectural Aluminum, or AAMA 260, Specification for Pigmented Organic Coatings.

3.6.1.9 METAL STUD PARTITIONS

Performance level does not consider fire rating requirements. Metal stud framing must comply with AISI/COFS S220, North American Standard for Cold-Formed Steel Framing – Nonstructural Members. Stud sizes and thickness are minimums; increased dimensions and/or reduced spacing may be necessary to meet deflection requirements. Gypsum board must comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers.

3.6.1.10 MASONRY PARTITIONS

Performance level does not consider fire rating requirements. Concrete masonry units must comply with ASTM C129, Standard Specification for Non-load bearing Concrete Masonry Units. Metal furring must comply with AISI/COFS S220, North American Standard for Cold-Formed Steel Framing – Nonstructural Members. Gypsum board must comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers.

3.6.1.11 DEMOUNTABLE PARTITIONS

Demountable partitions are prefabricated assemblies designed to be installed, removed, and relocated in various configurations. Demountable Partitions extend from finish floor to ceiling. Systems and demountable systems can include doors, hardware, and borrowed lights. Visual privacy can be achieved using a variety of methods, including applied film, etching and panel material selection. Acoustical privacy can be increased through solid panels, double-glazing, and the use of sound-batt insulation. Sliding or barn doors must not be used when acoustical privacy is critical. Demountable partitions do not have fire ratings.

3.6.1.12 OPERABLE WALLS

Operable walls described below are welded steel construction, hung from a supporting structure above, and move on a fixed track system. Accordion-type room dividers are not considered here. Operable walls do not provide fire ratings.

3.6.1.13 MILLWORK AND CABINETS

Millwork includes custom wood fabrications such as paneling, built-in furniture, shelving, and other items of architectural woodwork. Cabinets include base and wall cabinets. The descriptions below do not apply to metal cabinets or casework such as the type that might be found in laboratories. Quality descriptions for millwork and cabinets are based on the Architectural Woodwork Institute's (AWI) Standards. Quality standards for hardware such as drawer slides, hinges, pulls, latches and locks, and shelf supports are based on ANSI/BMHA 156.9, Cabinet Hardware.

3.6.1.14 COUNTERTOPS

Countertops, often associated with millwork and cabinets, include any fabricated work surface including those in offices, kitchens, laboratories, or toilet rooms. Countertops include backsplashes and endsplashes. Quality descriptions are based on the AWI's Architectural Woodwork Quality Standards.

3.7 INTERIOR FINISHES PERFORMANCE TABLE

3.7.1 Broadloom/Carpet Tile		
Durability		
Baseline		Minimum TARR Rating for Lobby, Entrances, Corridors, and Open Office Spaces: 3.5 TARR Minimum TARR Rating for all other office spaces: 3.0 TARR
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Minimum TARR Rating for Lobby, Entrances, Corridors, and Open Office Spaces: 3.5 TARR Minimum TARR Rating for all other office spaces: 3.0 TARR
Construction Verification		Verify compliance through mockup and product submittal information.
Durability (Fiber)		
Baseline		Type 6 or Type 6,6 Nylon Fiber
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe the nylon type used.
Construction Verification		Verify compliance through mockup and product submittal information.
Service Life		
Baseline		Commercial Limited Lifetime Warranty that includes materials, freight & labor
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Provide copy of Manufacturers Published Warranty
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		Third-Party Multi-attribute Certification Required: NSF/ANSI 140 Gold or Cradle to Cradle Silver EPD Required: Product-specific Type III EPD
Tier 1		N/A
Tier 2		N/A

Tier 3		N/A
M & V		N/A
Plans & Specs		Yes.
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information.

3.7.2 Vinyl Composition Tile (VCT)

Durability		
Baseline		VCT - ASTM F1066, Standard Specification for Vinyl Composition Tile
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document Product Size and Thickness based on Application
Plans & Specs		ASTM F1066 Standard Specification for Vinyl Composition Floor Tile
Calculations & Analysis		N/A
References		
Basis of Design		Describe type of backing when used. Identify Installation: Glue down Identify whether a finish is required or not
Construction Verification		Verify compliance through product submittal information.
Static Load - Verify application if rolling traffic/dynamic load is a required attribute		
Baseline		ASTM F970 compliance, depression less than 5 mil after 24 hours. Method cites 250 psi max. as referenced in Vinyl Composition Tile - ASTM F1066
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document static load in PSI.
Plans & Specs		ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading
Calculations & Analysis		If dynamic load is required, determine maximum and verify with product technical specifications.
References		
Basis of Design		Document static limit load rating as compliant with ASTM F1066
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Factory Finish + Wax/Polish Applied
Tier 1		N/A

Tier 2		N/A
Tier 3		N/A
M & V		Document frequency and type of cleaning and disinfection.
Plans & Specs		Product maintenance per manufacturer recommendations and product application requirements
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		
Construction Verification		Verify compliance through product submittal information.
Product Service Life		
Baseline		5 Year Warranty or 2) Determined by the Owner Project Requirements (OPR)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document anticipated product service life in years
Plans & Specs		Provide Warranty Documentation, Owner Project Requirements (OPR) Documentation, and/or Type III EPD
Calculations & Analysis		Verify Type III EPD
References		
Basis of Design		Document anticipated product service life in years
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPD
Tier 1		NA
Tier 2		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPD
Tier 3		NA
M & V		N/A
Plans & Specs		Yes.
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information.

3.7.3 Sheet Vinyl

Durability		

Baseline		Heterogeneous Sheet Vinyl - ASTM F1303 Standard Specification for Vinyl Sheet Floor Covering with Backing
Tier 1		N/A
Tier 2		N/A
Tier 3		Homogeneous Sheet Vinyl - ASTM F1913 Homogeneous Sheet Vinyl - ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering without Backing
M & V		Document product thickness and sheet width based on application.
Plans & Specs		ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering without Backing, or ASTM F1303 Standard Specification for Vinyl Sheet Floor Covering with Backing
Calculations & Analysis		N/A
References		
Basis of Design		Glue down. Identify installation: Cold or Hot Weld. Identify requirements for integral coved base.
Construction Verification		Verify compliance through product submittal information.
Static Load - Verify application if rolling traffic/dynamic load is a required attribute		
Baseline		ASTM F970 compliance, depression less than 5 mil after 24 hours. Method cites 250 psi max. as referenced in Heterogeneous Sheet Vinyl - ASTM F1303 for 75, 125, or 175 psi based on use classification
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document static load in PSI. as referenced in Homogeneous Sheet Vinyl - ASTM F1913
Plans & Specs		ASTM F970 Standard Test Method for Measuring Recovery Property of Floor Coverings after Static Loading
Calculations & Analysis		If dynamic load is required, determine maximum and verify with product technical specifications.
References		
Basis of Design		Document static limit load rating as compliant with ASTM F1303. or ASTM F1913
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Factory Finish - No Wax
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document frequency and type of cleaning and disinfection.
Plans & Specs		Product maintenance per manufacturer recommendations and product application requirements
Calculations & Analysis		N/A
References		
Basis of Design		Identify maintenance requirements as determined by Owner Project Requirements (OPR). Provide product manufacturer recommendations. Verify cleaning and disinfection chemical compatibility and efficacy.
Construction Verification		Verify compliance through product submittal information.
Product Service Life		
Baseline		5 Year Warranty, 2) Determined by the Owner Project Requirements (OPR)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document anticipated product service life in years
Plans & Specs		N/A
Calculations & Analysis		Provide Warranty Documentation, Owner Project Requirements (OPR) Documentation, and/or Type III EPD
References		
Basis of Design		Document anticipated product service life in years
Construction Verification		Verify compliance through product submittal information.

Environmental		
Baseline		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPD
Tier 1		NA
Tier 2		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPD
Tier 3		NA
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		N/A
Construction Verification		NA

3.7.4 Rubber Tile/Rubber Sheet

Durability		
Baseline		Rubber Tile - ASTM F1344 Rubber Sheet w/ Backing - ASTM F1860 Rubber Sheet w/out Backing - ASTM F1859
Tier 1		N/A
Tier 2		N/A
Tier 3		NA
M & V		Document product thickness and sheet width or tile size based on application
Plans & Specs		ASTM F 1344 Standard Specification for Rubber Floor Tile ASTM F1860 Standard Specification for Rubber Sheet Floor Covering With Backing ASTM F1859 Standard Specification for Rubber Sheet Floor Covering Without Backing
Calculations & Analysis		N/A
References		
Basis of Design		Glue down. Identify Installation: Cold or Hot Weld Identify requirements for integral coved base with sheet product.
Construction Verification		Verify compliance through product submittal information.

Static Load - Verify application if rolling traffic/dynamic load is a required attribute		
Baseline		ASTM F970 compliance, depression less than 5 mil after 24 hours. Method cites 250 psi max. as referenced in Rubber Tile - ASTM F1344 Rubber Sheet w/ Backing - ASTM F1860 Rubber Sheet w/out Backing - ASTM F1859
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document static load in PSI.
Plans & Specs		ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading

Calculations & Analysis		If dynamic load is required, determine maximum and verify with product technical specifications.
References		
Basis of Design		Document static limit load rating as compliant with ASTM F1344, ASTM F1860, or ASTM F1859 as applicable to rubber flooring product type.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Optional Polyurethane Layer
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document frequency and type of cleaning and disinfection.
Plans & Specs		Product maintenance per manufacturer recommendations and product application requirements.
Calculations & Analysis		N/A
References		Based on cleaning and efficacy requirements for product installation, reference: [Design for the Environment (DfE)]
Basis of Design		Identify maintenance requirements as determined by Owner Project Requirements (OPR). Provide product manufacturer recommendations. Verify cleaning and disinfection chemical compatibility and efficacy.
Construction Verification		Verify compliance through product submittal information.
Product Service Life		
Baseline		1) 5 Year Warranty or 2) Determined by the Owner Project Requirements (OPR)
Tier 1		Determined by Type III EPD
Tier 2		N/A
Tier 3		N/A
M & V		Document anticipated product service life in years.
Plans & Specs		Manufacturer Warranty; Owner Project Requirements (OPR) Documentation; Type III EPD
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period. Document OPR. Review Type III EPD
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		Multi-Attribute Certification Required: NSF/ANSI 332 Level 1 or Conformant EPD Required: Product Specific Type III EPD
Tier 1		NA
Tier 2		Multi-Attribute Certification Required: NSF/ANSI 332 Level 2 or Gold or Cradle to Cradle Silver EPD Required: Product Specific Type III EPD
Tier 3		NA
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.5 Linoleum

Durability

Baseline		Linoleum Tile - ASTM F2195 Standard Specification for Linoleum Floor Tile; Linoleum Sheet - ASTM F2034 Standard Specification for Sheet Linoleum Floor Covering
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document Product Thickness and Sheet Width or Tile Size based on Application.
Plans & Specs		ASTM F2195 Standard Specification for linoleum Floor Tile; ASTM F2034 Standard Specification for Sheet Linoleum Floor Covering
Calculations & Analysis		N/A
References		
Basis of Design		Glue down. Identify installation: Cold or Hot Weld; Identify requirement for integral coved base with sheet product.
Construction Verification		Verify compliance through product submittal information.
Static Load - Verify application if rolling traffic/dynamic load is a required attribute		
Baseline		ASTM F970 compliance, depression less than 5 mil after 24 hours. Method cites 250 psi max. as referenced in Linoleum Tile - ASTM F2195 Linoleum Sheet - ASTM F2034
Tier 1		NA
Tier 2		N/A
Tier 3		N/A
M & V		Document static load in PSI.
Plans & Specs		ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading
Calculations & Analysis		If dynamic load is required, determine maximum and verify with product technical specifications.
References		
Basis of Design		Document static limit load rating as compliant with ASTM F2195 or ASTM F2034 as applicable to linoleum flooring product type.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Factory Finish
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document frequency and type of cleaning and disinfection.
Plans & Specs		Product maintenance per manufacturer recommendations and product application requirements
Calculations & Analysis		N/A
References		Based on cleaning and efficacy requirements for product installation, reference: Design for the Environment (DfE)
Basis of Design		Identify maintenance requirements as determined by Owner Project Requirements (OPR). Provide product manufacturer recommendations. Verify cleaning and disinfection chemical compatibility and efficacy.
Construction Verification		Verify compliance through product submittal information.
Product Service Life		
Baseline		1) 5 Year Warranty or 2) Determined by the Owner Project Requirements (OPR) or 3) Determined by EPD (LCA) Cradle to Grave
Tier 1		Determined by Type III Environmental Product Declaration (EPD)
Tier 2		N/A
Tier 3		N/A
M & V		Document anticipated product service life in years
Plans & Specs		Manufacturer Warranty; Owner Project Requirements (OPR); Documentation on Type III EPD

Calculations & Analysis		NA
References		
Basis of Design		Document warranty period. Document OPR. Review Type III EPD
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		Multi-Attribute Certification Required: NSF/ANSI 332 Level 1 or Conformant EPD Required: Product Specific Type III EPD
Tier 1		NA
Tier 2		Multi-Attribute Certification Required: NSF/ANSI 332 Level 2 or Cradle to Cradle Silver EPD Required: Product Specific Type III EPD
Tier 3		NA
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.6 Luxury Vinyl Tile (LVT) and Luxury Vinyl Plank (LVP)

Durability		
Baseline		LVT/LVP - ASTM F1700 Standard Specification for Solid Vinyl Tile - Class III
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document Product Size and Thickness based on Application.
Plans & Specs		Standard Specification for Solid Vinyl Tile - Class III
Calculations & Analysis		N/A
References		
Basis of Design		Describe type of backing, when applicable. Identify installation: Glue down or Loose Lay. Identify Required Wear Layer for Application.
Construction Verification		Verify compliance through product submittal information.
Static Load - Verify application if rolling traffic/dynamic load is a required attribute		
Baseline		ASTM F970 compliance, depression less than 5 mil after 24 hours. Method cites 250 psi max. as referenced in LVT/LVP - ASTM F1700 - Class III
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document static load in PSI.
Plans & Specs		ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading

Calculations & Analysis		If dynamic load is required, determine maximum and verify with product technical specifications.
References		
Basis of Design		Document static limit load rating as compliant with ASTM F1700 - Class III.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Polish Free Product
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document frequency and type of cleaning and disinfection.
Plans & Specs		Product maintenance per manufacturer recommendations and product application requirements.
Calculations & Analysis		N/A
References		Based on cleaning and efficacy requirements for product installation, reference: Design for the Environment (DfE)
Basis of Design		Identify maintenance requirements as determined by Owner Project Requirements (OPR). Provide product manufacturer recommendations. Verify cleaning and disinfection chemical compatibility and efficacy.
Construction Verification		Verify compliance through product submittal information.
Product Service Life - Note: Warranty is a measure of risk tolerance. For reference service life, verify as part of programming phase or in Cradle to Grave EPD.		
Baseline		1) 15 Year Commercial Limited Warranty, to include materials, freight & labor or 2) Determined by the Owner Project Requirements (OPR) or 3) Determined by Type III EPD
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document anticipated product service life in years.
Plans & Specs		Manufacturer Warranty; Owner Project Requirements (OPR); Documentation of Type III EPD
Calculations & Analysis		NA
References		
Basis of Design		Document warranty period. Document OPR. Review Type III EPD:
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPD
Tier 1		N/A
Tier 2		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified EPD Required: Product Specific Type III EPDNSF-332 Gold or product specific Type III EPD and GREENGUARD Gold
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA

Construction Verification		Verify compliance through product submittal information.

3.7.7 Porcelain Tile

Durability		
Baseline		Conforms to ANSI A137.1
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document conformance with ANSI A137.1.
Construction Verification		Verify compliance through mockup and product submittal information.
Durability - Abrasion		
Baseline		Light Commercial Abrasion Class III
Tier 1		Commercial Abrasion Class IV
Tier 2		N/A
Tier 3		Heavy Commercial Abrasion Class V
M & V		N/A
Plans & Specs		ASTM C1027
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Durability - Water		
Baseline		N/A
Tier 1		Vitreous (P3/E3/O3)
Tier 2		Vitreous (P2/E2/O2)
Tier 3		Vitreous (P1/E1/O1)
M & V		N/A
Plans & Specs		ASTM C373
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.

Durability - Breakage		
Baseline		N/A
Tier 1		Breaking Strength >350lbs
Tier 2		Breaking Strength >400lbs
Tier 3		Breaking Strength >450lbs
M & V		N/A
Plans & Specs		ASTM C648
Calculations & Analysis		N/A
References		
Basis of Design		Document floor tile breaking strength.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Stain		
Baseline		Stain Class Reported
Tier 1		Stain Class B or Better
Tier 2		Stain Class A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C1378
Calculations & Analysis		N/A
References		
Basis of Design		Describe Stain Class.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Chemical		
Baseline		Chem Class Reported
Tier 1		Chem Class B or Better
Tier 2		Chem Class A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C650
Calculations & Analysis		N/A
References		
Basis of Design		Describe Chemical Class.
Construction Verification		Verify compliance through product submittal information.
Service Life		
Baseline		1 Year Warranty
Tier 1		18 Month Warranty

Tier 2		2 Year Warranty
Tier 3		3 Year Warranty
M & V		N/A
Plans & Specs		Manufacturer
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		Multi-Attribute Certification Required: Green Squared EPD Required: Product Specific Type III EPD
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.8 Quarry Tile

Durability		
Baseline		Conforms to ANSI A137.1
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document conformance with ANSI A137.1.
Construction Verification		Verify compliance through mockup and product submittal information.
Durability - Abrasion		
Baseline		Light Commercial Abrasion Class III
Tier 1		Commercial Abrasion Class IV

Tier 2		N/A
Tier 3		Heavy Commercial Abrasion Class V
M & V		N/A
Plans & Specs		ASTM C1027
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Durability - Water		
Baseline		N/A
Tier 1		Vitreous Max. Absorp. Class E3
Tier 2		Vitreous Max. Absorp. Class E2
Tier 3		Vitreous Max Absorp. Class E1
M & V		N/A
Plans & Specs		ASTM C373
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.
Durability - Breakage		
Baseline		N/A
Tier 1		Breaking Strength > or equal to 350lbs
Tier 2		Breaking Strength > or equal to 400lbs
Tier 3		Breaking Strength > or equal to 450lbs
M & V		N/A
Plans & Specs		ASTM C648
Calculations & Analysis		N/A
References		
Basis of Design		Document floor tile breaking strength.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Stain		
Baseline		Stain Class Reported
Tier 1		Stain Class B or Better
Tier 2		Stain Class A
Tier 3		N/A
M & V		N/A

Plans & Specs		ASTM C1378
Calculations & Analysis		N/A
References		
Basis of Design		Describe Stain Class.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Chemical		
Baseline		Chem Class Reported
Tier 1		Chem Class B or Better
Tier 2		Chem Class A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C650
Calculations & Analysis		N/A
References		
Basis of Design		Describe Chemical Class.
Construction Verification		Verify compliance through product submittal information.
Service Life		
Baseline		1 Year Warranty
Tier 1		18 Month Warranty
Tier 2		2 Year Warranty
Tier 3		3 Year Warranty
M & V		N/A
Plans & Specs		Manufacturer
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		Multi-Attribute Certification Required: Green Squared EPD Required: Product Specific Type III EPD
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A

References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information a

3.7.9 Mosaic Tile

Durability		
Baseline		Conforms to ANSI A137.1
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document conformance with ANSI A137.1.
Construction Verification		Verify compliance through mockup and product submittal information.

Durability - Abrasion		
Baseline		Light Commercial Abrasion Class III
Tier 1		Commercial Abrasion Class IV
Tier 2		Commercial Abrasion Class IV
Tier 3		Heavy Commercial Abrasion Class V
M & V		N/A
Plans & Specs		ASTM C1027
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.

Durability - Water		
Baseline		N/A
Tier 1		Vitreous Max. Absorp. Class P3/E3/O3
Tier 2		Vitreous Max. Absorp. Class P2/E2/O2
Tier 3		Vitreous P1/E1/O1
M & V		N/A
Plans & Specs		ASTM C373
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.

Construction Verification		Verify compliance through mockup and product submittal information.
Durability - Breakage		
Baseline		N/A
Tier 1		Breaking Strength > or equal to 350lbs
Tier 2		Breaking Strength > or equal to 400lbs
Tier 3		Breaking Strength > or equal to 450lbs
M & V		N/A
Plans & Specs		ASTM C648
Calculations & Analysis		N/A
References		
Basis of Design		Document floor tile breaking strength.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Stain		
Baseline		Stain Class Reported
Tier 1		Stain Class B or Better
Tier 2		Stain Class A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C1378
Calculations & Analysis		N/A
References		
Basis of Design		Describe Stain Class.
Construction Verification		Verify compliance through product submittal information.
Maintenance - Chemical		
Baseline		Chem Class Reported
Tier 1		Chem Class B or Better
Tier 2		Chem Class A
Tier 3		Chem Class A
M & V		N/A
Plans & Specs		ASTM C650
Calculations & Analysis		N/A
References		
Basis of Design		Describe Chemical Class.
Construction Verification		Verify compliance through product submittal information.
Service Life		

Baseline		1 Year Warranty
Tier 1		18 Month Warranty
Tier 2		2 Year Warranty
Tier 3		3 Year Warranty
M & V		N/A
Plans & Specs		Manufacturer
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		Multi-Attribute Certification Requirement: Green Squared EPD Requirement: Product Specific Type III EPD
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information
3.7.10 Limestone Tile		
Durability		
Baseline		Abrasion Resistance > or equal to 10
Tier 1		N/A
Tier 2		N/A
Tier 3		Abrasion Resistance > or equal to 15
M & V		N/A
Plans & Specs		ASTM C568
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Absorption max. 7.5

Tier 1		N/A
Tier 2		N/A
Tier 3		Absorption max. 3
M & V		N/A
Plans & Specs		ASTM C97
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.
3.7.11 Slate Tile		
Durability		
Baseline		Abrasion Resistance > or equal to 8
Tier 1		N/A
Tier 2		N/A
Tier 3		Abrasion Resistance > or equal to 15
M & V		N/A
Plans & Specs		ASTM C629
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Absorption max. 0.45
Tier 1		N/A
Tier 2		N/A
Tier 3		Absorption max. 0.25
M & V		N/A
Plans & Specs		ASTM C121
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.
3.7.12 Marble		
Durability		
Baseline		Abrasion Resistance > or equal to 10

Tier 1		N/A
Tier 2		N/A
Tier 3		Abrasion Resistance > or equal to 15
M & V		N/A
Plans & Specs		ASTM C503
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Absorption max. 0.20 / Density 144 min
Tier 1		NA
Tier 2		NA
Tier 3		Absorption max. 0.20 / Density 168 min
M & V		N/A
Plans & Specs		ASTM C97
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.
3.7.13 Granite		
Durability		
Baseline		Abrasion Resistance > or equal to 25
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM C615
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Absorption max. 0.50
Tier 1		N/A
Tier 2		N/A

Tier 3		Absorption max. 0.40
M & V		N/A
Plans & Specs		ASTM C97
Calculations & Analysis		N/A
References		
Basis of Design		Document water absorption requirement.
Construction Verification		Verify compliance through mockup and product submittal information.

3.7.14 Terrazzo

Durability		
Baseline		Cementitious Polyacrylate 3/8" thick
Tier 1		N/A
Tier 2		N/A
Tier 3		Epoxy 1/4" or 3/8" thick
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		N/A
Construction Verification		N/A

Durability - Abrasion		
Baseline		Abrasion < or equal to 40% Loss
Tier 1		N/A
Tier 2		N/A
Tier 3		Hardness ≥ 10
M & V		N/A
Plans & Specs		MIL-D-3134 Par. 4.7.10/ ASTM C 241
Calculations & Analysis		N/A
References		
Basis of Design		Document ASTM abrasion resistance.
Construction Verification		Verify compliance through product submittal information.

Maintenance		
Baseline		Anti-fracture Membrane
Tier 1		N/A
Tier 2		N/A
Tier 3		Flexible Membrane and vapor barrier
M & V		N/A

Plans & Specs		ASTM E 1745
Calculations & Analysis		N/A
References		
Basis of Design		Document maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		Recycled Marble Chips
Tier 1		N/A
Tier 2		N/A
Tier 3		Recycled Glass/Stone Chips
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.15 Laminate Flooring

Durability		
Baseline		Commercial, Wear Resistance IP > or equal to 4000 cycles using NEMA test 3.7 - Taber model 5130 test or equivalent.
Tier 1		N/A
Tier 2		N/A
Tier 3		Heavy commercial Wear Resistance IP > or equal to 6000 cycles using NEMA test 3.7- Taber model 5130 test or equivalent.
M & V		N/A
Plans & Specs		NAFLA LF-01
Calculations & Analysis		N/A
References		
Basis of Design		Document wear resistance rating.
Construction Verification		Verify compliance through product submittal information.
Durability – Static Load		
Baseline		Static Load Limit > or equal to 8 MPa (1160 psi)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A

Plans & Specs		NAFLA LF-01
Calculations & Analysis		N/A
References		
Basis of Design		Document static load limit.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		High Wear Resistant Thermoset Surface
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		NAFLA Std
Calculations & Analysis		N/A
References		
Basis of Design		Document maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Service Life		
Baseline		10 Year Warranty
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold, or FloorScore Certified. 50% Recycled Content
Tier 1		N/A
Tier 2		N/A
Tier 3		90% Recycled Content
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A

References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.16 Wood Flooring

Durability		
Baseline		Hardness - 380-950
Tier 1		Hardness - 950-1500
Tier 2		Hardness - 1500-2600
Tier 3		Hardness - 2600-3800
M & V		N/A
Plans & Specs		Janka Test
Calculations & Analysis		N/A
References		
Basis of Design		Document Janka Test hardness level.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Varnish topcoat applied
Tier 1		N/A
Tier 2		Polyurethane topcoat applied
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM D 4060
Calculations & Analysis		N/A
References		
Basis of Design		Describe maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		IAQ Requirement: Greenguard Gold, Indoor Advantage Gold, or FloorScore certified.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA

Construction Verification		Verify compliance through product submittal information,

3.7.17 Bamboo Flooring

Durability		
Baseline		Hardness 1300 min
Tier 1		Hardness 1400 min
Tier 2		Hardness 1500 min
Tier 3		Hardness 1600 min
M & V		N/A
Plans & Specs		Janka Test
Calculations & Analysis		N/A
References		
Basis of Design		Document Janka Test hardness level.
Construction Verification		Verify compliance through product submittal information.

Maintenance		
Baseline		Varnish topcoat applied
Tier 1		N/A
Tier 2		Polyurethane topcoat applied
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM D 4060
Calculations & Analysis		N/A
References		
Basis of Design		Describe maintenance requirements.
Construction Verification		Verify compliance through product submittal information.

Environmental		
Baseline		IAQ Requirement: Greenguard Gold, Indoor Advantage Gold, or FloorScore certified.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.18 Glazed Wall Tile		
Durability		
Baseline		Conforms to ANSI A137.1
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document wear resistance rating.
Construction Verification		Verify compliance through product submittal information.
Durability - Absorption		
Baseline		Absorption Class P4
Tier 1		Absorption Class P4, breaking strength greater than or equal to 175 lbs.
Tier 2		Absorption Class P4, breaking strength greater than or equal to 200 lbs.
Tier 3		Heavy commercial (Abrasion Class V), Vitreous (P1/E1/O1). Breaking strength greater than or equal to 450 lbs.
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document absorption and load limit.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Stain and chemical class reported.
Tier 1		Stain and chemical class B or better.
Tier 2		Stain and chemical class A.
Tier 3		N/A
M & V		N/A
Plans & Specs		ANSI A137.1
Calculations & Analysis		N/A
References		
Basis of Design		Document maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Service Life		

Baseline		1 Year Warranty
Tier 1		18 Month Warranty
Tier 2		2 Year Warranty
Tier 3		3 Year Warranty
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		Multi-Attribute Certification Required: Green Squared
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.19 Interior Architectural Coatings

Environmental		
Baseline		IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 1		N/A
Tier 2		N/A
Tier 3		Multi-Attribute Certification Required: Cradle to Cradle Bronze IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA.
Construction Verification		Verify compliance through product submittal information

3.7.20 Exterior Architectural Coatings

Durability		
Baseline		No Blistering present after 12 months exposure; No Erosion present after 12 months exposure; No Flaking or Peeling after 12 months exposure; No Biologic Growth present after 9 months exposure
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		N/A
References		ASTM D714 ASTM D662 ASTM D772 ASTM D3274
Basis of Design		Document requirements in basis of design.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		VOC Level: CARB 2007 SCM or IAQ certification required for interior architectural coatings (above)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information,

3.7.21 Wall Covering Type II

Durability		
Baseline		Compliance to W-101 (2011)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Manufacturer Provided Specifications
Plans & Specs		N/A
Calculations & Analysis		W 101 Physical Test Requirements
References		
Basis of Design		Describe durability requirements.
Construction Verification		Verify compliance through product submittal information.
Maintenance		

Baseline		Scrubbability - 300 cycles/ min Washability - 100 cycles/ min
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Manufacturer Provided Specifications
Plans & Specs		ASTM F 793
Calculations & Analysis		W 101 Physical Test Requirements
References		
Basis of Design		Describe maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental – Wall Covering		
Baseline		Multi-attribute Certification Required: NSF/ANSI 342
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		NA
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information
Environmental – Adhesives and Sealants		
Baseline		IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.22 Wall Paneling Plastic/Laminate

Durability		
Baseline		Standard Laminate
Tier 1		High Pressure Laminate

Tier 2		Fiber Reinforced Laminate
Tier 3		Fiberglass Reinforced Plastic
M & V		
Plans & Specs		ASTM D 695
Calculations & Analysis		
References		
Basis of Design		Describe proposed laminate system.
Construction Verification		Verify compliance through product submittal information.
Durability - Abrasion		
Baseline		Abrasion Resistance > or equal to 400
Tier 1		Abrasion Resistance > or equal to 420
Tier 2		Abrasion Resistance > or equal to 440
Tier 3		Abrasion Resistance > or equal to 460
M & V		N/A
Plans & Specs		ISO 4586 Test
Calculations & Analysis		N/A
References		
Basis of Design		Document Physical Properties Technical Data
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Cleanability 20 cycles
Tier 1		Cleanability 18 cycles
Tier 2		Cleanability 14 cycles
Tier 3		Cleanability 10 cycles
M & V		N/A
Plans & Specs		ISO 4586 Test
Calculations & Analysis		N/A
References		
Basis of Design		Describe cleanability and maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Service Life		
Baseline		1 Year Warranty
Tier 1		2 Year Warranty
Tier 2		5 Year Warranty
Tier 3		10 Year Warranty
M & V		N/A

Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period.
Construction Verification		Verify compliance through product submittal information and manufacturer certification.
Environmental		
Baseline		3rd party certified 40% Recycled Material IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 1		3rd party certified 50% Recycled Material IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 2		3rd party certified 60% Recycled Material IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.23 Wall Paneling Wood

Durability		
Baseline		Hardness - 380-950
Tier 1		Hardness - 950-1500
Tier 2		Hardness - 1500-2600
Tier 3		Hardness - 2600-3800
M & V		N/A
Plans & Specs		Janka Test
Calculations & Analysis		N/A
References		
Basis of Design		Document Janka Test hardness level.
Construction Verification		Verify compliance through product submittal information. Conduct Janka test to verify compliance after installation.
Maintenance		
Baseline		Varnish topcoat applied
Tier 1		Varnish topcoat applied
Tier 2		Polyurethane topcoat applied
Tier 3		Polyurethane topcoat applied

M & V		N/A
Plans & Specs		ASTM D 4060
Calculations & Analysis		N/A
References		
Basis of Design		Describe cleanability and maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		IAQ Requirement: Greenguard Gold or Indoor Advantage Gold certified.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.24 Wall Paneling Composite Board

Durability		
Baseline		Min 6mm thickness
Tier 1		Min 10mm thickness
Tier 2		Min 20mm thickness
Tier 3		Min 30mm thickness
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		
Construction Verification		
Maintenance		
Baseline		Factory Sealant applied
Tier 1		Topcoat applied
Tier 2		N/A
Tier 3		Polyurethane topcoat applied
M & V		N/A
Plans & Specs		ASTM D 4060

Calculations & Analysis		N/A
References		
Basis of Design		Describe cleanability and maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.25 Wall Paneling Sculptural

Durability		
Baseline		Min 6mm thickness
Tier 1		Min 10mm thickness, factory sealant applied
Tier 2		Min 20mm thickness, factory sealant applied
Tier 3		Min 30mm thickness, factory sealant applied
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe proposed thickness.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		900 psi.
Tier 1		920 psi.
Tier 2		940 psi.
Tier 3		960 psi
M & V		N/A
Plans & Specs		ASTM D 638
Calculations & Analysis		N/A
References		

Basis of Design		Describe cleanability and maintenance requirements.
Construction Verification		Verify compliance through product submittal information.
Environmental		
Baseline		3rd party certified 40% Recycled Material IAQ Certification Required: Greenguard Gold or Indoor Advantage Gold
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.26 Wall Base

Durability		
Baseline		4" Vinyl Wall Base (Thermoplastic)
Tier 1		6" Vinyl Wall Base (Thermoplastic)
Tier 2		4" Rubber Wall Base (Thermoset)
Tier 3		6" Rubber Wall Base (Thermoset)
M & V		Document Product Profile, Height, and Thickness, based upon application.
Plans & Specs		ASTM F 1861 Standard Specification for Resilient Wall Base
Calculations & Analysis		N/A
References		
Basis of Design		Coved, Straight, or other type of profile to be identified. See Resilient Flooring Sheet Vinyl for integral cove base information.
Construction Verification		Verify compliance through product submittal information.
Maintenance		
Baseline		Not through color
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		: Determine installation based upon resilient flooring type.
Calculations & Analysis		N/A
References		

Basis of Design		Identify maintenance requirements as determined by Owner Project Requirements (OPR). Provide product manufacturer recommendations. Verify cleaning and disinfection chemical compatibility and efficacy.
Construction Verification		Verify compliance through product submittal information.
Service Life		
Baseline		1) 5 Year Warranty or 2) Determined by the Owner Project Requirements (OPR) or 3) Determined by EPD (LCA) Cradle to Grave
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Document number of years.
Plans & Specs		Manufacturer Warranty Owner Project Requirements (OPR) Documentation; Type III EPD
Calculations & Analysis		N/A
References		
Basis of Design		Document warranty period. Document OPR. Review Type III EPD:
Construction Verification		Verify compliance through product submittal information
Environmental		
Baseline		Multi-Attribute Certification Required: NSF/ANSI 332 Level 1 or Conformant EPD Required: Product Specific Type III EPD
Tier 1		N/A
Tier 2		Multi-Attribute Certification Required: NSF/ANSI 332 Level 2 or Gold EPD Required: Product Specific Type III EPD
Tier 3		N/A
M & V		N/A
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		NA
Construction Verification		Verify compliance through product submittal information

3.7.27 Acoustical Ceilings

Surface Texture		
Baseline		Fine textures with perforations
Tier 1		Smooth White acoustical
Tier 2		N/A
Tier 3		N/A
M & V		
Plans & Specs		
Calculations & Analysis		

References		
Basis of Design		Describe surface texture for each ceiling type
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Open Office NRC		
Baseline		≥ 0.85
Tier 1		≥ 0.90
Tier 2		N/A
Tier 3		N/A
M & V		UL Classified Acoustical Performance
Plans & Specs		ASTM C423
Calculations & Analysis		N/A
References		
Basis of Design		Describe acoustical properties for each ceiling type
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Open Office CAC		
Baseline		≥ 35
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		UL Classified Acoustical Performance
Plans & Specs		ASTM E1414
Calculations & Analysis		N/A
References		
Basis of Design		Describe acoustical properties for each ceiling type
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Enclosed Office NRC		
Baseline		≥ 0.60
Tier 1		≥ 0.75
Tier 2		N/A
Tier 3		N/A
M & V		UL Classified Acoustical Performance
Plans & Specs		ASTM C423
Calculations & Analysis		N/A
References		
Basis of Design		Describe acoustical properties for each ceiling type

Construction Verification		Verify compliance through product submittal information and manufacturer certification
Enclosed Office CAC		
Baseline		≥ 35
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		UL Classified Acoustical Performance
Plans & Specs		ASTM E1414
Calculations & Analysis		N/A
References		
Basis of Design		Describe acoustical properties for each ceiling type
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Durability – Impact Resistance		
Baseline		Impact Resistance
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		
Plans & Specs		Modified ASTM D1037
Calculations & Analysis		N/A
References		
Basis of Design		Verify compliance through product submittal information and manufacturer certification
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Durability – Moisture Resistance		
Baseline		Moisture resistance: indoor environment less than 90% relative humidity and less than 100 degrees F
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Ceilings panels maintain superior sag resistance. Recommended for areas subject to high humidity, up to, but not including standing water and outdoor applications
Plans & Specs		ASTM D3274
Calculations & Analysis		N/A
References		
Basis of Design		Manufacturer's Warranty and/or Declaration
Construction Verification		Manufacturer's Warranty and/or Declaration
Maintenance		

Baseline		Vacuum with soft brush attachment
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Provide manufacturer's written cleaning instructions
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Verify compliance through product submittal information and manufacturer certification
Construction Verification		Verify compliance through product submittal information and manufacturer certification
Service Life		
Baseline		30 Year Systems Warranty
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Manufacturer's Warranty
Plans & Specs		N/A
Calculations & Analysis		N/A
References		
Basis of Design		Describe service life for each ceiling type
Construction Verification		Verify compliance through product submittal information
Light Reflectance		
Baseline		Light Reflectance ≥ 80% (Color Panels excluded)
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		N/A
Plans & Specs		ASTM E1477
Calculations & Analysis		N/A
References		
Basis of Design		
Construction Verification		
Environmental		
Baseline		Total Recycled Content ≥ 80% for NRC ≥ 0.60, or ≥ 70% for NRC ≥ 0.80 IAQ Certification Required: Greenguard Gold, Indoor Advantage Gold EPD Required: Product-specific Type III EPD

Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		NA
Plans & Specs		Yes
Calculations & Analysis		N/A
References		https://sftool.gov/greenprocurement
Basis of Design		N/A
Construction Verification		Verify compliance through product submittal information

3.8 INTERIOR FINISHES PERFORMANCE ATTRIBUTES

Interior Finishes and Materials addresses performance levels of typical floor, wall, and ceiling finishes, focusing on each product's durability, maintenance, service life, and environmental qualities, including low embodied carbon. Metrics and attributes vary by finish based on performance need. Durability describes composition/content, thickness, hardness, strength, wear resistance, load limit, and water absorption. Maintenance addresses wear layer/sealer, barrier/backing, cleanability, stain resistance, microbial resistance, and mold/mildew resistance. Service life is described in terms of the length of anticipated product service life that may be reflected in product warranties, established in Owner Project Requirements (OPR), or reviewed in Type III Environmental Product Declarations that include minimally a Cradle to Grave Life Cycle Assessment (LCA). Environmental addresses recycled content, renewable resources, local materials, VOC emissions, and embodied carbon.

3.8.1 INTERIOR FINISHES AND MATERIALS

Finishes must meet the allowable fire performance and smoke development requirements of Chapter 7, Fire Protection, and the International Building Code. Other codes and application specific performance attributes (e.g., severe traffic area, raised access flooring) need to be considered. Finishes should incorporate recycled-content materials to the maximum extent where possible.

3.8.1.1 INTERIOR COATINGS (PAINT)

Finishes adjacent to vehicular doors or access must be moisture resistant.

3.8.1.2 WALL COVERING TYPE II

Type II wall covering is not allowed on any surface where it could function as a vapor barrier and trap moisture within a wall assembly.

3.9 INTERIOR REQUIREMENTS

3.9.1 ACOUSTICS

The standards in this section establish adequate acoustic qualities in federal buildings. Tables 3.2a and 3.2b provide acoustics design criteria. For additional guidance on office acoustics, refer to GSA Sound Matters. Post-construction commissioning will confirm that the acoustical standards have been met.

3.9.1.1 GENERAL CRITERIA FOR BUILDING SPACES

Four key concepts govern the quality of office acoustics.

1. Speech Privacy: Provide areas where people can conduct private conversations without being overheard by others. Speech privacy relates to background sound levels, sound absorptive finishes and the noise isolation capabilities of interior and exterior construction assemblies.

2. Background Sound: Limit the extent that the building systems and office equipment generate noise and vibrations. Ensure that background sound is loud enough to mask distracting occupant noises and aid in achieving speech privacy.

3. Absorption: Provide sound-absorbing finishes to control reverberation in enclosed rooms for speech intelligibility and help decrease the distance sound travels through open spaces for speech privacy, fewer distractions, and lower noise levels.

4. Noise Isolation: Provide a building envelope that limits the amount of environmental noise that transmits into the building. Provide interior partitions, floors, door, and windows that limit the amount of occupant noise that transfers between rooms.

3.9.1.2 CLOSED OFFICES VERSUS OPEN PLAN

For work that requires a balance between individual work, ongoing, active collaboration, easy workgroup reconfiguration, flexible settings, and minimized unwanted acoustic distraction, an open plan setting with a well-engineered acoustical design is recommended.

Key components of such engineered open plan designs are highly absorptive ceilings, suitable height partition panels that both absorb and block sound, suitable levels of background sound (typically provided by electronic sound masking systems), and ready access to acoustically private (closed office) meeting spaces.

Meeting spaces and closed offices that require speech security must be designed in conjunction with a qualified acoustical consultant.

In enclosed offices, HVAC background sound may be an important component in achieving the required level of privacy because it helps to cover up or "mask" speech transmitted between adjacent spaces. In open plan areas, the background sound provided by contemporary HVAC equipment is often not uniform and/or does not have the tonal balance and loudness needed to mask speech transmitted between adjacent cubicles. For this reason, additional electronic background noise or sound masking is often deployed in these areas. This sound masking may not disrupt the ability of people with hearing disabilities from listening and joining in conversations with other people in the open office. Refer to GSA Sound Matters for additional methods to achieve acoustical comfort.

3.9.1.3 MECHANICAL AND PLUMBING NOISE

All mechanical equipment must be vibration isolated from the building frame as required by Chapter 5. Ambient noise from mechanical equipment must not exceed noise criteria (NC) values described in the acoustical section of this chapter. Diffusers with an NC rating 5 points less than the noise criterion for the space being served must be used where occupied space occurs adjacent to, above, or below mechanical or electrical equipment or machine rooms, or adjacent to HVAC or elevator shafts. The intervening structure (partitions, shaft walls, doors, floor, and ceiling assemblies, etc.) must be sufficient to control noise intrusion to no greater than the maximum NC or room criteria (RC) values. Where an elevator shaft or equipment room occurs adjacent to noise-sensitive spaces (NC/RC 35 or lower), the maximum intrusion level of elevator noise must be limited to 5 dB below the maximum NC/RC for the space in all octave bands. In the walls, ceilings, and floors enclosing noise-sensitive spaces (Table 3.1, column 1, RC/NC 35 or less), all water, wastewater, and drain piping must be vibration-isolated from the structure, finishes, and other piping. Install R-11 batt insulation in all wall spaces where such piping is located and install the piping at least 200 mm (1 in.) away from the gypsum wall board.

3.9.1.4 ABSORPTION AND ISOLATION

Absorptive materials are required in all normally occupied rooms and spaces to control reverberation and noise levels. Table 3.1a shows the absorption requirements for walls and ceilings for various spaces. The first number in each column refers to the minimum level of the material's performance in terms of Noise Reduction Coefficient (NRC) or Sound Absorption Average (SAA); the second refers to the minimum percentage of the ceiling (exclusive of lights and HVAC devices) or walls that must have finishes achieving this absorption performance.

Floor and ceiling assemblies separating office spaces must achieve an NIC of not less than 50 (when furnished) and an Impact Sound Rating (ISR) of not less than 50. Table 3.1b, column 4,1b lists the minimum noise isolation (NIC) for spaces requiring acoustically rated walls.

For constructions on suitable slab floors, when properly detailed and constructed, and with all connections caulked airtight with acoustical sealant, the following wall assemblies typically will satisfy the minimum specified NIC requirements for furnished spaces. These wall examples are not the only constructions that will satisfy the performance criteria; they are intended solely to provide guidance on projects that do not require a qualified acoustical consultant during the design phase.

- NIC 53 (teleconference room): Double stud wall, two layers of gypsum board each side, batt insulation in the stud cavities. Full height (slab to slab). Doors in NIC 40 or greater partitions to include doors with a comparable rating.
- NIC 48 (meeting rooms, training facilities): Staggered stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab). Doors in NIC 40 or greater partitions to include doors with a comparable rating.
- NIC 45 (private offices, confidential speech privacy): Single stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab) or 6 inches above a hung gypsum board ceiling. Doors in NIC 40 or greater partitions to include doors with a comparable rating.
- NIC 40 (private offices, normal speech privacy): Single stud wall, two layers of gypsum board one side, one layer of gypsum board the other side, batt insulation in stud cavity. Slab to slab (preferred); minimum 6 inches above acoustical tile ceiling (minimum CAC 44). Doors in NIC 40 or greater partitions to include doors with a comparable rating.
- NIC 35 (private offices, normal speech privacy, sound masking): Single stud wall, single layer gypsum board each side, batt insulation in stud cavity. Minimum 6 inches above acoustical tile ceiling (minimum CAC 44).

- NIC 31 (private offices, normal speech privacy, low voice level, miscellaneous other spaces): Single stud wall, single layer of gypsum board each side, batt insulation in the stud cavity. Terminates at underside of acoustical tile ceiling (minimum CAC 35).

Acoustical performance will be verified during the commissioning of the building. The commission requirements are further defined in the GSA Building Commissioning Guide.

Table 3.2a Sound Absorption and Reverberation

Space	Performance Level	Descriptor	Ceiling (SAA/NRC)[1]	Walls (SAA/NRC)[2]	Time (Seconds) (RT60)[3]
Training rooms	Baseline	Deskbound, interactive	0.80/100%	0.8/25%	0.6
Meeting rooms	Tier 1	Frequent tele/video conferencing	0.90/100%	0.8/25%	0.5
	Baseline	Infrequent tele/video conferencing	0.80/100%	0.8/25%	0.6
	Baseline	Less than 6-person capacity	0.80/100%	n/a	0.6
Private offices	Tier 1	High speech privacy	0.85/100%	n/a	0.6
	Baseline (masking)	Normal speech privacy, deskbound, concentrative	0.8/100%	n/a	0.6
	Baseline (no masking)	Normal speech privacy, internally mobile, interactive	0.75/100%	n/a	0.6
Quiet rooms	Baseline (no masking)	Individual or small group, interactive	0.75/100%	n/a	0.6
	Baseline (masking)	Individual or small group, concentrative	0.75/100%	n/a	0.6
Misc. enclosed spaces	Baseline	Short occupancy, no speech privacy	0.70/100%	n/a	0.8
Open plan offices	Tier 1	High density occupancy, internally mobile or interactive	0.90/100%	0.8/25%	0.8
	Baseline	Low density occupancy, deskbound and concentrative	0.80/100%	n/a	0.8
Child care center	Baseline		0.90/100%	0.70/25%	0.5

1 For alternative absorption systems such as islands, baffles, or clouds, ensure equivalent amount of absorption to ceiling at the required performance level.
2 Absorption should be placed on two adjacent walls.
3 Additional absorption to that required in columns 1 and 2 may be needed to comply with the maximum reverberation time.

Table 3.2b Background Sound, Noise Isolation and Speech Privacy

Space	Performance Level	Descriptor	Mechanical Noise (RC/NC)	Electronic Sound Masking Level (dBA)[1]	Minimum Noise Isolation (NIC)[2]	Minimum Privacy (PI/SPP)[3]
Training rooms	Baseline	Deskbound, interactive	30 min - 35 max	n/a	48	78 SPP
Meeting rooms	Tier 1	Frequent tele/video conferencing	25 min - 30 max	n/a	53	78 SPP
	Baseline	Infrequent tele/video conferencing	30 min - 35 max	n/a	48	78 SPP
	Baseline	Less than 6-person capacity	30 min - 35 max	n/a	45	75 SPP

Space	Performance Level	Descriptor	Mechanical Noise (RC/NC)	Electronic Sound Masking Level (dBA)[1]	Minimum Noise Isolation (NIC)[2]	Minimum Privacy (PI/SPP)[3]
Private offices	Tier 1	High speech privacy	35 max	40-42	45	85 SPP
	Baseline (masking)	Normal speech privacy, deskbound, concentrative	35 max	40-42	35	75 SPP
	Baseline (no masking)	Normal speech privacy, internally mobile, interactive	35 min - 40 max	n/a	40	75 SPP
Quiet rooms	Baseline (no masking)	Individual or small group, interactive	35 min - 40 max	n/a	45	80 SPP
	Baseline (masking)	Individual or small group, concentrative	35 max	40-42	40	80 SPP
Misc. enclosed spaces	Baseline	Short occupancy, no speech privacy	35 max	n/a	30	65 SPP
Open plan offices	Tier 1	High density occupancy, internally mobile or interactive	40 max	45-48	n/a	80% PI
	Baseline	Low density occupancy, deskbound, concentrative	35 min - 40 max	n/a	n/a	80% PI
Child care center	Baseline		35 max	n/a	35	n/a

1 Steady state background noise to be provided by electronic sound masking system.
2 Operable walls and partitions must achieve the required NIC rating for the space that they are separating.
3 Speech Privacy Potential (SPP) = NC/RC (column 4) + NIC (column 6) if sound masking is not used. If sound masking is used, then SPP = sound masking level

3.9.1.5 PARAMETERS USED IN ACOUSTICAL DESIGN

The following parameters are used to specify acoustical standards for GSA buildings:

- Background noise—The loudness of background noise is quantified by Noise Criterion (NC) or Room Criterion (RC) ratings and their associated frequency contours per ANSI/ASA S12.2.
- Noise isolation—The amount of noise transmitted through the perimeter boundary elements of a space. Sound transmission class (STC) quantifies the sound insulating performance of building elements such as walls, windows, and doors when tested in a laboratory in accordance with ASTM E90. NIC quantifies the field-tested sound isolation between two enclosed spaces separated by a partition when tested in accordance with ASTM E336. FIIC quantifies the field-tested impact sound insulating properties of a floor/ceiling assembly when tested in accordance with ASTM E1007. ISR quantifies the field-tested impact sound insulating properties of a floor/ceiling assembly when tested in accordance with ASTM E1007.
- Speech Privacy – The extent to which speech is understandable in adjacent rooms or areas. Privacy Index (PI) is used for open offices per ASTM E1130. Sound Privacy Potential (SPP) is used for enclosed rooms. It results from adding the background sound level (NC/RC) to the noise isolation rating (NIC/STC).
- Reverberation time—The time required for sound to decay 60 decibels in the 500 Hz band in an enclosed space., measured per ISO 3382-2. For the reverberation time requirements in Table 3.1a, use the average of the reverberation time in the 500, 1000, and 2000 Hertz octave bands.

- Sound absorption—The amount of sound absorbed by a surface finish. Noise Reduction Coefficient (NRC) and Sound Absorption Average (SAA) quantifies the efficiency of a material in absorbing sound energy when tested in accordance with ASTM C423.

Rules of thumb for interpreting ratings are:

- STC 35: Loud speech audible but not intelligible.
- STC 40: Onset of "privacy."
- STC 45: Loud speech barely audible.
- STC 50: Loud speech not audible; shouting barely audible.
- STC 55: Very loud sounds such as musical instruments or a stereo can be faintly heard.
- STC 60: Superior soundproofing; most sounds inaudible.

3.9.1.6 NOISE ISOLATION AND PRIVACY

The perception of speech privacy and freedom from annoying and distracting noises between enclosed rooms are related to both the noise isolating capabilities of building assemblies such as partitions and floor-ceiling systems and the loudness and quality of the background sound level. Both must be considered together. A partition that provides privacy at one level of background noise may not provide privacy if the background noise decreases, for example, when the HVAC system cycles off. Speech Privacy Potential (SSP) is a measure of speech privacy between enclosed rooms that considers both the background sound level and the noise isolating capability of the architectural barriers. SSP requirements for various rooms are listed in Column 7 of Table 3.1b. Subjective descriptions of SSP values are provided below.

- SPP 85 High speech privacy (shouting), no annoyance or distractions
- SPP 80 High speech privacy (raised speech level), generally no annoyance or distractions
- SPP 75 Good speech privacy (normal speech level), little annoyance or distractions
- SPP70 Minimum; low speech privacy; noises occasionally annoying and distracting
- SPP<70 Typically insufficient privacy between closed rooms; frequent annoyance and distraction

To assist in meeting the required SPP requirements, Table 3.1b provides requirements for background noise levels (Column 4, or Column 5 if sound masking is used) and noise isolation class ratings (NIC, Column 6). SPP results from adding the background noise level to the noise isolation value of the wall or floor-ceiling assembly.

Select wall types, floor-ceiling assemblies, doors, and windows based on their laboratory tested sound transmission class (STC) ratings. Control flanking noise paths so that those STC-based constructions result in the required field-measured noise isolation class (NIC) ratings. The subjective perceptions of the STC/NIC levels of noise isolation below assume a background sound level of 35 dBA. Higher background sound levels will increase the SPP ratings and the perception of privacy while lower background sound levels will decrease both.

- STC/NIC 60 Most loud sounds are inaudible
- STC/NIC 55 Very loud sounds such as equipment noise are barely audible
- STC/NIC 50 Shouting and moderate music occasionally audible, but not intelligible/distracting

- STC/NIC 45 Loud speech is occasionally audible, but not intelligible
- STC/NIC 40 Onset of privacy, normal speech occasionally audible, but not intelligible
- STC/NIC<40 Privacy not expected, storage, kitchenettes, mail/copy rooms, etc.

Because NIC is measured in buildings and accounts for all ways sound travels between rooms, it can be lower than the laboratory measured STC ratings of independent wall, door, and floor-ceiling assemblies. Examples of wall components that may be required for specific STC/NIC ratings are provided below.

- STC/NIC>50: Double studs, resilient channels, multiple layers of gypsum board, cavity insulation, full height from slab to slab, sealed penetrations (meeting rooms, executive private offices)
- STC/NIC 40-50: Single or staggered studs, resilient channels, single or multiple layers of gypsum board, cavity insulation, full height from slab to slab or use of plenum barrier over wall above ceiling level, sealed penetrations (training rooms, private offices)
- STC/NIC <40: Not recommended for normally occupied rooms. Single stud, single layer gypsum board, no cavity insulation, height terminates at underside of ceiling (storage rooms, closets, kitchenettes, copy rooms, etc.)

When renovating existing spaces that have partitions that terminate at the ceiling or slightly above the ceiling but do not extend full height to the slab above, consider implementing plenum barriers above the ceiling to achieve the required NIC ratings.

Acoustical performance will be verified during the commissioning of the building. The commission requirements are further defined in the GSA Building Commissioning Guide.

3.9.2 FIRE PERFORMANCE AND SMOKE DEVELOPMENT

Interior wall and ceiling finish materials must comply with the applicable requirements in the IBC for fire performance and smoke development (i.e., flame spread index and smoke developed index). The allowable fire performance and smoke development of interior wall and ceiling finish materials are based on occupancy classification. Typically, interior wall or ceiling finishes are classified as either Class A (i.e., flame spread index 0-25; smoke developed index 0-450), Class B (i.e., flame spread index 26-75; smoke developed index 0-450), or Class C (i.e., flame spread index 76-200; smoke developed index 0-450) based on test results from ASTM E84 or ANSI/UL 723. Wherever the use of Class C interior wall and ceiling finish is required, Class A or Class B must be permitted. Wherever the use of Class B interior wall and ceiling finish is required, Class A must be permitted.

Interior floor finish and floor covering materials must meet the applicable fire performance floor finish and floor covering material requirements in the IBC. Typically, interior floor finishes are classified as either Class I having a critical radiant flux of not less than 0.45 W/cm^2 or Class II having a critical radiant flux of no less than 0.22 W/cm^2 but less than 0.45 W/cm^2 based on test results from NFPA 253 or ASTM E 648. Wherever the use of Class II interior floor finish is required, Class I interior floor finish must be permitted.

Carpet and carpet-like interior floor finishes must comply with ASTM D 2859 or DOC FF-1 “pill test” (CPSC 16 CFR §1630).

Decorative materials and trim must comply with the applicable requirements in the IBC. Decorative materials are considered materials applied over the building interior finish for decorative, acoustical, or other effect (such as curtains, draperies, fabrics, streamers, and surface coverings), and all other materials utilized for decorative effect (such as batting, cloth, cotton, hay, stalks, straw, vines, leaves, trees, moss, and similar items), including foam plastics and materials containing foam plastics. Decorative materials do not include floor coverings, ordinary window shades, interior finish, and materials 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering tightly to a substrate. Typically, decorative materials suspended from walls or ceilings must meet the flame propagation performance criteria of NFPA 701 or be noncombustible.

Combustible materials installed on or embedded in floors of buildings of Type I or Type II construction must comply with the applicable interior finish requirements in the IBC.

3.10 WORKPLACE REQUIREMENTS

Establish workplace strategies and design goals that are based on the customer's mission as well as their business and financial objectives. Refer to the GSA Total Workplace Solutions Library, agency-specific utilization rate and design standards, and the Total Workplace Scorecard. Requirements studies of the customer's work style, work patterns, mobility readiness must be performed. Use the Workplace Scorecard or another tool to measure and validate existing workplace conditions and assess the opportunity for improvement.

Consult the following GSA publications for additional workplace design guidance:

- Space Measurement & Building Efficiency
- Circulation: Defining & Planning
- Workplace Investment & Feasibility Modeling (WIFM) tool
- Total Workplace Scorecard
- GSA Total Workplace Solutions Library

Strong and focused leadership, when supported by successful workplace design, promotes organizational change. If leadership promotes change, the workplace design must embrace, and ultimately facilitate, the organization's cultural transformation.

Design of federal workplaces today demands flexibility, effectiveness, and efficiency without compromise to aesthetics, functionality, and safety. These high-performing environments must offer a variety of space types that encourage dynamic, often impromptu but productive interactions as well as consideration for building materials and finishes that enhance the indoor environment, promoting wellness and productivity. Productivity is no longer viewed as long, solitary hours of research, analysis, and documentation with an occasional break. In today's successful workplaces, workers are expected to collaborate, learn from each other, and even socialize.

A high-performance workplace is designed to

- Encourage internal and external mobility
- Increase work productivity
- Provide for a multi-generational workforce
- Foster diversity
- Advance the use of new technology

- Achieve sustainability
- Promote and enhance occupant health and wellbeing
- Create work-life balance
- Promote team-based work modes
- Maximize space efficiency
- Assign space on the work performed, not the position

Intelligent planning and design strives to achieve the right balance between open and closed spaces, which requires careful consideration of the organization's culture, mission, goals, and work styles.

Creating a sense of health and well-being for building occupants must consider the interaction of three health domains – physical, psychological, and social. The challenge for workplace design is to identify cost-effective ways to eliminate health risks, and to promote and enhance occupant health across all three domains. Guidance is provided in the following resources:

- SFTool Buildings and Health
- LEED Pilot Credit 108 Integrative Process for Health Promotion
- Section 2 of GSA's Total Workplace Scorecard, a compliance path for Guiding Principles for Sustainable Federal Buildings – Criteria 4.9 (Occupant Health and Wellness)

3.10.1 PLANNING AND DESIGN STRATEGIES

3.10.1.1 GOAL SETTING

Goal setting for a high-performance workplace includes goals for measuring performance and involves all levels of stakeholders early in the process.

3.10.1.2 PLANNING AND DESIGN PROCESS

The planning and design process for a high-performance workplace includes all stakeholders early within the process and includes plans for monitoring and maintaining workplace performance throughout the life of the facility.

3.10.1.3 REQUIREMENTS DEVELOPMENT

Design standards and decisions must be based on expert analysis of the organization's work styles and patterns, space utilization, and mobility readiness. Design consultants should be engaged as necessary.

3.10.1.4 BALANCE OF ALL DESIGN FACTORS

Design for productivity considers the whole building synergistically.

3.10.2 HEALTH AND COMFORT: ENVIRONMENTAL CONTROLS

3.10.2.1 VENTILATION AND THERMAL COMFORT

While the Temperature, Humidity, and Air Control sections of Chapter 5 address the designed and measurable values of ventilation and thermal comfort in the workplace, it is important also to measure employee satisfaction with workplace environmental comfort.

3.10.2.2 LIGHTING/DAYLIGHTING

While the Lighting Quality and Lighting Quantity sections of Chapter 6 address the designed and measurable values of lighting, it is important also to measure employee satisfaction with lighting and daylighting in the workplace.

3.10.2.3 ACOUSTIC COMFORT

While the Acoustic Control section of Chapter 3 addresses the designed and measurable values of sound in the workplace, it is important also to measure employee satisfaction with workplace acoustics.

3.10.3 IMAGE

3.10.3.1 WORKPLACE IMAGE

The workplace image creates identity and enhances a sense of place. Public spaces and private areas alike should present a professional image that conveys the organization's mission and business.

3.10.3.2 WAYFINDING

Wayfinding design is the organization of spatial and environmental information—including circulation paths, signage, and visual cues—to help users find their way.

3.10.4 WORKPLACE TOOLS AND PROCESSES

Use workplace program analysis and development tools and processes that provide cost- and time-effective ways to analyze existing space performance, space constraints, and organizational mission and goals, and provide design criteria that directly address these issues. The analysis must include the following.

3.10.4.1 A BALANCED SCORECARD APPROACH

Developed by Harvard's Kaplan and Norton, this provides a framework to analyze and measure the performance of an organization in four domains—finance, business process, customer, and human capital. GSA uniquely uses this framework to directly link workplace solutions to the organization's goals.

3.10.4.2 QUANTITATIVE AND QUALITATIVE DISCOVERY PROCESSES AND TOOLS

These are used to derive design concepts and solutions from an understanding of the organization—its goals, culture, and current and desired work practices—using both quantitative and qualitative data. This includes gathering quantitative and qualitative data; gaining in- depth knowledge of the customer organization; conducting on-site observations, interviews, and focus groups; and developing written guidelines to inform the design and design review processes.

3.10.4.3 CHANGE MANAGEMENT

This involves a broad segment of the organization to help define workplace needs and build project consensus. By engaging occupants early on, change management can be approached as an organizational opportunity, and occupant expectations can be managed proactively.

3.10.4.4 FEEDBACK LOOP

This involves identifying connections between business and workplace goals and design solutions, measuring for desired outcomes, and using the findings to improve existing and future organizational operations and work-place projects. This includes preoccupancy and post occupancy surveys, design commissioning, testing, and measurement.

For more information visit the [Center for Workplace Strategy website]() for analysis processes and tools.

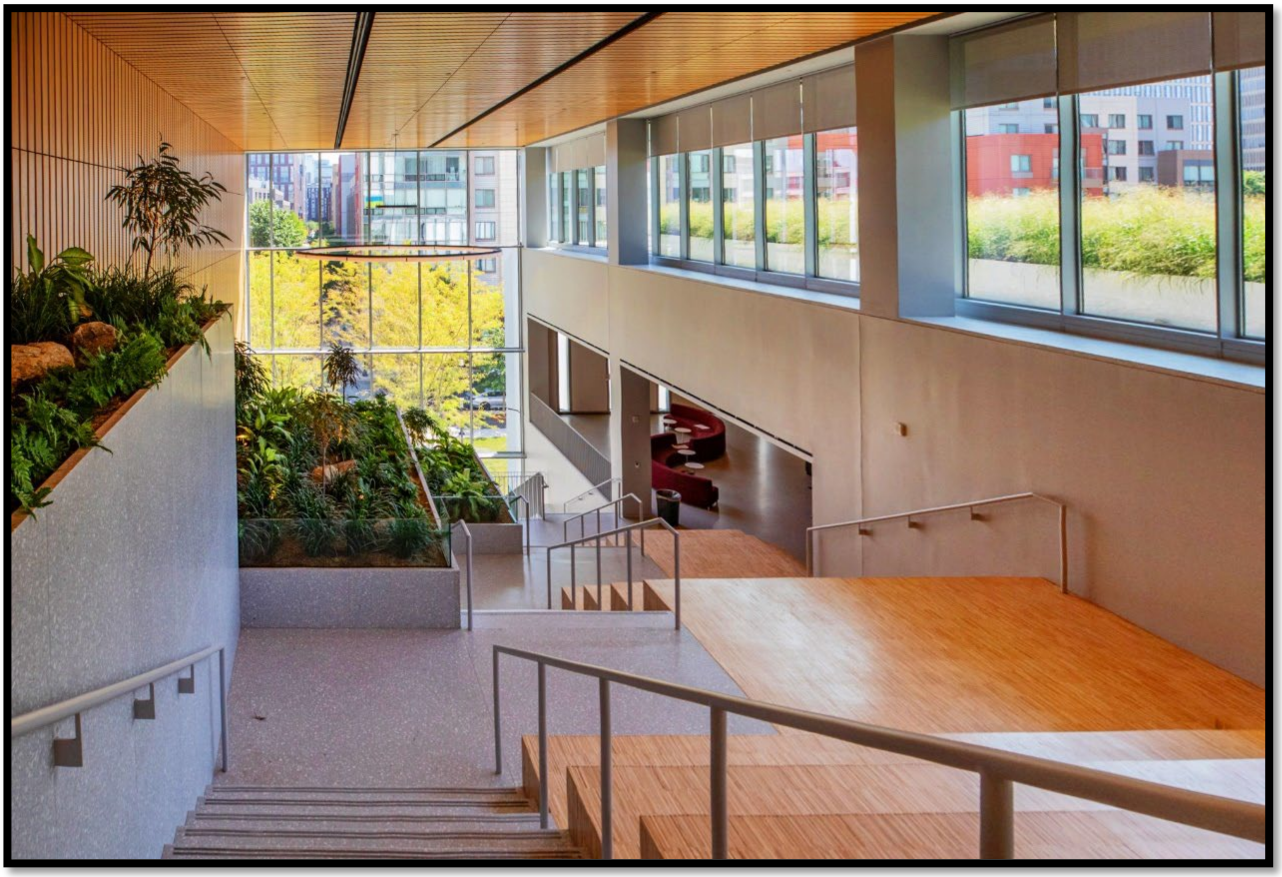


Figure 12: U.S. Department of Transportation Volpe Center Interior Cambridge, MA

4

STRUCTURAL AND CIVIL ENGINEERING

Figure 13: U.S. Courthouse Structure
Greenville, MS

4.1 STRUCTURAL PERFORMANCE TABLE

4.1.1 Live Load		
Uniform Office Floor Loading		
Baseline		100 psf including partitions, reducible
Tier 1		100 psf including partitions, non-reducible
Tier 2		N/A
Tier 3		N/A
M & V		Y
Plans & Specs		Y
Calculations & Analysis		Project team must provide calculations showing requirements are met. Calculations required at all performance levels.
References		ASCE 7
Basis of Design		Describe design narrative for how the floor structure design addresses the requirements.
Construction Verification		N/A
4.1.2 Seismic		
Structure		
Baseline		Risk Category I & II Structures
Tier 1		Risk Category III Structures
Tier 2		Risk Category IV Structures
Tier 3		N/A
M & V		N/A
Plans & Specs		Y
Calculations & Analysis		Project team must provide calculations showing requirements are met. Calculations required at all performance levels.
References		For existing buildings reference ASCE 41. For new buildings, reference IBC. For new buildings above baseline, also reference ASCE 41 for tiering performance goals.
Basis of Design		Describe seismic resistance design assumptions.
Construction Verification		Verify that all IBC and other specific required special inspections have been performed and reports have been submitted.
Non-Structural		
Baseline		Risk Category I & II Structures
Tier 1		Risk Category III Structures
Tier 2		Risk Category IV Structures
Tier 3		N/A
M & V		N/A
Plans & Specs		Y

Calculations & Analysis		Project team must provide calculations showing requirements are met. Calculations required at all performance levels.
References		For existing buildings reference ASCE 41. For new buildings, reference IBC. For new buildings above baseline, also reference ASCE 41 for tiering performance goals.
Basis of Design		N/A
Construction Verification		N/A

4.1.3 Wind

Structure		
Baseline		Risk Category I & II Structures
Tier 1		Risk Category III Structures
Tier 2		Risk Category IV Structures
Tier 3		N/A
M & V		Y
Plans & Specs		Y
Calculations & Analysis		Project team must provide calculations showing requirements are met. Calculations required at all performance levels.
References		ASCE 7, SEAOC PV2 17
Basis of Design		Describe wind resistance design assumptions.
Construction Verification		N/A

4.1.4 Vibrations

Serviceability		
Baseline		No More than 10 times the ISO Baseline Curve
Tier 1		No more than 4 times the ISO Baseline Curve
Tier 2		As required for Laboratories and Sensitive Equipment
Tier 3		N/A
M & V		Y
Plans & Specs		Y
Calculations & Analysis		Project team must provide calculations showing requirements are met. Calculations required at all performance levels.
References		AISC Design Guide Series 11, Floor Vibrations Due to Human Activity and International Organization of Standards ISO 2631-2:2003 Mechanical Vibration and Shock Evaluation of Human Exposure to Whole-Body,
Basis of Design		Describe design narrative for how the floor structure design addresses the effects of vibration.
Construction Verification		N/A

4.2 STRUCTURAL PERFORMANCE ATTRIBUTES

The structural design of new or modification of existing buildings, structures, and portions thereof must follow the latest edition of the International Code Council *IBC Code and Commentary*, except as modified in this chapter. Generally, the baseline and tier performance levels are intended to align with the structure risk categories as defined by the IBC.

4.2.1 LOADS AND NATURAL HAZARDS

Loads must be governed by the latest edition of American Society of Civil Engineers & Structural Engineering Institute *ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures*.

The designer must verify local regulations that require loads exceeding those specified by ASCE 7 and coordinate with the GSA Structural Engineer to determine if they should be incorporated.

Design loads must be itemized and categorized in calculations and on construction documents.

4.2.1.1 LIVE LOAD

Floor framing members supporting general office space must be designed using a uniform live load of 100 pounds per square foot (psf) over the entire floor for all elevated slabs unless the tabulated uniform live load required by the ASCE 7 is higher than 100 psf. This includes a nominal partition load of 15 pounds per square foot but excludes heavy loads like the planned use of heavy file systems, book racks, ammunition storage, sliding room partitions, safes, and other similar items. Some projects may require that the designer not use live load reductions for 1) horizontal framing members, 2) transfer girders supporting columns, or 3) columns or walls supporting roofs where mechanical equipment can be located. The designer will discuss this issue with the GSA structural engineer early in the project development. Live load reductions must be considered in the design of foundation members regardless of the restrictions placed on individual members.

For buildings having plaza areas where there is a possibility of vehicular traffic these loads, including impact must be provided for in the design.

4.2.1.2 SEISMIC LOAD

Seismic design of new buildings and building additions must be governed by the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Retrofit of existing buildings must conform to the Basic Performance Objectives defined by the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings based on the facility Risk Category.

4.2.1.2.1 STRUCTURAL LATERAL RESISTANCE SYSTEM

In addition to meeting the requirements of the IBC the guidelines from ASCE 41 must be applied to achieve varying performance objectives for the Basic Safety Earthquake. It is not permitted to design the building for seismic performance below the minimum level specified by the current edition of The Interagency Committee on Seismic Safety in Construction *Standards of Seismic Safety for Existing Federally Owned and Leased Buildings ICSSC Recommended Practice*.

4.2.1.2.2 NON-STRUCTURAL COMPONENTS

Seismic design of nonstructural components for new buildings and building additions must be governed by the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Retrofit of nonstructural components in existing buildings must conform to the Basic Performance Objectives defined by the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings.

4.2.1.3 WIND LOAD

The requirements of the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures must be applied to achieve varying performance levels based on the Risk Category of the facility. It is not permitted to design the building for wind speeds below the applicable building code specified minimum. Wind speeds are dependent on region and other factors specified in ASCE 7. Wind tunnel testing may be used during the design phase to determine loads on building structure more precisely than ASCE 7. A rigid model test can be used to determine localized pressures and overall mean loads applied to the building. An aero-elastic model test can be used to evaluate the dynamic response of the building due to wind loading. PV array supporting structures are to be considered as importance category II or greater and their design will enhance the requirements of ASCE 7 with the recommendations in Structural Engineers Association of California Wind Design for Solar Arrays; SEAOC Solar Voltaic Systems Committee Report SEAOC PV2-2017, July 2017.

4.2.1.4 SNOW LOAD

Loads must be governed by the latest edition of American Society of Civil Engineers Structural Engineering Institute ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. The designer must verify local regulations that require loads exceeding those specified by ASCE 7 and coordinate with the GSA Structural Engineer to determine if they should be incorporated.

4.3 STRUCTURAL REQUIREMENTS

4.3.1 VIBRATIONS

The designer must use the principles of structural dynamics to evaluate the potential for structural vibrations as it relates to both human comfort and the tenant agency program of requirements.

The design must be based on recommendations of American Institute of Steel Construction *Steel Design Guide Series 11 Floor Vibrations Due to Human Activity* and the International Organization of Standards *ISO 2631-2:2003 Mechanical Vibration and Shock Evaluation of Human Exposure to Whole-Body Vibration - Part 2: Vibration in Buildings (1 Hz to 80 Hz).*

Architectural facade elements for shading or screening or architectural expression must be reviewed by the structural engineer of record for wind induced vibration. This review must be documented in the project structural calculations.

4.3.2 INNOVATIVE METHODS AND MATERIALS

When designing with new or uncommon materials or methods of construction the merits of the methods or materials must be established. If the merits are established, new, unusual, or innovative materials, systems, or methods may be incorporated into designs when evidence shows that such use is in the best interest of the Government from the standpoint of economy, lower life-cycle costs, lowest feasible embodied carbon, higher stored carbon, renewable materials, and quality of construction.

When new and innovative methods and materials are proposed for a project, a peer review expert, approved by GSA, must evaluate, and approve the adequacy of the methods, systems, and materials proposed by the designer. Innovative design methods include but are not limited to non-linear finite element analysis, time-history loading development, computational fluid dynamics, and other methods deemed innovative by the GSA Structural Engineer.

4.3.3 STRUCTURAL SYSTEMS AND ELEMENTS

Precast floor framing systems must not be used in new or additions to existing federal office buildings or courthouses. When the design can be demonstrated to adapt well to future changes in locations of heavy partitions or equipment, precast systems may be considered for low-rise structures such as parking garages, industrial buildings, and storage and maintenance facilities. Precast must not be used as part of the structural framing to prevent progressive collapse.

Pre-tensioned and post-tensioned floor and roof framing systems are not allowed.

Exception: Pre-tensioned or post-tensioned systems, bonded or unbonded, for parking structures that are separate from the occupied building are allowed. Post tensioning is allowed for repair or retrofit to reduce deflections or enhance capacity.

Footings and permanent support structures, such as tiebacks, must not project beyond property lines.

Building additions must be designed and constructed using materials and systems compatible with the existing structure.

4.3.4 ALTERATIONS TO HISTORIC STRUCTURES

Historic buildings must meet the same life safey objectives as other buildings while preserving historic spaces and features to the greatest extent possible. Any decision made to preserve essential historic features must not result in a lesser seismic performance than that required by the current edition of *Standards of Seismic Safety for Existing Federally Owned and Leased Buildings ICSSC Recommended Practice*.

Alteration requires ingenuity and imagination. They are inherently unsuited to rigid sets of rules, since each case is unique. It is recognized that total compliance with standards may not be possible in every case. Where serious difficulties arise, creative solutions that achieve the intent of the standard are encouraged. These must be approved by both the GSA historic preservation Architect and GSA Structural Engineer.

4.3.5 GEOTECHNICAL REQUIREMENTS

Geotechnical investigations must be performed in accordance with the requirements of the latest edition of the *IBC Code and Commentary*. See Appendix A for additional requirements.

Building additions must utilize foundation systems compatible with the existing structure. When this is not considered feasible the designer must estimate the potential differential settlements and demonstrate that the selected foundation system will not adversely affect either the existing building or the new construction.

The designer must specify and delineate installation of new soils or treatments to existing soils on the construction documents to achieve the performance levels for ground supported structures.

4.3.6 SEISMIC INSTRUMENTATION

New and existing buildings undergoing a seismic upgrade in Seismic Design Category D, E, and F that are over six stories in height with an aggregate floor area of 5,574 m2 (60,000 ft2) or more, and every Seismic Design Category D, E, and F building over 10 stories in height regardless of floor area, must be provided with U.S. Geological Survey (USGS) approved recording accelerographs. The Seismic Instrumentation of Buildings (with Emphasis on Federal Buildings), Special GSA/USGC project, USGS Project No 0-7460-68170 must be used. The location and specifications for this equipment must be included in the construction documents.

4.3.7 CROSS-DISCIPLINARY COORDINATION

The designer is responsible for coordination with other engineering and architectural disciplines to ensure physical and dimensional compatibility of systems interfacing with or supported by the structure. Where major elements of other disciplines work interfaces with the structure, this information must be shown on construction documents. The IBC specifies the minimum required information to be included on construction documents. However, the GSA Structural Engineer has the final authority to require what additional information must be shown.

4.3.8 GENERAL

The designer must coordinate with the GSA Structural Engineer early (prior to the first submittal) in the project to establish the required content and organization of structural engineering calculations. When computer programs are used to perform design calculations or estimate complex building behavior, supporting analysis files & models used to create the calculation package or used for structural design are to be provided, in their original native format, if requested by the GSA Structural Engineer. The designer must submit complete calculations for all aspects of the structural design. The submission must be developed under the direction of, and bear the seal of a licensed engineer in the State, District, or Territory of the project location. The submission must include a complete set of indexed and sealed calculations that includes a narrative of the analytical methods and assumptions used for design and analysis.

4.3.9 SPECIAL DURABILITY REQUIREMENTS

The designer must incorporate the use of more durable construction materials and detailing for structures supporting vegetative roofs, plaza areas and other structural elements exposed to weather and/or exterior environmental conditions.

4.3.10 FORCED ENTRY RESISTANCE

When required by the project scope, the designer must incorporate forced entry resistance into ground floor windows and doors and other pedestrian accessible points of entry. The designer must reference current GSA guidance and policy when applicable.

4.3.11 STORAGE OF AMMUNITION AND EXPLOSIVES OR HAZARDOUS MATERIALS

When the storage of such materials is necessary and has been approved by GSA, the designer must provide a secure structural separation between the storage location and adjacent public and/or tenant spaces. The separation must have the ability to resist accidental release, discharge, or detonation of such materials. The structural capacity of the separation must be verified by analysis. The designer must reference current GSA guidance and policy when applicable.

4.3.12 DELEGATED DESIGNS

When deferred submissions require design by other than the Engineer of Record, the submission must be developed under the direction of, and bear the seal of a licensed engineer in the State, District, or Territory of the project location. The submission must include a complete set of indexed and sealed calculations that includes a narrative of the analytical methods and assumptions used in design.

4.3.13 INSPECTIONS AND CERTIFICATIONS

The designer must include all required special structural inspections and manufacturer/materials certifications on the construction documents. When not shown, at a minimum the contractor must follow the requirements of the IBC.

4.4 PHYSICAL SECURITY PERFORMANCE TABLE

4.4.1 Security		
Physical Security Performance		
Baseline		ISC Level I or II
Tier 1		ISC Level III
Tier 2		ISC Level IV
Tier 3		ISC Level V
M & V		N/A
Plans & Specs		N/A
Calculations & Analysis		Project team must provide calculations showing requirements are met for Tier 1 and above.
References		The Risk Management Process: An Interagency Security Committee Standard, General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process for Federal Facilities: An Interagency Security Committee Standard - Appendix B: Countermeasures 2nd Edition, December 21, 2018
Basis of Design		The Risk Management Process: An Interagency Security Committee Standard, General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process for Federal Facilities: An Interagency Security Committee Standard - Appendix B: Countermeasures 2nd

		Edition, December 21, 2018, and the Building Specific Risk Assessment. Describe ISC Level used in design and how the criteria and risk assessment were met.
Construction Verification		N/A

4.5 PHYSICAL SECURITY PERFORMANCE REQUIREMENTS

Physical security performance levels are based upon Facility Security Level (FSL) as defined by:

- The Risk Management Process: An Interagency Security Committee Standard (Current edition)
- General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process for Federal Facilities: An Interagency Security Committee Standard - Appendix B: Countermeasures 2nd Edition, December 21, 2018

Each of these documents is For Official Use Only (FOUO) and contains sensitive details that are not repeated here. Refer to the ISC references for more information.

Design and construction of GSA buildings must be performed in accordance with the ISC Risk Management Process and Appendices for the given Facility Security Level (FSL). The designer must verify the facility security level early in the project to verify security requirements.

4.5.1 BLAST DESIGN REQUIREMENTS

In addition to the ISC Risk Management Process, blast design for GSA facilities must be in conformance with General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process for Federal Facilities: An Interagency Security Committee Standard - Appendix B: Countermeasures 2nd Edition, December 21, 2018.

4.5.2 PROGRESSIVE COLLAPSE DESIGN REQUIREMENTS

In addition to the ISC Risk Management Process, progressive collapse design for GSA facilities must be in conformance with General Services Administration Alternate Path Analysis & Design Guidelines for Progressive Collapse, Revision 1, January 28, 2016.

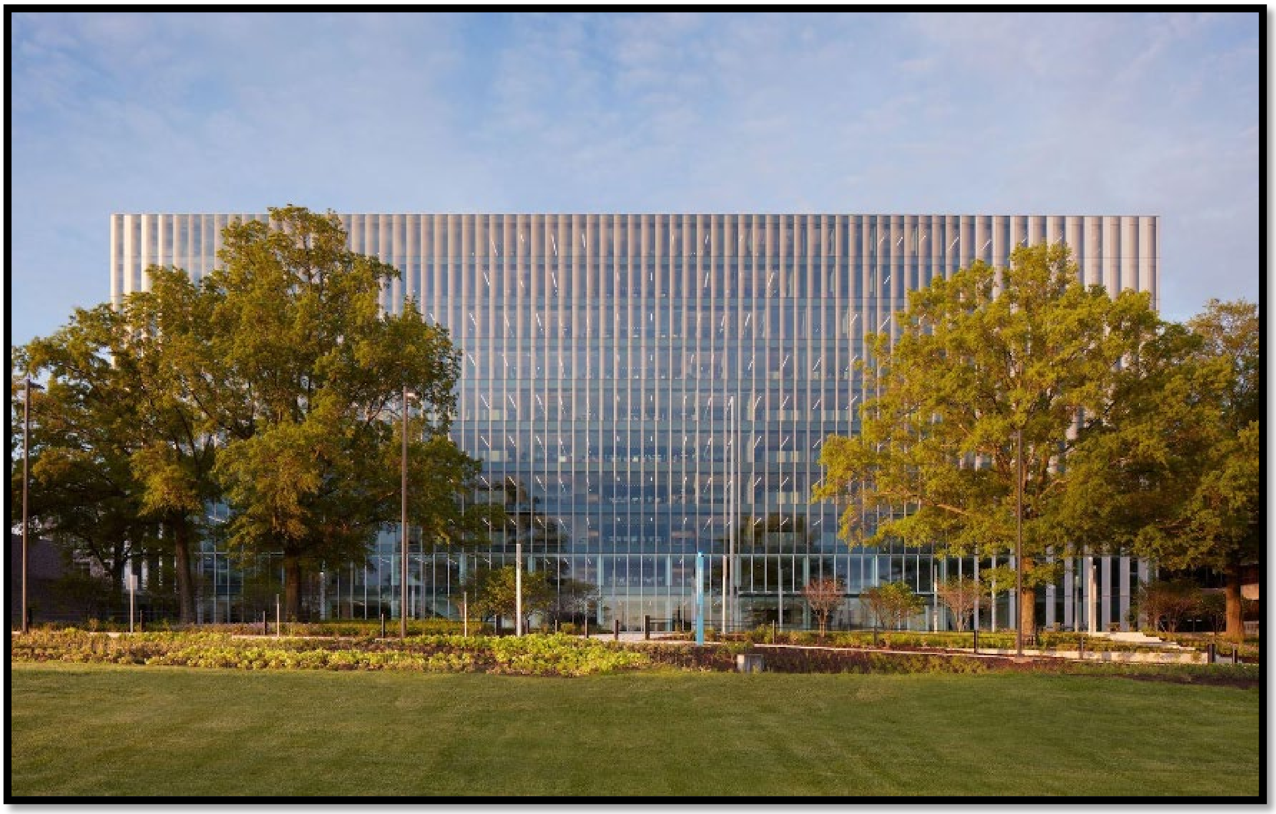


Figure 14: Altmeyer Federal Building
Woodlawn, MD

4.6 CIVIL PERFORMANCE TABLE

4.6.1 Flood Resistant Design Requirements

Building Enclosure and Site			
		Non-Critical Action	Critical Action
Baseline		Design Flood Elevation (DFE) = Base Flood Elevation (BFE) + 2 feet. ASCE 24 Flood Design Class (FDC) = 2. Risk Category (RC) = I & II.	DFE = BFE + 3 feet or 500-year Elevation, whichever is higher. FDC = 3. RC = III.
Tier 1		DFE = BFE + 3 feet or 500-year Elevation, whichever is higher. FDC = 3. RC = III.	DFE = BFE + 4 feet or 500-year Elevation, whichever is higher. FDC = 4. RC = IV.
Tier 2		DFE = higher than Tier 1. FDC = 4. RC = IV.	DFE = higher than Tier 1. FDC = 4. RC = IV.
Tier 3		N/A	N/A
M & V		N/A	
Plans & Specs		Yes, and included in the Emergency Action Plan.	
Calculations & Analysis		Project team must provide calculations showing requirements for all performance levels.	
References		Flood Study and Mapping, ASCE 24, ASCE 7 Supplement on Flood Loads, ANSI/FM 2510.	
Basis of Design		Describe flood resistance design requirements.	
Construction Verification		N/A	

Electrical and Generator System		
	Non-Critical Action	Critical Action
Baseline	DFE = BFE + 5 feet. FDC = 2. RC = I & II.	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is lower. FDC = 3. RC = III.
Tier 1	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is higher. FDC = 3. RC = III.	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is higher. FDC = 4. RC = IV.
Tier 2	DFE = higher than Tier 1. FDC = 4. RC = IV.	DFE = higher than Tier 1. FDC = 4. RC = IV.
Tier 3	N/A	N/A
M & V	N/A	
Plans & Specs	Yes, and included in the Emergency Action Plan.	
Calculations & Analysis	Project team must provide calculations showing requirements are met. Calculations required at all performance levels.	
References	Flood Study and Mapping, ASCE 24, ASCE 7 Supplement on Flood Loads, ANSI/FM 2510.	
Basis of Design	Describe flood resistance design requirements.	
Construction Verification	N/A	

Mechanical		
	Non-Critical Action	Critical Action
Baseline	DFE = BFE + 5 feet. FDC = 2. RC = I & II.	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is lower. FDC = 3. RC = III.
Tier 1	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is higher. FDC = 3. RC = III.	DFE = 500-year elevation + 5 feet, or BFE + 8 feet, whichever is higher. FDC = 4. RC = IV.
Tier 2	DFE = higher than Tier 1. FDC = 4. RC = IV.	DFE = higher than Tier 1. FDC = 4. RC = IV.
Tier 3	N/A	N/A
M & V	N/A	
Plans & Specs	Yes, and included in the Emergency Action Plan.	
Calculations & Analysis	Project team must provide calculations showing requirements are met. Calculations required at all performance levels.	
References	Flood Study and Mapping, ASCE 24, ASCE 7 Supplement on Flood Loads, ANSI/FM 2510.	
Basis of Design	Describe flood resistance design requirements.	
Construction Verification	N/A	

4.7 CIVIL PERFORMANCE ATTRIBUTES

4.7.1 FLOOD RESISTANT DESIGN REQUIREMENTS

Flood resistance must be accounted for when developing designs for new construction or improvements to existing assets to safeguard and prevent damage, loss, or mission and site access interruption. The design must correlate with the degree of hazard and the criticality of the asset as determined by the customer. Proposed buildings and structures subject to flood hazard must be programmed and designed, in accordance with ASCE 24, Flood Resistant Design and Construction and ASCE 7 supplement on flood loads.

See Chapter 1, Facility Definitions for Critical Action designation.

A flood determination study must be completed in early concept development to determine the 1-percent-annual-chance flood elevation (also known as the 100-year flood elevation or BFE) and 0.2-percent-annual-chance flood elevation (500-year flood elevation). Ideally, a study would be completed as part of compliance with the Floodplain Desk Guide, PBS 1095.8A. In situations where the floodplain elevation is not readily available or the available data is deemed outdated, where the hydrologic and hydraulics analysis is more than 15 years old, then a new flood analysis must be conducted and certified by a professional engineer to determine the applicable floodplains and elevations. The analysis must assess past flooding conditions and the availability of high-water marks. The study must meet the criteria of the National Flood Insurance Program (NFIP) mapping standards. In the event only the BFE is available and is deemed up to date, then the 500-year flood elevation can be established at the BFE plus an additional 3 feet. Refer to Section 5.1, Step 1 of the companion Desk Guide to PBS 1095.8A for the various flood data sources to determine the BFE and 500-year flood elevation.

Where attainable, a simplified Climate-Informed Science Approach (CISA) elevation may be substituted for the Building Enclosure and Site baseline DFE in coastal areas, as recommended by the FFRMS Floodplain Determination Job Aid. In computing the CISA elevation, at minimum, the intermediate scenarios must be used for non-critical action and intermediate-high scenarios for critical action, with the result rounded up to the nearest whole foot. The required service life input must factor in any possible service life extensions, such as renovations, additions, repairs...etc.

Any proposed development in an existing floodplain (mapped or unmapped) must demonstrate no adverse impact in accordance with local and state requirements. A pre- and post-development analysis (including modeling) can be required to demonstrate compliance and to confirm the applicable DFE.

Floodproofing (dry and wet) must be designed in accordance with ASCE 24 and must correspond to the applicable flood hazard area designation (Flood Hazard, High Risk Flood Hazard, or Coastal High Hazard and Coastal A Zones). Floodproofing products must meet ANSI/FM 2510 standard. The DFE, FDC, and RC provided in Chapter 4, Civil Performance must be used for ASCE 24 and ASCE 7 implementation, unless a more restrictive design requirement is warranted.

Higher design tiers and additional mitigation measures must be considered, particularly where local requirements dictate a higher standard or in the presence of high hazard conditions, such as pluvial flooding and floods caused by tsunamis, seiches, and dam and levee failures. Impacts from urban flash flooding, high hazards dams and levees must be considered and mitigated as part of the design and emergency action plan.

The applicable DFE and flood resistance design must be documented, at minimum, in the design narrative, plans, specification, and emergency action plan. A section must be dedicated in the design narrative to describe the flood resistance design and its bearing on an emergency action plan.

- Refer to E.O. 11988, Floodplain Management of May 24, 1977.
- Refer to E.O. 14030, Climate-Related Financial Risk of May 20, 2021.
- Refer to GSA Order PBS 1095.8A, Floodplain Management and Companion Desk Guide of November 30, 2023.
- Refer to FFRMS Floodplain Determination Job Aid of August 2023.
- Refer to the Guiding Principles for Sustainable Federal Buildings 1.2 Sustainable Siting.

- Refer to IgCC Section (5.3.1.2) Prohibited Development Activity.

4.8 PRESCRIPTIVE CIVIL REQUIREMENTS

Civil site design features should follow local jurisdictional requirements for the region the facility resides in. The following guidelines represent desirable design features and best practices that must be addressed during design. They are not intended to replace requirements from Chapter 2 of this document.

4.8.1 SITE GRADING AND DRAINAGE

- Balance cut and fill soil quantities on site.
- Provide positive grading minimum 2% grade from building to curb line.
- Control erosion design (meet local and state requirements for sediment control or follow EPA requirements) must consider ease of maintenance of the site.
- Comply with EISA section 438, state and local stormwater management requirements.
- Storm Drainage System – follow local and state requirements, locate in unpaved areas to the extent possible, avoid trees, consider future maintenance, integrate into landscape design to minimize visual impact, design for a 25-year storm, use gravity flow, rainwater not collected for reuse must be discharged into the storm drain.
- Provide drainage system performance analysis for the 100- and 500-year storm events. This is an assessment to mitigate any adverse flooding impacts due to the proposed drainage design, in compliance with Chapter 4, Civil Performance.
- Inlets and catch basins to include bicycle safe grate.
- The minimum pipe velocity for a storm drain must be 2 ft/s "flowing full" with a desired minimum "self-cleaning" velocity of 3 ft/s. The maximum pipe velocity must not exceed 10 ft/s.
- Small buildings in rural areas may use gutters, downspouts, and splash blocks.

4.8.2 SITE UTILITIES

- Utility Location – avoid trees, consider future maintenance, integrate into landscape design to minimize visual impact.
- Water – follow regulations of local water authority, locate behind curb lines or under sidewalks or unpaved areas, do not place under foundations or within building footprint. Provide maintainable strainers on all primary connections to the public water supply.
- Sanitary Sewer - follow regulations of local sanitary sewer authority, separate storm, and sanitary systems on site, provide cleanouts 5’ from building, provide manholes at service line entry points, provide drop manholes when service line does not enter at main sewer line invert, if septic systems are necessary, follow regulations of local code and provide 50% surplus capacity.
- Coordinate site utility design with the requirements of Chapter 5 & 6.
- Water Recycling – follow local and state requirements. Refer to Chapter 1, Water Net-Zero and Chapter 2, Rainwater Catchment.

4.8.3 SITE CIRCULATION

- Separate service traffic from parking entries.
- Truck maneuvering areas must provide adequate space (one way traffic preferred).
- Loading docks must be nearly flat (1:50 slope) in the apron area.
- At surface lots minimum parking stall size must be 9’x18’-6. Maximum grade 5%.
- Consult with the local fire department for emergency access requirements.
- If possible, provide a public drop off area along the street near the main entrance.
- Follow ABAAS requirements.

4.8.4 PAVEMENTS

- Use local governing design standards – if not available follow State DOT.
- Materials must be suitable for traffic loads and volume.
- Durability must be compatible for site climate with consideration to maintenance.
- Slip resistant – in northern climates address snow removal and snowmelt.
- Do not use surface applied curbs.
- Use concrete pavements at truck maneuvering areas.
- Coal tar sealants are prohibited

4.9 GEOLOGIC HAZARD REPORT

A geologic hazard report must be prepared for all new building construction in regions of low, moderate, and high seismicity, except for structures located in regions of low seismicity designed to the life safety performance level. Geologic hazard reports are not required for minor or relatively unimportant facilities for which earthquake damage would not pose a significant risk to either life or property.

4.9.1 REQUIRED INVESTIGATION

When required by the project scope, a geologic hazard investigation that addresses the hazards indicated below must be performed. Whenever possible, a preliminary investigation should be performed in the planning stage of siting a facility, to provide reasonable assurance that geologic hazards do not preclude construction at a site. During a later stage of geotechnical investigations for a facility at a selected site, supplemental investigations may be conducted as needed to define the geologic hazards in more detail and/or develop mitigating measures. The scope and complexity of a geologic hazard investigation depends on the economics of the project and the level of acceptable risk. In general, major new building complexes, high-rise buildings, and other high value or critical facilities must have thorough geologic hazard investigations. Small, isolated buildings need not have elaborate investigations.

4.9.2 SURFACE FAULT RUPTURE

For purposes of new building construction, a fault is an active fault and a potential location of surface rupture if the fault exhibits any of the following characteristics:

- Has had documented historical macroseismic events or is associated with a well-defined pattern of microseismicity
- Is associated with well-defined geomorphic features suggestive of recent faulting
- Has experienced surface rupture (including fault creep) during approximately the past 10,000 years (Holocene time)

Fault investigations must be directed at locating any existing faults traversing the site and determining the recency of their activity. If an active fault is found to exist at a site and the construction cannot reasonably be located elsewhere, investigations must be conducted to evaluate the appropriate set-back distance from the fault and/or design values for displacements associated with surface fault rupture.

4.9.3 SOIL LIQUEFACTION

Recently deposited (geologically) and relatively unconsolidated soils and artificial fills, without significant cohesion and located below the water table, are susceptible to liquefaction. Sands and silty sands are particularly susceptible. Potential consequences of liquefaction include foundation bearing capacity failure, differential settlement, lateral spreading, and flow sliding, flotation of lightweight embedded structures, and increased lateral pressures on retaining walls. The investigation must consider these consequences in determining the size of the area and the depth below the surface to be studied. An investigation for liquefaction may take many forms. One acceptable method is to use blow count data from the standard penetration test conducted in soil borings. This method is described in publications by H. B. Seed and I. M. Idriss, (1982), Ground Motions and Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, Oakland, CA, Monograph Series, 134 p. and H.B. Seed et al, (1985) “The Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations”: Journal of Geotechnical Engineering, ASCE 111(12): pp. 1425-1445.

4.9.4 LANDSLIDING

New construction must not be sited where it may be within a zone of seismically induced slope failure or located below a slope whose failure may send soil and debris into the structure. Factors that affect slope stability include slope angle, soil type, bedding, ground water conditions, and evidence of past instability. The geologic hazard investigation must address the potential for seismically induced slope deformations large enough to adversely affect the structure.

4.9.5 DIFFERENTIAL SETTLEMENT

Loosely compacted soils either above or below the water table can consolidate during earthquake shaking, producing surface settlement. The potential for total and differential settlements beneath a structure must be assessed. If liquefaction is not expected to occur, then in most cases, differential settlement would not pose a significant problem to construction.

4.9.6 FLOODING

Earthquake-inducing flooding can be caused by tsunamis, seiches, and dam and levee failures. The possibility of flooding must be addressed for new construction located near bodies of water. Refer to Chapter 4, Flood Resistant Design Requirements.

4.9.7 DURATION OF STRONG GROUND SHAKING

Estimates of the duration of strong ground shaking at a site are defined by earthquake magnitude and must be used to assess geologic hazards such as liquefaction and slope failure. Strong motion duration is strongly dependent on earthquake magnitude.

Estimates of the duration of strong ground shaking must assume the occurrence of a maximum considered earthquake generally accepted by the engineering and geologic community as appropriate to the region and to the subsurface conditions at the site.

4.9.8 MITIGATIVE MEASURES

A site found to have one or more geologic hazards may be used, provided the hazards are removed, abated, or otherwise mitigated in the design, or if the risk is judged to be acceptable. Examples of mitigative measures include removal and recompaction of poorly compacted soils, use of special foundations, stabilizing slopes, and draining, compaction, or chemical treatment of liquefiable soils. The geological hazard report must identify feasible mitigative measures.

4.9.9 REQUIRED DOCUMENTATION

Investigations of geologic hazards must be documented. As noted in the paragraph entitled “Required Investigation” above, a preliminary geologic hazard investigation must be conducted, and a report issued during the siting phase for a facility. However, unless the geologic hazard investigations have been documented in a stand-alone report, they must be addressed in a section of the geotechnical engineering report prepared during the design phase of a project. The geologic hazard report, whether it is a separate report or a section of the geotechnical engineering report, must at a minimum contain the following:

- List of hazards investigated, which must include the five described earlier in this section
- Description of the methods used to evaluate the site for each hazard
- Results of any investigations, borings, etc.
- Summary of findings
- Recommendations for hazard mitigation, if required
- In some cases, estimates of site ground motions may be needed for assessment of geologic hazards such as liquefaction and slope failure.

5

MECHANICAL ENGINEERING

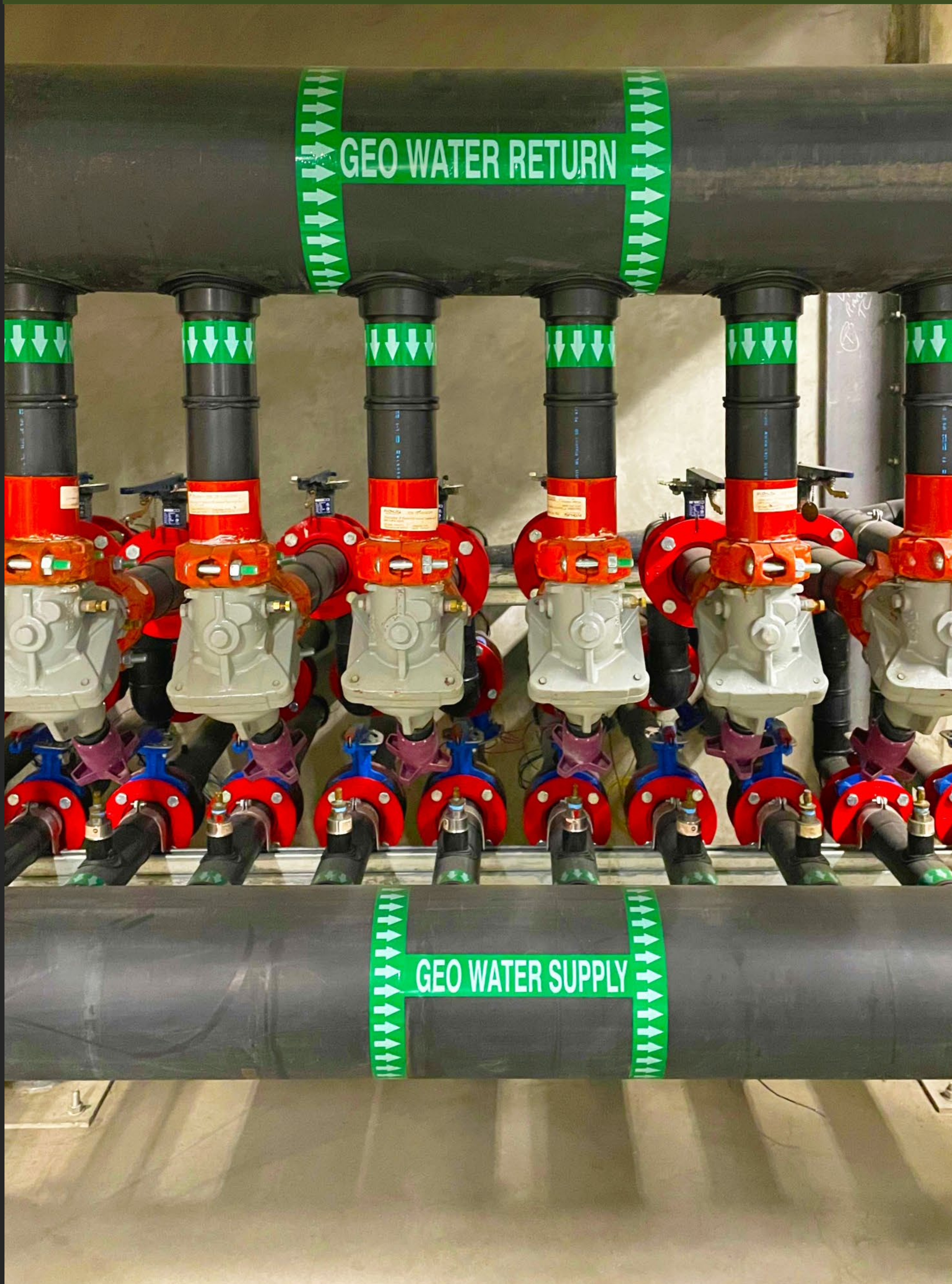


Figure 15: Land Port of Entry Geothermal System San Ysidro, CA

5.1 MECHANICAL PERFORMANCE TABLE

5.1.1 Temperature		
Performance		
Baseline		24±2ºC (75±3ºF) cooling, 22±2ºC (72±3ºF) heating, Allowance for unoccupied hour setup and setback optimized with re-occupancy pick-up and pull-down energy demands within a range of 13ºC to 28ºC (55ºF to 83ºF). Thermal zones limited to 42 m^2 (450 ft^2) at the perimeter 5m (15ft) (or no more than 3 private offices for the interior zones, and no more than 3 private offices on the same solar orientation for the exterior zones) and 140 m^2 (1500 ft^2) interior
Tier 1		Baseline features and add passive control of surface radiant temperature to provide surface radiant temperatures ±4ºC (±7ºF) of the air temperature. Thermal zones limited to 42 m^2 (450 ft^2) at the perimeter 5 m (15ft) (or no more than 3 private offices on the same solar orientation) and 75 m^2 (800 ft^2) interior
Tier 2		Tier 1 AND building automation system control of surface radiant temperatures to provide surface radiant temperatures ±1ºC (±2ºF) of the air temperature, or inversely offset expanded air temperature ranges and do not form condensation
Tier 3		Tier 2 AND individual occupant-controlled surface radiant temperatures within optimized limits determined by a BAS and optimized air at 24-27 ºC (75-80ºF) cooling 18-22 ºC (65-72ºF) heating
M & V		Baseline: No Tier 1: No Tier 2: Yes Tier 3: Yes
Plans & Specs		Yes
Calculations & Analysis		Provide calculations of the transient coupled one-dimensional heat and moisture transport in multi-layer building components exposed to natural weather using WUFI-ORNL/IBP for each construction condition.
References		ASHRAE 55, ASHRAE & SMACNA Procedural Guide
Basis of Design		Show proposed zoning and corresponding square footage for all conditioned spaces. Show temperature range for each zone and interior surface temperatures, when applicable.
Construction Verification		After occupancy, provide 2 weeks of 15-minute trend history of space and surface temperature (when controlled).

5.1.2 Humidity Control		
Performance		
Baseline		Maximum 55F dew point – occupied, 60F dew point – unoccupied
Tier 1		(For the preservation of “medium vulnerability” woodwork; this does not necessarily require humidification equipment) RH setpoint (Historic annual average at indoor dry bulb temperature = 21ºC (70ºF), default 50%RH), Class C (ASHRAE Applications) control (no short-term RH range), 25% to 75% seasonal setpoint adjustment, and 13ºC (55ºF) dew point maximum.
Tier 2		(For the preservation of “high vulnerability” woodwork. No archival storage of fabrics, books, film, or photos is considered.) RH setpoint (Historic annual average at indoor dry bulb temperature = 21ºC (70ºF), default 45%RH), Class B (ASHRAE Applications) controlled range of +/- 10% RH short term, +/- 10% seasonal setpoint adjustment, and 13ºC (55ºF) dew point maximum.
Tier 3		(Preservation of “high vulnerability” woodwork, small risk to archival storage items e.g. fabrics, books, film, or photos.) RH setpoint (Historic annual avg at indoor DB temperature = 21ºC (70ºF), default 45%RH,

		Class A, controlled range of +/- 5% RH short term, +/- 10% seasonal setpoint adjustment (OR +/- 10% RH and NO seasonal setpoint adjustment), and 13ºC (55ºF) dew point max.
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		ASHRAE 55, ASHRAE & SMACNA Procedural Guide
Basis of Design		Show relative humidity control range for each zone and describe method of control when applicable.
Construction Verification		After occupancy, provide 2 weeks of 15-minute trend history of space relative humidity (when controlled).

5.1.3 Cooling Robustness (Redundancy)

Performance		
Baseline		Failure of one machine (chiller, pump, cooling tower, etc.) will result in a building dry bulb temperature rise of no more than 5°F, and building maximum humidity <60% Relative Humidity (RH).
Tier 1		Failure of one machine (chiller, pump, cooling tower, etc.) will not result in a rise of building dry bulb temperature, and building maximum humidity <60% RH.
Tier 2		N/A
Tier 3		N/A
M & V		Commission cooling system at the most extreme temperatures and humidity levels possible, measuring performance with one of each equipment type turned off. Only one piece of equipment (chiller, pump, or cooling tower) should be turned off in each test.
Plans & Specs		
Calculations & Analysis		Show calculations for system performance upon failure of the largest of each type of machine, calculating performance at 0.4% cooling design dry bulb temperature at mean coincident wet bulb, at 0.4% design dehumidification dewpoint temperature at mean coincident dry bulb temperature, and (for evaporative machines) at the 0.4% evaporation design wet bulb temperature at mean coincident dry bulb temperature. Where chilled and condenser water temperatures change upon failure of the largest piece of equipment, consider the performance degradation from when deviating from design water temperatures. Upon an indoor dew point rise above 60%, the chilled water temperature reset function will be locked out.
References		ASHRAE Fundamentals Handbook, Chapter 14; ASHRAE HVAC Systems and Equipment Handbook.
Basis of Design		Show cooling capacity and operating parameters that will result in the performance indicated in the selected performance Tier.
Construction Verification		See M&V.

5.1.4 Heating Robustness (Redundancy)

Performance		
Baseline		Failure of one machine (boiler, pump, etc.) will result in a building temperature drop of no more than 5°F.
Tier 1		Failure of one machine (boiler, pump, etc.) will not result in a drop of building temperature.
Tier 2		N/A
Tier 3		N/A
M & V		Commission heating system at the most extreme temperatures possible, measuring performance with one of each equipment type turned off. Only one piece of equipment (boiler or pump) should be turned off in each test.
Plans & Specs		

Calculations & Analysis		Show calculations for system performance upon failure of any one (1) machine, calculating performance at 0.4% heating design dry bulb temperature at mean coincident wet bulb. Where hot water temperatures change upon failure of any one (1) piece of equipment, consider the performance degradation from when deviating from design water temperatures.
References		ASHRAE Fundamentals Handbook, Chapter 14; ASHRAE HVAC Systems and Equipment Handbook.
Basis of Design		Show heating capacity and operating parameters that will result in the performance indicated in the selected performance Tier.
Construction Verification		See M&V.
5.1.5 Air Movement		
Performance		
Baseline		Less than 0.2 m/s (40 fpm) at occupied level
Tier 1		Zone occupant-controlled air speed at the occupied level between 0.1 and 0.76 m/s (20 and 150 fpm). No more than 6 occupants per zone.
Tier 2		Individual occupant-controlled air speed at the occupied level between 0.1 and 0.76 m/s (20 and 150 fpm)
Tier 3		N/A
M & V		Baseline: No Tier 1: Yes Tier 2: Yes Tier 3: Yes
Plans & Specs		Yes
Calculations & Analysis		
References		ASHRAE 55, ASHRAE & SMACNA Procedural Guide
Basis of Design		Describe air speed performance and how it will be achieved by the proposed design.
Construction Verification		Verify space air speed at occupant level during TAB/Cx.
5.1.6 Pressure		
Performance		
Baseline		Positive building pressure when occupied, and when outside dew point is higher than 8ºC (47ºF) when unoccupied.
Tier 1		Active exterior space pressure control by floor to achieve 12Pa (0.05” wc) positive building pressure when occupied, and when outside dew point is higher than 8ºC (47ºF) when unoccupied.
Tier 2		Maintain building perimeter zones at 5 Pa (0.02” wc) positive pressure with respect to outdoor; control per exposure per floor when outside dew point is higher than 8ºC (47ºF). No design negative pressure spaces at building perimeter. Return air plenums require isolation near the perimeter.
Tier 3		Tier 2 AND provide envelope cavities at 5 Pa (0.02” wc) positive pressure with respect to interior occupied space when outside temperature drops below dew point of inside air.
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		ASHRAE Handbook – HVAC Applications, ASHRAE & SMACNA Procedural Guide
Basis of Design		Describe building air pressure performance and how it will be achieved by the proposed design.

Construction Verification		Prior to occupancy, provide 24 hours of 5-min trend history of building air pressure.

5.1.7 Ventilation

Performance		
Baseline		• Standard 62.1 Ventilation Rate Procedure only • Air Flow Measurement Stations (AFMS) on VAV systems
Tier 1		• Standard 62.1 Ventilation Rate Procedure only • Comply with LEED V4 IAQ building materials credits 4.1, 4.2, 4.3 & 4.4 • Air Flow Measurement Stations on VAV systems
Tier 2		• Standard 62.1 Ventilation Rate Procedure only • Comply with LEED V4 IAQ building materials credits 4.1, 4.2, 4.3 & 4.4 • Air Flow Measurement Stations on all systems
Tier 3		• Tier 2, AND: • Provide an occupant indoor air quality survey in the Post Occupancy Evaluation
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide Standard 62.1 VRP calculations for each air handling system
References		ASHRAE 62.1, ASHRAE & SMACNA Procedural Guide, ASHRAE 111
Basis of Design		Describe how minimum ventilation rates will be maintained for all systems.
Construction Verification		Verify HVAC system minimum ventilation rates during TAB/Cx. Provide 24 hours of 15-minute trend history of each AFMS to verify minimum ventilation control.

5.1.8 Filtration

Performance		
Baseline		Pleated MERV 13A filters are preferred (if available) for 100% recirculation air terminal units such as fan coil units (both Dx and hydronic), and fan powered boxes. Pleated MERV 13/10A to be provided otherwise. Pleated MERV 8 prefilters, and bag MERV 13A final filters for all central air handling units and DOAS/ERVs except for DOAS/ERVs units that have direct connections to air handlers with MERV 13A filters. Direct connect DOAS/ERV's must have MERV 11A filters. UV Lights for all central air handling unit cooling coils, including DOAS units. For Locations where Operational Management and Design for Smoke Migration Risk from Wildfires are determined to be part of the project scope, the HVAC unit filter module must be ready capable for installation of carbon air filters and the outdoor air intake/ductwork must have permanent filter racks capable for installation of MERV 15A filters and gas-phase filters suitable for removal of particulate and gaseous contaminants from smoke. See P100 section on Building Security Performance Requirements for the Interagency Security Committee (ISC) Standard filter requirements that supersede these requirements based on the building Facility Security Level.
Tier 1		In areas designated as Wildland Urban Interface areas, and areas known to periodically experience prolonged incidence of wildfire smoke, provide filter racks and fan performance that can accommodate MERV 15A bag filters in the event of prolonged wildfire smoke. Provide a set of MERV 15A filters and gas-phase filters suitable for removal of particulate and gaseous contaminants from smoke.
Tier 2		N/A
Tier 3		N/A
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide a completed 'Standard 52.2 Air-Cleaner Performance Report Summary with Option Conditioning Procedure According to Appendix J' form. All fields must be accurately populated to be considered complete and achieve the MERV-A classification of the specified filter media.

References		ASHRAE 62.1, ASHRAE & SMACNA Procedural Guide
Basis of Design		Describe proposed filtration design for all air handling systems.
Construction Verification		Verify installed filtration during TAB/Cx.

5.1.9 HVAC Noise Control

Performance		
Baseline		Comply with ASHRAE Applications Chapter 48, Table 1
Tier 1		Comply with ASHRAE Applications Chapter 48, Table 1 Provide sound masking in open office spaces per P100
Tier 2		Tier 1 AND Provide occupant indoor acoustical survey in the POE
Tier 3		N/A
M & V		Yes, Field Measurement of Sound Insulation in Buildings and GSA Workplace 20.20 testing protocol for speech privacy calculation in private offices (Tiers 1 & 2)
Plans & Specs		Yes
Calculations & Analysis		
References		ASHRAE Handbook – HVAC Applications, ASTM E336
Basis of Design		List design RC level goals for all space types and describe how design will meet these goals.
Construction Verification		Verify space acoustic sound levels during TAB/Cx.

5.1.10 HVAC Operational Efficiency

Equipment Performance		
Baseline		Comply with the more stringent of ASHRAE 90.1 Minimum Efficiencies or the most current version of FEMP Minimum Efficiency Requirements (FEMP Link). Chillers must comply with the more stringent of full load efficiency and integrated-part load value (IPLV) of ASHRAE 90.1 Path B Part Load Intensive Applications or FEMP Part-Load Optimized Applications. Submit a waiver if sizing chillers for full-load-intensive applications is recommended or required.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe what efficiency level is proposed for the HVAC equipment.
Construction Verification		CxP to confirm equipment efficiencies during equipment submittal review.

Fan Energy Performance		
Baseline		Comply with ASHRAE 90.1-Fan System Power Limitation Requirements
Tier 1		5% Below ASHRAE 90.1-Fan System Power Limitation Requirements

Tier 2		Comply with IgCC Fan System Power Limitation Requirements
Tier 3		5% Below IgCC Fan System Power Limitation Requirements
M & V		
Plans & Specs		Yes
Calculations & Analysis		Provide fan power limitation calculation per ASHRAE 90.1 Table 6.5.3.1.1. footnote A
References		
Basis of Design		Describe how fan energy performance will be less than metric.
Construction Verification		CxP to confirm fan equipment efficiencies during equipment submittal review.
HVAC Energy Metering		
Baseline		Comply with ASHRAE 90.1
Tier 1		Install on 50% of HVAC Energy
Tier 2		Install on 80% of HVAC Energy
Tier 3		Install on 100% of HVAC Energy
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide energy model results showing that % HVAC energy metering is met.
References		
Basis of Design		Describe proposed HVAC metering scheme.
Construction Verification		Calibrate all meters and provide 2 weeks of 15-minute trend history for all HVAC meters.
Whole Building Metering		
Baseline		All major utilities
Tier 1		Baseline AND All major building systems
Tier 2		Tier 1 AND Building subsystems
Tier 3		Tier 2 AND Tenant Metering
M & V		No
Plans & Specs		No
Calculations & Analysis		
References		
Basis of Design		Describe proposed building metering and subsystem metering scheme.
Construction Verification		Calibrate all meters and provide 2 weeks of 15-minute trend history for all HVAC meters.

5.2 MECHANICAL PERFORMANCE ATTRIBUTES

The premise of achieving higher levels of building performance is to provide indoor environments that are most conducive to comfort, health, and productivity; to increase the longevity of the property; and to deliver these in an optimally energy efficient and cost-effective manner. Protection of property includes assets such as wood furnishings, art, and archives where applicable, as well as minimizing detrimental effects of mold growth and material corrosion and decay.

5.2.1 TEMPERATURE

Temperature is one of several determining factors of a comfortable and productive environment; however, maintenance and control of temperature alone does not assure an acceptable environment. Other component attributes include air movement, humidity, acoustics, air quality, the physical and psychological dispositions of the occupants, and the ability of the occupants to have autonomy over the control of their environment. Increasing levels of indoor environmental performance as impacted by the discrete attribute of temperature are defined in the Performance Table.

5.2.2 HUMIDITY CONTROL

Humidity is one of several determining factors of an acceptable environment, but the limits for occupant comfort and productivity are much more widespread than the humidity limits required for asset protection and longevity. ASHRAE Standard 55, “Thermal Environmental Conditions for Human Occupancy,” does not require a lower limit of humidity with respect to maintaining an acceptable environment.

The high-performance tiers of humidity performance are intended to protect humidity-sensitive finishes and contents of the space, if present, such as art collections, rare documents, vulnerable woodwork, etc. The selected levels of performance reference the ASHRAE Handbook–HVAC Applications, Museums, Galleries, Archives, and Libraries.

Increasing levels of indoor environmental performance as impacted by the discrete attribute of humidity are defined in the Performance Table.

5.2.3 AIR MOVEMENT

Air movement is discussed under the temperature attribute because the amount and control of air movement directly affects the level of temperature control required to maintain a comfortable and productive environment. Levels of indoor environmental performance as impacted by the discrete attribute of air movement are defined in the Performance Table.

5.2.4 PRESSURE

Pressure is a factor contributing to longevity of the property and the resultant indoor air quality. Under ordinary conditions, the relatively small orders of magnitude of air pressure experienced in and immediately around a facility do not usually create uncomfortable indoor environments. Control of space pressurization is important, in overall facility operations, to manage moisture, water vapor, airborne contaminants, and the consequent effects of mold growth. Levels of building performance as impacted by the discrete attribute of pressure are as shown in the Performance Table.

5.2.5 VENTILATION

Ventilation is one of the key elements (along with source control and air cleaning) to achieving acceptable indoor air quality. Source control alone is not sufficient because it is impossible to eliminate all off-gassing materials in the built environment, and people are also a source of pollutants (bioeffluents). Hence, ventilation is required in all occupied spaces. ASHRAE Standard 62.1 is the consensus standard prescribing ventilation requirements in the United States. It has been integrated into the International Mechanical Code. See the Performance Table.

5.2.6 FILTRATION

Filtration and air cleaning can improve indoor air quality by removing contaminants from ventilation air. It is particularly effective in areas where outdoor air quality is poor. Particulate filtration can also improve air quality by reducing dirt on surfaces that can support microbial growth such as cooling coils. See the Performance Table.

5.2.7 HVAC NOISE CONTROL

Acoustics in the workplace can affect productivity, and excessive noise can also cause physical symptoms. Crosstalk in open offices can also be a detriment to worker productivity. However, there is no evidence to suggest that these factors are improved with lower sound pressure levels. Hence requirements are to simply meet the industry standard Room Criteria (RC) levels per Chapter 3 Acoustics.

5.2.8 TREATING BIOLOGICAL GROWTH IN WATER SYSTEMS

Building water systems must comply with ASHRAE Guideline 12, Minimizing the Risk of Legionellosis Associated with Building Water Systems and ASHRAE Standard 188, Legionellosis: Risk Management for Building Water Systems.

Figure 16: Ronald Reagan Federal Building Mechanical Piping Washington, DC

5.3 MECHANICAL PRESCRIPTIVE REQUIREMENTS

All mechanical and electrical equipment within the building or on the property must be in areas not subject to flooding. Refer to Chapter 4, Flood Resistant Design Requirements. Refer to the ISC for mechanical system requirements per the facility security level.

5.3.1 DESIGN CRITERIA

Outdoor air design criteria must be based on weather data tabulated in the latest edition of the ASHRAE Handbook of Fundamentals.

- Winter design conditions must be based on the 99.6 percent column dry bulb temperature.
- Summer design conditions for sensible heat load calculations must be based on the 0.4 percent column dry bulb temperature, with its mean coincident wet bulb temperature.
- Design conditions for the summer ventilation load, cooling tower selection, and all dehumidification load calculations must be based on the 0.4 percent dew point, with its mean coincident dry bulb temperature.

Table 5.1 Indoor Design Conditions–Supplemental Spaces

Type of Area	Summer DB	Winter DB
Locker rooms	26˚C (78˚F)	21˚C (70˚F)
Electrical rooms	26˚C (78˚F)	13˚C (55˚F)
Mechanical spaces	35˚C (95˚F)	13˚C (55˚F)
Main Electrical Room	27˚C (80˚F)	13˚C (55˚F)
Elevator machine room	26˚C (78˚F)	13˚C (55˚F)
Emergency generator room	40˚C (104˚F)	18˚C (65˚F)
Transformer vaults	40˚C (104˚F) or as required by utility	
Stairwells	(none)	18˚C (65˚F)
Storage room	30˚C (85˚F)	18˚C (65˚F)
Other		

5.3.1.1 HVAC LOAD CALCULATION REQUIREMENTS

Mechanical occupancy loads must be determined as follows:

- Determine occupant density (persons/m^2 or persons/ft^2) from the occupancy schedule of the Project Program of Requirements.
- In the event this information is not available, use the occupancy density values in ASHRAE 62.1.
- For dining areas, auditoriums, and other high-occupancy spaces, occupancy densities must represent the number of seats available.
- Sensible and latent loads per person must be based on the latest edition of the ASHRAE Handbook of Fundamentals.

The HVAC load calculations must be performed with a computer-based program using the latest ASHRAE Handbook of Fundamentals Heat Balance (HB) Method, Radiant Time Series (RTS) Method, or Transfer Function Method (TFM), developed for the hourly analysis of heating and cooling loads in commercial buildings.

The program must be capable of calculating each zone's peak heating and cooling loads as well as the whole-building simultaneous peak load. The program must, at a minimum, calculate solar gains through fenestration; internal gains from occupants, including latent heat for cooling purposes; internal gains from lighting and equipment; outside air loads (sensible and latent) from ventilation and infiltration; and heat and moisture gains or losses through fenestration, walls, floors, and roofs. The heating load calculations must be done without credit for occupants and internal gains. The HVAC load calculations must not include additional safety factors unless specifically asked for in the applicable tenant design guides.

Provide HVAC load calculations at each design phase. The HVAC load calculations report must include all input and output used in the heating and cooling calculation program. The report must also include zone peak heating and cooling loads results and whole-building simultaneous peak load, air-handling unit coil selections, and Psychrometric charts that show the complete cycle of all the processes in the HVAC system.

5.3.1.2 ENERGY ANALYSIS

A building energy analysis must be performed at each phase of the design to demonstrate that the building design meets or exceeds the energy performance goals established for the project. Energy software used for proof of compliance must conform to ASHRAE Standard 140.

The compliance methodology must be in accordance with Sections 5 (except Section 5.6), 6, 7, 8, 9, and 10 of ASHRAE 90.1. See P100 Appendix A.6 LCCA Requirements and 2024 P100 Submittal Matrix for the energy modeling and documentation requirements.

5.3.2 HVAC SYSTEMS

All projects installing HVAC equipment must use all-electric equipment. Ensure the analysis of alternatives and LCCA include ground source, air source, and water source heat pump technologies. See Chapter 1, Electrification.

The designer must specifically address capacity turndown with respect to minimum building loads, chiller tonnage/ boiler MMBtu, and pumping capacity.

5.3.2.1 CHILLER PLANT

Peak cooling loads must be met using equally sized chillers. The chillers must be sized to meet the peak cooling load. The chilled water system must be capable of turning down to 10% of peak load and designed to operate in a stable manner. All units must have adequate valving to isolate the offline unit without interruption of service. A waterside-economizer cycle must be analyzed during the design of the chiller plant and incorporated in the design if it improves the performance.

In addition to meeting the minimum efficiency requirements of the latest edition of ASHRAE 90.1, air-cooled and water-cooled electric chillers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

New chiller equipment may only use refrigerants listed as "Acceptable" by the EPA's Significant New Alternatives Policy (SNAP) Program, e.g. for centrifugal or positive displacement chillers. Refrigerants listed as Unacceptable may not be used in new chiller equipment at GSA projects, even where EPA's "unacceptable as of" date is in the future. Verify whether state and/or local jurisdictions have refrigerant use limitations in addition to those outlined by EPA SNAP. Refrigerants at or below 10 GWP should be prioritized if listed as "Acceptable" by SNAP. Only A1 Refrigerants are permitted for direct or high probability systems. Any refrigerant other than A1 must be contained within a machinery room complying with ASHRAE 15 and other applicable codes.

New chillers may only use refrigerants that meet the Global Warming Potential (GWP) Limit and installation compliance date established by the EPA Technology Transitions Restrictions on the Use of Certain HFCs under Subsection (i) of the AIM Act.

5.3.2.2 BOILER PLANT

The central boiler plant within the building or on the property must be provided with equally sized modular boilers. The boilers must be sized to meet the peak heating load. Increasing the boiler size for spare or backup capacity is not permissible. The boiler system must be capable of turning down to 10% of peak load and design to operate in a stable manner. All units must have adequate valving to isolate the offline unit without interruption of service.

In addition to meeting the minimum efficiency requirements of the latest edition of ASHRAE 90.1, boilers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

5.3.2.3 COOLING TOWERS

Each chiller must have its own matching cooling tower or cell, condenser, and chilled water pump. Multiple cooling towers must have equalizing lines and the necessary automatic control valves for individual chiller/cooling tower operation. The cooling tower fan(s) must be equipped with appropriately sized variable frequency drives to better control the condenser water supply temperature to the chiller(s). A minimum 4-foot clearance must be maintained between the top of the roof and underside of the cooling tower basin.

5.3.2.4 WATER DISTRIBUTION SYSTEMS

5.3.2.4.1 PRIMARY HEATING SYSTEMS

GSA requires low-temperature hydronic heating systems, with the lowest working pressure suitable for the system and a maximum temperature limitation of 93.3°C (200°F).

5.3.2.4.2 DISTRICT STEAM HEATING

When steam is furnished to the building, it must be converted to hot water with a heat exchanger in the mechanical room near the entrance into the building. Steam heating is discouraged inside the building, other than the conversion of steam to hot water in the mechanical room.

The designer must investigate the use of district steam condensate for preheating domestic hot water.

5.3.2.4.3 HYDRONIC SYSTEM GLYCOL

If glycol is used for freeze protection, it must be propylene glycol; use of ethylene glycol is prohibited.

5.3.2.4.4 PIPING SYSTEMS

Hot water and chilled water air systems must use a four-pipe main distribution system. Dual temperature piping systems are not permitted.

5.3.2.4.5 PIPING INSULATION

Pipes operating at a temperature below ambient must be insulated with closed-cell insulation with all joints sealed and having a system permeance of ≤0.02 perms, such as cellular glass, or with closed-cell insulation covered with a continuous vapor retarder with a permeance of ≤0.02 perms. All insulation and vapor retarder materials must meet the appropriate ASTM material standard for that type.

5.3.2.5 AIR DISTRIBUTION SYSTEMS

Supply air distribution systems must be fully ducted to the spaces that are served.

For plenum return air systems, the horizontal distance from the farthest point in the plenum to a return air duct must not exceed 50 feet. All transfer air openings must be sized with no more than 300 FPM air velocity.

5.3.2.6 ROOF-MOUNTED EQUIPMENT

Mechanical equipment, except for cooling towers, air-cooled chillers, Dedicated Outside Air Systems (DOAS), evaporative condensers, air-source heat pumps, condensing units, condensers, and exhaust fans, are not permitted on the roof of the building. Access to roof-mounted equipment must be by stairs or freight elevator; ship's ladders are not permitted. LPOE vehicle inspection booths are exempt from this requirement and may have rooftop equipment provided there is an efficient and safe way to access the equipment for maintenance and the LPOE vehicle lanes are not blocked during the equipment maintenance. See Chapter 3, Roofing and Horizontal Waterproofing-Membrane System for membrane requirements.

5.3.2.7 CONTROLS/BUILDING AUTOMATION SYSTEMS

For new construction, use direct digital control (DDC) with an open BACnet communication protocol in accordance with ASHRAE Standard 135.

For repair and alteration projects and new additions to existing projects, the following options are permitted: 1) installation of DDC with the BACnet or LonTalk protocol, 2) if existing system is primarily LonWorks, use of the LonTalk protocol is permitted, 3) integrating the existing system with customized gateways to the BACnet or LonTalk protocol.

All specified technologies must be Native BACnet and meet GSA Smart Building requirements, see GSA Order ADM 7002.1 Smart Buildings. Control capabilities and the connected points must comply with GSA Data Normalization for Building Automation Systems document except for variable refrigerant flow (VRF) systems which must identify the maximum number of points meeting the requirements and obtain approval from Facilities Management GSA Smart Buildings personnel and GSA PB-ITS prior to BAS system specification. The controls must be connected to a GSA IT remediated building monitoring and control system and successfully pass the GSA IT Security Procedural Guide: Building Monitoring and Control (BMC) Systems Security Assessment Process CIO-IT Security-16-76 six step security assessment process prior to being specified, purchased, and installed. Standalone systems are not permitted.

Contact the RPMT for access to the Telecommunications Distribution Design Guide for coordination.

5.3.2.8 COORDINATION OF DIGITAL CONTROL SYSTEMS

Digital building control systems are beginning to share common protocols, compatible equipment, and uniform standards with other building IT services. GSA seeks BAS designs that integrate with other IT systems to minimize costs and improve operations. Since this technology is in a constant state of improvement and contract methodologies are not well established in the design and construction industry, the design team and RPMT must coordinate the design of controls and monitoring systems with the PBS CIO (Chief Information Officer) and the Regional Smart Building Team or primary Smart Building POC at the beginning of design. These systems include, but are not limited to utility metering, HVAC building automation systems, lighting controllers, and renewable energy systems.

The CIO may provide Government Furnished Equipment and will specify system components to insure compatibility with the GSA network. Related IP network design must be reviewed and approved by the CIO. All network connections will be made through the GSA network. All server applications must be able to be hosted in a virtual server environment. Other GSA IT policies and procedures may also apply.

Any use of external/commercial network connection for managing or monitoring of building systems in any GSA owned, non-delegated, building will not be tolerated. Such connections will be removed upon discovery.

5.3.2.9 BUILDING AUTOMATION SYSTEM SOFTWARE

BAS is often thought of as the central system for smart buildings. These systems are designed to control the Heating, Ventilation, and Air Conditioning (HVAC) equipment from the chiller plant to the thermostat on the wall. HVAC is a major energy consumer in most commercial facilities and therefore offers a big opportunity for energy savings

Any BAS software system must follow all GSA IT and Smart Building system requirements. This includes requiring that all IP addressable devices complete the Scan and Remediation process as well as all networking infrastructure (switches, routers, servers, and workstations) must be Government furnished. The RPMT will provide the Building Technologies Technical Reference Guide for details on scanning, servers, and other network requirements along with all Smart Building documentation to address Smart Building requirements.

BAS software must be installed in the GSA environment, including server software, client software, and any additional tools needed for management and control of the system. This includes system update tools, network management tools, and any software that is used to make changes to the controllers.

BAS software must be compatible with the most current version of required standard software and all OS and database software updates (Microsoft Server, Linux, SQL, etc.)

BAS software must be capable of trending and exporting data.

BAS software must have multiple user level controls, including administrator, programmer, and users. These user levels must be capable of an audit to determine operator’s use.

BAS software credentials must be unique for every user.

BAS software must be installed with a minimum number of licenses needed for system use. In cases of virtual environment installation, the number of licenses required should consider the cases in which client use could come from an off-site user.

BAS client software must have point-and-click graphics, configured for system operators, unless integration to the GSA Unified User Interface application is included in the project scope.

BAS software licenses must be software licenses and not rely on a physical license key or dongle.

BAS must be licensed to GSA. End user license agreements (EULA) must be approved by GSA IT prior to installation onto GSA equipment.

5.3.2.10 BUILDING AUTOMATION SYSTEM CONTROLLERS

Building Automation systems generally rely on network controllers that communicate to a server and control edge devices. (Note: Rapid Spanning Tree Protocol or similar must not be proposed or utilized for edge devices within the GSA inventory at this time. Please see the Building Technologies Technical Reference Guide for additional information.) These controllers are generally the system engines making most of the control decisions. The following apply for all BAS controllers:

Building automation systems must be 100 percent DDC systems, utilizing a server, controller, and edge device hierarchy.

BAS controllers must be programmed to maintain schedules, set point and normal operation control in cases of network connection loss. Network connection loss scenarios must be tested and verified as part of the commissioning process for any BAS.

BAS controllers must be capable of storing data and uploading data in case the server connection is lost.

BAS controllers must be capable of hosting graphics or terminal interfaces to allow for direct connection and control from a workstation for emergency control. This could be accomplished over IP, serial, or USB connections.

BAS controllers must have embedded tools or means to direct connect that allow for troubleshooting or programming in cases of communication loss. Means to “direct connect” to building system controls could include IP, serial cable, or USB connectivity options. Please see the Building Technology Technical Reference Guide for details on IT Security requirements.

Building automation systems are subject to PBS fire protection/life safety requirements, e.g., fire alarm systems may permit read-only data interchange with, but may not share control infrastructure with, other building automation systems. See Chapter 7. This information is from the OFM “Technology Policy for PBS-Owned Building Monitoring and Control Systems” dated December 2022. See the RPMT for access to Building Technologies Technical Reference Guide for more information.

5.3.2.11 POINT NAMING

GSA has created a point naming convention for standardization of point naming for all new construction, ESPC, and repair and alteration projects. The intent of this standard is to establish and require a consistent means of naming building automation points across the GSA portfolio. The term “point” is a generic description for the class of object represented by analog and binary inputs, outputs, and values either physical or virtual. All systems must use this naming convention and process. Point naming must be consistent through system drawings, records, files, and documents. Please reference GSA Data Normalization for Building Automation Systems_v2.5 for more information.

Designs for Building Control System and HVAC controllers are unique to every project. Designs can be influenced by budget, climate, system type, size of system, desired sequence of operations, existing infrastructure, and a multitude of other factors. As such, the equipment, level of control, sensors, and sophistication of systems will vary greatly. Good system design and proper control sequence documentation will always clearly dictate the points in a BAS required to execute the control sequence.

5.3.2.12 INTEGRATED SEQUENCES OF OPERATIONS (ISOO)

Successful designs hinge on the smooth, integrated interaction between the systems installed in a building and the functions they are to perform. Integrated Sequences of Operations (ISOO) allow for more unified controls strategies and can not only save energy but improve the tenant experience. By allowing building systems to act in unison and react to changing conditions identified by each system, a smarter, more efficient solution can be realized. Integrated sequences must be considered in all designs.

Sequences of Operation must follow the most recently published version of ASHRAE Guideline 36, High-Performance Sequences of Operation For HVAC Systems. Provide the hardwired points required in Guideline 36, Section 4, List of Hardwired Points, with the following additions:

- All fan statuses (including supply, return, relief, fan-powered boxes) are Required
- All filter pressure drop transducer analog inputs are Required
- Outside air flow sensors are Required
- Each controlled air distribution zone must have a BAS-connected air flow sensor
- Air handler sensors including MAT, RAT, heating coil SAT are Required
- Chilled water plant and hot water plant points marked as O (Optional) must be supplied as A-Apply (Apply if the feature/system hardware is included by the designer)
- All CO2 sensors marked as A (if applicable) are Required

Location of all pressure sensors controlling the VFDs (Air and Water sides) must be shown clearly on design documents and as-built drawings. Riser diagrams and floor plans must clarify the exact location for the pressure sensors. In addition, appropriate notes will be included in BAS graphics to clarify the location of the sensors for building operating staff. To identify the exact location of the sensors, floor level and structural column numbers must be used instead of room names/numbers.

5.3.2.13 SPACE UTILIZATION SYSTEMS

5.3.2.13.1 HOTELING

Effective management of tenants and space utilization presents another unique way to save resources across a portfolio. These activities, in unison with mechanical and electrical building systems, cannot only provide efficiencies but can improve tenant satisfaction.

Hoteling systems allow for automated control of building populations and space sharing. Implementing a system that can dynamically control population and distribution of tenants can allow for a greater balance of resources in a smaller footprint. Hoteling systems must be considered when building populations are flexible and operations allow for a mobile tenant.

Hoteling systems must be coordinated with tenant agencies, facility managers, and operations and maintenance organizations to ensure the understanding of multiuse tenant space and how it affects the Building Operation Plan (BOP).

When utilizing a hoteling system, the information available on occupancy, space utilization, and population density should be used to best manage the other building systems. This information may be connected directly to schedules of HVAC and lighting controls to ensure the systems are only occupied when spaces are reserved or may be useful indicators to system operators of expected building population for a given day.

If tenant space is flexible and reservations are required, facility managers and operators must consider using the reservation system to “dynamically stack” the building. By consolidating the population into a select area, areas, wings, or entire floors could be put into an “unoccupied” mode, reducing the energy use. This dynamic stacking requires flexible tenants and tenant spaces but offers great energy savings when fully deployed.

5.3.2.13.2 OCCUPANCY COUNTING

Public buildings or offices that share spaces can have large fluctuations in the building population, and these variances often go unnoticed by building systems. Deploying occupancy detection or people counting technology can help maximize building utilization, manage effective use of shared workspaces, and improve the operation of mechanical systems. Several solutions to occupancy counting include but are not limited to physical access control systems or passive sensor technologies placed at entries and exits.

Occupancy counting systems should be configured to capture all regular entry and egress locations. The data from these systems must provide a live count of the population inside a building. Occupancy counting systems must be designed and installed with methods of utilizing the data they create with the ability to save and archive occupancy data. This data could be useful for digital signage (normalizing energy usage per person), HVAC control, security, or other building operations, and as such must be integrated (at minimum) to the Building Automation System. If the building has been or is scoped to be connected to the GSA Unified User Interface application, all occupancy related data should be integrated to the interface application as well. Any device or system installed to monitor or record use of a means of egress must be designed and installed to meet the requirements in NFPA 101 so that it cannot, even in case of failure, impede or prevent emergency use of such means of egress. Any Occupancy counting system must follow all GSA IT and Smart Building system requirements. This includes requiring that all IP addressable devices complete the Scan and Remediation process as well as all networking infrastructure (switches, routers, servers, and workstations) must be Government furnished. The RPMT will provide the Building Technologies Technical Reference Guide for details on scanning, servers, and other network requirements along with all Smart Building documentation to address Smart Building requirements.

5.3.2.14 WILDFIRE SMOKE MODE

Wildfire smoke is affecting locations that previously were never affected. This is expected to continue. New and existing buildings which house mission critical activities that are in or adjacent to wildfire-prone areas or have already endured smoke incidents must have the capability to readily adapt to a “Smoke Mode” operation during these events that can:

- filter out smoke contaminants

- operate at a slight positive pressure
- operate so that exhaust air systems function properly

These systems must comply with [ASHRAE Guidance for Commercial Building Occupants from Smoke During Wildfire Events].

5.3.2.15 TESTING, ADJUSTING, AND BALANCING

Specify testing, adjusting, and balancing (TAB) procedures that result in not only the operation of individual pieces of equipment, but also the operation of the overall HVAC and plumbing systems, in accordance with the design intent. The TAB contractor who performs these procedures must have up-to-date certification by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting, and Balancing Bureau (TABB).

5.3.2.16 AIR CONDITIONING AND HEAT PUMP REFRIGERANTS

New air conditioning and heat pump equipment may only use refrigerants listed as "Acceptable" by the EPA's SNAP Program for air conditioning and heat pumps. Refrigerants listed as Unacceptable may not be used in new air conditioning or heat pump equipment at GSA projects, even where EPA's "unacceptable as of" date is in the future. Verify whether state and/or local jurisdictions have refrigerant use limitations in addition to those outlined by EPA SNAP. Refrigerants at or below 10 GWP should be prioritized if listed as "Acceptable" by SNAP. Only A1 Refrigerants are permitted for direct or high probability systems. Any refrigerant other than A1 must be contained within a machinery room complying with ASHRAE 15 and other applicable codes.

New air conditioning and heat pump equipment may only use refrigerants that meet the Global Warming Potential (GWP) Limit and installation compliance date established by the EPA Technology Transitions Restrictions on the Use of Certain HFCs under Subsection (i) of the American Innovation and Manufacturing (AIM) Act.

5.3.2.17 CONNECTIVITY TO THE GSA NETWORK AND IP ADDRESSABLE DEVICES

Note: additional information on all the items below can be found in the Building Technologies Technical Reference Guide (BTTRG.)

5.3.2.17.1 OCCUPANCY COUNTING

BMC devices relate to all IP addressable devices to be connected to the GSA network in support of Smart Buildings and Building Automation. Those devices may be, but are not limited to: HVAC, Lighting Controls, Metering, ePACS, Sensors, Elevators (Emergency Communications System), Fire & Life Safety (dual path communicators).

All BMC devices must be submitted for scanning & remediation and approved prior to installation on the GSA network.

5.3.2.17.2 RAPID SPANNING TREE PROTOCOL (RSTP)

This is a solution preferred by some vendors for connecting edge devices to the GSA network by utilizing the second port of a BAS device/controller and creating a "loop" with the devices. This protocol is not currently accepted by GSA.

5.3.2.17.3 IPV6

This is a federal mandate that GSA is adhering to. As of July 1, 2023, any non-compatible IPv6 devices will not be accepted or allowed onto the GSA network.

5.3.2.17.4 VULNERABILITY PATCHING

All IP addressable components must complete vulnerability patching within 30 calendar days of issuance of said patch.

VM servers will be patched by GSA, while the applications residing on the VM are the responsibility of PBS (vendor supported).

5.3.2.17.5 SMART BUILDING REVIEW OF PROJECTS (SB SIGN-OFF PROCESS)

Sign-off Process:

1. GSA employees, contractors and representatives must work with regional SB contacts or their designees to initiate projects and confirm official signoff has been obtained through key project milestones.
2. Coordination should be initiated through the regional SB contacts or their designees to align stakeholders.
3. Stakeholders will include the regional facility management SB specialists, PBS SB IBIEs, and GSA-IT regional BTSD technical PMs.

In accordance with the Federal Information Security and Management Act, GSA IT must be engaged before the acquisition package is submitted for all procurements that include information technology (IT) components (e.g., IP-enabled devices, network connectivity, cloud components, and wireless).

5.3.3 HVAC COMPONENTS

5.3.3.1 AIR HANDLING UNITS

All air handling units (AHUs) must have DDC (BACnet or LonTalk) self-contained controls that are capable of being connected to the central BAS. Controller must have a current-sensing device that transmits information to the BAS for calculating the energy consumption of the AHU motor.

All AHUs except OAVS must be provided with factory-fabricated mixing boxes on the return side of the AHU.

AHU housing must consist of formed and reinforced, insulated panels, fabricated to allow removal for access to internal parts and components. All AHUs must be double wall construction.

There must be a maximum 1 percent leakage on the casing. Outside air intakes for AHUs with air side economizers must be provided with minimum and maximum outside air dampers.

Refer to Chapter 6 for requirements on variable frequency drive systems.

5.3.3.2 OUTDOOR AIR INTAKE LOCATIONS

The placement and location of outdoor air intakes must follow the ISC standard.

Place outdoor air intakes on rooftops or walls at least 30 feet (three stories) above grade. Table 5.2 provides requirements for minimum separation distances between ventilation air intakes and other building features.

Outdoor air intakes and distribution, if not conditioned, must be ducted directly to the Air Handling Unit or terminal unit supplying air to the space; the equipment room or plenum must not be used as an outdoor air intake plenum.

Table 5.2 Air Intake Minimum Separation Distances

Object	Min Distance in m	Min Distance in ft
Garage entry, loading dock	7	25
Driveway, street, or public way	3	10
Limited-access highway	7	25
Cooling tower or evaporative condensers	7	25
Exhaust fans and plumbing vents	5	15
Kitchen exhaust air	7	25
Mail Rooms and Entrance Lobbies	9	30

5.3.3.3 TEMPERATURE AND AIRFLOW CONTROL

Psychrometric process charts must be prepared for each air-handling unit application, characterizing full-load and part-load operating conditions for all processes in the system. Air-handling unit/coil designs must ensure that conditioned space temperatures and humidity levels are within an acceptable range, per programmed requirements.

5.3.3.4 COOLING AND HEATING COILS

Equipment and other obstructions in the air stream must be located sufficiently downstream of the coil so that it will not meet the water droplet carryover. Cooling coils must be selected at or below 2.5 m/s (500 fpm) face velocity. Heating coils must be selected at or below 3.8 m/s (750 fpm) face velocity.

HVAC coils subject to outside air in hot, humid, and marine climates must be provided with copper tubes and copper fins or electro coated copper tubes with electro coated aluminum fins with a coating thickness to be maintained between 0.6 –mil and 1.2- mil and with minimum salt spray resistance of 6,000 hours. For urban environments and combined urban/marine environments, aluminum fins with electro coating are preferable to copper fins for NOX/SOX corrosion protection from fossil fuel combustion products.

Individual finned-tube cooling coils of five or fewer rows may have a maximum of 12 fins per inch. Individual finned-tube cooling coils of six rows or more must not exceed 10 fins per inch.

5.3.3.5 BOILERS

Boilers for hydronic heating applications must be modular units. Boilers must be installed in a mechanical room with all provisions made for breaching, flue stack, and combustion air. Modular systems must have bank controllers and grandmaster bank controllers to prevent individual modules within a bank from simultaneously cycling ON/OFF with another separate bank of modules.

Boilers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

5.3.3.6 HYDRONIC, STEAM, NATURAL GAS, AND FUEL OIL PIPING

HYDRONIC
Materials acceptable for hydronic piping are black steel and copper. Specify ASTM A53 Sch 40 black steel pipe up to 12 in. diameter. For hydronic piping 12 in. and larger, use schedule 30 pipe. For copper piping, specify type L copper for above ground and type K for below ground.

STEAM and CONDENSATE
Steam piping must use ASTM A53 Sch 40 and all steam condensate must use ASTM Sch 80.

FUEL OIL
Fuel oil piping must be ASTM Sch 40.

NATURAL GAS
Natural gas piping must be ASTM Sch 40. Only Sch 40 black steel pipe is acceptable. Gas piping must comply with Chapter 4 of the International Fuel Gas Code. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but must not be used in concealed locations.

STEEL PIPE FITTINGS
For steel piping, threaded malleable iron fittings for 50mm (2in) and under, and welded Sch 40 fittings for pipes 64mm (2 ½in) and over are acceptable.

Grooved fittings are acceptable for water services 110-deg C (230 deg F) and under. All grooved products must be of a single manufacturer. The grooving tool must be of the same manufacturer as the grooved components. The grooved manufacturer must provide on-site training for the contractor’s field personnel and must periodically visit the job site to ensure best practices in grooved joint installation are being followed. Grooved pipe and fittings must not be installed in concealed spaces, shafts, or above hard ceilings. Coordinate access for future repairs or replacements.

Steel Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but must not be used in concealed locations.

COPPER PIPE FITTINGS
For copper piping, brazed, soldered, and press-seal (test to 2100 1050 kPa [300 150 psi]) fittings are acceptable. Grooved or mechanically formed T-type fittings are not acceptable. Piping must not be installed in concealed locations when press-seal fittings are used.

Refrigerant piping must be Type ACR or Type K copper with brazed joints. Installation must comply with all requirements of ASHRAE Standard 15 Safety Standard for Refrigeration Systems and ASHRAE Standard 34 Designation and Safety Classification of Refrigerants, refrigerant concentration limits. ASHRAE Standard 15 and ASHRAE Standard 34 refrigerant concentration limit calculations must be provided for each space containing refrigeration piping for each design phase submittal."

Refrigerant piping must be installed in accessible areas (i.e. corridors, machine rooms, etc.) and be located at a ceiling height that would make the piping accessible for repair and replacement. Cooling coil condensate piping must be Type L copper.

CONCEALED LOCATIONS
Concealed locations are defined as those areas where there is no direct access such as pipe chases, hard ceilings (access doors do not change the definition of a hard ceiling to accessible) and other inaccessible locations. Interlocking ceiling tile systems are considered inaccessible, but acoustical ceiling tile is not.

5.3.3.7 HYDRONIC PUMPS

Pumps must be centrifugal type and must generally be selected to operate at 1750 RPM. The number of primary pumps must correspond to the number of boilers, chillers, or cooling tower cells plus a stand-by pump. Secondary piping systems must be provided with variable flow pumping system with a stand-by pump.

Refer to Chapter 6 for requirements on variable frequency drive systems.

5.3.3.8 ISOLATION OF PIPING AT EQUIPMENT

Isolation valves, shutoff valves, bypass circuits, drain valves, flanges, and unions must be provided for piping at equipment to facilitate equipment repair and replacement. Equipment requiring isolation includes boilers, chillers, pumps, coils, terminal units, and heat exchangers. Valves must also be provided for zones off vertical risers, including drain valves.

5.3.3.9 HOUSEKEEPING PADS

Housekeeping pads must be provided for floor mounted equipment and must be minimum 152 mm (6 in.) high and must extend minimum 102 mm (4 in.) beyond on all sides of the equipment they support.

5.3.3.10 FLEXIBLE PIPE CONNECTORS

Flexible pipe connectors must be fabricated from annular close pitched corrugated and braided stainless steel. All pumps, chillers, cooling towers, and other rotating equipment must have flexible connectors. All flexible piping must be sized one size larger than the piping connected size.

5.3.3.11 COOLING TOWERS

Galvanized steel is prohibited on water contact surfaces for cooling towers.

5.3.3.12 METERS, GAUGES, AND FLOW MEASURING DEVICES

Each piece of mechanical equipment must be provided with instrumentation (e.g. analog pressure and temperature gauges) in addition to test ports to verify critical parameters, such as capacity, pressures, temperatures, and flow rates. Each meter, gauge, and flow measuring device must be calibrated before startup and must have provisions for periodic calibration at its location. All the metering devices must be capable of transmitting information to the central BAS for monitoring and control.

5.3.3.13 AIR SOURCE HEAT PUMP DOMESTIC WATER HEATER CONDENSER DISCHARGE

Where practical and cost effective, cold discharge air from an air source heat pump domestic water heart condenser must be recovered and diverted into adjacent electrical rooms, mechanical rooms, I.T. / Telecom closets, etc. via ductwork and/or louvers, for supplemental cooling service. This supplemental source of cooling must not be the only means of cooling for the space, as it is intended to complement the primary cooling source as an energy recovery measure.

5.3.4 AIR DISTRIBUTION

5.3.4.1 AIR DELIVERY DEVICES

Ceiling diffusers or booted-plenum slots must be specifically designed for VAV air distribution. Booted plenum slots must not exceed 1.2 m (4 ft.) in length unless more than one source of supply air is provided. For mixed air systems, the locations of the air delivery devices and the ranges of their outlet airflow rates must be selected to ensure that the air diffusion performance index values remain above 80 percent during all full-load conditions (NOTE: ADPI is not applicable to displacement air systems), and below the specified noise level to achieve the background noise criteria, in accordance with the test procedures specified in Appendix A of ASHRAE Standard 113. Adequate space ventilation requires that the selected diffusers effectively mix the total air in the room with the supplied conditioned air that contains adequate ventilation air.

Table 5.3 Recommended Air Velocities for Supply, Ducted Return, and Exhaust. Submit with Basis of Design

Application	Main Ducts m/s	Main Ducts fpm	Branch Ducts m/s	Branch Ducts fpm
Private offices Conference rooms Libraries	6	1,200	4	800
Theaters Auditoriums	4	800	2	400
General offices	7.5	1,500	5	1,000
Cafeterias	9	1,800	6	1,200

5.3.4.2 NOISE CONTROL IN DUCT SYSTEMS

Acoustic duct lining used in air systems must be non-fiberglass material impregnated with an antimicrobial agent and, above 6 m/s (1200 fpm), covered by an internal perforated sheet metal liner.

5.3.4.3 DUCT CONSTRUCTION

All conventional supply, return and exhaust air ductwork must be fabricated of galvanized sheet metal, unless otherwise indicated.

5.3.4.4 FLEXIBLE DUCT CONNECTORS

Flexible duct connectors must be limited to a maximum of 5-feet of distribution and are only permitted to make final connections between terminal branch ductwork and air outlet. The use of flexible ductwork is not permitted above hard ceilings that are not easily accessible.

5.3.5 WATER TREATMENT

5.3.5.1 SUBMITTAL REQUIREMENTS

A licensed water treatment specialist must design the water treatment for closed and open hydronic systems with consideration of the operational and maintenance needs of all system equipment, including such components as boilers, chillers, cooling towers, other heat exchangers, pumps, and piping. The design must address four aspects of water treatment: biological growth, dissolved solids and scaling, corrosion protection, and environmental discharge regulations. Subject to the specific requirements of the components, the performance of water treatment for closed and open systems must include:

5.3.5.2 CLOSED SYSTEMS

- The pH must be in the ranges of 8.5–9.5 for chilled water systems, and 9–10.5 for heating water systems.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- Total dissolved solids must have a maximum value not to exceed 1500 ppm.

5.3.5.3 OPEN SYSTEMS

- The pH of the water must be maintained between 7.5 and 9.5.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- The iron content of the water must have a maximum value not to exceed 3 ppm.
- Soluble copper must have a maximum value not to exceed 0.2 ppm.
- Total dissolved solid must have a maximum value of 1500 ppm.
- Total aerobic plate counts must have maximum values not to exceed 1,000 organisms/ml, and an additional limit of 10 CFU/ml Legionella.

The methods used to treat the systems' makeup water must have demonstrated prior success in existing facilities on the same municipal water supply and must follow the guidelines outlined in ASHRAE Handbook of HVAC Applications.

The chemical feed system must have BACnet or LonTalk self-contained controls.

5.3.5.4 CORROSION MONITORING

The Contractor must install coupon racks, or an equivalent electronic monitoring system for corrosion, in condenser water loops, heating hot water loops, steam condensate loops, and the building main chilled water loop, if not already present, not later than 30 calendar days after submission of the water treatment plan. (For the primary condenser water system, the installation of the water treatment monitoring system described elsewhere in this document meets this requirement.) The Contractor must propose the type and manufacture of the proposed coupon racks to be installed to the CO or their designee for final approval before installation. If coupon racks are present, the Contractor may use such existing equipment, but is responsible for bringing it into conformity with all requirements in this document. The minimum quantity of coupons and frequency of inspections must be described in the water treatment plan. Laboratory analysis of coupons must be no less frequent than quarterly for major systems (e.g., primary building condenser and chilled water loops, as opposed to specialized systems serving limited areas), and annually for other systems. At a minimum, a two-station coupon rack must be installed for each loop and used to monitor mild steel and copper pipes. Coupon racks will be the property of the Government upon installation. The Contractor must have responsibility for maintaining (and if necessary, replacing) the coupon racks for the duration of the Contract. The liability threshold for repairs does not apply to this equipment; the Contractor has full responsibility. Acceptable corrosion rates are established in the most current Public Buildings Service Operations and Maintenance Standards. Molybdenum must not be used in GSA buildings.

5.4 PLUMBING

All projects installing domestic water heating (service water heating) equipment must use all-electric equipment. Ensure the analysis of alternatives and LCCA include solar water heating, ground source, air source and water source heat pump water heater technologies. When using electric resistance water heaters, size equipment based on careful consideration of intended usage (e.g. showering), recovery rate, and any hot water storage capacity. See Chapter 1, Electrification.

In compliance with EISA 2007 Section 433(a), water conservation technologies must be applied to the extent that the technologies are life-cycle cost-effective.

GSA requires the use of plumbing products labeled under the EPA WaterSense program. WaterSense is a partnership program sponsored by the U.S. Environmental Protection Agency. Its mission is to protect the future of our nation's water supply by promoting and enhancing the market for water-efficient products and services. More information is available at EPA WaterSense.

All plumbing fixtures must be water-conserving/saving-type fixtures, faucets, and valves. Low-flow water fixtures must be provided. Plumbing Fixtures and Fittings must comply with IgCC Section 6.3.2.1. Water Closet flush valves must be manual dual flush.

Modifications to point-of-use water outlets used for human consumption or washing purposes must include post-installation flushing and testing procedures that comply with the most current version of the PBS Drinking Water Policy and Desk Guide.

Plumbing fixture accessibility clearances, installation, and accessories must be compliant with the Architectural Barriers Act Accessibility Standard (ABAAS).

Dead legs are prohibited in potable water plumbing, to lessen the risk of Legionella proliferation.

Janitorial closets must be provided with domestic hot and cold water.

5.4.1 KITCHEN FAUCETS

Maximum water use—5.7 L/min (1.5 gpm) when tested in accordance with ASME A112.18.1/CSA B125.1.

5.4.2 DRINKING FOUNTAIN WITH BOTTLE FILLING STATION

In addition to the IgCC requirement, provide a minimum of one bottle filling station per floor with the accessible drinking fountain.

5.4.3 EMERGENCY FIXTURES

Eyewash (0.025 L/s [0.4 gpm] per fountain), face wash (0.2 L/s [3 gpm] each), or shower (1.3 L/s [20 gpm] each) must be tempered immediately at the fixture or group of fixtures within 7.6 m (25 ft) to deliver tepid water between 29°C (85°F) and 37.8°C (100°F), at 0.207 megapascal (30 psi), within 10 seconds, for a minimum period of 15 minutes, and must account for temperature drop across the valve (generally 7°C or 20°F) at flow.

5.4.4 SOLAR WATER HEATING

In compliance with EISA 2007, if lifecycle cost-effective, as compared to other reasonably available technologies, meet at least 30 percent of the domestic hot water demand for each new federal building or federal building undergoing a major renovation through the installation and use of solar hot water heaters.

5.4.5 PLUMBING PIPING

SANITARY, WASTE, VENT, AND STORM PIPING

Sanitary, waste, vent, and storm piping above ground must be hub and spigot service weight cast iron pipe and fittings with compression gaskets conforming to the requirements of ASTM C564 or hubless pipe and fittings must be service weight cast iron pipe and fittings conforming to ASTM A 888 with heavy duty couplings complying with ASTM C1277 and ASTM C1540, stainless steel shield with stainless steel bands (4 straps) with tightening devices. A two-strap fitting does comply with code, but a 4 strap is mandatory. ASTM C564 rubber sleeve with integral center rubber stop will not be accepted.

No PVC pipe and fittings allowed except as noted in the paragraph below. Type DWV Copper piping with soldered joints may be used for piping above ground (except for urinal drains) in lieu of cast iron pipes for pipe sizes 102 mm (4”) and under. Where copper tubing is used for urinal drains, the tubing must be “K” copper. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but must not be used in concealed locations.

Sanitary, waste, vent, and storm piping below ground must typically be hub and spigot service weight cast iron pipe and fittings with compression gaskets conforming to the requirements of ASTM C564. Sanitary, waste, vent, storm PVC and HDPE pipe and fittings may be used below ground in lieu of the typical cast iron pipe and fittings. Pipe and fittings must be schedule 40 DWV type and conform to ASTM D 2665 solid wall PVC pipe. PVC pipe with cellular core, foam core or composite core is NOT approved for use. Piping installed in stable soil must conform with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications. Piping installed in unstable or unusual soil conditions must conform with ASTM F2536 Standard Guide for Installing Plastic DWV Piping Suspended from On-Grade Slabs.

Any project scope related to piping up to five (5) feet outside of the building, reference Chapter 4, Site Utilities.

DOMESTIC WATER PIPING

Above ground domestic water piping must be Type L copper with lead free solder joints. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but must not be used in concealed locations. Solid copper supply lines must be installed from the fixture shut off valve to the fixture connection. Flexible water connectors from the fixture shut off valve to the fixture connection are not permitted. Plumbing fixtures with factory provided flexible water connectors are not permitted. All copper piping used in below ground water applications must be Type K copper with lead free solder joints. Press fitting systems are not allowed for below grade piping.

Provide a recirculation loop on all cold-water risers and major branch distribution ends, for flushing purposes.

CONCEALED LOCATIONS

Concealed locations are defined as those areas where there is no direct access such as pipe chases, hard ceilings (access doors do not change the definition of a hard ceiling to accessible) and other inaccessible locations. Interlocking ceiling tile systems are considered inaccessible, but acoustical ceiling tile is not.

5.4.6 ISOLATION VALVES

Isolation valves must be provided on all lateral piping entering all bathrooms, mechanical rooms, kitchens, and other rooms provided with domestic water where there is at least more than one fixture. These valves must be in areas that can be reached without the use of a ladder, and are easily accessed, in case of an emergency. All locations must be identified with a printed sign. Valves must be exercised regularly.

For detention areas in courthouses, isolation valves must not be in prisoner holding cells.

5.4.7 HOSE BIBBS

Hose bibbs must be provided along all exterior facades at ground level and rooftop level of the building at a minimum increment of 100 FT on center. Hose bibb locations and distance to be determined based on design and input from the regional GSA facility management team. Hose bibbs must also be provided in mechanical rooms and parking structures. Ensure that hose bibbs are easily accessible and able to be isolated for future repair/replacement without having to perform an entire system drain down.

5.4.8 FLOOR DRAINS

Floor drains must be provided in all bathrooms, mechanical rooms, kitchens, kitchenettes, lactation rooms and other rooms provided with domestic water. Floor drains must have either deep traps, trap primers or waterless trap primers.

5.4.9 OVERFLOW PANS

Overflow pans are required to be furnished under all domestic hot water heaters. Pans are required to be equipped with water sensing controllers that will shut off water to the units and send an alarm to the BAS system, or produce an audible alarm if the BAS is not capable.

5.4.10 FUEL STORAGE TANKS

Aboveground storage tanks (ASTs) and underground storage tanks (USTs) used to store fuel are herein referred to collectively as fuel storage tanks (FST). All newly installed FSTs must be installed in accordance with all federal, state, and local regulatory requirements, codes, and GSA Policy including Order PBS 1095.2.

USTs must meet the regulatory design, monitoring, and installation criteria for USTs whether or not the UST meets the regulatory definition of a regulated UST. Each new UST must also be equipped with an automatic tank gauge (ATG).

Upgrades to USTs must meet current regulatory requirements and include a method of continuous leak detection that can detect a release from any portion of the tank and the connected underground piping that routinely contains product. Based on engineering soundness, existing tanks must also be retrofitted with ATGs.

Aboveground storage tanks must be equipped with a method of leak detection and appropriate secondary containment.

5.5 OPERABILITY AND MAINTAINABILITY

5.5.1 ACCESSIBLE FOR MAINTENANCE

Install equipment so that it can be safely and easily maintained and inspected. Comply with requirements for mechanical room sizes and manufacturer's recommended clearances around installed equipment.

Do not install equipment that requires maintenance below a raised access floor.

Do not install domestic hot water heaters above ceilings.

Split air-cooled systems providing cooling to a space must reject heat outside of the building envelope.

5.5.2 OPERATIONS

Design the HVAC system so that equipment failures and normal maintenance have minimal impact on the tenants. Failure of one piece of equipment must not shut down large portions of the building. Install piping and valves so that equipment can be easily isolated for repair and so that different combinations of equipment can be used during replacement and overhaul. Equipment components, spare parts, and materials should be readily available, and the equipment should be repairable by crafts people available in the local area. This is especially important in the remote locations of some Land Ports.

5.5.3 ROBUST AND RELIABLE: EXTENDED LIFE EXPECTANCY

Public buildings have a longer life expectancy than most commercial office buildings. Forty percent of GSA's occupied inventory is over 50 years old. Many buildings are over 100 years old and are expected to continue in service for decades to come. HVAC systems are expected to have extended service lives. They will be modified many times over the life of the building and operated by many different maintenance firms and occupied by many different tenants. Selection of robust, reliable, energy efficient equipment is important. Systems that can be reliably operated at near design conditions over the long term are needed.

5.6 ALTERATIONS IN EXISTING BUILDINGS

The following steps must be followed for HVAC work in existing buildings:

- Design HVAC systems to avoid affecting other systems and historic finishes, elements, and spaces.
- Place exterior equipment where it is not visible. Recess equipment from the edge of the roof to minimize visibility of the equipment from grade. Alternatively, explore creating a vault for easier access to large mechanical equipment. If equipment cannot be concealed, specify equipment housings in a color that will blend with the historic face. As a last resort, enclose equipment in screening designed to blend visually with the facade.
- Locate equipment with particular care for weight and vibration on older building materials. These materials cannot accept the same stress as when the equipment is used in newer construction.

- If new ceilings are to be installed, ensure that they do not block any light from the top of existing windows or alter the appearance of the building from the outdoors. Original plaster ceilings in significant spaces, such as lobbies and corridors, must be retained to the extent possible and modified only as necessary to accommodate horizontal distribution. Use soffits and false beams where necessary to minimize the alteration of overall ceiling heights.
- In buildings containing ornamental or inaccessible ceilings, piping and ductwork must be routed in furred wall space or exposed in the occupiable building area. Exposed ducts must also be considered in historic industrial buildings with open plan, tall ceiling, and high window spaces suited to flexible grid/flexible density treatments.
- If new vertical air distribution risers are required, they should be located adjacent to existing shafts.
- Select system types, components, and placement to minimize the alteration of significant spaces. In previously altered spaces, design systems to allow historic surfaces, ceiling heights, and configurations to be restored. Reuse of HVAC system elements is permitted only with written documentation obtained from GSA Facility Manager by the design team.
- Retain decorative elements of historic systems where possible. Ornamental grilles and radiators and other decorative elements must be retained in place.
- Retain and enhance the performance of the original type of system where a new one cannot be totally concealed or would adversely affect historic spaces or features. For example, adapt existing radiators with modern heating and cooling units, rather than adding another type of system that would require the addition of new ceilings or other non-original elements.
- To the greatest extent possible, ensure that space is available to maintain and replace equipment without damaging significant features and select components that can be installed without dismantling window or door openings. Select temperature and humidity conditions that do not cause deterioration of building materials.
- Direct replacement-in-kind of equipment that is aged out is prohibited. Any new equipment installation must be specifically sized for the current programmatic needs of the spaces served.

Refer to HVAC Upgrades in Historic Buildings for additional guidance.

6

ELECTRICAL ENGINEERING

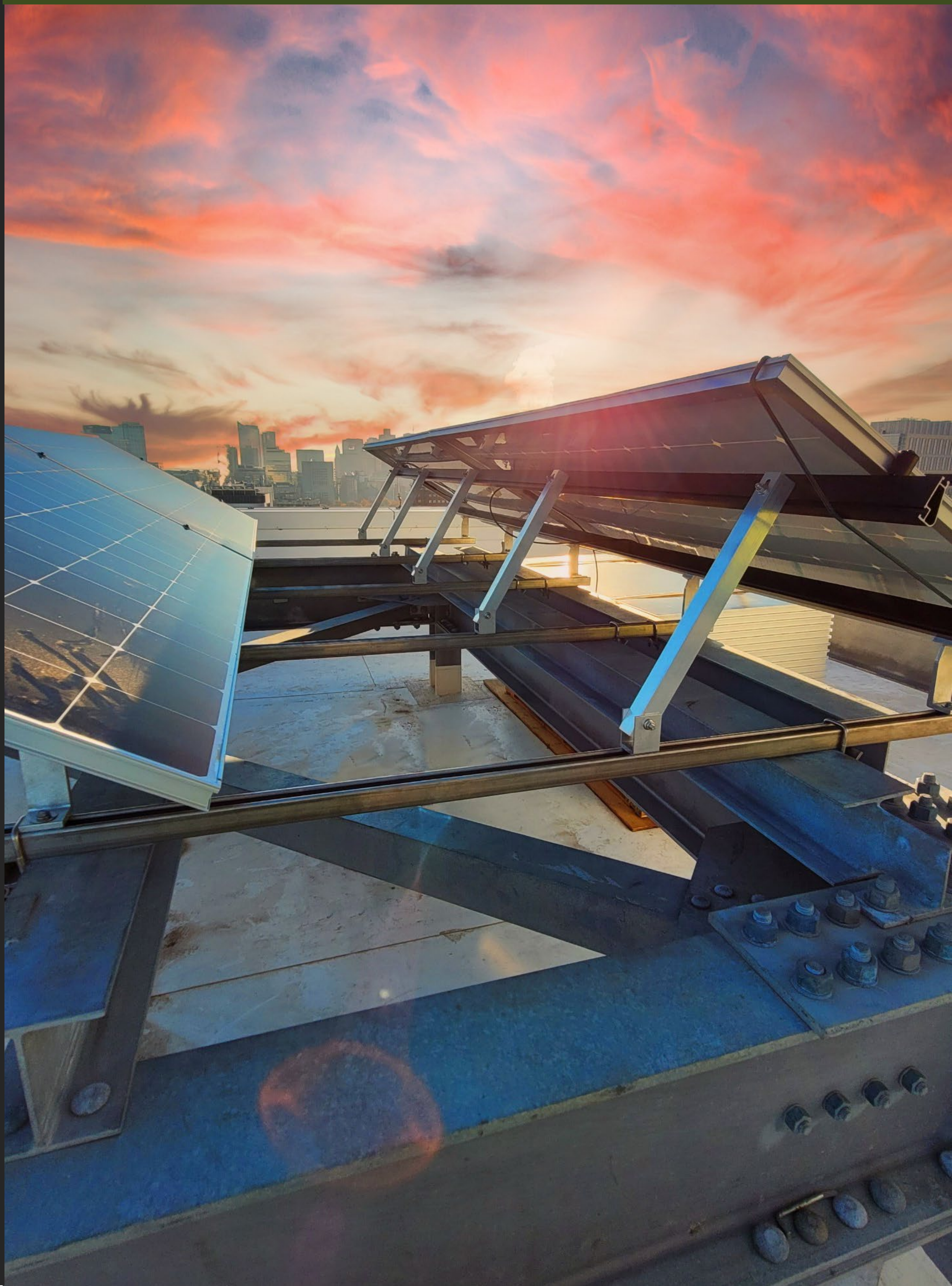


Figure 17: Solar on U.S. Department of Transportation Volpe Center Cambridge, MA

6.1 LIGHTING PERFORMANCE REQUIREMENTS

6.1.1 Lighting Quality - Interior		
Luminance Balance		
Baseline		Minimum of 40 to 1
Tier 1		3 to 1 (task to immediate surround); 20 to 1 (non-work areas)
Tier 2		3 to 1 (task to immediate surround); 10 to 1 (non-work areas)
Tier 3		3 to 1 (task to immediate surround); 10 to 1 (non-work areas)
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide photometric calculations.
References		
Basis of Design		Describe luminance balance requirements.
Construction Verification		Using photometer measure footcandle levels at task and at immediate surroundings at 3' above floor level. Record illumination levels in footcandles and verify conformance to attribute.
CCT		
Baseline		<4100K
Tier 1		Tunable between the ranges of 3000 - 6000K
Tier 2		Tunable between the ranges of 3000 - 6000K
Tier 3		Tunable between the ranges of 3000 - 6000K
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Document color temperature requirements.
Construction Verification		Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute.)
CRI		
Baseline		≥80
Tier 1		≥80
Tier 2		≥90
Tier 3		≥90
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Document color rendering index requirements.
Construction Verification		

Fidelity (Rf)		
Baseline		N/A
Tier 1		85
Tier 2		85
Tier 3		85
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		
Construction Verification		
Color Saturation (Rg)		
Baseline		N/A
Tier 1		110
Tier 2		110
Tier 3		110
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		
Construction Verification		
Human Centric Lighting		
Baseline		N/A
Tier 1		Circadian Effective Lighting-Circadian Stimulus (CS) of 0.3 in morning, or equivalent melanopic lux (EML) of 240 in morning, or 400 photopic lx EV in morning on vertical plane at eye level. Daylighting should be used to the maximum extent possible.
Tier 2		Circadian Effective Lighting-Circadian Stimulus (CS) of 0.3 in morning, or equivalent melanopic lux (EML) of 240 in morning, or 400 photopic lx EV in morning on vertical plane at eye level. Daylighting should be used to the maximum extent possible.
Tier 3		Circadian Effective Lighting-Circadian Stimulus (CS) of 0.3 in morning, or equivalent melanopic lux (EML) of 240 in morning, or 400 photopic lx EV in morning on vertical plane at eye level. Daylighting should be used to the maximum extent possible.
M & V		Yes
Plans & Specs		
Calculations & Analysis		Provide photometric calculations
References		
Basis of Design		Refer to UL 24480 Design Guideline

Construction Verification		Use photometer to measure vertical CS levels at eye level at sitting & standing height after construction
6.1.2 Lighting Quality - Exterior		
CCT		
Baseline		<3500K
Tier 1		<3500K
Tier 2		<3500K
Tier 3		<3500K
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe color temperature requirement.
Construction Verification		Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute.
CRI		
Baseline		≥70
Tier 1		≥70
Tier 2		≥70
Tier 3		≥70
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe color rendering index requirement.
Construction Verification		
Light Pollution/Light Trespass		
Baseline		Meet BUG ratings per lighting zone of site
Tier 1		Meet BUG ratings per LZ2
Tier 2		Meet BUG ratings per LZ1
Tier 3		Meet BUG ratings per LZ1
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe BUG ratings for fixtures.
Construction Verification		Verify luminaire BUG ratings during submittal review.

6.1.3 Lighting Quantity - Interior		
Illuminance - Horizontal		
Baseline		Meets IES Lighting Library
Tier 1		Meets IES Lighting Library
Tier 2		Meets IES Lighting Library
Tier 3		Meets IES Lighting Library
M & V		
Plans & Specs		
Calculations & Analysis		Provide photometric calculations.
References		
Basis of Design		Describe horizontal illuminance requirements.
Construction Verification		Measure light levels at 3' A.F.F. using a footcandle meter after installation/commissioning to verify compliance with IES.
Illuminance - Vertical		
Baseline		Meets IES Lighting Library
Tier 1		Meets IES Lighting Library
Tier 2		Meets IES Lighting Library
Tier 3		Meets IES Lighting Library
M & V		
Plans & Specs		
Calculations & Analysis		Provide photometric calculations.
References		
Basis of Design		Describe vertical illuminance requirements.
Construction Verification		Measure light levels on vertical surfaces/walls using a footcandle meter after installation/commissioning to verify compliance with IES.

6.1.4 Lighting Quantity - Exterior		
Illuminance - Horizontal		
Baseline		Meets IES Lighting Library
Tier 1		Meets IES Lighting Library
Tier 2		Meets IES Lighting Library
Tier 3		Meets IES Lighting Library
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide photometric calculations.
References		
Basis of Design		Define acceptable exterior illuminance levels in conformance with IES HB.
Construction Verification		Measure horizontal light levels at pavement/grade using a footcandle meter after installation/commissioning to verify compliance with IES.

Illuminance - Vertical		
Baseline		Meets IES Lighting Library
Tier 1		Meets IES Lighting Library
Tier 2		Meets IES Lighting Library (adjustable)
Tier 3		Meets IES Lighting Library (adjustable)
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Provide photometric calculations.
References		
Basis of Design		Define acceptable illuminance levels in conformance with IES HB.
Construction Verification		Measure light levels using a footcandle meter after installation/commissioning on vertical walls/facades to verify compliance with IES.
6.1.5 Lighting Energy Use - Interior		
Controls		
Baseline		ASHRAE 90.1
Tier 1		Addressable + personal
Tier 2		Addressable + personal
Tier 3		Addressable + personal
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe lighting control system.
Construction Verification		Verify control system operation/commission system after installation to verify compliance.
Energy Use		
Baseline		Modeling
Tier 1		Modeling
Tier 2		Modeling + Monitoring
Tier 3		Modeling, Monitoring, Feedback
M & V		
Plans & Specs		Yes
Calculations & Analysis		Yes
References		
Basis of Design		Describe the energy use scheme proposed in the design.
Construction Verification		Document interior lighting energy after installation/commissioning and confirm/document actual interior lighting energy consumed to modeled energy.
6.1.6 Lighting Energy Use - Exterior		

Controls		
Baseline		Nighttime setback controls added (Not less than 50% maximum output)
Tier 1		Nighttime setback controls added (Not less than 50% maximum output)
Tier 2		Network Controls (Not less than 50% maximum output)
Tier 3		Network Controls (Not less than 50% maximum output)
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe lighting control system.
Construction Verification		Verify control system operation/commission system after installation to confirm nighttime set back controls at less than 50%.

Energy Use		
Baseline		Modeling
Tier 1		Modeling
Tier 2		Modeling + Monitoring
Tier 3		Modeling, Monitoring, Feedback
M & V		
Plans & Specs		Yes
Calculations & Analysis		Yes
References		
Basis of Design		Describe the energy use scheme proposed in the design.
Construction Verification		Document exterior lighting energy after installation/commissioning and confirm/document actual exterior lighting energy consumed to modeled energy.

6.1.7 Power Quality

Power Factor (Full Light Output)		
Baseline		>0.90
Tier 1		>0.90
Tier 2		>0.90
Tier 3		>0.95
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe power factor accepted values in basis of design for lighting at full brightness
Construction Verification		Use power meter to confirm ratio of total active to reactive power to confirm the power factor of the system. Measure input power on light fixtures circuits to confirm the parameter and verify compliance.

Power Factor (Fully Dimmed)		
Baseline		.>.75

Tier 1		.>.80
Tier 2		.>.85
Tier 3		.>.85
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe power factor accepted values in basis of design for lighting at lowest lighting levels
Construction Verification		Use power meter to confirm ratio of total active to reactive power to confirm the power factor of the system. Measure input power on light fixture circuits to confirm the parameter and verify compliance
Total Harmonic Distortion at the LED driver (Full Light Output)		
Baseline		<20%
Tier 1		<15%
Tier 2		<10%
Tier 3		<5%
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe acceptable percentages of total harmonic distortion in drivers.
Construction Verification		`
Total Harmonic Distortion at the LED driver (Fully Dimmed)		
Baseline		<30%
Tier 1		<30%
Tier 2		<20%
Tier 3		<20%
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		
Construction Verification		
Wiring		
Baseline		Run separate neutral for each circuit
Tier 1		Run separate neutral for each circuit
Tier 2		Run separate neutral for each circuit
Tier 3		Run separate neutral for each circuit

M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Indicate provision of a separate neutral for each lighting circuit in basis of design.
Construction Verification		Provide in Lighting specifications and confirm by inspecting during installation to verify compliance.

6.1.8 Maintenance

Equipment Life		
Baseline		5 Yr Warranty
Tier 1		10 Yr Warranty
Tier 2		10 Yr Warranty
Tier 3		15 Yr Warranty
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe warranty for each equipment.
Construction Verification		Verify through light fixture submittals and warranty certificates.

Accessibility		
Baseline		Coordinate design with facilities maintenance to ensure all luminaires can be reached with lifts, ladders, etc.
Tier 1		N/A
Tier 2		N/A
Tier 3		N/A
M & V		Yes
Plans & Specs		Yes
Calculations & Analysis		Yes
References		
Basis of Design		Provide requirement for easy access to luminaires and their components.
Construction Verification		Verify installation of fixtures heights and locations in shop drawing submittal and actual heights and clearances after

Diagnostics		
Baseline		None
Tier 1		Full Ability
Tier 2		Full Ability
Tier 3		Full Ability + Predictive
M & V		Yes

Plans & Specs		Yes
Calculations & Analysis		
References		
Basis of Design		Describe the ability to diagnose lighting systems.
Construction Verification		Verify through shop drawing submittal and product submittal information.

6.2 LIGHTING PERFORMANCE ATTRIBUTES

The following attributes make up a lighting system for any space. The descriptions below do not isolate electric lighting from daylighting. Instead, the attributes apply to both sources of light and continually interact throughout the day to provide adequate and appropriate visibility.

6.2.1 LIGHTING QUALITY

The quality of a visual environment considers a wide range of variables including luminance balance, color appearance, visibility of multiple visual tasks (often accomplished by a layered lighting system), visual comfort, daylight and views, control and finally, user acceptance.

Luminance balance refers to the brightness of surfaces (vertical and horizontal) within the view of an occupant. When excessive brightness and darkness are combined in the same view, the contrast leads to visual discomfort and even headaches as the eyes continually adjust between the extremes. Balancing these luminance values means maintaining good uniformity between all the surfaces that make up a field of view. Lighting the vertical wall surfaces is one of the best ways to improve luminance balance. Since luminance, especially for interior areas, is difficult to calculate, the IES Lighting Library recommends illuminance and uniformity values for vertical surfaces such as walls. If surfaces have very low reflectance values such as dark wooden walls, these illuminance values may need to be increased.

Color appearance is made up of the correlated color temperature (CCT–the color of the light source) and the color rendering index (CRI–how well the light portrays the color of objects), as well as the individual wavelengths that make up the light (the Spectral Power Distribution [SPD]). The R9 value refers to a specific rating of the red component of the light color.

Office and industrial building occupants generally prefer warm to neutral color temperatures in the 3000-4100K range. Cooler colors than this can produce slightly higher visual acuity in some applications but may also create a sense of starkness and institutionalism. Tunable lighting allows occupants to automatically (or manually) change ambient light color in the ranges of 3000-6200K to better match occupants' body circadian rhythm.

Layering the lighting system with ambient, task, and accent light creates variety in spaces and makes it easier to maintain the luminance balance. An ambient layer provides a low level of diffuse lighting that can help illuminate objects and people's faces, which is helpful for general wayfinding, face-to-face communication, and a sense of brightness, and illuminates the architectural surfaces, such as the walls and ceiling. Task lighting provides the actual quantity of light necessary to perform a job (such as reading paperwork or filing) and draws the eye to the work surface. Accent lighting adds emphasis and visual variety in a space. Luminance balance means keeping enough brightness variety in the space to make it interesting and to highlight work areas, without making the lighting appear spotty or full of shadows.

Visual comfort relates mostly to glare from any light source–a luminaire, window, skylight, etc. Unfortunately, glare tolerance is often subjective and varies between individuals. Glare is controlled by selecting luminaires that direct their light toward the ceiling, walls, or work areas, but not into the employee's eyes. Louvers, shields, fins, overhangs, and window treatments all reduce glare from windows and skylights, louvers, lenses, baffles, and the optics of the luminaire control glare from electric sources. Coordinate with the Sustainability Section for connections to electrical and control systems for window treatments.

Closely related to visual comfort, views to the outdoors are essential parts of visual comfort–providing a link to activity, changes in time and weather, more organic forms, and other variety for the eyes. However, care must be taken to eliminate unwanted glare and excessive brightness that can occur at some times of the day. Glare from windows must be minimized and balanced with the other views of the space.

Lighting control is essential for the users. View-preserving window treatments minimize direct sun and glare from windows or skylights. Personal controls give the individual user the ability to adjust task lighting and balance brightness in their own workstation. Automatic controls for daylight dimming and occupancy save energy.

The true test of a quality lighting system is customer feedback. Post-occupancy evaluation of the daylighting, views, electric lighting, and controls will be the best evaluator of the lighting quality success.

A function of light is to synchronize or entrain the body's circadian system to the light/dark cycle of the solar day. If a person's circadian functioning is entrained, a person sleeps well at night and is alert during the day. Research and emerging industry practice recommended building occupants receive a circadian stimulus (CS) of 0.3 in the morning or 240 equivalent melanopic lux (EML) as measured on the vertical plane following the UL Design Guideline for Promoting Circadian Entrainment with Light for Day-Active People (UL 24480).

6.2.2 LIGHTING QUANTITY

The quantity of light is easier to measure and verify than the many components of lighting quality.

Illuminance measures the quantity of light falling on a surface (either vertical or horizontal). Recommended values of illuminance can be found in Table 6-1 below and as stipulated by the Illuminating Engineering Society (IES).

Table 6.1 Interior Lighting Requirements (Unless otherwise required by agency design guides)		
Area/Activity	Illuminance Lux	Illuminance Fc
Office Enclosed (Ambient)	323	30
Office Open (Ambient)	323	30
Conference/Meeting	323	30
Classroom/Lecture	323	30
Lobby	108	10
Atrium	108	10
Lounge/Recreation	108	10
Dining Area	108	10
Food Preparation	538	50
Restrooms	108	10
Corridor/Transition	108	10
Stairs	108	10
Active Storage	108	10
Inactive Storage	54	5
Electrical/Mechanical/Technology	323	30

Availability refers to the how well the daylight is provided to the space. With good building orientation and glare control, quality daylight can be provided throughout the space. High reflectance surfaces and high ceilings also help to distribute daylight throughout the space. Low partitions and interior glazing allow for daylight delivery deeper into the building, as well as providing views to the outdoors for more occupants. Operational efficiency relates to the availability and the quality aspect of layered lighting. Because the light level recommended for a particular task does not need to be provided throughout an entire space, a specific portion of the work area can be illuminated with task lighting. As more and more of the lighting requirements are met with task lighting (close to the task) the ambient layer can be lowered if luminance balance is maintained. This shifting between lighting layers results in a net improvement in system efficiency.

6.2.3 ENERGY USE

If life cycle cost-effective, new federal buildings must be designed to be 30% more efficient than ASHRAE 90.1 energy consumption levels. The lighting system design should be developed to assist the overall building in achieving this goal. Solid state high efficiency luminaires meeting the requirements of Design Lights Consortium (DLC) must be used to improve efficiency levels. Additionally, controls can provide energy efficiency and a level of user satisfaction with adjustability of the working environment. They also eliminate or reduce energy use when daylight provides adequate or a partial level of visibility, when a space is unoccupied, and when less light is desired. An additional element of lighting control shows the facility manager the real time energy use of the different building systems including lighting. While not a control that reduces energy use, it can identify potential maintenance and operation issues or potential areas for additional energy savings.

6.2.4 POWER QUALITY

Lighting, and especially dimmable lighting, can have a negative effect on the overall power quality of a building. Dimming of Solid-State Lighting sources can lower the power factor and introduce harmonic distortion to the electrical system. In many cases, electrical components must be added at the building service entrance.

Additionally, separate neutrals must be run for circuits that contain LED dimming. Otherwise, flickering can occur over the entire circuit, even when part of the circuit is not being dimmed.

6.2.5 MAINTENANCE

Warranty periods are required on all lighting equipment per the performance tiers.

6.2.6 SERVICE LIFE

The serviceable life of the lighting system may not be as long as the actual life of all its individual components. Retrofits may make sense for improved energy savings. Renovations may require changes in lighting locations. The replacement of luminaires and sources might make sense in some cases. Ideally, individual components could be easily replaced rather than entire luminaires. Sources could be relocated or simply replaced with more efficient versions with the same form factor. As solid-state lighting takes on a wider range of applications and shapes while still rapidly increasing in efficiency, service life must be carefully considered.

6.3 LIGHTING PRESCRIPTIVE REQUIREMENTS

6.3.1 LIGHTING CRITERIA

6.3.1.1 QUALIFICATIONS OF THE LIGHTING PRACTITIONER

Lighting design for new construction, lighting renovations, and energy retrofits must be performed or supervised by a professional lighting practitioner with a minimum of 5 consecutive years full-time experience in lighting design with at least one of the three following qualifications of LC, IES member, or IALD member, and who devotes most of his/her professional time to the design of lighting.

6.3.1.2 ARTWORK

Solid State Lighting is the correct light source for highlighting artwork, fabrics, and historical artifacts due to the absence of light IR and UV energy spectrum that is detrimental to their preservation. Additional museum standards for lighting works of art must follow the IES Lighting Library and Fine Arts Collection Policies and Procedures for additional information.

6.3.1.3 EXTERIOR LIGHTING DESIGN CRITERIA

Exterior lighting must meet the IES Lighting Library recommendations and comply with the IDA/IES Model Lighting Ordinance (MLO) for lumen density limits and backlight, up-light, and glare (BUG) ratings or light pollution and light trespass performance method.

All federal facilities must be designed to the RP-8 and ISC Appendix A-C Standard for "Enhanced Security Lighting."

Exterior luminaries and control systems must comply with all local zoning laws, and lighting levels for exterior spaces must not exceed the IES Lighting Library recommendations.

Luminaires with instant on light sources at all entrances and exits must be connected to the emergency lighting system.

6.3.1.4 SITE LIGHTING

Illumination of exterior exit discharges must be in accordance with the requirements in NFPA 101.

6.3.1.5 OPEN PARKING LOTS AND ROADWAY LIGHTING

Parking lots and roadway lighting must be designed per RP-8 and RP-20 in addition to the IES and IDA/IES MLO requirements.

6.3.1.6 PARKING STRUCTURES

Parking structure lighting must be designed to IES recommended practices per (RP-20 which was incorporated into RP-8). Meet ASHRAE 90.1 requirements for controls related to parking garage luminaires. Luminaires must meet the following standards:

- Meet DesignLights Consortium (DLC) SSL Version 5.1 (outdoor mid lumen output) or greater efficacy requirements.
- DLC LUNA 1.0 as appropriate
- IP-66 & NEMA 4X rated
- Withstand mechanical vibration
- Life of minimum 50,000 operating hours for solid state lighting before reaching the L_{70} as calculated per IES standard TM-21
- Luminaire classification per IES TM-15

6.3.1.7 ILLUMINATION OF MEANS OF EGRESS

Illumination of means of egress must be provided in accordance with the requirements in NFPA 101. In addition, the use of automatic, motion sensor-type lighting switches must be permitted within the means of egress, provided that the lighting control devices comply with the requirements in NFPA 101.

6.3.1.8 EXIT STAIR ILLUMINATION AND PHOTOLUMINESCENT MATERIALS

Exit enclosures where photoluminescent materials are installed must comply with the requirements in NFPA 101 and ASHRAE 90.1.

When photoluminescent materials are present, the lowest light level must be selected to keep the photoluminescent material fully charged.

6.3.1.9 EMERGENCY LIGHTING CRITERIA

Power loss resulting from utility system interruptions, building electrical distribution system failure, or the accidental opening of switches or circuit breakers dictates the requirement for emergency lighting.

6.3.1.10 LUMINAIRES

Emergency electric lighting systems may consist of separate luminaries and wiring with an independent power source, e.g., a diesel generator, or separate luminaries or unit devices supplied by the normal power supply and a secondary source that comes on automatically when the normal power supply fails. Luminaires installed within a drop ceiling grid must have additional support directly to the building structure by wire, chain, or threaded support rod of sufficient strength to carry the luminaire. Square and rectangular fixtures will be supported at each end of a diagonal axis of the luminaire, at a minimum.

6.3.1.11 EMERGENCY LIGHTING

Emergency lighting for means of egress must be provided in accordance with the requirements in NFPA 101 and tenant mission requirements. Emergency lighting outside the building must also provide illumination to either a public way or a safe distance away from the building, whichever is closest to the building being evacuated.

6.3.1.12 PERFORMANCE OF EMERGENCY LIGHTING SYSTEM

The performance of the emergency lighting system must be in accordance with the requirements in NFPA 101.

6.3.2 LOAD CRITERIA

6.3.2.1 LIGHTING LOADS

The lighting and daylighting systems must be sensitive to the architectural design, provide adequate quality and quantity of illumination for interior and exterior lighting, comply with the design criteria, minimize maintenance requirements, and use 30 percent less electrical energy (kwh) than required for compliance with Section 9.6 (Alternative Compliance Path: Space-by-Space Method) of ASHRAE 90.1.

General lighting must comply with the following luminaire, lamp, and driver requirements.

6.3.2.2 SOLID STATE LUMINAIRES AND RETROFIT KITS

All new interior and exterior lighting must utilize solid state high efficiency luminaires that meet the requirements of DesignLights Consortium (DLC) SSL Version 5.1 and/or DLC LUNA 1.0, as appropriate. Where DLC ratings do not cover a given category (e.g., decorative fixtures), the project lighting practitioner must evaluate on a case-by-case basis to ensure lighting quality and efficiency levels are being met and follow P100 requirements. All luminaires must be appropriately selected based upon the expected application and be provided with replaceable dimmable drivers. Type B retrofits with sockets powered by line voltage will not be utilized. PCB containing ballast must not be reused and must be disposed of through specialized disposal firms that destroy the PCBs.

Where parabolic luminaires are used, louvers must be semi-specular or diffuse finishes; specular finishes must not be used.

LED retrofit lamps or kits may only be used if the existing luminaire housing photometric output is equivalent to the original fixture and all of the following requirements are met:

- UL rating is maintained for ENTIRE fixture to include UL 1598C and UL 1993.
- LED retrofit kits must be DLC and be published on their Qualified Products website.

- Product MUST BE dimmable using 0-10V or digital control signal, and compatible with existing lighting control systems and future daylighting technologies.
- LED products must have a “low risk” level of flicker (light modulation) through compliance with recognized standards such as IEEE Standard 1789-2015 or NEMA 77-2017.
- Space photometrics and glare control must meet IES guidelines for tasks performed in the retrofitted spaces.
- A mockup retrofit of typical areas of the building is required to confirm the above performance requirements of lighting output suitability controllability and flicker measurements.
- Proposed installation facility and LED retrofit have been reviewed and approved by regional engineering staff prior to purchase.

Minimize lamps, light sources, and driver types.

6.3.2.3 LAMPS

Effort must be made to minimize the number of fixture and lamp types within a facility to simplify lamp maintenance.

In retrofit scenarios, all fluorescent lamps must be recycled by firms that recover the mercury that is contained within the lamps.

6.3.2.4 DRIVER ACOUSTICS

Electronic Drivers must be used wherever possible and have a sound rating of “A.” All PCB-containing ballasts must be disposed of through specialized disposal firms that destroy the PCBs.

LED lamps must not be retrofitted into existing luminaries unless the retrofitted product meets all the following requirements:

- Retrofit lamps must be tested by a recognized testing laboratory in accordance with IES Standards LM-79.

6.3.2.5 LIGHTING CONTROLS

Control systems must be compatible with lamps, light sources, and drivers.

Controls must be provided in accordance with ASHRAE 90.1 and other BAS signals such as demand response.

Lighting control systems that enable digital addressability per LED driver can provide multiple benefits such as increased energy savings, remote reconfiguration, fault diagnostics, and integration with other building systems such as HVAC. Various factors are relevant when considering this type of technology such as: building size, project type, overall project goals, and implementation expertise and resources. Standardized digital protocols such as DALI-2 and D4i can enable interoperable components (e.g., drivers and sensors). Standardization of mechanical form factors and connectors for sensor replacements are found in Zhaga Book 18 (exterior) and Book 20 (interior). Product certification should be verified to ensure multi-vendor replacement which is an important consideration for long-term maintenance. In some cases, overall project costs can be reduced but savings should be validated by comparing installed costs, energy savings, and system integrations.

Power over Ethernet (PoE) installations must adhere to the following requirements:

- Use red cabling for emergency lighting to differentiate from other lighting cabling
- Comply with UL924 where applicable for emergency lighting
- Cabling must be different in color from IT cabling for identification purposes, minimum CAT5e or above
- Limit cable bundles to 24 or less to reduce heat gain while increasing the systems longevity
- PoE systems shall adhere to the maximum power output of the switch and individual port used to power the luminaire
- Cable runs must be limited to 328 feet
- Comply with IEEE 802.3bt class 8, 90watt standard
- Comply with NEC Articles 725 and 840
- All luminaires must be provided with dedicated drivers
- GSA IT must provide and maintain PoE switches

Lighting controls must be commissioned to operate as intended without false triggering. All lighting controls must be compatible with luminaires. Lighting control devices provided for illumination within exit enclosures must comply with the requirements in NFPA 101. Please see the Building Technology Technical Reference Guide for details on IT Security requirements.

Automatic controls/occupancy sensors must not be used in electrical or mechanical rooms.

6.3.3 SECURITY LIGHTING, EXIT SIGNS, AND EMERGENCY LIGHTING

6.3.3.1 SECURITY LIGHTING

Security lighting is lighting that remains on during unoccupied hours per applicable GSA and tenant criteria. Security lighting in daylit spaces must be controlled by photosensors. When security lighting also functions as emergency lighting, separate circuits and emergency ballasts are required.

6.3.3.2 EXIT SIGNS

Exit signs must meet the requirements in NFPA 101 and be energy efficient and environmentally friendly products (e.g., light emitting diodes (LED type), photoluminescent type. Tritium exit signs must not be installed.

6.3.3.3 EMERGENCY LIGHTING

Emergency lighting must be provided in accordance with the requirements of NFPA 101. At a minimum, unswitched emergency lighting must be provided in the following areas:

- Zones covered by closed-circuit TV cameras
- Security zones
- Fire command center
- Security control center
- Where required in NFPA 101
- UPS and battery rooms

Emergency lighting may be manually switched from within in the following areas:

- Communication equipment rooms
- Electrical rooms
- Technology/server rooms
- Engineers' offices
- Elevator machine rooms

Supplemental battery-powered emergency lighting must be provided in the following spaces to bridge the generator startup time:

- Generator rooms
- Main mechanical and electrical rooms
- Any locations where lighting cannot be interrupted for any length of time

6.3.4 SPECIFIC LIGHTING REQUIREMENTS

6.3.4.1 SPECIAL AREAS

Certain areas, where the lighting design must be an integral part of the architecture, require special lighting design concepts. The certified lighting designer must integrate the design with the interior finishes and furniture arrangement to enhance the functionality of the spaces. Further consideration must be taken to adhere to the energy criteria and maintenance criteria, as well as minimizing the number of special lamp types and fixtures required. Areas generally requiring special lighting treatment are as follows:

- Main entrance lobbies
- Atriums
- Elevator lobbies
- Public corridors
- Public areas
- Auditoriums
- Conference rooms
- Training rooms
- Dining areas and serveries
- Libraries

6.3.4.2 LIGHTING – HISTORIC BUILDINGS

Historic chandeliers, pendant lights, sconces, and other period lighting may be upgraded with energy efficient light sources and optical enhancements that preserve the historic appearance of the luminaire and space. Replica lighting for restoration zones must be fabricated or modified to accept energy efficient lamps. Supplemental lighting, when required, must be designed, and located to minimize penetration of ornamental wall and ceiling surfaces and to avoid competing visually with historic lighting. Recommended alternatives for increasing light levels in ceremonial spaces, when relamping is not sufficient, include compatibly designed floor lamps, task lights, and discretely placed indirect lighting. Refer to Upgrading Historic Building Lighting for additional guidance.

6.4 ELECTRICAL PERFORMANCE REQUIREMENTS

6.4.1 Transformers		
Efficiencies for Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)		
Baseline		10 CFR §431.196
Tier 1		10 CFR §431.196
Tier 2		5 Percent less losses than 10 CFR §431.196
Tier 3		10 Percent less losses than 10 CFR §431.196
M & V		Yes
Plans & Specs		Submit certified performance data for each unit
Calculations & Analysis		
References		10 CFR §431.196
Basis of Design		Describe transformer efficiency requirements.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Insulating fluid for oil-filled Distribution Transformers, Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)		
Baseline		65 °C USDA -designated biobased insulating oil (minimum 66% biobased synthetic ester-based or minimum 95% biobased vegetable oil-based)
Tier 1		65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content)
Tier 2		65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content)
Tier 3		65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content)
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		7 CFR §3201.20. ASTM D6871 or IEEE C57.147
Basis of Design		Describe transformer insulating fluid requirements.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied transformer units.
Efficiencies for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)		
Baseline		10 CFR §431.196
Tier 1		10 Percent less losses than 10 CFR §431.196
Tier 2		20 Percent less losses than 10 CFR §431.196
Tier 3		25 Percent less losses than 10 CFR §431.196
M & V		
Plans & Specs		Certified Representative Factory Test Report
Calculations & Analysis		

References		10 CFR §431.196
Basis of Design		Describe low voltage distribution transformer efficiencies.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied transformer units.
Impedance for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)		
Baseline		>4 %Z
Tier 1		>4 %Z
Tier 2		>4 %Z
Tier 3		>5 %Z
M & V		
Plans & Specs		Certified Representative Factory Test Report
Calculations & Analysis		
References		NEMA TP-1-2002, 10 CFR §431.196
Basis of Design		Describe transformer impedance requirements.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Harmonic Rated Transformers & Harmonic Mitigating Transformers		
Baseline		Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)
Tier 1		Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)
Tier 2		Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)
Tier 3		Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)
M & V		
Plans & Specs		Certified Representative Factory Test Report
Calculations & Analysis		
References		NEMA TP-1 -2002
Basis of Design		Describe transformer harmonic requirements.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.

6.4.2 Variable Frequency Drives

Use on motors up to 25 Hp (18.7kW) where ASHRAE 90.1 requires motors to operate at reduced speeds		
Baseline		6-pulse width modulation (PWM) IGBT Drives, Passive Harmonic Filtration <5% THD Current at Drive Terminals
Tier 1		6-pulse width modulation (PWM) IGBT Drives, Passive Harmonic Filtration <5% THD Current at Drive Terminals

Tier 2		6-pulse width modulation (PWM) IGBT Drives, Active Harmonic Filtration <5% THD Current at Drive Terminals
Tier 3		12-pulse width modulation (PWM) IGBT Drives, IGBT Front End <5% THD Current at Drive Terminals
M & V		
Plans & Specs		
Calculations & Analysis		
References		IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals
Basis of Design		Describe VFD requirements to show compliance with metrics.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.
Use on motors 30HP (22.4kW) to 100HP (74.6 kW)		
Baseline		6-pulse width modulation (PWM) IGBT Drives. Provide 12 or 18 pulse where the harmonic analysis indicates noncompliance, Passive Harmonic Filtration <5% THD Current at Drive Terminals
Tier 1		12-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
Tier 2		18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
Tier 3		18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
M & V		
Plans & Specs		
Calculations & Analysis		
References		IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals
Basis of Design		Describe VFD requirements to show compliance with metrics.
Construction Verification		Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.
Use on motors 125HP (93.3kW) and larger		
Baseline		12-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
Tier 1		18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
Tier 2		18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
Tier 3		18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM), <= 5% THD Current at Drive Terminals
M & V		
Plans & Specs		
Calculations & Analysis		
References		IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals
Basis of Design		Describe VFD requirements to show compliance with metrics.

Construction Verification		Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.

6.4.3 Metering/Monitoring

Metering/Monitoring		
Baseline		As required by ASHRAE 90.1, voltmeter reading all phase to phase and phase to neutral voltages. Switchable ammeter and three-phase totalizing watt-hour meter. The power meter must be pulse-type and digital networked and/or tied into the Advanced Metering System.
Tier 1		Baseline, plus Utility Class 0.2%, (Phase Volts, Phase Currents, Neutral Currents, Ground Currents, power consumption KWH, adjustable power demand KW, KVA & KVAR, Power Factor)
Tier 2		Tier 1, plus Harmonic Waveform Analysis
Tier 3		Tier 2, plus Transient Disturbance Monitoring for capture, remote alarm monitoring and disturbance download to laptop
M & V		yes
Plans & Specs		
Calculations & Analysis		yes
References		ANSI C12.1 & C12.20 ASHRAE 90.1
Basis of Design		Describe building electrical meter requirements and show on single line diagram.
Construction Verification		Verify submittals and supplied meter specifications to verify compliance.

6.4.4 Building Automation System - Interface from Electrical Systems

Electrical Meters input to BAS and graphic displays		
Baseline		MODBUS/TCP/IP Protocol Meters/BACnet/LonWorks protocol Meters to match BAS with twisted pair to BAS for monitoring.
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics. Interfaced to BAS and configured for Advanced Metering System. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end)
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end) and Wireless Submeters
M & V		yes
Plans & Specs		
Calculations & Analysis		yes
References		ANSI C12.1 & C12.20; EPACT 2005, EISA 2007 - Section 434(b)
Basis of Design		Describe meter/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm metering data to verify compliance.

PV Systems Input to BAS and graphic displays		
Baseline		MODBUS/TCP/IP Protocol Meters/BACnet/LonWorks protocol Meters to match BAS with twisted pair to BAS for monitoring.

Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH}, status and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH}, status and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end
M & V		yes
Plans & Specs		
Calculations & Analysis		
References		eMerge Alliance 24VDC Occupied Space Standard
Basis of Design		Describe PV system metering/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Automatic Transfer Switches input to BAS and graphic displays		
Baseline		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for ATS status (also ethernet for TCP/IP for ATS customized graphical GUI at BAS front end)
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for ATS status (also ethernet for TCP/IP for ATS customized graphical GUI at BAS front end)
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} status, and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} status, and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe ATS/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Standby Generator input to BAS and graphic displays		
Baseline		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for generator status and alarms
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for generator status and alarms
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and generator status and alarms (NFPA 110 status and alarms)
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and generator

		status and alarms (NFPA 110 status and alarms) Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe Standby Generator/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Uninterruptible Power Systems input to BAS and graphic displays		
Baseline		N/A
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end)
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe UPS/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Variable Frequency Drives Input to BAS and graphic displays		
Baseline		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH, Amps, % speed}, status (HOA, run, bypass), troubles, and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe VFD/BAS interface requirements.

Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Motor Starters Input to BAS and graphic displays		
Baseline		N/A
Tier 1		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers
Tier 2		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers
Tier 3		MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for status [HOA, run], power measurements [KW, KVA, Power Factor, KWH}, and alarms. Also, ethernet for TCP/IP for metering customized graphical GUI at BAS front end.
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe motor starters/BAS interface requirements.
Construction Verification		Verify interface with BAS system and confirm indicated metered data to verify compliance.
Additional computer-based BAS interface requirements		
Baseline		DDC using BACnet or LonTalk open communication protocols
Tier 1		IP sensors, thermostats, & devices
Tier 2		wireless self-powered switches & devices
Tier 3		wireless self-powered switches & devices
M & V		Yes
Plans & Specs		
Calculations & Analysis		yes
References		EnOcean Alliance
Basis of Design		Describe BAS interface requirements with switches and devices.
Construction Verification		Verify interface with BAS system and confirm indicated devices to verify compliance.
Additional computer-based BAS energy management requirements		
Baseline		Energy management & monitoring software
Tier 1		interface with smart phones & tablets
Tier 2		interface with smart phones & tablets
Tier 3		interface with smart phones & tablets
M & V		yes
Plans & Specs		
Calculations & Analysis		yes
References		
Basis of Design		Provide BAS interface requirements with smart phones and tablets.

Construction Verification		Verify interface with BAS system and confirm indicated devices to verify compliance.
6.4.5 Interior Electrical Distribution		
Energy saving controls for automatic interruption of non-critical power after operating hours		
Baseline		ASHRAE 90.1
Tier 1		ASHRAE 90.1, Time of day scheduling for auto shutdown of task lighting receptacle circuits or integrate occupancy sensors with task lights.
Tier 2		ASHRAE 90.1, Time of Day controllable branch panel breakers for automatic shutdown of computers, displays and task lighting after scheduled hours
Tier 3		ASHRAE 90.1, Time of Day controllable branch panel breakers for automatic shutdown of computers, displays and task lighting after scheduled hours
M & V		yes
Plans & Specs		
Calculations & Analysis		
References		ASHRAE 90.1, LEED M&V Standards
Basis of Design		Describe scheme for automatic shutdown of lighting and computer/display and task lighting circuits.
Construction Verification		Verify shut down of stated loads after installation of systems to verify control sequences and shut down of stated loads after scheduled hours.
6.4.6 Arc- Flash Reduction Maintenance Switches (ARMS) and Arc Flash barriers		
Arc Reduction Maintenance Switches (ARMS)		
Baseline		NEC 240.87 Arc Energy Reduction Applies
Tier 1		NEC 240.87 Arc Energy Reduction Applies at 1000A
Tier 2		NEC 240.87 Arc Energy Reduction Applies at 600A
Tier 3		NEC 240.87 Arc Energy Reduction Applies at 200A
M & V		
Plans & Specs		
Calculations & Analysis		
References		NFPA 70, 70E, NEMA, UL
Basis of Design		Describe requirements of arc flash maintenance switches.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
6.4.7 Power Factor Correction		
Power Factor Correction		
Baseline		95% PFC with harmonic-tuned filters
Tier 1		95% PFC with automatic controls and harmonic-tuned filters
Tier 2		95% PFC with automatic controls and active harmonic filters
Tier 3		98% PFC with automatic controls and active harmonic filters
M & V		
Plans & Specs		

Calculations & Analysis		
References		NFPA 70, NEMA
Basis of Design		Describe power factor correction requirements.
Construction Verification		Measure power factor using a power meter to confirm compliance with stated requirements.

6.4.8 Surge Protection Devices

277/480 Volt distribution at Main Switchgear		
Baseline		Surge Protection Device - Type 2 (SPD-2) (300KA)
Tier 1		Surge Protection Device - Type 2 (SPD-2) (300KA)
Tier 2		Surge Protection Device - Type 2 (SPD-2) (300KA)
Tier 3		Surge Protection Device - Type 2 (SPD-2) (300KA)
M & V		
Plans & Specs		
Calculations & Analysis		
References		UL 1449 Current Edition
Basis of Design		Describe surge protection requirements at main switchgear.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
277/480V Volt distribution at Distribution Panels		
Baseline		Surge Protection Device - Type 2 (SPD-2) (160KA)
Tier 1		Surge Protection Device - Type 2 (SPD-2) (160KA)
Tier 2		Surge Protection Device - Type 2 (SPD-2) (160KA)
Tier 3		Surge Protection Device - Type 2 (SPD-2) (160KA)
M & V		
Plans & Specs		
Calculations & Analysis		
References		UL 1449 Current Edition
Basis of Design		Describe surge protection requirements at distribution panels.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
277/480V Volt Branch Panels		
Baseline		NFPA 70 700.8 (Emergency Panels)
Tier 1		NFPA 70 700.8 (Emergency Panels)
Tier 2		NFPA 70 700.8 (Emergency Panels)
Tier 3		Surge Protection Device - Type 2 (SPD-2) (50KA)
M & V		
Plans & Specs		
Calculations & Analysis		

References		NFPA 70 700.8, UL 1449 Current Edition
Basis of Design		Describe surge protection requirements at branch panels.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
120/208V Volt Branch Panels		
Baseline		NFPA 70 700.8 (Emergency Panels)
Tier 1		NFPA 70 700.8 (Emergency Panels)
Tier 2		NFPA 70 700.8 (Emergency Panels)
Tier 3		Surge Protection Device - Type 2 (SPD-2) (50KA)
M & V		
Plans & Specs		
Calculations & Analysis		
References		NFPA 70 700.8, UL 1449 Current Edition
Basis of Design		Describe surge protection requirements at branch panels.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.

6.4.9 Lightning Protection Systems (LPS)

Lightning Protection Systems		
Baseline		Yes, where required per NFPA 780 Risk Assessment
Tier 1		Yes, where required per NFPA 780 Risk Assessment
Tier 2		Yes, where required per NFPA 780 Risk Assessment
Tier 3		Yes, where required per NFPA 780 Risk Assessment
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		UL 96, NFPA 780
Basis of Design		Describe lightning protection system.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Lightning Protection Systems UL Compliance		
Baseline		UL 96
Tier 1		UL 96
Tier 2		UL 96
Tier 3		UL 96
M & V		
Plans & Specs		Yes
Calculations & Analysis		

References		UL 96, NFPA 780
Basis of Design		Describe lightning protection system.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Lightning Protection Systems UL Master Label Compliance		
Baseline		Master Label
Tier 1		Master Label
Tier 2		Master Label
Tier 3		Master Label
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		UL 96 (Master Label)
Basis of Design		Describe lightning protection system.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Surge Protection for building service, incoming copper cables and equipment per Master Label Requirements		
Baseline		N/A
Tier 1		N/A
Tier 2		Yes
Tier 3		Yes
M & V		
Plans & Specs		Yes
Calculations & Analysis		
References		UL 96 (Master Label)
Basis of Design		Describe lightning surge protection requirements.
Construction Verification		Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.

6.4.10 Grounding

Earth counterpoise		
Baseline		N/A
Tier 1		5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
Tier 2		2 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
Tier 3		1 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		NFPA 70, IEEE, BICSI/TIA
Basis of Design		Describe grounding requirements.

Construction Verification		Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values.
Separate grounding system for Lightning Protection System and single point bond to building counterpoise system.		
Baseline		N/A
Tier 1		5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
Tier 2		5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
Tier 3		5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.
M & V		
Plans & Specs		
Calculations & Analysis		
References		NFPA 70, 780, UL 96
Basis of Design		Describe grounding requirements.
Construction Verification		Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values.
Equipment Grounding Conductors		
Baseline		All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.
Tier 1		All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.
Tier 2		All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.
Tier 3		All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.
M & V		
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe grounding conductor requirements.
Construction Verification		Verify provision of grounding conductors for each of the low voltage distribution systems.

6.4.11 Uninterruptible Power Systems (UPS)

Efficiency		
Baseline		Double conversion efficiency of 90%
Tier 1		Double conversion efficiency of 95%
Tier 2		IGBT rectifier and IGBT inverter Double conversion efficiency of 96%
Tier 3		IGBT rectifier and IGBT inverter Double conversion efficiency of 97%
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		

Basis of Design		Describe UPS efficiency requirements.
Construction Verification		Verify submittals from manufacturer for supplied units to verify compliance.
Power Factor - Output		
Baseline		80%
Tier 1		80%
Tier 2		90%
Tier 3		90%
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe UPS output power factor requirements.
Construction Verification		Measure output power factor using a power meter to confirm compliance with stated requirements.
Power Factor – Input		
Baseline		80%
Tier 1		80%
Tier 2		90%
Tier 3		100%
M & V		Yes
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe UPS input power factor requirements.
Construction Verification		Measure input power factor using a power meter to confirm compliance with stated requirements.
Input Harmonics		
Baseline		<30% current THD
Tier 1		Rectifier with filters for <7% current THD
Tier 2		IGBT rectifier for <5% current THD
Tier 3		IGBT rectifier for <5% current THD
M & V		Certified Representative Factory Test Report
Plans & Specs		
Calculations & Analysis		
References		
Basis of Design		Describe UPS THD requirements.
Construction Verification		Measure harmonics using a power meter per IEEE 519 standard to confirm compliance with stated requirements.

6.5 PRESCRIPTIVE ELECTRICAL ENGINEERING REQUIREMENTS

6.5.1 GOALS AND OBJECTIVES

This chapter identifies criteria that must be used to program and design electrical power, lighting, and communications systems in GSA buildings. These systems support the many types of equipment in a reliable fashion. During the life span of a federal building, many minor and major alterations are necessary as the missions of Government agencies change. The flexibility to adjust to alterations and perform maintenance must be designed into the building systems from the outset. Maintenance requirements must be taken into consideration within each system design, which serves to maximize equipment reliability, performance, and usability/life span. Electrical power, lighting, and communications systems must provide ample capacity for increased load concentrations and allow modifications and maintenance to be performed in one area without causing major disruptions in other areas of the facility.

The electrical system design must be signed by a registered professional electrical engineer.

6.5.1.1 DESIGN INTENT

The design of electrical power, lighting, communications systems, and other building components must function together resulting in a building that meets the project's program requirements, as well as incorporating GSA's commitment to sustainability and energy efficiency.

GSA recognizes that communication needs and technology are growing at an increasingly rapid pace. Workstations are becoming more powerful, requiring faster and easier access to more information. It is GSA's intent to provide the wiring and interfaces to support these requirements. The design of all communications cabling systems is the responsibility of GSA IT.

A computer-based Building Automation System (BAS) that interfaces, monitors, and automatically controls lighting, heating, ventilating, and air conditioning is critical to the efficient operation of modern federal buildings, including courthouses, office buildings, and other facilities. GSA requires the integration of building automation systems, except for fire alarm and security systems, which must function as stand-alone systems with a monitoring-only interface to the BAS (see Electrical Performance Criteria).

Security is important in the design, construction, and operation of electrical power, lighting, and communications systems design. Refer to ISC Security Guidelines.

Electrical power, lighting, and communications systems must be adapted to support all performance objectives defined for the project, typically including sustainability, workplace performance (productivity and efficiency), fire safety, security, historic preservation, and improved operations and maintenance. All new or modified electrical equipment must be UL listed. Compliance with Submittal Matrix is required to demonstrate that these systems have been adapted into the project at each phase of the design.

Maintainability and reliability are paramount to the operation of federal buildings. Therefore, the design and installation of all electrical systems and equipment must allow for the safe repair, removal, and replacement—including major components such as switchgear, motor control centers, and emergency/standby generators—without removal of exterior walls and impact to adjacent equipment and building occupants.

Electrical power, lighting, and communications systems must be specifically designed to meet all the defined performance objectives of the project at full-load and part-load conditions that are associated with the projected occupancies and modes of operation.

Commissioning of major changes to electrical power, lighting, and communications systems must be initiated at the conceptual design phase of the project and continue through all design and construction phases.

Anchorage and bracing of system components will meet the load requirements specified in Chapter 4.

For special design considerations and design criteria for U.S. Court facilities, see Chapter 8, Design Standards for U.S. Court Facilities.

6.5.2 CODES, STANDARDS, AND GUIDELINES

Refer to Chapter 1 for guidance on code compliance.

6.5.2.1 ELECTRICAL DESIGN PUBLICATIONS AND STANDARDS

The latest editions of publications and standards listed in Appendix B are intended as guidelines for design. They are mandatory only where referenced as such in the text of this chapter or in applicable codes. The list is not meant to restrict or preclude the use of additional guides or standards.

When publications and standards are referenced as mandatory, any recommended practices or features must be considered as "required." When discrepancies between requirements are encountered, GSA will determine the governing requirement.

6.5.2.2 COMMUNICATION SYSTEM PATHWAYS AND SPACES DESIGN STANDARDS

The communications system pathways and spaces must be designed in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual and coordinated with specific project requirements. Proprietary wireless communication for lighting controls may be considered if scanned and approved by GSA IT. The following standards define the minimum allowable requirements.

Wireless systems must be designed in accordance with the latest edition of the BICSI Wireless Design Reference Manual and coordinated with GSA IT to fulfill specific requirements.

Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) Standards are listed below.

- EIA/TIA Standard 568, Commercial Building Wiring Standard (and related bulletins)
- EIA/TIA Standard 569, Commercial Building Standard for Telecommunications Pathways and Spaces (and related bulletins)
- EIA/TIA Standard 606, Administration Standard for the Commercial Telecommunications Infrastructure (and related bulletins)
- EIA/TIA Standard 607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (and related bulletins)
- EIA/TIA Standard 758, Customer-Owned Outside Plant Telecommunications Cabling Standard

6.5.2.3 LOAD CRITERIA

In determining electrical loads for federal buildings, it is important to look beyond the immediate requirements stated in the project program. Future moves and changes have the effect of redistributing electrical loads. Unless otherwise specifically defined in the program requirements, the connected receptacle loads and lighting loads must be combined with other electrical loads in the building, multiplied by the appropriate demand factors and with spare capacity added, to determine the overall electrical load of the building. The specific electrical power loads must be determined independently for the following load groups:

- Lighting
- Receptacle loads
- Motor and equipment loads
- Elevator and other vertical transportation loads
- Electric vehicle Charging
- Miscellaneous loads

6.5.2.3.1 RECEPTACLE LOADS

A list of typical receptacle load requirements is shown in Table 6-2. This table represents minimum loading requirements for usable square feet. Refer to Chapter 6, Space Conditions for further information on the receptacle design conditions and constraints.

Table 6.2 Minimum Receptacle Load

Area/Activity	Service Equip. W/m^2	Service Equip. W/ft^2	Distribution Equip. W/m^2	Distribution Equip. W/ft^2
Office/enclosed	14.00	1.30	27	2.50
Office open	14.00	1.30	35	3.25
Non-workstation areas	5.00	0.46	10	0.93
Core and public areas	2.50	0.23	5	0.46
Technology/server rooms	540.00	50.18	700	65.06

6.5.2.3.2 MOTOR AND EQUIPMENT LOADS

Loads associated with motors and equipment must use the rated brake horsepower of specified equipment and nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE 90.1. Refer to Chapter 5, Mechanical Prescriptive Requirements for additional criteria.

6.5.2.3.3. ELEVATOR AND OTHER VERTICAL TRANSPORTATION LOADS

Electrical power loads for elevators and other vertical transportation equipment must be based on the rated brake horsepower of the specified equipment and nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE 90.1. Demand factors identified in NFPA 70, Chapter 6 must be applied. Refer to Chapter 5, Mechanical Prescriptive Requirements for additional criteria.

6.5.2.3.4 MISCELLANEOUS LOADS

These loads include:

- Security, communication, BAS, and alarm systems

- Heat tracing
- Kitchen equipment
- Central computer servers and data centers
- Uninterruptible power supply (UPS) and battery rooms

Electrical loads for miscellaneous equipment must be based on the rated electrical power requirements or brake horsepower of the specified equipment and on the nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE 90.1. Demand factors identified in NFPA 70 must be applied.

6.5.2.3.5 DEMAND LOAD AND SPARE CAPACITY

To ensure maximum flexibility for future systems changes, new components of the electrical system must be sized for the demand load with additional spare capacity as follows:

Demand factors identified in NFPA 70, Chapter 6, must be applied.

- Panelboards for branch circuits: 50 percent spare ampacity and 35 percent spare circuit breakers. All panelboards must be fully populated with both active and spare breakers of a size and rating of breakers used in the panelboard (minimum spare circuit breakers of two of each type excluding subpanel feeds) or as directed by GSA.
- Panelboards serving lighting only: 50 percent spare ampacity and 25 percent spare circuit breakers. All panelboards must be fully populated with both active and spare breakers of a size and rating of breakers used in the panelboard (minimum spare circuit breakers of two of each type excluding subpanel feeds) or as directed by GSA.
- Switchboards and distribution panels: 35 percent spare ampacity and 25 percent spare circuit breakers. Switchboards must be provided with spare circuit breakers, minimum one per each size or as directed by GSA.
- Switchgear: 25 percent spare ampacity and 25 percent spare circuit breakers. Switchgear must be provided with enclosed, drawout-type breakers, minimum spare circuit breakers of one per each frame size fully equipped spare breaker or as directed by GSA.

All distribution equipment ampacities must be calculated in accordance with NFPA 70 Article 220 and as modified in this chapter. If the addition of 25 or 35 percent spare circuit capacity results in the need for a two-section panel, the design engineer must limit the spares to the capacity of the panel in question and assign sufficient space in the electrical room layout to accommodate a future panel and associated transformer.

Before adding the spare equipment ampacity to account for future load growth, it is important that the load study reflect actual demand loads rather than connected loads. The designer must apply realistic demand factors by considering various energy-conserving devices such as variable frequency drives applied to brake horsepower, energy-efficient motors, occupancy sensors, and so on. The designer must also avoid adding the load of standby motors and must be careful to distinguish between summer and winter loads by identifying such “noncoincidental” loads. A “diversity factor” must be applied to account for the fact that the maximum load on the elevator system, as a typical example, does not occur at the same time as the peak air conditioning load. Once the estimated “peak demand” load is established, the factor for load growth must be added.

6.5.2.3.6 MAXIMUM VOLTAGE DROP

The maximum allowable voltage drop for feeders is 2 percent and for lighting and branch circuits is 3 percent. Both normal and emergency distribution must comply.

6.5.2.4 VISUAL IMPACT

Options regarding the location and selection of electrical work that will have a visual impact on the interior and exterior of the building must be closely coordinated with the architectural design. This includes the placement and specification of the lightning protection system, colors, and finishes of light fixtures, outlets, switches, and device plates.

6.5.3 UTILITY COORDINATION

6.5.3.1 POWER COMPANY COORDINATION

A detailed load study, including connected loads and anticipated maximum demand loads, as well as the estimated size of the largest motor, must be included in the initial contact with the local utility company to prepare its personnel for discussions relative to the required capacity of the new electrical service.

The service entrance location for commercial electrical power must be determined concurrently with the development of conceptual design space planning documents. Standards for equipment furnished by utility companies must be incorporated into the concept design. Locations of transformers, vaults, meters, and other utility items must be coordinated with the architectural design to avoid conflicts with critical architectural features such as main entrances and must accommodate both equipment ventilation and equipment removal.

6.5.3.2 COMMUNICATIONS SERVICE COORDINATION

The telecommunications design professional must contact the local telecommunications providers and coordinate with the client agency and GSA IT to determine the number, size, and location of the incoming services and to determine the enclosure and pathway requirements for telecommunications systems. The scope of services varies with each project; it includes, at a minimum, the design of the infrastructure (pathway and enclosure) and may include the full design and specification of the telecommunications system. The design professional must contact the local telecommunications providers through GSA IT early in the project.

Provision must also be made to provide either cable television (CATV) or satellite service to the facility. CATV or satellite service may be independent from other communications services. The need for multiple space service conduits to accommodate multiple voice/data vendors must be evaluated.

The need for separate redundant internal and external pathways may be required depending on the level of security and mission that may be required by the building occupant.

6.5.4 SITE REQUIREMENTS

The routing of site utilities and location of manholes must be determined early in the design process in coordination with the site civil engineer. The designer must coordinate with the utility company to determine the capabilities, rate structure options, and associated initial costs to the project and must evaluate the available utility service options. All incoming electrical utility feeders must be installed underground.

6.5.4.1 ELECTRICAL POWER SERVICES

For buildings greater than 25,000 gsf and less than 250,000 gsf, electrical secondary service must be a minimum of 480Y/277V. For buildings 250,000 gsf and larger, or for campus sites, secondary electrical service must be provided to the building, at medium-voltage distribution, up to 34.5kV, for primary power distribution to substations.

For renovated buildings greater than 25,000 gross square feet where the local utility only has network voltage of 120/208 volt primary service available, the normal and emergency voltages upon entering the building must be stepped up to 480/277 volt.

6.5.4.2 PRIMARY CABLE SELECTION

Medium-voltage cable selection must be based on all aspects of cable operation and on the installation environment, including corrosion, ambient heat, rodent attack, pulling tensions, potential mechanical abuse, and seismic activity. Conductors for new construction buildings must be shielded, insulated with cross-linked polyethylene (XLP) or ethylene propylene rubber (EPR). Conductors smaller than 1/0 must be copper. New cabling to be connected to equipment built or installed before 1980 must be investigated to determine compatibility of aluminum-to-copper terminations prior to specifying aluminum cabling. Insulation must be rated at 133 percent. Individual conductor size must not exceed 240 mm^2 (500 mcm).

6.5.4.3 DIRECT BURIED CONDUIT

If PVC conduit is direct buried, it must be schedule 80. Coated intermediate metallic conduit (IMC) or coated rigid galvanized steel may also be used for the distribution of exterior branch circuits. Backfill around the conduits must be selected based on the thermal conductivity and be free of materials detrimental to the conduit surface.

Direct buried conduit must be continuously indicated by installation of tracer tape 300 mm (12") above the conduit.

6.5.4.4 CONCRETE-ENCASED DUCTBANKS

Concrete encased PVC Schedule 40 must be used for all services entering the building (power, communications, and/or life safety) and a minimum conduit diameter of 100mm [4in] must be utilized. Where redundant service is required, alternate and diverse paths must be provided.

Concrete-encased ducts must be provided with a backfill cover that is at least 750 mm (30 in.) deep. Ductbanks under railroads must be reinforced. Ducts must slope toward manholes and all entries into buildings must have watertight seals. Changes in direction must be by sweeps with a radius of 1.2 m (4 ft.) or more.

Stub-ups into electrical equipment may be installed with manufactured rigid steel elbows. Duct line routes must be selected to avoid the foundations of other buildings and structures. Electrical power and communication ducts must be kept clear of all other underground utilities, especially high-temperature water, steam, or gas.

Where it is necessary to run communication cables parallel to power cables, two separate ductbanks must be provided with separate manhole compartments. The same holds true for normal and emergency power cables. Ductbanks must be spaced at least 300 mm (1 ft.) apart. BICSI Standards govern the installation of telecom infrastructure.

Direct buried duct banks must be continuously indicated by installation of tracer tape 300 mm (12”) above the exterior of the duct bank.

6.5.4.5 DUCT SIZES AND QUANTITY

Ducts must be sized as required for the number and size of cables. Inner ducts must be provided inside communication ducts wherever fiber optic cables will be used. Spare ducts must be included for planned future expansion; in addition, a minimum of 50 percent spare ducts must be provided for unknown future expansion and/or cabling replacement.

6.5.4.6 MANHOLES

Manholes must be spaced no farther than 150 m (500 ft.) apart for straight runs. The distance between the service entrance and the first manhole must not exceed 30 m (100 ft.). Double manholes must be used where electric power and communications lines follow the same route. Separate manholes must be provided for low- and medium-voltage systems. Manholes must have clear interior dimensions of no less than 1,800 mm (6 ft.) in depth, 1,800 mm (6 ft.) in length, and 1,800 mm (6 ft.) in width, with an access opening at the top of not less than 900 mm (36 in.) in diameter. Medium-voltage manholes must be sized in accordance with utility company requirements. Manholes must have a minimum wall space of 1,800 mm (6 ft.) on all sides where splices may be racked. Manholes must be provided with pulling eyes, sumps, and grounding provisions as necessary.

6.5.4.7 STUBS

A minimum of two spare stubs must be provided (to maintain a square or rectangular ductbank), so that the manhole wall will not need to be disturbed when a future extension is made. Stubs for communications manholes must be coordinated with GSA’s federal Technology Service.

6.5.4.8 PENETRATIONS

Lighting and communication circuits that penetrate fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions, and between floors must be properly sealed in accordance with the requirements of the IBC with approved firestopping materials.

6.5.4.9 EXTERIOR CONCRETE

Concrete pads constructed to support exterior mechanical and electrical equipment must be provided with sufficient conduit penetrations to provide the necessary power and control connections plus an additional 50 percent for future equipment additions and modifications. Spare conduits need not extend more than 1,200 mm (4 ft.) past the end of the concrete slab. All spare conduits must be capped at both ends.

6.5.5 ADVANCED BUILDING METERING AND CONTROL

All projects must install advanced meters for electricity. Advanced electric meters capable of bidirectional monitoring of phase voltages, phase currents, power consumption (demand), power factor, kVAR, and availability. These meters must be capable of communicating via MODBUS/TCP/IP. Meters must meet at a minimum the definition stated. Government projects are encouraged to also include demand reduction logic in the building automation system that is capable of activation upon input from the building operator or the intelligent meters. Ideally, the logic would be capable of three tiers of demand reduction—low/no occupant impact, minor occupant impact, and some impact. The equipment curtailed or set points changed during each level must be identified by the design team and agreed to by the RPMT.

Building total electricity, HVAC, interior and exterior lighting, tenant usage, and receptacles must be metered in compliance with ASHRAE 90.1.

All networked metering required by ASHRAE 90.1 or Advanced Building Metering below the Whole Building Meter or Multi-point Submeter capturing total system loads, must be tied to the Building Automation System (BAS). Whole Building Meter or Multi-point Submeters with total system loads, can be tied to the BAS and/or the central Advanced Metering Interface. (See GSA's Advanced Metering Implementation Guide for detailed delineation of AMI vs BAS metering)

6.5.6 DISTRIBUTION SYSTEM ALTERNATIVES

6.5.6.1 PRIMARY DISTRIBUTION

Where the design alternatives have been thoroughly evaluated and a medium-voltage service is selected as the optimal utility service for the application, the design professional must request that the utility company provide multiple 15 kV (nominal) feeders to serve the facility. Feeders must not be connected to the same utility switchgear bus section. Where feasible, it should be requested that facility feeders be extended from different substations.

The following types of primary distribution systems are listed in terms of increasing flexibility, reliability, and cost:

- Looped primary
- Radial primary
- Primary selective
- Primary selective-secondary selective
- Network

Where primary service is provided, GSA where allowed, will purchase, own, and maintain the building transformers.

Mission critical facilities must be provided with dual utility feeders. In the event only a single utility feeder is available, the feeder must be double tapped to provide a dual feed.

6.5.6.1.1 MEDIUM-VOLTAGE SWITCHGEAR

Design of the medium-voltage switchgear must meet all the requirements of the local utility and UL1558. Switchgear must be provided with enclosed, drawout-type vacuum interrupter breakers, one per each size fully equipped spare cubicle, a breaker lifting device, and a ground and test device. The ground and test device must be stored in a spare switchgear cubicle.

Voltmeters, ammeters, and watt-hour digital meters with demand registers on each feeder must be provided for medium-voltage switchgear in addition to utility-approved digital relaying. Meters must be digital pulse-type for connection to and monitoring by the Advanced Metering Equipment. IR camera inspection ports must be provided on the enclosure of all medium voltage switchgear for ease of inspecting switchgear for thermal problems while under load.

Switchgear must be provided with a mimic bus.

All switchgear sections must be installed on four-inch concrete housekeeping pads.

6.5.6.1.2 MEDIUM-VOLTAGE CONDUCTORS

Conductors rated for less than 250A must be copper. Aluminum conductors must use properly rated crimp connections. All conductor insulation must be either XLP or EPR and be rated at 133 percent of the voltage rating. Individual conductor size must not exceed 240 mm^2 (500 mcm).

6.5.6.1.3 MEDIUM VOLTAGE TRANSFORMERS

Transformers must be dry type with epoxy resin cast coils or liquid filled, 300 C° or greater fire point, USDA-designated biobased insulating-oil type. Liquid-filled transformers must be used outdoors and for below-grade vault construction. Provide lightning arrestors on the primary side of all transformers. Provide surge suppression on the secondary and/or downstream busses. Transformer efficiencies must meet or exceed 10 CFR §431.196.

Where silicon or oil-filled transformers are used, the design must comply with all spillage containment and electrical code requirements. Transformer location design must comply with all federal and state spillage containment and electrical code requirements.

GSA owned Network transformers must have a kVA rating as required, with either aluminum or copper primary and secondary windings. Transformers must be equipped with provisions for fans and/or dual temperature ratings to increase the rated capacity and must be provided with sufficient contacts to permit the remote monitoring of the status of the network protector, temperature and pressure in the enclosure, and other components recommended by the manufacturer. Fans must not be used in determining the initial rating of the transformer. In addition, transformers must be provided with voltage taps ±2.5 percent with a no-load tap changer. Network transformers and tap changers located in areas subject to flooding or water backup must be specified as waterproof. Network transformers must be provided with disconnects for safe isolation servicing. The energized status of the transformers must be monitored by the Advanced Metering System.

6.5.6.1.4 MEDIUM VOLTAGE DOUBLE-ENDED SUBSTATIONS

Where either a primary selective or primary selective-secondary selective (double-ended) substation is selected, the following paragraph applies:

If reliability is critical and spot networks are not feasible, double-ended substations must be used. Transformers must be equipped with provisions for fans to increase the rated capacity. The sum of the estimated demand load of both ends of the substation must not exceed the rating of either transformer and must not exceed the fan cooling rating. All double-ended substations must be equipped with two secondary main breakers and one tie breaker configured for open transition automatic transfer, initiated with an under-voltage relaying scheme. Breakers must be of the electrically operated drawout type.

6.5.6.2 SECONDARY DISTRIBUTION

6.5.6.2.1 MAIN SWITCHGEAR

Switchgear must meet UL 1558 and be provided for the service entrance equipment and associated distribution sections/circuit breakers of any service 1200 amperes or greater.
The UL1558 switchgear must have enclosed, drawout-type circuit breakers, one per each size fully

equipped spare cubicle, a breaker lifting device, and a ground and test device. The ground and test device must be stored in a spare switchgear cubicle. If the switchboards are used for service entrance equipment below 1200 amperes, they must be constructed in accordance with UL 891. Breakers with solid state trip units must have modbus communications and must be tied into the BAS for status and power monitoring.

All breakers in the service main switchgear must be fully rated. Series rating is not to be permitted. Main and feeder breakers must be provided with integral solid-state ground-fault protection tripping elements.

IR camera inspection ports must be provided on the enclosure of all switchgear for ease of inspecting switchgear for thermal problems while under load.

Switchgear must be provided with a mimic bus. All switchgear or switchboard panels must have hinged covers in lieu of removable covers for safety purposes.

All switchgear or switchboard sections must be installed on four-inch concrete housekeeping pads.

6.5.6.2.2 SURGE SUPPRESSION

Surge suppression on the main secondary service must be provided.

6.5.6.2.3 SWITCHGEAR METERING

All utility main switchgear metering sections must contain a voltmeter capable of reading all phase-to-phase and phase-to-neutral voltages. The meter section must have a switchable ammeter and a three-phase totalizing watt-hour meter. The power meter must be networked and tied into the Advanced Metering System.

6.5.7 SPACE CONDITIONS

Provide adequate space and suitable locations for the electrical systems serving the facility and a planned method to install and replace this equipment. During the concept phase, provide detailed space requirements and suggested preferred locations of all critical space requirements for the power and communication systems for the facility. Provide the required space conditions, clear of any structural columns or beams as well as shear walls, stairways, duct shafts, and other obstructions. Equipment space selection must take into consideration adjacencies, such as stairs, mechanical rooms, toilets, elevators, air/piping shafts, and fire-rated assemblies, to permit secondary distribution of electrical and telecommunications circuitry to exit the assigned spaces.

Do not run electrical power or communication systems within stair enclosures unless power or communication serves the stair or is part of the emergency communication system.

Note: The designers must refer to Chapter 7, for design criteria related to the following elements of the electrical and communication systems:

- Main equipment rooms
- Electrical rooms
- Communications rooms
- Building engineer’s office
- Security control center

- Fire command center
- UPS systems and batteries
- Emergency generator

6.5.7.1 MAIN EQUIPMENT ROOMS–ELECTRICAL AND TELECOMMUNICATIONS

Main switchgear room doors must be large enough (in width and height) to allow for the removal and replacement of the largest piece of equipment. All equipment doors and personnel doors must swing out and be provided with panic hardware. Refer to NEC 110.26 for clearance requirements.

The sizes and locations of the telecommunications service rooms must be established in concert with the local communications service provider. Depending on the equipment selected, telecommunication service rooms may require 24-hour HVAC service, and may need protection from contaminants by proper filtration equipment.

See Chapter 7 for additional information and special requirements.

6.5.7.2 ELECTRICAL ROOMS

Electrical rooms must be located within the core areas of the facility and must be stacked vertically. A minimum of two perimeter walls of each electrical room must be accessible for conduit penetration. Adequate numbers of electrical rooms must be provided, such that no electrical room serves more than 930 m^2 (10,000 sq. ft.) and no branch circuit is more than 120 feet long horizontally. Electrical rooms must be provided with minimum unobstructed dimensions of 1,800 mm by 3,000 mm (6 ft. by 10 ft.) and are not scalable down in size to match floor plate dimension. A minimum of 30 percent future use wall space must be provided with available NEC clearance. If transformers are in the rooms, comply with NEC Article 450.9 for temperature control. All transformers must be floor mounted in new construction and must only feed the floors on which they are located.

6.5.7.3 COMMUNICATIONS ROOMS

Communications rooms are also generally located within the core areas of the facility and must be stacked vertically. Rooms must be sized to contain adequate floor space for frames, racks, and working clearances in accordance with EIA/TIA standards. Depending on the equipment selected, provisions may be required for 24-hour air conditioning in these rooms. The installation of dedicated electrical panelboards within the tenant’s communications rooms should be considered to minimize electrical noise and to prevent unauthorized access.

6.5.7.4 BUILDING ENGINEER’S OFFICE

Even if not included in the building program, office space for the building engineer must be evaluated. Most GSA buildings require such a space, which houses the consoles for the BAS and remote annunciators for other critical systems such as fire alarm, generator status, miscellaneous alarm systems, and lighting control systems. This space is normally located near the loading dock or main mechanical spaces.

6.5.7.5 SECURITY CONTROL CENTER

Each GSA building with a local security force must have a control center. If the building will not be served by a local security force, this room may be combined with the building engineer's office or the fire command center.

The security control center must be located within the most secure area of the building and must be sized to house the command station for the security guards and their equipment, for current as well as anticipated future building needs.

6.5.7.6 SPACES FOR UNINTERRUPTIBLE POWER SYSTEMS (UPS) AND BATTERIES

Since all UPS systems are considered above standard for GSA space, the requirement for a UPS system will be a tenant agency requirement. To establish the proper size, locations, and environmental requirements for the UPS and battery systems, the electrical engineer must arrange to meet with the architect and representatives of the tenant agencies to determine the required/estimated load and physical size requirements and the nature of the critical loads. Refer to the UPS and battery manufacturers' installation instructions for heat dissipation requirements, weights, dimensions, efficiency, and required clearances in the design.

For small systems up to 50kVA, the UPS modules and sealed cabinet batteries must be installed in the room with the equipment being served.

For medium and large systems greater than 50kVA, the UPS system must be provided with standby generator backup to limit the battery capacity. The UPS system equipment and batteries must be in separate rooms if wet cell batteries are utilized. Weight and noise must be considered in UPS placement.

Space for storage of safety equipment, such as goggles and gloves, must be provided. Special attention must be given to floor loading for the battery room, entrance door dimensions for installation of the UPS, and ceiling height for clearance of the appropriate HVAC systems and exhaust systems.

6.5.7.7 FIRE COMMAND CENTER

See Fire Protection, for specific requirements for the Fire Command Center.

6.5.7.8 FLOODPLAIN CLEARANCE

Electrical equipment must be elevated above the applicable flood elevation. Refer to Chapter 4 Flood Resistant Design Requirements. The electrical engineer must determine from local jurisdictions any additional freeboard requirements above this base level.

6.5.8 SECONDARY BRANCH POWER DISTRIBUTION

6.5.8.1 FEEDER ASSIGNMENTS (BUS DUCTS VS CABLE-IN-CONDUIT)

The secondary main branch power distribution system conveys power to the various load groups distributed throughout the building. The decision as to whether this power is conveyed to the various loads in copper cables-in-conduit or in either aluminum or copper bus duct must be based on the following factors:

- Size and shape of the facility
- Design of the main switchgear
- Coordination with piping and ductwork in the lower levels

- Design of the electric rooms–proximity to the transformer vault
- Ceiling space available
- Access to bus splice connections for testing
- Flexibility
- Reliability
- Cost

At the early stages of a project, alternate designs comparing the factors listed above must be evaluated to determine the feeder assignments.

Bus ducts must be copper or aluminum, fully rated, 3-phase, 3-wire or 3-phase, 4-wire with 100 percent neutral, and an integral ground bus, sized at 50 percent of the phase bus, IP54 or higher.

6.5.8.2 MOTOR CONTROL CENTERS

Grouped motor controls must be used where eight or more starters are required in an equipment room. Motor control center (MCC) construction must be NEMA Class I, Type B copper, with magnetic (or solid-state if appropriate) starters and either molded case solid state circuit breakers or fused switches. The minimum starter size in motor control centers must be Size 1. MCCs must be provided with Advanced Metering for remote monitoring. Control circuit voltage must be 120V connected ahead of each starter via a fused control transformer. Reduced-voltage starters may be used for larger motors to reduce starting kVA.

Time-delay relays must be incorporated in the starters or programmed in the BAS system to reduce inrush currents on the electrical system.

Where variable frequency drives (VFDs) are used on a project, an LCC evaluation must be conducted to determine when VFDs must be incorporated into the MCCs. If determined not appropriate, then VFDs must be powered from distribution panels installed for that purpose. See below for additional VFD requirements.

6.5.8.3 ELEVATOR AND OTHER VERTICAL TRANSPORTATION POWER

If two or more switchgears are available, the load of the elevator and other vertical transportation feeders must be divided among the secondary switchgears, provided that alternate elevator machines must be fed from different switchgears.

Note: One elevator in each bank must be connected to the emergency power supply system (EPSS). Where multiple elevators are in a common bank, provide a common emergency feeder from the elevator automatic transfer switch (ATS) to allow each elevator to be operated individually during an emergency. See Section on Emergency and Standby Power Systems for additional requirements. Interlocking the ATS with the elevator group controller, programming must be made by the elevator supplier to set up a controlled return to the terminal floor and then to limit the number of elevators in that bank that can be run concurrently.

See Chapter 7 for additional information on standby power requirements for fire service access elevators and occupant evacuation elevators. Sufficient standby power must be provided to operate all designated fire service access elevators and occupant evacuation elevators along with their associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces, simultaneously. Ensure critical control circuits in elevator pits are positioned or otherwise protected from water intrusion during flooding or sprinkler activation to ensure operability during OEE or fire service use.

Elevator machines must be electrically powered by non-auto resetting circuit breakers with padlocking capabilities. Elevator controllers must have a Short Circuit Current Rating (SCCR) which exceeds the calculated available fault current in compliance with NEC Article 620.16. Shunt trip, through circuit breakers or current limiting fused disconnect must be provided when automatic sprinklers are installed in hoistways, machine rooms, and control rooms containing elevator driving machines. The electrical supply must disconnect automatically prior to application of water. Elevator breakers must be in the elevator machine room.

6.5.8.4 VARIABLE FREQUENCY DRIVE

Variable frequency drives must be used on all motors where ASHRAE 90.1 requires motors to operate at reduced speeds. However, VFDs generate harmonics, which are injected into the secondary power distribution system. These harmonics must be minimized using filters tuned to the peak harmonic generated by the drive. All VFDs must be provided with a contactor bypass and phase monitoring. All VFD motors must be provided with either Shaft Grounding Rings (SGRs) or Common Mode Filters to eliminate high frequency damage to motor bearings.

VFDs must use a minimum 6-pulse width modulation (PWM) design because of their excellent power factors and high efficiencies. VFDs must be specified with passive harmonic filters and with isolation transformers where required. Individual or simultaneous operation of the variable frequency drives must not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator (if applicable), per IEEE 519, latest edition. The load side of the main breaker must be the point of common coupling.

A harmonic (voltage and current) analysis must be conducted by the electrical engineer, including all calculations.

Where the harmonic analysis indicates noncompliance, the application of 12-pulse, pulse width modulation, or zig-zag transformers or other approved alternate method must be used to reduce the total harmonic voltage distortion.

Thermal sensors must be specified that interlock with the VFD control circuit for additional protection for motors running at low speeds and subject to overheating. This is in addition to the standard over-current protection required.

Distance between VFDs and their load must not exceed VFD manufacturer's recommendations. VFD rated wire must be provided between the VFD and the motor being served.

6.5.9 BRANCH WIRING DISTRIBUTION SYSTEMS

6.5.9.1 LIGHTING–CIRCUIT LOADING

120 volt circuits must be limited to a maximum of 1,400 volt-amperes.

277 volt circuits must be limited to a maximum of 3,200 volt-amperes.

6.5.9.2 RECEPTACLES–CIRCUIT LOADING

120 volt circuits must be limited to a maximum of 8 duplex receptacles.

Each special purpose receptacle must be circuited on a dedicated circuit to a protective device to match the rating of the receptacle.

Emergency receptacles must be red. Isolated grounding receptacles must be orange. Special purpose and dedicated receptacles must be gray. Controlled receptacles must be marked in accordance with ASHRAE 90.1. Provide gasket seals at receptacles/switches on exterior walls and along interior walls between conditioned and non-conditioned spaces.

Building standard receptacles must be duplex, specification-grade NEMA 5-20R. Each Ground Fault Circuit Interrupter (GFCI) receptacle must have a light indicating when it has been tripped. Communication room equipment receptacles must be locking type to prevent accidental disconnection. Special purpose receptacles must be provided as required.

Plug load controls must comply with ASHRAE 90.1.

6.5.9.3 PLACEMENT OF RECEPTACLES

6.5.9.3.1 CORRIDORS

Receptacles in corridors must be located 15 m (50 ft.) on center and 7.5 m (25 ft.) from corridor ends.

6.5.9.3.2 OFFICE SPACE

Receptacles for housekeeping must be placed in exterior walls and walls around permanent cores or corridors. Where receptacles are placed on exterior walls, installation of conduits and wallboxes must minimize air infiltration and moisture incursion. See Chapter 3 and 5 for additional requirements.

Placement of receptacles in walls must be avoided where raised access floors are used. See Chapter 6, Underfloor Raceway Systems, for additional requirements. For areas where raised access floors or underfloor raceway systems are not used, placement of receptacles must comply with the project requirements.

6.5.9.3.3 CONFERENCE AND TRAINING ROOMS

Conference rooms and training rooms must be served in the same fashion as office space, except where specifically outfitted for audio-visual equipment.

6.5.9.3.4 COURTROOMS AND RELATED AREAS

Refer to Chapter 8 for special electrical requirements.

6.5.9.3.5 MAINTENANCE SHOPS

Maintenance shops require plug-mold strips above work benches with duplex outlets 900 mm (36 in.) on center. Receptacles must be wired on alternating circuits. Receptacles or circuit breakers must be of the ground fault interrupt (GFI) type. Provide emergency power off stations and associated contactors for shops containing freestanding equipment.

6.5.9.3.6 COMMUNICATIONS ROOMS

Communication rooms must contain power and grounding including a dedicated telecom room ground busbar for the passive and active devices used for the telecommunications system, including at least two dedicated 20A, 120 volt duplex electrical outlets on emergency power, and additional lock type convenience outlets at 1,800 mm (6 ft.) intervals around the walls and direct connection to the main building grounding system. If uninterruptible power is required in communications rooms, it must be furnished as part of the communications system. Larger communication rooms must be provided with ceiling-mounted locking receptacles on ceiling-hung strain relief whips.

6.5.9.3.7 MECHANICAL AND ELECTRICAL ROOMS

All mechanical and electrical equipment rooms must each have, at a minimum, one emergency power receptacle that is identified as such at the receptacle.

6.5.9.3.8 EXTERIOR MECHANICAL EQUIPMENT

Provide one receptacle adjacent to mechanical equipment exterior to the building, including each roof section. Receptacles must be of the weatherproof GFI type. Receptacles must be located within 7.62 m (25 ft.) of each piece of equipment in accordance with NFPA 70 210-63.

6.5.9.3.9 TOILET ROOMS

Each toilet room must have at least one GFI receptacle at the vanity or sink. All receptacles located in toilet rooms must be GFI protected. Carefully coordinate the location of the receptacles with all toilet accessories.

6.5.9.3.10 LAW ENFORCEMENT AND SPECIAL LAB DESIGN REQUIREMENTS

Law Enforcement facilities and critical lab functions must be designed to insure high reliability of electrical service throughout operation, tenant upgrades, and maintenance. TI funded maintenance risers must allow a continual feed to critical equipment while primary electrical risers are undergoing maintenance.

6.5.9.4 UNDERFLOOR RACEWAY SYSTEMS

Underfloor raceways fall into three categories:

6.5.9.4.1 RAISED ACCESS FLOORS

All wiring beneath a raised access floor must meet the requirements in NFPA 70 and must be routed in rigid metal or flexible conduit to underfloor distribution boxes. One distribution box per bay is recommended. Flush-mounted access floor service boxes must be attached to the underfloor distribution boxes by means of a modular, prewired system to facilitate easy relocation.

6.5.9.4.2 CELLULAR METAL DECK

In cellular metal decks that frame the concrete floor slabs in a steel building, the cells are generally fully “electrified” by the placement of steel sheets enclosing the underside of the cells. Access to the individual cells is obtained by a series of compartmented header ducts. The width of the header duct is sized according to the area served and the depth is 63 mm (2 1/2 in).

6.5.9.4.3 UNDERFLOOR DUCT SYSTEM

A 3-cell underfloor duct system is placed in a 100 mm (4 in.) concrete fill over the concrete slab. The cells are generally located on 1,500 mm (5 ft.) to 1,800 mm (6 ft.) centers. Note: This type of raceway system is frequently found in existing buildings selected for modernization.

The cell assignments in cellular metal deck systems and the 3-cell duct systems are generally designated as 1) power, 2) voice/data, and 3) signal. However, the recent increase in bandwidth required by the latest IT equipment has been accompanied by the use of CAT 6 cables and fiber optic cables. The CAT 6 cables cannot tolerate the proximity to the power cables and neither of these cables is compatible with the sharp bends from the header ducts to the cells and to the outlets, which significantly diminishes the practical use of these systems.

6.5.9.5 PANELBOARDS

Panelboards must be constructed to comply with the requirements of UL 67 and UL 50.

Type written replacement panelboard schedules must be provided.

All panelboard interiors must be constructed using hard-drawn copper of 98 percent conductivity, with AIC bracing greater than the calculated available fault current. The minimum short circuit rating for 208Y/120V panelboards must be 10,000 amperes symmetrical. The minimum short circuit rating for 480Y/277V panelboards must be 14,000 amperes symmetrical. A full-size copper ground bus for connecting ground conductors must be bonded to the steel cabinet.

Branch circuit breakers must be bolt-on designed for replacement without disturbing the adjacent units. Breakers must comply with the requirements of UL 489, thermal magnetic type with a short-circuit rating greater than the calculated available fault current. Panels must be specified with “door-in-door” trim.

6.5.9.5.1 POWER DISTRIBUTION PANELS

Circuit breaker-type panels must be the standard of construction for federal buildings. Except for lighting and receptacle panelboards, fusible switches may be considered if specific design considerations warrant their application, such as in electrical coordination of electrical over-current devices.

6.5.9.5.2 LIGHTING AND RECEPTACLE PANELBOARDS

Lighting and receptacle panelboards must be circuit breaker type: a maximum of 30 poles for 100 amp panelboards and subfeeds from these panelboards are prohibited.

6.5.9.5.3 PANELBOARD SURGE PROTECTION

All new emergency panelboards must be provided with integral surge protection devices as required by NFPA 70, section 700.8. Panelboard circuits feeding outside loads (lighting, receptacles, charging stations, etc.) must also be protected with type 2 SPDs if building lightning protection is provided.

6.5.9.6 CONDUCTORS & CONDUIT SYSTEMS

The specification must list the various types of conduit systems that are approved for use on the project and the specific raceway applications for which they are to be used. Conductors and accessible portions of conduit must not be abandoned in place.

6.5.9.6.1 CONDUITS

Minimum conduit size must be ¾”. Conduit systems must be used between the panelboard and the first wiring device. Conduit systems are limited to the following:

- RSC – Rigid galvanized steel conduit

- RAC – Aluminum conduit (with steel elbows)
- IMC – Intermediate steel conduit
- EMT – Electrical metallic tubing (full compression steel fittings only)
- FMC – Flexible steel conduit – connections to recessed lighting fixtures, motors, or concealed in movable wall partitions.
- LFMC – Liquid flexible steel conduit with PVC jacket. Connections to vibrating equipment (motors, transformers, etc.)
- PVC – Polyvinyl chloride - Underground, see Chapter 6, Concrete-Encased Ductbanks.

6.5.9.6.2 CONDUCTORS

Aluminum or copper conductors are acceptable for motor windings, distribution transformer windings, switchgear bussing, and switchboard bussing, where the conductor is purchased as part of the equipment. Feeders 1/0 aluminum and larger are permitted for electrical distribution. All other conductors must be copper.

Conductors #10 and below must be solid conductors.

All conductor terminations must be compression type. Mechanical type connections are not permitted.

All conductors, including neutrals, must be labeled with the circuit number at panelboards and multi-circuit junction boxes.

Conductor insulation must be colored in accordance with the following:

(208/120-V: A-black, B-red, C-blue, neutral-white, ground-green, isolated ground-green w/ yellow stripes)

(480/277-V: A-brown, B-orange, C-yellow, neutral-gray, ground-green, isolated ground-green w/ yellow stripes)

MC cable may be used for portions of branch circuits not excluded below and that do not terminate directly at a panelboard.

Materials and Construction

- Metal-Clad Cable must be steel armored and not exceed #10 AWG.
- Metal-Clad Cable must be labeled a minimum of every three feet with 360 degree paint bands indicating number of conductors and voltage (either 480/277 or 208/120v) of conductors
- Conduit systems must be used between the panelboard and the first wiring device.
- All accessible and serviceable Metal-Clad Cable runs must be provided with permanent typed labels at all deck-to-deck wall penetrations with tags indicating panelboard and circuit feed from.
- Individual Metal-Clad Cables must NOT contain more than three current carrying conductors to prevent having to derate the cables due to heat; however, integral lighting control conductors are acceptable for lighting circuits.
- Metal-Clad Cable must be secured to the structure as stipulated in the National Electric Code unless otherwise noted in this document. All cables must be secured within 12 inches of the cable termination device.

- Snap in type fittings must not be used.

Metal-Clad Cable must not be used in the following areas:

- In the construction of, or major renovations to highly finished spaces such as courtrooms, judge's chambers, historical areas, lobbies, and conference centers
- In wet, damp, hazardous, chemical using areas, outdoor structures, basements, garages, penthouses, elevator shafts, mechanical rooms/spaces, or areas subject to physical damage from vehicular or maintenance equipment
- Metal-Clad Cables must NOT be directly embedded in concrete structures/columns or below unmovable flooring (e.g., hardwood flooring)
- Metal-Clad Cable must not be directly embedded in finished plaster surfaces
- Metal-Clad Cable must NOT be used to feed either building or tenant critical electrical infrastructure such as servers, HVAC, intrusion detection, access control and fire alarm/protection systems.

6.5.9.7 EQUIPMENT LABELING

All electrical equipment installed must be provided with exterior, typewritten, machine-made labels indicating the panel and circuit number from which they are electrically fed. This requirement applies to all electrical cover plates, lighting switch plates, disconnects, transformers, etc. For equipment viewable within highly finished spaces, labels may be placed on the interior of device plates / equipment doors with local approval by the regional electrical engineer. This requirement is in addition to NEC 408.4 Field Identification Requirements.

6.5.9.8 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

See Chapter 8 for EVSE requirements.

6.5.10 VOICE AND DATA DISTRIBUTION SYSTEM

The configuration and type of the voice and data cabling distribution systems must be developed at the earliest stages of design. All voice and data cabling located throughout the building must be required to be in a cable management system equivalent to a tray, conduit, etc. Hooks must be allowed on data circuits of 20 or less. Cabling supported by ceiling tiles is not permitted. System requirements are user generated and are generally translated into distribution system requirements by the design engineer in conjunction with GSA IT, who together develop systems in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual and the GSA IT Telecommunications Distribution Design Guide found at infrastructure@gsa.gov

6.5.10.1 EQUIPMENT GROUNDING CONDUCTOR

Except for isolated ground systems, all low-voltage power distribution systems must be supplemented with a separate, insulated equipment grounding conductor.

6.5.10.2 COMMUNICATIONS RACEWAYS

Communication raceways must meet the installation requirements in NFPA 70.

6.5.10.2.1 RAISED ACCESS FLOOR

If GSA has determined that raised access floors are to be used for cable management in the project, see Chapter 6, Underfloor Raceway Systems, the communications services must be installed by laying the cable in a tray for main runs and then branching directly on the floor slab below the raised access flooring system.

6.5.10.2.2 CABLE TRAYS IN HUNG CEILINGS

Since underfloor raceway systems cannot accommodate the large turning radii required by the CAT 6 and fiber optic cables, the primary alternative to a raised floor system is a series of cable trays installed above accessible hung ceilings. Cable trays must be continuously grounded.

6.5.11 EMERGENCY AND STANDBY POWER SYSTEMS

Emergency and standby power systems must be designed to comply with the requirements of the IBC, ISC Appendix A-C, NFPA 110, and NFPA 111. Compliance with the electrical safety of the installation, operation, and maintenance of emergency systems is required, as addressed in Article 700 of NFPA 70. All facilities must be provided with an EPSS to supply power to the facility in the event of a sudden loss of power.

6.5.11.1 CLASSIFICATION OF EMERGENCY POWER SUPPLY SYSTEMS (EPSS)

The class and type of Emergency Power Supply Systems (EPSSs) for federal buildings must be a minimum of Class 48, where 48 is the minimum time in hours for which the EPSS is designed to operate at its rated load without being refueled (see Chapter 4, NFPA 110). Note that the fuel storage for the fire pump is only required for 16 hours of runtime. The EPSS must have a designation of Type 10, where 10 is the maximum time in seconds that the EPSS will permit the load terminals of the transfer switch to be less than 90 percent of the rated voltage.

Switchgear must meet UL 1558 and be provided for the EPSS 1200 amperes or greater. Switchgear must have enclosed, drawout-type circuit breakers, one per each size fully equipped spare cubicle, a breaker lifting device, and a ground and test device. The ground and test device must be stored in a spare switchgear cubicle. If the switchboards are used for EPSS equipment below 1200 amperes, they must be constructed in accordance with UL 891. Breakers with solid state trip units must have modbus communications and must be tied into the BAS for status and power monitoring.

All breakers in the switchgear must be fully rated. Series rating is not to be permitted. Main and feeder breakers must be provided with integral solid-state ground-fault protection tripping elements.

Switchgear and switchboards must be provided with a mimic bus and all sections installed on a four-inch high concrete housekeeping pad.

IR camera inspection ports must be provided on the enclosure of all switchgear for ease of inspecting switchgear for thermal problems while under load. All switchgear or switchboard panels must have hinged covers in lieu of removable covers for safety purposes.

6.5.11.1.1 EMERGENCY SYSTEM

The EPSS must supply emergency loads through an automatic transfer switch upon failure of the normal supply. The transfer time limit must not exceed 10 seconds. Emergency illumination must include all required egress lighting, illuminated exit signs, and all other lights specified as necessary to provide required illumination. See Chapter 6, Lighting Prescriptive Requirements for additional criteria and requirements.

An emergency supply source must supply equipment classified as emergency through an automatic transfer switch upon failure of the normal supply.

Emergency loads (life safety loads) must include:

- Emergency lighting
- Fire Alarm and Emergency Communication Systems
- Exit signs
- Automatic fire detection equipment for smokeproof enclosures
- Emergency voice/alarm communication systems
- Smoke control systems
- Exit stairway pressurization systems
- Fire pump
- Pressure maintenance (jockey) pump
- Air compressors serving dry pipe or pre-action systems
- Power and lighting for fire command center and security control center
- Fire service access elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators)
- Occupant evacuation elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators)

6.5.11.1.2 REQUIRED STANDBY SYSTEM

This system must automatically supply power to selected loads (other than those classified as the emergency system) upon failure of the normal source. The transfer time limit must not exceed 60 seconds.

Required standby loads must include:

- Security systems/access controls
- Exterior roll up doors
- Security bollards/crash protection
- Sump pumps
- Sewage ejection pumps
- FAA aircraft obstruction lights
- Domestic water booster pumps (high rise buildings)
- Ancillary heating equipment necessary to freeze-protect the building
- GSA owned uninterruptible power systems serving technology/server rooms
- HVAC systems for GSA owned technology/server room, UPS rooms, and communications rooms
- Automatic flushometers and faucets that are not battery powered (for portions of facilities where continuity of operations is required during a power outage)

6.5.11.1.3 OPTIONAL STANDBY SYSTEM

This system must supply power to the facilities or property where life safety does not depend on the performance of the system. The optional standby system must supply on-site generated power to selected loads, either automatically or by manual transfer.

Optional standby system loads may include:

- General areas of the buildings
- Visitor screening equipment
- Telephone switches and fiber cable battery systems
- BASs
- Uninterruptible power systems serving technology/server rooms
- HVAC systems for technology/server rooms, UPS rooms, and communications rooms
- Exhaust fan in UPS battery rooms
- HVAC and refrigeration systems
- Data processing and communications systems
- Boiler, hot water pumps, perimeter HVAC units
- Receptacles and emergency lighting in large conference rooms to facilitate command and control operations during an emergency

6.5.11.2 GENERATOR SYSTEM

The emergency and standby generator system must consist of one or more central engine generators and a separate distribution system with automatic transfer switches, distribution panels, lighting panels, and, where required, dry-type transformers feeding 208Y/120V panels. The electrical engineer must coordinate with the mechanical engineer and architect on the design of the generator system.

Diesel fuel, natural gas or propane are permitted as energy sources for building emergency generators. The designer of record must evaluate the generator fuel source based on the load, fuel availability and other determining factors for individual facilities. Diesel fuel is preferred in high seismic areas and for generator sizes larger than 500kW. Biodiesel is not permitted. Generators must be registered with the applicable regulatory authority.

Generators must be certified as fully EPA compliant at the manufacturing facility.

6.5.11.2.1 SERVICE CONDITIONS

If possible, locate the generators outside and on grade. If installed outdoors, they must be provided with a suitable reach-in acoustic enclosure and jacket water heaters to ensure reliable starting in cold weather. In harsh weather environments, walk-in enclosures should be considered. The generators must be elevated above the applicable flood elevation. Refer to Chapter 4, Flood Resistant Design Requirements.

When installed at high altitudes or in areas with very high ambient temperatures, the generators must be derated in accordance with manufacturers' recommendations. Operation of starting batteries and battery chargers must also be considered in sizing calculations. In humid locations heaters can reduce moisture collection in the generator windings. Critical silencers are required for all generators. Acoustical treatment of the generator room must be provided as necessary. Temperature and ventilation must be maintained within the manufacturers' recommendations to ensure proper operation of the unit. Calculations to support the size of the intake air supply for combustion, cooling, and radiation, as well as exhaust piping and exhaust paths, must be provided by the mechanical engineer.

Radiators must be unit mounted if possible. If ventilation is restricted in indoor applications, remote installation is acceptable. Heat recovery and load shedding must not be considered. The remote location of radiators must be designed to avoid excess pressure on the piping seals.

A permanently installed load bank, sized at a minimum of 20 percent for gas and 75 percent for diesel, of generator rating, must be provided. The load bank may be factory mounted to the radiator. Care should be taken in selecting materials that will tolerate the high temperatures associated with radiator-mounted load banks to include belts, flex connections, motors, sprinkler heads, and so on.

The load bank must provide a load add/shed feature that will maintain load levels at a minimum, including building load, of the generator manufacturer's recommended loads when operating at 50 percent of generator KW nameplate. The load bank must have a minimum of four automatic load taps controlled by a load add/shed relay incorporated into the run circuit on the generator.

6.5.11.2.2 CAPACITY

The engine generators must be sized to serve approximately 150 percent of the design load and to run at a maximum of 60 percent to 80 percent of their rated capacities after the effect of the inrush current declines. When sizing the generators, the initial voltage drop on generator output due to starting currents of loads must not exceed 15 percent. Day tanks must be sized for a minimum capacity of four hours of generator operation. Provide direct fuel oil supply and fuel oil return piping to the on-site storage tank. Piping must not be connected into the boiler transfer fuel oil delivery "loop."

Care must be exercised in sizing fuel oil storage tanks by considering that the bottom 10 percent of the tank is unusable and that the tank is normally not full (normally at a 70 percent level) before the operation of the generator.

6.5.11.2.3 GENERATOR ALARMS

Generator alarms must be provided on the exterior wall of the generator room. All malfunctions must be transmitted to the BAS. In all buildings, with or without BAS, a generator alarm annunciator must be located within the fire command center. The generator output breaker must have a contact connected to the BAS indicating output breaker position, to allow annunciation of the open position on the BAS.

6.5.11.2.4 AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches serving motor loads must have in-phase monitors (to ensure transfer only when normal and emergency voltages are in phase) to prevent possible motor damage caused by an out-of-phase transfer. They must also have pretransfer contacts to signal time delay returns in the emergency motor control centers.

Automatic transfer switches must include a bypass isolation switch that allows manual bypass of the normal or alternate power source to ensure continued power to emergency circuits in the event of a switch failure or required maintenance. Automatic transfer switches must be installed on four-inch high concrete housekeeping pads.

6.5.11.2.5 LOCATION

The generators and the generator control panel must be in separate rooms or enclosures.

6.5.11.2.6 LOAD SHEDDING

Life safety generators may be designed to operate in parallel with the local utility, thus allowing for load shedding and smart grid and intelligent building initiatives. Before designing emergency generators for peak shaving purposes, local, state, and federal authorities must be contacted due to the need for possible noise, air quality permitting, and additional hardware requirements.

6.5.12 CLEAN POWER SYSTEMS

6.5.12.1 UNINTERRUPTIBLE POWER SYSTEMS AND BATTERY ROOMS

In some facilities, technology/server room backup systems are designed by the tenant agency. If this is the case, shell space and utility rough ins must be provided. In facilities where UPS systems are to be provided as part of the building construction, they must be designed as described in this section. All UPS systems are considered to be above standard for GSA space. Tenant agencies with UPS requirements must be advised that a maintenance contract is recommended.

Requirements for UPS systems must be evaluated on a case-by-case basis. If UPS is required, it may or may not require generator backup. When generator backup is unnecessary, sufficient battery capacity must be provided to allow for an orderly shutdown.

6.5.12.1.1 CRITICAL TECHNICAL LOADS

The nature, size, and locations of critical loads to be supplied by the UPS will be provided in the program. Noncritical loads must be served by separate distribution systems supplied from either the normal or electronic distribution system. A UPS system must be sized with at least a 25 percent spare capacity. The specification of a redundant module must depend upon the criticality of the loads.

6.5.12.1.2 EMERGENCY ELECTRICAL POWER SOURCE REQUIREMENTS

When the UPS is running on the site emergency generator, the amount of current to recharge the UPS batteries must be limited to not overload the generator. This limited battery charging load must be added to the required standby load (see Chapter 6, Emergency and Standby Power Systems) when sizing the standby generator.

If the UPS system is backed up by a generator to provide for continuous operation, the generator must provide power to all necessary auxiliary equipment, i.e., the lighting, ventilation, and air conditioning supplying the UPS and the critical technical area (see Chapter 6, Emergency and Standby Power Systems).

6.5.12.1.3 SYSTEM STATUS AND CONTROL PANEL

The UPS must include all instruments and controls for proper system operation. The system status panel must have an appropriate audio/visual alarm to alert operators of potential problems. It must include the following monitoring and alarm functions: system on, system bypassed, system fault, out of phase utility fault, and closed generator circuit breaker. It must have an audible alarm and alarm silencer button. Since UPS equipment rooms are usually unattended, an additional remote system status panel must be provided in the space served by the UPS. The alarms must also be transmitted to the BAS.

6.5.12.1.4 UPS AND BATTERY ROOM REQUIREMENTS

Emergency lighting must be provided in both spaces and a telephone must be provided in or adjacent to the UPS room. The battery room design must provide proper ventilation, hydrogen detection, spill containment, and working clearances. See Chapters 3, 5, and 7 for additional requirements for the UPS and battery rooms. Also, see NFPA 70.

6.5.12.2 COMPUTER CENTER POWER DISTRIBUTION UNIT

In some GSA buildings the power distribution system for computer centers is designed by the tenant agency. If this is the case, utility rough-in must be provided under the construction contract. If power distribution is to be provided under the building contract, it must be designed according to the criteria in this section.

6.5.12.2.1 POWER DISTRIBUTION UNITS (PDUS)

PDUs with internal or remote isolation transformers and output panelboards must be provided in all computer centers to reduce/eliminate harmonic currents generated by nonlinear loads and reflected back to the neutral service conductors. PDUs with internal or remote isolation transformers must be harmonic mitigating to serve nonlinear loads.

6.5.12.2.2 COMPUTER CENTER GROUNDING

To prevent electrical noise from affecting computer system operation, a low-frequency power system grounding and a high-frequency signal reference grounding system must be provided. The design of the technology/server room grounding system must be coordinated with the computer center staff.

6.5.12.2.3 LOW-FREQUENCY POWER SYSTEM GROUNDING

A safe, low-frequency, single-point grounding system must be provided that complies with Article 250 of NFPA 70. The single-point ground must be established to ground the isolation transformer or its associated main service distribution panel.

A grounding conductor must be run from the PDU isolation transformer to the nearest effective earth grounding electrode as defined in NFPA 70. All circuits serving automated data processing equipment from a PDU must have grounding conductors equal in size to the phase conductors.

6.5.12.2.4 HIGH-FREQUENCY POWER SYSTEM GROUNDING

A high-frequency signal reference grounding system must consist of a grid made up of 600 mm (2 ft.) squares must be provided as a signal reference grounding system. If a raised floor has been provided, its grid with mechanically bolted stringers may be used. Alternatively, a grid can be constructed by laying a 600 mm mesh (2 ft. squares) of braided copper strap or 1.3 mm (16 gauge, 0.051 in.) by 50 mm (2 in.) copper strap directly on the structural floor. Data processing equipment must be connected to the reference grid by the most direct route with a braided copper strap.

6.5.12.2.5 COMMON-MODE NOISE REDUCTION

The reduction of common-mode noise is particularly important for the proper operation of computer-based, distributed microprocessor-based systems, i.e., BASs, electronic security systems, card-access control systems, and local area networks.

The following steps must be taken to reduce common-mode noise:

- Avoid running unshielded metallic signal or data lines parallel to power feeders.
- Where metallic signal or data lines are routed in noise-prone environments, use shielded (grounded at one end) cables or install wiring in ferrous metal conduit or enclosed cable trays.
- Locate metallic signal or data lines and equipment at a safe distance from arc-producing equipment such as line voltage regulators, transformers, battery chargers, motors, generators, and switching devices.
- Provide isolation transformers, electronic power distribution panelboards, or power conditioners to serve critical electronics equipment loads.
- Replace metallic data and signal conductors with fiber optic cables where practical.

6.5.12.3 HARMONIC MITIGATION—TRANSFORMERS

Harmonic frequencies are introduced into the branch circuit distribution system by non-linear loads. This harmonic distortion will create overheating and power quality problems such as overheating in transformers and conductor neutrals, premature motor failures, false tripping of protective devices, computer operational problems, and hardware component failures. To accommodate/correct these problems, the electrical design for data centers and other high harmonic generating loads must utilize Harmonic Mitigating distribution transformers and not only K-rated transformers.

Application of engineered strategies must be confirmed by a harmonic (voltage and current) analysis. Use Zigzag Harmonic Mitigating Transformers to target 3rd order harmonics and match two, phase shifting, Harmonic Mitigating Transformers for 5th and 7th order harmonics.

Transformer efficiencies of all building transformers must meet or exceed 10 CFR §431.196.

6.5.13 GROUNDING SYSTEMS

Grounding systems must be designed to coordinate with the specific type and size of the electrical distribution system, including the following applicable generic types of grounding systems or grounding components.

6.5.13.1 SEPARATE EQUIPMENT GROUND CONDUCTORS

The types, sizes, and quantities of equipment grounding conductors must comply with NFPA 70, Article 250, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

- Insulated equipment grounding conductors must be installed with circuit conductors for the following items, in addition to those required by NFPA 70:
- Feeders and branch circuits
- Lighting circuits
- Receptacle circuits
- Single-phase motor and appliance branch circuits
- Three-phase motor and appliance branch circuits
- Flexible raceway runs
- Metal clad cable runs
- Cable Trays (bond each individual section)

6.5.13.2 BUSWAY SUPPLY CIRCUITS

Insulated equipment grounding conductors must be installed from the grounding bus in the switchgear, switchboard, or distribution panel to the equipment grounding bar terminal on the busway.

6.5.13.3 SEPARATELY DERIVED GROUNDS

To minimize extraneous “noise” on certain systems, particularly those in which harmonics are generated, the specific system grounds must be separated before grounding at the service grounding electrode or counterpoise.

6.5.13.4 RAISED FLOORS

All access floors must be grounded. A grounding conductor must be bonded to every other floor pedestal and must be extended to the technology/server room common ground bus.

6.5.13.5 COUNTERPOISE

Where feasible, a grounding conductor (counterpoise) must be provided in an isosceles triangle configuration with sides greater than or equal to 3 meters (10 ft.). The conductor must be tinned copper not less than No. 4/0 AWG and must be electrically connected to the incoming domestic water services (provided the piping for the water service is a conducting material) on either side of the building as well as the various clusters of three ground rods spaced at intervals. Ground rods must be 15 mm (5/8 in.) diameter by 2,400 mm (96 in.) long and must be zinc coated copper. The counterpoise loop will involve direct burial in earth 600 mm (24 in.) below grade. Ground test well must be provided. The following items must be connected to the counterpoise loop. All ground rod and grounding connections must be exothermically welded:

- Lightning protection system “down conductors”
- Transformers in substations
- Emergency generator ground
- Telecom and data room grounds
- Separately derived grounds
- Isolated ground panels
- Main switchgears
- Normal and emergency distribution systems
- Flagpoles

6.5.13.6 COMMON GROUND SYSTEM

Consideration must be given to providing a common ground bus throughout the building. Conceptually a common ground bus would originate from the main service entrance and run up through stacked electrical rooms, where an insulated wall-mounted copper ground plate would be installed for connecting any equipment needing a common ground. Where conditions might prohibit an isosceles triangle counterpoise ground, consideration must be given to installing chemical ground rods in trenches or borings supplemented with conductivity-enhancing soil conditioners such as Bentonite clay or conductive concrete.

6.5.14 SAFETY SYSTEMS, EQUIPMENT, AND PERSONAL PROTECTION

6.5.14.1 LIGHTNING PROTECTION SYSTEMS

Lightning protection systems are important safety features in the design of electrical distribution systems. Their application on any specific project is a function of its geographic location, height, proximity of taller adjacent structures, regional ground resistance, and the architectural configuration of the building. The decision to provide a lightning protection system must be made at the earliest stages of design and must be supported by a study, as prescribed by NFPA 780.

Systems served at utilization voltages 208Y/120V or 480Y/277V must be provided with two levels of protection for sensitive electronic loads.

If a decision is made to provide a lightning protection system, specify that it be installed in compliance with NFPA 780, the components meet the requirements of UL 96 and provide UL MasterLabel certification.

6.5.14.1.1 ALTERNATE SYSTEMS

The requirement of a UL certification imposes certain restrictions or limitations on the design of the system, which may conflict with the architectural design, particularly if the facade includes large, curved surfaces that preclude the installation of air terminals and where the spacing of down conductors is limited. In those instances, the electrical engineer may appeal to the contracting officer to waive the UL certification requirement on the basis that the design generally follows the Faraday Cage principle of lightning protection.

6.5.14.1.2 GROUNDING

The down conductors must follow direct paths from the air terminals to the ground connections or to the counterpoise loop. Lightning ground conductors must have long sweeping bends and not hard 90 degree bends forcing them to conform to architectural building features.

6.5.14.2 SECURITY SYSTEMS

Every Government building, virtually without exception, whether new or existing, large or small, recent vintage or historic, must have provisions for a security system. The type and level of security system must be determined by GSA, FPS, and the client agency. The security requirements must be integrated into the design for the project. The systems must be integrated with the emergency and standby power systems.

6.5.14.3 SHORT CIRCUIT, COORDINATION AND ARC FLASH STUDY

The electrical engineer must submit a preliminary short circuit analysis on all projects. The final short circuit, coordination, and arc flash and analysis must be completed by the electrical contractor). The building power system model must be provided in a format coordinated by the region. GSA must be provided the source code for the analysis and have rights to the source native files at no additional cost to the Government. Updates to existing power system models must be incorporated into any modifying project. For facilities where no building power system model exists, a model is required to be generated if the main service equipment is replaced or if greater than 25% of the overall electrical distribution system is replaced.

The data from the arc flash calculations for individual pieces of electrical equipment must be transposed to NFPA 70E-approved labels and all panelboards, motor control centers, switchgear, and major electrical equipment must be appropriately labeled, and protection boundaries delineated per OSHA 1910 Subpart S and NFPA 70E requirements. New and refurbished equipment must conform to NEC 240.87.

6.5.15 ALTERATIONS IN EXISTING BUILDINGS AND HISTORIC STRUCTURES

The goal of alteration projects is to meet the same standards described in this document for new projects. The prospectus for a capital project, or statement of work for a smaller project, will describe the extent of the replacement and upgrade of existing systems and equipment. Equipment that is unsafe or beyond the useful service life must be demolished and new systems designed to meet the current and future usage of the facility. Renovation and rehabilitation designs must satisfy the immediate occupancy needs and anticipate additional future changes. Remodeling must make building systems more flexible. Parameters of reuse and disruption of service must be clearly specified in construction documents. All replacement and upgrades must comply with the requirements of this chapter. The result of these projects should be enhanced performance, not just equipment replacement.

6.5.15.1 LIGHTING – HISTORIC BUILDINGS

Historic fixtures may be upgraded with energy efficient lamps, ballasts, reflectors, or other means to achieve required light levels, if changes can be made without affecting the appearance of the fixture. Energy-efficient light sources should match incandescent light or daylight correlated color temperature as closely as possible, 2700K and 4000K respectively. In restoration zones, opportunities should be sought to replace unsympathetic contemporary lighting with replicas of original historic fixtures. Original or replica lighting containing exposed incandescent bulbs may be retrofitted with filament LED reproduction lamps such as A19 LED (pear-shaped, clear glass lamp) or equal. Freestanding torchieres, task lighting, and discrete accent lighting are recommended for increasing light levels in ceremonial spaces containing historic chandeliers, pendant lights, or sconces.

6.5.16 PHOTOVOLTAIC SYSTEMS

The installation of photovoltaic (PV) systems presents concerns for safety (energized equipment, trip hazards, etc.) and firefighting operations (restricting venting locations, limiting walking surfaces on roof structures, etc.). The intent of the requirements below is to address these issues while embracing the environmental advantages of this technology.

Be cognizant that because of the growing demand for PV system products, manufacturers are developing new products and methods daily and therefore GSA may encounter PV systems that will require an alternative means of compliance. Please note that it is not intended to prohibit the use of alternative systems, methods, or devices not specifically prescribed, provided GSA approves all proposed alternatives.

Before the PV system installation, the RPMT must meet with the contractor, GSA facility manager, GSA fire protection engineer, GSA safety specialist, local power utility company, and local fire official to ensure the proposed PV system design and layout is acceptable to all parties.

Before the acceptance of the PV system, the RPMT must confirm that the PV system has been tested. All testing must be witnessed and documented by a qualified independent third party test entity. The third party test entity must have an advanced understanding of the installation, operation, and maintenance of the PV system installed. The project’s commissioning agent must witness the PV system testing. At the completion of witnessing the PV system testing, the project’s commissioning agent entity must provide to the RPMT documentation verifying that the PV system is in compliance with the design and specifications.

6.5.16.1 REQUIREMENTS

The installation of PV systems at GSA federal buildings must comply with the requirements in the Structural Chapter, International Building Code, International Fire Code, National Fire Protection Association (NFPA) 70, National Electrical Code, IEEE 1547, and UL 1741. Refer to RPMT for access to GSA-Severe Weather Specification dated November 2023 for guidance on various weather conditions.

6.5.16.2 MARKING

PV systems must be marked in accordance with NFPA 70, Article 690, and the following:

6.5.16.2.1 MARKING DIRECT CURRENT (DC) CIRCUITS

All interior and exterior DC conduits, raceways, enclosures, cable assemblies, and junction boxes associated with the PV system must be marked to alert individuals that DC power is present. The marking must be placed every 10 feet or fraction thereof, at turns and above and below penetrations, and on all DC combiner and junction boxes.

The marking must contain the text “CAUTION: PV CIRCUIT ENERGIZED” in capital letters a minimum of 3/8 inches in height with white letters on a red background. The materials used for marking must be reflective and weather resistant in accordance with UL 969 that is suitable for the environment.

6.5.16.2.2 MARKING ACCESS TO ROOFS

Signage is required on all doors providing access to the roof where PV systems are installed. Each door providing access to the roof must have a sign affixed to the interior side of the door.

The signage must contain the text “CAUTION PHOTOVOLTAIC SYSTEM INSTALLED ON ROOF.” The sign must consist of letters at least 2 inches high on a contrasting background.

6.5.16.3 SMOKE VENTILATION

The PV system must be designed such that smoke ventilation opportunity areas are provided on the roof and meet the following requirements:

Each array must be no greater than 150 x 150 feet in distance in either axis.

Ventilation options between array sections must meet one of the following:

- A pathway 8 feet or greater in width
- A pathway 4 feet or greater in width that borders on existing roof skylights or ventilation hatches or,
- A pathway 4 feet or greater in width bordering 4 ft. x 8 ft. “venting cutouts” every 20 feet on alternating sides of the pathway.

6.5.16.4 LOCATION OF DC CONDUCTORS

Exposed conduit, wiring systems, and raceways for PV circuits must be located as close as possible to the ridge or hip or valley on the roof to reduce trip hazards and maximize ventilation opportunities.

Conduit runs between subarrays and conduit runs to DC combiner boxes must be designed in a manner that minimizes total amount of conduit on the roof. The DC combiner boxes must be located such that conduit runs are minimized in the pathways between arrays.

To limit the hazard of cutting live conduit in fire department venting operations, DC wiring must be run in metallic conduit or raceways when located within enclosed spaces in a building and must be run, to the maximum extent possible, along the bottom load-bearing members.

6.5.16.5 ROOF CLEARANCE REQUIREMENTS

The PV system, including supports and power conductors, must not interfere with roof drains, expansion joints, air intakes, existing electrical and mechanical equipment, existing antennas, and planned areas for future installation of equipment.

Rooftop installation must coordinate with the building rigging plan associated with powered platforms, boatswain chairs, etc., and address the relocation or incorporation of the davits.

In addition to the pathway requirements noted above, a 3-foot clear path of travel must be maintained to and around all rooftop equipment.

6.5.16.6 ROOF MOUNTING REQUIREMENTS

Mounting systems must be either fully ballasted or must limit penetrations of the roofing system. All roof penetrations must be designed and constructed in collaboration with the roofing professional or manufacturer responsible for the roof and roofing material warranty for the specific site. The number and size of the penetrations necessary to extend the power and control cable into the building must be kept to a minimum and grouped in a single location when practicable. All weatherproofing of penetrations must be compatible with the roof warranty.

6.5.16.7 EQUIPMENT AND COMPONENTS

All PV hardware and structural components must be either stainless steel or aluminum. All interconnecting wires must be copper. Power provided must be compatible with on-site electric distribution systems.

6.5.16.8 SAFETY

Provide detailed Lock Out/Tag Out instructions for all equipment.

Provide lightning protection meeting UL96 and NFPA 780.

PV Modules must be UL Listed and must be properly installed according to manufacturer’s instructions, IBC, IFC, and NFPA 70.

6.5.16.9 REQUIRED: PV SYSTEM APPROVAL

Before PV system installation, the RPMT must ensure the proposed PV system design and layout is acceptable to all parties:

- GSA Facility manager
- GSA Fire Protection Engineer
- GSA Safety Specialist

- Local fire officials
- Electric Utility

6.5.17 QUALITY ASSURANCE OF ELECTRICAL POWER SYSTEMS AND EQUIPMENT

The purpose of field-based electrical testing and commissioning is to assure that electrical power generation and distribution systems are safe, reliable, operational, and are in conformance with applicable codes, standards, and manufacturers' tolerances, and are installed in accordance with design specifications. Electrical acceptance and commissioning specifications must describe the systematic process of documenting, assessing the suitability for initial energization, placing into service, and final acceptance of newly installed, or retrofitted electrical power equipment and systems. ANSI/NETA ATS and ANSI/NETA ECS must be consulted and referenced when defining these specifications. Continued quality assurance relies on routine, preventive maintenance as specified by the ANSI/NETA MTS.

6.5.17.1 ELECTRICAL TESTING FIRM

Accredited, third-party, field-experienced, electrical testing firms or OEM certified technicians must be utilized for field-testing and commissioning inspections and tests of major electrical upgrades/installations to assure accurate electrical power system and component testing, reporting, and recommendations.

6.5.17.2 QUALIFIED ELECTRICAL TESTING PERSONNEL

Qualified electrical testing technicians certified in accordance with ANSI/NETA ETT, NICET EPT, or OEM certified technicians must be specified when performing the visual, mechanical, and electrical tests and inspections. Section 3.2 of these standards should be consulted when considering project requirements as related to the qualifications of field testing and commissioning personnel.

6.5.17.3 SAFETY, SUITABILITY OF TEST EQUIPMENT, AND DOCUMENTATION

When specifying project requirements for safety and precautions, suitability of test equipment, test instrument calibration, and test reports, Section 5 of the ANSI/NETA ATS, ANSI/NETA ECS, must be consulted and referenced.

6.5.17.4 POWER SYSTEM STUDIES AND ELECTRICAL COMMISSIONING PROCESS

When specifying power system studies such as short-circuit, coordination, arc-flash hazard analysis, load-flow, stability, and harmonic-analysis, Section 6 of the ANSI/NETA ATS must be referenced. When designing commissioning specifications for electrical power systems, section 6 of the ANSI/NETA ECS must be consulted and referenced regarding commissioning intent, project requirements, basis of design, and the commissioning plan.

6.5.17.5 VISUAL, MECHANICAL, AND ELECTRICAL INSPECTIONS AND TESTS AND INSPECTION AND COMMISSIONING PROCEDURES

When specifying necessary visual, mechanical, and electrical inspections, tests, and results for electrical acceptance and electrical commissioning of electrical power generation and distribution equipment and systems, Section 7 of the ANSI/NETA ATS ANSI/NETA ECS must be consulted and referenced.

6.5.17.6 VISUAL, MECHANICAL, AND ELECTRICAL INSPECTIONS AND TESTS FOR ROUTINE AND PREVENTIVE MAINTENANCE

When specifying necessary visual, mechanical, and electrical inspections, tests, and results for routine and preventive maintenance of electrical power generation and distribution equipment and systems, Section 7 of the ANSI/NETA MTS must be consulted and referenced.

6.5.18 REBATE PROGRAMS

The Energy Act of 2020 includes extended product system rebate programs to encourage replacement of energy inefficient electric motors and transformers. Additionally, there are often utility or locality-based rebate programs that are available. These rebate programs should be utilized to both improve GSA's energy performance as well as to reduce installation costs. Coordinate with the BA63 Energy Rebate program.

Figure 18: Building 48 Denver Federal Center Electrical Denver, CO

7

FIRE PROTECTION

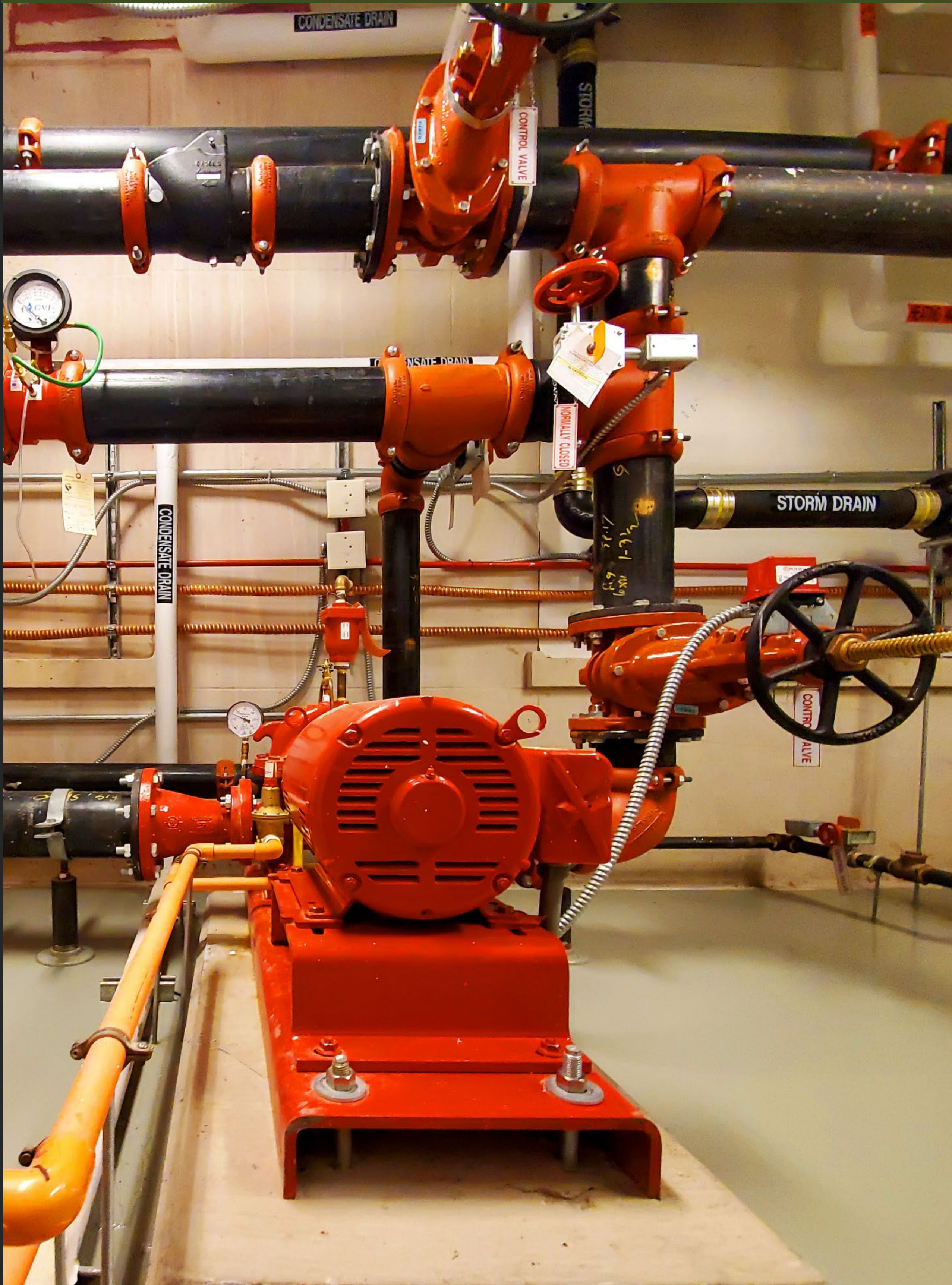


Figure 19: U.S. Courthouse Fire Pump Mobile, AL

7.1 GOALS AND OBJECTIVES

The goal of GSA's fire protection program is to incorporate into all projects fire protection and life safety systems that are effective in detecting, extinguishing, or controlling a fire event, thereby improving overall building safety to an acceptable level. The primary goal is to protect human life from fire and products of combustion. The secondary goals are to reduce federal government and taxpayers' potential losses from fire (i.e., protect federal real and personal property, maintain client agency mission continuity, and control environmental impact).

7.1.1 SCOPE

This chapter provides the fire protection and life safety requirements for GSA facilities to meet the goals identified above. Areas where GSA's requirements differ from the referenced national codes and standards are delineated in Chapter 1. The provisions located in the introduction and in Chapter 1 within this document also apply to this chapter. All other text is mandatory.

7.1.2 APPLICABILITY

Where work areas consist of portions of a building, the requirements within this chapter are limited to the work area in which work is being performed, unless specified otherwise by the GSA regional fire protection engineer.

7.1.3 RESPONSIBILITIES

7.1.3.1 PROJECT TEAM FIRE PROTECTION ENGINEER

A qualified fire protection engineer must be a full participant of the project team for each phase of the project from concept through design, construction, and occupancy.

Therefore, the project team qualified fire protection engineer, as the Fire Protection Engineer Designer of Record, at a minimum must:

- review all submittals related to fire protection systems (i.e. egress, locking, textile or plastic interior finishes, smoke control, sprinklers, fire alarm, firestopping, etc.);
- must review all RFIs and change orders to address those systems;
- must verify by inspection that the installation met the design requirements, and
- must verify that the preliminary testing confirmed that the design parameters were met.

The project team qualified fire protection engineer must be a licensed engineer who has passed the principals and practice of engineering examination in fire protection administered by the National Council of Examiners for Engineering and Surveying (NCEES) and which can be verified by documentation. The project team qualified fire protection engineer must have three consecutive years of experience directly involved in fire protection engineering and life safety applicable to the specific project as determined by the GSA regional fire protection engineer, and which can be verified by documentation. (Please note that GSA does not require the design professional to be licensed in the state where the project is being constructed, so the project team qualified fire protection engineer may be licensed in any state that formally recognizes a professional fire protection engineer.) The project team qualified fire protection engineer must perform the following:

Analysis of:

- Building construction
- Occupancy classification
- Means of egress
- Fire alarm system
- Water-based fire extinguishing system(s)
- Non-water-based fire extinguishing system(s)
- Smoke control system(s)

Calculations for:

- Egress
- Water supply
- Smoke control (fire dynamics)

Design of all fire protection and life safety systems, including, but not limited to:

- Fire alarm system
- Water-based fire extinguishing system(s)
- Fire detection system

See the Appendices for specific submission requirements.

The project team qualified fire protection engineer will participate in each phase of the project from concept through design, construction, final acceptance, and occupancy to ensure fire protection and life safety requirements are incorporated into the project. The project team qualified fire protection engineer will review design plans, specifications, and related information; review contractors' submittals for compliance with contract documents; witness acceptance testing, integrated testing, and commissioning of fire protection and life safety systems before occupancy.

7.1.3.2 GSA REGIONAL FIRE PROTECTION ENGINEER

The GSA regional fire protection engineer will participate in each phase of the project from concept through design, construction, final acceptance, and occupancy to ensure fire protection and life safety requirements are incorporated into the project. The GSA regional fire protection engineer will review design plans, specifications, and related information; review contractors' submittals for compliance with contract documents; witness acceptance testing and commissioning of fire protection and life safety systems; and upon successful completion of commissioning and acceptance of tested systems, will issue certificates of occupancy (or temporary certificates of occupancy) before occupancy.

The GSA regional fire protection engineer is the authority having jurisdiction (AHJ) for technical requirements in this chapter, including all fire protection and life safety code interpretations and code enforcement requirements. As the AHJ, the GSA regional fire protection engineer has the right to revise the specific requirements within this chapter based on a technical evaluation and analysis and the project's specific needs.

7.1.3.3 ALTERNATIVE DESIGNS

The project team fire protection engineer may propose alternative designs to that prescribed herein, but the GSA regional fire protection engineer must approve the alternative design. Such review must determine if the proposed alternative is deemed equivalent or superior to the intent of the prescribed requirements in this chapter. See Chapter 1 for additional information.

7.1.3.4 CERTIFICATE OF OCCUPANCY

No portion of a new construction or major renovation and alteration project may be occupied until the GSA regional fire protection engineer has issued a certificate of occupancy or a temporary certificate of occupancy to the RPMT. Issuance of a certificate of occupancy must not be construed as an approval of any violation of a national code or GSA design standard or criterion.

7.2 REFERENCES

The national codes and standards adopted by GSA are discussed in Chapter 1. Additional codes and standards for the design of fire protection and life safety systems are included in the text of this chapter and listed in Appendix B, References.

7.3 FIRE SAFETY DURING PROJECTS

7.3.1 FIRE SAFETY DURING NEW CONSTRUCTION PROJECTS

Fire safety during new construction projects must comply with the requirements in the IBC, IFC, and NFPA 241.

7.3.2 FIRE SAFETY DURING REPAIR AND ALTERATION PROJECTS

Fire safety during repair and alteration projects must comply with the requirements in the IBC, IFC, and NFPA 241.

SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in the IBC, IFC, and NFPA 241:

- A fire prevention program superintendent is not required for a repair and alteration project unless required by the GSA regional fire protection engineer.

7.3.3 FIRE SAFETY DURING DEMOLITION PROJECTS

Fire safety during demolition projects must comply with the requirements in the IBC, IFC, and NFPA 241.

7.3.4 EXISTING FIRE PROTECTION SYSTEMS

Impairments to existing fire alarm and sprinkler systems must be kept to a minimum or avoided. The project team fire protection engineer must delineate phasing of construction to ensure that installations of new systems are expedited and existing systems are kept in service until the replacement system is operational. If fire protection systems are to be disrupted, procedures must be incorporated into the design to maintain equivalent levels of fire protection and provide formal notification to the facility while systems are impaired.

7.4 MEANS OF EGRESS

The means of egress requirements for the building must meet the requirements in NFPA 101. The technical egress requirements in NFPA 101 must be used in place of the technical egress requirements in the IBC.

7.4.1 SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 101:

- Interlocking (scissor) stairs must count as only one exit stair.
- Fire escape stairs, as defined in the NFPA 101, are not considered approved exits.
- In new construction projects where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, or more than 9.1 m (30 ft.) below the level of exit discharge serving such floor levels, exit stairways must be pressurized in accordance with the requirements in the IBC.

7.4.2 EVACUATION ROUTE DIAGRAMS

Evacuation route diagrams must be posted in a tamper-resistant frame or engraved on a placard that is mounted on the walls in each passenger elevator lobby, freight elevator lobby, and any mechanical spaces that may be occupied by contractors or other personnel not familiar with floor layouts and exit locations. The minimum size of the diagram must be 8½ inches by 11 inches. This diagram must be depicted in either landscape or portrait form depending on the architectural layout and orientation of the elevator lobbies at each floor. Provide labeling as required in PBS ORDER 3490.2. The diagram must consist of a CAD-generated floor plan for each floor with the evacuation routes identified. The floor plan must be legible. A minimum of at least two routes to the nearest two exits must be shown. Those routes must be shown in a solid, bold, red line weight that also includes several paths of egress solid, directional arrow heads, within each route, indicating the direction of travel at a minimum. All Manual Fire Alarm Boxes along any Evacuation Route must be shown as an F within a square box (in red). Provide a “YOU ARE HERE” designation pointing directly to the sign’s final installed orientation. The current diagram’s location must be indicated by a solid red circle at least 1⁄4 in. in diameter and labeled “YOU ARE HERE” in capital letters. Also, the top of the Evacuation Route Diagram must display a title indicating the floor number, such as “6th Floor Evacuation Route Diagram”. This diagram may contain a zoomed-in core area of the building (for a larger view of routes) if all evacuation routes and exit stairs are legibly shown. The diagram must contain a legend for clarification purposes of any additional items shown on these evacuation plans.

7.4.3 EXIT STAIR PATH MARKINGS

In new construction projects where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, exit enclosures must be equipped with exit stair path markings meeting the requirements in NFPA 101.

7.4.4 EXIT STAIRWAY IDENTIFICATION SIGNAGE

In new construction projects, exit stairway identification signage must meet the requirements in NFPA 101 and be made of a material having a luminescent background.

7.5 INTERIOR FINISHES

The interior finish requirements for walls, ceilings, floors, draperies, curtains, and movable partitions must meet the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Adhesives and other materials used for the installation of carpets must be limited to those having a flash point of 60° C (140° F) or higher.
2. Wood used in construction that is required to be fire retardant must be treated with fire retardant chemicals by a pressure impregnation process or other method that treats the materials throughout (as opposed to surface treatment). The labeling for fire retardant treated wood must be visible.

7.6 FIRE ALARM AND EMERGENCY COMMUNICATION SYSTEMS

Fire alarm and emergency communication systems must be installed in accordance with the requirements in NFPA 72 and the IBC. All documentation requirements in NFPA 72 are required to be submitted for review and approval.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

1. All fire alarm systems installed in buildings must be an emergency communication system when any one of the following conditions exists:
   a. The building is two or more stories in height above the level of exit discharge.
   b. The total calculated occupant load of the building is 300 or more occupants.
   c. The building is subject to 100 or more occupants above or below the level of exit discharge.
2. Fire alarm and emergency communication system control equipment that is installed in non-high-rise buildings must be located within a room separated from the remainder of the building by not less than a one-hour fire resistance-rated fire barrier. The room must be provided in a location approved by the GSA fire protection engineer after consultation with the local fire department. The room must be a minimum of 9.3 m^2 (100 sq. ft.) with a minimum dimension of 2.4 m (8 ft.).
3. Fire alarm and emergency communication system control equipment that is installed in U.S. Courthouses must include redundant functionality installed within the U.S. Marshals Service (USMS) Command and Control Center. The redundant controls must have the same capabilities

and operation as the main fire alarm and emergency communication system control unit, including annunciation, except there must be no capability to initiate “Signal Silence” (turning notification appliances off), “Acknowledge” (of any signal), and “Reset” (resetting the system to normal) operations. In addition, the control unit’s alarm, supervisory, and trouble audible signals must be capable of being silenced. Subsequent alarm, supervisory, and trouble conditions must cause the local audible signal to resound. The master microphone located at the main fire alarm and emergency communication system control unit must be arranged to take priority over the redundant microphone located in the USMS Command and Control Center.

4. All fire alarm signals (i.e., alarm, supervisory, and trouble signals) must be automatically transmitted to a supervising station evaluated by Underwriters Laboratories (UL) to UL Standard 827, Central Station Alarm Services (UUFX Category Code). Two different communication paths are required to be provided. The GSA network may be used as a communication path with the use of a GSA-IT remediated and approved dual path fire alarm communicator.

5. All fire alarm wiring must be installed in conduit. Conduit must be rigid metal or electrical metallic tubing, with a minimum inside diameter of 19 mm (3/4 inch) that utilizes compression type fittings and couplings.

6. All new emergency generators must be monitored by the fire alarm system for the following supervisory conditions: Generator Running, Generator Common Trouble. In addition, the generator controllers must include the NFPA 110 required generator monitoring and output contacts.

7.6.1 MANUAL FIRE ALARM BOXES

Manual fire alarm boxes must be installed in accordance with the requirements in NFPA 72 and the IBC.

SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

1. Manual fire alarm boxes must be installed in all new fire alarm system projects, including in buildings protected throughout with an automatic sprinkler system.

2. Manual fire alarm boxes installed in public areas located on the ground floor of a building must be equipped with a listed protective cover with a built-in warning horn that sounds when cover is lifted to gain access to the manual fire alarm box to prevent unwanted alarms without restricting legitimate operation.

7.6.2 WATERFLOW SWITCHES

Waterflow switch(es) must be installed in accordance with the requirements in NFPA 13, NFPA 72, and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13, NFPA 72, and the IBC:

1. Each waterflow switch must be separately annunciated at the main fire alarm control unit and all required annunciators.

7.6.3 SMOKE DETECTORS

Smoke detectors must be installed in accordance with the requirements in NFPA 72 and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

1. Area smoke detectors must not be installed in any of the following rooms: mechanical equipment rooms, electrical rooms, telephone closets, and emergency generator rooms.
2. Smoke detection appropriate for the application must be installed in each of the following: uninterruptible power service rooms, main electric rooms, transformer vaults, telephone exchanges, and information technology equipment as specified in this chapter. When smoke detection is installed in rooms having high voltage equipment, the smoke detection must not be installed directly above the high voltage equipment.
3. Duct smoke detectors and associated operations must be provided as outlined in NFPA 90A.
4. Operation of a duct smoke detector must initiate a supervisory signal.
5. Smoke detectors used solely to initiate elevator recall must initiate an alarm signal, unless specifically approved by the GSA regional fire protection engineer to initiate a supervisory signal.
6. Smoke detectors located at doors for the exclusive operation of automatic door release must initiate an alarm signal, unless specifically approved by the GSA regional fire protection engineer to initiate a supervisory signal.

7.6.4 AUDIBLE NOTIFICATION APPLIANCES

Performance, location, and mounting of audible notification appliances must be in accordance with the requirements in NFPA 72.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. The design for achieving the required minimum dBA levels must take into consideration all building construction materials such as carpeting, hard surfaces, walls, doors, etc., and any other materials that can cause sound level attenuation and/or clarity problems in the placement and location of all audible notification appliances. In addition, all new emergency communication systems must include audible notification appliances in all normally occupied rooms and spaces unless an engineering analysis demonstrates adequate sound levels will be achieved without appliances in each room or space.
2. Where emergency communication systems are provided, fire alarm speakers must be installed in elevator cars and exit stairways; however, they must only be activated to broadcast live voice messages (e.g., manual announcements). The automatic voice messages must be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cars.
3. To prevent external tapping of the audio/speaker circuit(s) serving a sensitive compartmented information facility, any of the following methods are permitted to be used:

a. Self-amplified speakers

b. Remote dedicated amplification

c. Remote signal modules

7.6.5 VISUAL NOTIFICATION APPLIANCES

Placement and spacing of visual notification appliances must be in accordance with the requirements in NFPA 72.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. Visual notification appliances must be installed in public and common areas. For the purposes of this requirement, visual notification appliances are not required to be installed in individual offices. Public and common areas include, but are not limited to, public restrooms, reception areas, building core areas, conference rooms, and open office areas.

2. Visual notification appliances are not permitted to be installed in exit enclosures (e.g., exit stairs).

7.6.6 OCCUPANT NOTIFICATION

Transmission of an alarm signal from any fire alarm system initiation device to notify the occupants throughout the building must be in accordance with the requirements in NFPA 72 and the IBC.

SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

1. All alarm signals transmitted from any fire alarm system initiation device must activate the respective building audible and visual notification appliances to notify the occupants.

    a. Exception: Where approved by the GSA Regional Fire Protection Engineer, smoke detectors used solely to initiate elevator recall and smoke detectors located at doors for the exclusive operation of automatic door release are permitted to initiate a supervisory signal in lieu of an alarm signal.

    b. Exception: Where approved by the GSA Regional Fire Protection Engineer, a fire alarm system designed and operated with NFPA 72 Presignal features can only be operated in a fully sprinkler protected building, and the presignal arrangement is only permitted for building smoke detection or smoke detection systems.

    c. Exception: Duct smoke detectors must not activate the fire alarm system notification appliances.

7.6.7 FIRE ALARM NOTIFICATION STRATEGIES FOR HIGH-RISE BUILDINGS

In high-rise buildings, the fire alarm and emergency communication system must be designed for selective evacuation, unless specifically approved otherwise by the GSA regional fire protection engineer. The GSA regional fire protection engineer must establish a dialogue with the project team fire protection engineer to determine specific evacuation strategies for the building and subsequent operational features of the fire alarm system. This includes, but is not limited to, determining how and where the "fire zone" and "safe area zone" messages are used. The visual alarm notification appliance circuits must not be activated on floors designated as safe area zones.

7.6.8 SURVIVABILITY FOR FIRE ALARM AND EMERGENCY COMMUNICATION SYSTEMS

The fire alarm and emergency communication system must meet the survivability requirements in NFPA 72.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. Two vertical risers (e.g., supply and return inter-connected network circuits Class X) must be installed as far from each other as practicable so that a single fire does not impact both risers.
2. The two vertical risers must be protected as follow:
    a. Buildings that are protected by an automatic sprinkler system installed in accordance with NFPA 13, and circuits installed in metal raceway meet a pathway survivability of Level 1 as defined in NFPA 72.
    b. Buildings that are not protected by an automatic sprinkler system must meet one or more of the following requirements:
        i. 1-hour fire-rated circuit integrity (CI) or fire-resistive cable
        ii. 1-hour fire-rated cable system [electrical circuit protective system(s)]
        iii. 1-hour fire-rated enclosure or protected area
        iv. Performance alternatives approved by the GSA regional fire protection engineer
3. The horizontal interconnections between the two vertical risers must be protected as follows:
    a. Buildings that are protected by an automatic sprinkler system installed in accordance with NFPA 13, and circuits installed in metal raceway meet a pathway survivability of Level 1 as defined in NFPA 72.
    b. Buildings that are not protected by an automatic sprinkler system must meet one or more of the following requirements:
        i. 1-hour fire-rated circuit integrity (CI) or fire-resistive cable
        ii. 1-hour fire-rated cable system [electrical circuit protective system(s)]
        iii. 1-hour fire-rated enclosure or protected area
        iv. Performance alternatives approved by the GSA regional fire protection engineer

4. All circuits (speaker/audio, SLC, network, and/or power) necessary for the operation of the notification appliances must be protected until they enter the evacuation signaling zone (usually a floor) as follows:

    a. Buildings that are protected by an automatic sprinkler system installed in accordance with NFPA 13, and circuits installed in metal raceway meet a pathway survivability of Level 1 as defined in NFPA 72.

    b. Buildings that are not protected by an automatic sprinkler system must meet one or more of the following requirements:

        i. 1-hour fire-rated circuit integrity (CI) or fire-resistive cable

        ii. 1-hour fire-rated cable system [electrical circuit protective system(s)]

        iii. 1-hour fire-rated enclosure or protected area

        iv. Performance alternatives approved by the GSA regional fire protection engineer

5. A minimum of two distinct fire alarm audible notification appliance circuits and a minimum of two distinct visible notification appliance circuits must be provided on each floor.

6. Circuit integrity cable, if used, must be installed only in EMT, and be supported in accordance with manufacturer's requirements and UL 2196.

7. Provide a minimum of two (2) Class B Signaling Line Circuits (SLC) per floor. The system must be designed and installed so that a single open, wire to wire short, or any other Class B impairment on an SLC does not affect more than 2,415 m^2 (26,000 ft^2) of gross floor area. The floor SLCs must be isolated from the SLC risers and network.

8. New two-way communication systems for occupant use that are installed in area of refuge(s), elevator landing(s), and occupant evacuation elevator lobby(s) must meet the following requirements:

    a. Two vertical risers (e.g., supply and return inter-connected network circuits Class X) must be installed as far from each other as practicable so that a single fire does not impact both risers.

    b. All pathways must comply with NFPA 70.

    c. Two-way communication systems installed in buildings that are protected by an automatic sprinkler system installed in accordance with NFPA 13, and circuits installed in metal raceway meet a pathway survivability of Level 1 as defined in NFPA 72.

    d. Two-way communication systems installed in buildings that are not protected by an automatic sprinkler system must meet one or more of the following requirements:

        i. 1-hour fire-rated circuit integrity (CI) or fire-resistive cable

        ii. 1-hour fire-rated cable system [electrical circuit protective system(s)]

        iii. 1-hour fire-rated enclosure or protected area

iv. Performance alternatives approved by the GSA regional fire protection engineer

7.6.9 FIRE COMMAND CENTER

The fire command center must meet the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Each fire command center must be provided in a location approved by the GSA regional fire protection engineer after consultation with the local fire department.

2. Each fire command center must be provided with appropriate lighting, ventilation, and emergency lighting.

7.6.10 ANNUNCIATOR

All fire alarm systems must have at least one annunciator located in plain view within 7.6 m (25 ft.) of the primary fire department entrance to the building.

7.7 WATER SUPPLY FOR FIRE PROTECTION

The project team fire protection engineer must assess the adequacy of the existing water supply. Water supply flow testing of fire hydrants and/or fire pumps must be performed by or under the direction of the project team fire protection engineer. If the hydraulic data is less than one year old and is available from the local jurisdiction, the project team fire protection engineer must verify the locations involved as well as the quality and accuracy of the data. The required fire water flows and pressures for buildings must comply with the requirements in NFPA 13, 14, 20 and 24.

7.7.1 FIRE PUMPS

When a fire pump is necessary to supplement fire water flow and pressure, the size and the installation of the fire pump must be in accordance with the requirements of NFPA 13, 14, and 20.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13, 14, and 20:

1. The building's fire pump must be sized for the sprinkler system requirements only if the local responding fire department can provide the necessary flow and pressure for manual firefighting operations (i.e., standpipes), through fire department connections. Where fire pumps are provided to supply other fire suppression activities, they must be sized in accordance with the appropriate NFPA standard.

2. A fire pump must start automatically at 69 kPa (10 psi) below pressure maintenance pump (jockey pump) start pressure. The fire pump must be manually shut down, unless otherwise approved by the GSA Regional fire protection engineer. The fire pump installation must include a test header and a closed loop with a flow meter.

3. Emergency power must be provided in accordance with the requirements in Chapter 6.

4. The power transfer switch and the fire pump controller must be factory assembled and packaged as a single unit. Separate transfer switches are not permitted.

7.7.2 PRESSURE MAINTENANCE PUMP (JOCKEY PUMP)

A pressure maintenance pump must be used to maintain a uniform or relatively high pressure on the fire protection system. A jockey pump must be sized to make up the allowable leakage rate within 10 minutes or 3.8 lpm (1 gpm), whichever is larger. The pressure maintenance pump must be equipped with emergency power.

7.7.3 FIRE HYDRANTS

New fire hydrants must be installed in accordance with the requirements in NFPA 24 and the IFC unless the locations of the existing fire hydrants provide adequate coverage for the subject project. The local fire department must be consulted about the location of the fire hydrants and thread types for hydrant outlets.

7.7.4 POST INDICATOR VALVE

In a campus setting a post indicator valve is required on the fire protection service for each building.

7.8 AUTOMATIC SPRINKLER AND STANDPIPE SYSTEMS

Automatic sprinkler systems must be installed in accordance with the requirements in NFPA 13, and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

1. Automatic sprinklers must be installed throughout all new construction projects.

2. Automatic sprinklers must be installed throughout all renovation projects where the building has a sufficient municipal water supply system for the design and installation of a sprinkler system at the site or where the installation of a new fire pump is not cost prohibited.

3. Automatic sprinklers must be installed throughout the designated work area for all alteration projects where the building has a sufficient municipal water supply system for the design and installation of a sprinkler system at the site or where the installation of a new fire pump is not cost prohibited.

4. Where project sites are in remote or isolated areas having insufficient or nonexistent water supplies in proximity, design the fire sprinkler system in accordance with NFPA 13. See Automatic Sprinkler Systems for Remote or Isolated Facilities for additional information regarding automatic sprinkler system requirements.

5. Where automatic sprinklers are required to be installed, they must be installed throughout all locations unless the subject locations are specifically exempted by NFPA 13 or the IBC.

6. All sprinkler systems must be wet-pipe sprinkler systems, unless installed in areas subject to freezing.

7. Heat tape is not permitted on sprinkler piping.

8. Dry-pipe sprinkler systems must incorporate a nitrogen inerting process that replaces air with nitrogen gas when used to charge, maintain, or supervise a dry-pipe sprinkler system, unless specified otherwise by the GSA regional fire protection engineer.

9. Sprinkler systems must be designed using a minimum system design area of 139 m^2 (1,500 sq. ft.). No decreases are permitted.

10. Where floor openings are not classified as atriums, the sprinklers at the ceiling must be zoned with the lower level if it is enclosed on the upper level (the enclosure is effectively creating a high ceiling). Otherwise, sprinklers must be zoned with the upper level.

11. Sprinkler system control valves must be in accessible spaces. Sprinkler system control valves are not permitted in above ceiling spaces.

12. Antifreeze sprinkler systems are not permitted to be installed.

13. Pre-action-type sprinkler systems are not permitted to be installed.

14. Sprinkler guards must be provided in the following locations:

    a. Sprinklers installed less than 2.1 m (7 ft.) above the floor

    b. Sprinklers installed within elevator machine rooms and elevator pits

    c. Sprinklers installed within electrical rooms

15. Sprinklers installed in main electric rooms and transformer vaults must be provided with separate manual isolation valves and a separate water flow switch located outside the room in an accessible location. Tamper switches must be provided on all such valves. A means to test the water flow switch must be provided by fixed piping to a location approved by the GSA regional fire protection engineer.

7.8.1 TYPES OF SPRINKLERS

Sprinklers must be selected based on the associated hazards within the occupancy to be protected in accordance with the requirements in NFPA 13 and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

1. Sprinklers equipped with “O-ring” water seals are not permitted to be installed.

2. The use of saddle tees fitted with rubber gaskets is not permitted.

7.8.2 SPRINKLER PIPING

Sprinkler piping, fittings, control valves, check valves, and drain assemblies must meet the requirements in NFPA 13.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13:

1. Black steel piping or copper tubing must be used for all wet-pipe sprinkler piping installed in new construction and renovation projects. Nonmetallic sprinkler piping listed by a nationally recognized testing laboratory is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
2. Chlorinated polyvinyl chloride sprinkler piping is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
3. Galvanized (internal and external) sprinkler piping is not permitted to be used for dry-pipe sprinkler systems.
4. Steel pipe sizes 51 mm (2 in.) and smaller must be Schedule 40.
5. Steel pipe sizes larger than 51 mm (2 in.) must be minimum Schedule 10. Piping less than Schedule 40 must be roll grooved.
6. Threaded light wall pipe is not permitted to be installed.
7. Steel piping having a corrosion-resistant ratio less than 1 is not permitted to be installed.
8. Mechanical tees (side outlets) that utilize a U-bolt for connection to piping are not permitted.
9. Plain-end fittings are not permitted to be installed.
10. FM-approved flexible sprinkler hose fittings and their anchoring components intended for use in installations connecting the sprinkler system piping to sprinklers is permitted to be installed. The subject sprinkler hose fittings must follow the FM installation requirements. When installed and supported by suspended ceilings, the project team fire protection engineer must certify in writing that the ceiling meets ASTM C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, and will be installed in accordance with ASTM C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

7.8.3 AUTOMATIC SPRINKLER SYSTEMS FOR REMOTE OR ISOLATED FACILITIES

The requirements below apply to facilities located in remote or isolated areas having insufficient or nonexistent water supply sources for the design and installation of a fire sprinkler system in accordance with the requirements in NFPA 13.

If the following conditions exist, the sprinkler system must be designed and installed in accordance with the requirements in NFPA 13D:

- The costs associated with the installation of the interior NFPA 13 fire sprinkler system (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) exceed $10.00 per square foot; and
- The costs associated with connecting the interior NFPA 13 fire sprinkler system to the adequate water supply source (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) are greater than 50 percent of the cost for the installation of the interior NFPA 13 fire sprinkler system.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13D:

1. The water supply source for the sprinkler system must be a minimum of 3,785.4 liters (1,000 gallons) and must be capable of providing the hydraulic demand of the two hydraulically most demanding sprinklers for a minimum 30 minutes.
2. The number of sprinklers in the design area must be all the sprinklers within a compartment, up to a maximum of two sprinklers that require the greatest hydraulic demand.
3. Black steel piping and copper tubing must be used for all sprinkler piping installed in facilities located in remote or isolated areas having insufficient or nonexistent water supply sources. UL-listed nonmetallic sprinkler piping and tubing is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
4. Hydrostatically test the sprinkler system at 200 psi for 2 hours.
5. Antifreeze sprinkler systems are not permitted to be installed.

7.8.4 FIRE DEPARTMENT CONNECTIONS

Fire department connections must meet the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in the IBC:

1. UL-listed locking fire department connection caps must be installed on all fire department connections where the local fire department has a program and the hardware to accommodate locking fire department caps.

7.8.5 STANDPIPES

Standpipes must be installed in buildings where required in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. All standpipes must be connected to the fire protection water supply, permanently pressurized, and installed in accordance with the requirements in NFPA 14. The standpipe water supply must be in accordance with the requirements specified within this chapter.

2. Dry standpipes must be permitted to be installed only in spaces subject to freezing.
3. Where standpipe and sprinkler systems are required, a combination sprinkler/standpipe system design must be provided.

7.8.6 FIRE DEPARTMENT HOSE OUTLETS

Fire department hose outlets must be installed in buildings where required in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

Fire department hose outlets provided on the standpipe must consist of a 63 mm (2 ½ inch) hose connection and a cap. Threads of hose connections must be compatible with local fire department equipment. The outlets must be in the stair shaft. Pressure Reducing Valves (PRVs) if installed must be field adjustable.

7.9 NON-WATER-BASED FIRE EXTINGUISHING SYSTEMS

7.9.1 WET CHEMICAL EXTINGUISHING SYSTEMS

Wet chemical extinguishing systems must be installed to protect commercial food heat-processing appliances required to have a Type 1 hood in accordance with the requirements in NFPA 96 and NFPA 17A.

7.9.2 DRY CHEMICAL EXTINGUISHING SYSTEMS

Dry chemical extinguishing systems are not permitted to be installed to protect any commercial cooking equipment installations.

7.9.3 CLEAN AGENT EXTINGUISHING SYSTEMS

Clean agent extinguishing systems are not permitted to be installed, unless specifically approved for installation by the GSA regional fire protection engineer. The approved clean agent extinguishing system is considered a supplemental fire extinguishing system and is not to be installed in place of a wet-pipe sprinkler system.

7.9.4 CARBON DIOXIDE FIRE EXTINGUISHING SYSTEMS

Carbon dioxide fire extinguishing systems are not permitted to be installed.

7.9.5 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers must be installed in accordance with the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. In Federally owned buildings protected throughout with quick-response sprinklers, portable fire extinguishers must only be installed in areas such as mechanical, electrical, elevator equipment areas, computer rooms, UPS rooms, energy storage system rooms, generator rooms, kitchens, kitchenettes with cooktops or stoves, security screening stations, and special hazard areas (e.g., laboratories, flammable, and combustible liquid storage, etc.).
    a. For the above Federally owned buildings, portable fire extinguishers are not required to be installed in public and common areas, general office areas, courtrooms, judge's chambers, and similar locations.

7.10 ELEVATOR SYSTEMS

Elevator systems must be designed and installed in accordance with the requirements in ASME Standard A17.1/CSA B44 and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the ASME Standard A17.1/CSA B44, the IBC, NFPA 13, and NFPA 72:

1. Elevator machine rooms, machinery spaces, control rooms and control spaces containing elevator control equipment and driving machines (which includes MRL elevators), must be protected with automatic sprinklers unless specifically approved otherwise by the GSA regional fire protection engineer.
2. Automatic sprinklers are not required to be installed at the bottom of the elevator hoistways (i.e., elevator pits) or at the top of the elevator hoistway, unless required by the GSA regional fire protection engineer.
3. Where elevator machine rooms, machinery spaces, control rooms and control spaces containing elevator control equipment are protected with automatic sprinklers, the sprinkler system for these areas must be provided with separate manual isolation valves and a separate waterflow switch located outside each room in an accessible location. An alarm test connection must be provided to test each waterflow alarm device for each system. Tamper switches must be provided on all such valves. A means to test the water flow switch must be provided by fixed piping to a location where water may be discharged without causing property damage, approved by the GSA regional fire protection engineer. Discharge to service sinks or similar plumbing fixtures is not permitted.
4. Enclosed elevator lobbies and hoistway opening protection are not required to be provided in buildings protected throughout by an automatic sprinkler system unless the total height of any hoistway(s) sharing a common atmosphere exceeds 420 feet (128 m).
    a. Exception: Fire Service access elevators and occupant evacuation elevators.
5. The height of elevator hoistways sharing a common atmosphere by elevator door openings at a common floor or by openings between hoistways must be measured from the top of the lowest finished floor to the top of the highest finished floor of the floors served by the non-separated hoistways.

6. Fire service access elevators and occupant evacuation elevators can share a common lobby. Access to not more than one of the two required exits can be provided through enclosed elevator lobbies.

7.10.1 FIRE SERVICE ACCESS ELEVATORS

Fire service access elevators must be designed and installed in accordance with the requirements in the IBC, NFPA 72, and ASME Standard A17.1/CSA B44.

7.10.2 OCCUPANT EVACUATION ELEVATORS

Occupant evacuation elevators must be designed and installed in accordance with the requirements in the IBC, NFPA 72, and ASME Standard A17.1/CSA B44.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC and ASME Standard A17.1/CSA B44:

1. General—In any new construction project, when the building has an occupied floor more than 36.5 m (120 ft.) above the lowest level of fire department vehicle access, occupant evacuation elevators must be installed.

7.11 SPECIAL FIRE PROTECTION REQUIREMENTS

7.11.1 AIR DISTRIBUTION SYSTEMS

Fire dampers and smoke dampers installed in air distribution systems must be installed in accordance with the requirements in NFPA 90A.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 90A:

1. In buildings protected throughout by an automatic sprinkler system, smoke dampers are not required to be installed at penetrations of shafts unless smoke dampers are used as part of a smoke control system.

7.11.2 INFORMATION TECHNOLOGY EQUIPMENT, ROOMS, AND AREAS

Information technology equipment (ITE) and their associated ITE rooms and areas must be designed for the protection from the damage by fire or its associated effects – namely smoke, corrosion, heat, and water in accordance with the requirements in NFPA 75.

In addition, the design team's fire protection engineer is permitted to use a fire protection approach that utilizes both prescriptive-based and fire risk-based approaches to determine the construction, fire suppression, fire detection, and utility requirements for ITE systems, ITE rooms, and ITE areas where specifically permitted by NFPA 75.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 75:

1. A wet-pipe sprinkler system must be provided throughout ITE rooms and ITE areas.

2. Quick-response sprinklers must be installed throughout ITE rooms and ITE areas.

3. The sprinkler system must have a separate isolation valve and a separate water flow switch located outside of each protected area in an accessible location. Each valve must be provided with a tamper switch that is connected to the building's fire alarm system. Provide a means to test the water flow switch by fixed piping to a location approved by the GSA regional fire protection engineer.

4. An approved means must be provided to manually disconnect power to electronic equipment in normally occupied ITE rooms and ITE areas. An automatic disconnect must be provided when warranted by a fire risk assessment and approved by the GSA regional fire protection engineer. When an automatic power disconnect is required, activation of the sprinkler water flow switch must disconnect power to the ITE and to the HVAC systems with no time delay. Activation of smoke detection must disconnect power to the ITE and to the HVAC system after a preset time delay.

5. Disconnecting power to the ITE must also take into consideration disconnecting any UPS equipment or batteries from the load in accordance with the requirements in NFPA 70.

6. Smoke detection must be provided throughout the area, including data storage areas.

7. Clean agent fire extinguishing systems are not permitted to be installed in ITE rooms and ITE areas, unless warranted by a risk assessment and specifically approved by the GSA regional fire protection engineer.

8. Underfloor spaces within ITE rooms and ITE areas must be protected with a fire suppression system only where a risk assessment warrants this protection and specifically approved by the GSA regional fire protection engineer. If underfloor fire suppression is to be installed in an underfloor space that is 457 mm (18 in.) or greater in height, an automatic sprinkler system must be installed. If underfloor fire suppression is to be installed in an underfloor space that is less than 457 mm (18 in.) in height, use of a clean agent extinguishing system is permitted provided the design is specifically approved by the GSA regional fire protection engineer.

7.11.3 PLACES OF CONFINEMENT (HOLDING AREAS)

Places of confinement must be designed in accordance with the IBC.

SPECIAL REQUIREMENTS

The following requirements pertaining to places of confinement take precedence over the requirements in the IBC when the aggregate number of detainees within each holding area is not more than 50 detainees, and where no individual is detained for more than 24 hours.

1. Places of confinement must be designed in accordance with the requirements in NFPA 101 for lockups.

2. Sprinklers must be installed within all places of confinement, including, but not limited to, prisoner holding cells, the main prisoner detention cell block, and prisoner attorney interview rooms.

3. The sprinklers installed must be institutional quick-response flush pendent sprinklers designed for standard and extended coverage applications.

4. The institutional sprinklers must have a solder-link-type fusible element, a tamper-resistant escutcheon, and a retaining flange that prevents sprinkler movement away from walls and ceilings.

7.11.4 ATRIUMS

Atriums must be designed in accordance with the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. The atrium sprinkler system must be designed as a separate sprinkler zone. In addition, a separate manual isolation valve and a separate water flow switch must be in an accessible location. A tamper switch must be provided on all such valves.
2. Atrium smoke control systems must be installed using the exhaust method in accordance with the requirements in the IBC.
3. For new construction, the atrium smoke control system must not utilize automatic opening of exterior door(s) to supply makeup air to satisfy the system's design objectives.

7.11.5 COOLING TOWERS

Cooling towers must meet the requirements in NFPA 214.

7.11.6 RESIDENTIAL DWELLING UNITS

Residential dwelling units must meet the requirements in the International Residential Code (IRC).

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IRC:

1. Stairways in residential dwelling units must have a maximum riser height of 178 mm (7 in.) and a minimum tread depth of 279 mm (11 in.).
2. Residential dwelling units are required to be protected by an automatic sprinkler system. The design of the automatic sprinkler system for the residential dwelling unit must be based on the design and installation requirements in NFPA 13D. Each residential dwelling unit must be provided with a local waterflow switch that will initiate a local alarm. The sprinkler waterflow alarm must be arranged so that the operation of the waterflow switch must produce an alarm signal that is audible throughout all inhabited areas of the individual dwelling unit. The sprinkler system waterflow switch and control valve must be monitored for alarm, supervisory, and trouble conditions.
3. UL-listed nonmetallic sprinkler piping and tubing is permitted to be installed in residential dwelling units if approved for installation by the GSA regional fire protection engineer.
4. Residential dwelling units must be provided with approved multiple-station smoke alarms in all the following locations:
    a. In all sleeping rooms

b. Outside of each separate sleeping area in the immediate vicinity of the sleeping rooms

c. On each level of the dwelling unit, including basements

5. All smoke alarms must be designed and installed in accordance with the requirements in the NFPA 72. All smoke alarms within the residential dwelling unit must be interconnected in such a manner that the activation of any single smoke alarm will activate all the smoke alarms within the individual residential dwelling unit and produce an alarm signal that is audible throughout all inhabited areas of the individual residential dwelling unit.

6. Manual fire alarm boxes must not be installed in the residential dwelling unit.

7.11.7 CHEMICAL LABORATORIES

Laboratories must meet the design requirements in NFPA 45 and the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 45:

1. Laboratories handling or storing hazardous chemicals, flammable gases, flammable liquids, explosives, and biological laboratories must not be expanded in existing office buildings.

2. All chemical laboratories must be equipped with sprinklers, regardless of size. Sprinkler protection must be calculated to provide a density of 6.1 (L/min)/m^2 (0.15 gpm/ft.^{2}) over 279 m^2 (3,000 ft.^{2}).

7.11.8 RECORD STORAGE FACILITIES

Record storage facilities that have a storage volume of records exceeding 1,416 m^3 (50,000 cu. ft.) must meet the requirements in NFPA 232.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 232:

1. Record storage facilities that store federal records must meet the requirements in the National Archives and Records Administration (NARA) guidelines published in the NARA Code of Federal Regulations-36 CFR §1234, Appendix B-Alternative Certified Fire-safety Detection and Suppression System(s) and, when specified by NARA, the archival storage standards in NARA Directive 1571.

7.11.9 FLAMMABLE AND COMBUSTIBLE LIQUID STORAGE ARRANGEMENTS

The storage arrangements and protection of a flammable and combustible liquid storage area must meet the requirements in the IFC. For situations where storing flammable and combustible liquids is either unavailable or unacceptable inside a building, consider storing flammable and combustible liquid outdoors on federally owned property meeting the requirements in NFPA 30.

7.11.10 COMPACT STORAGE MODULES

A type of shelving unit consisting of compact storage whereby the units move to allow for storage to be pushed together creating a storage unit with no flues or minimal spaces between units. Aisles are created by moving the shelving unit. Compact storage modules can be manual or electric in operation.

At a minimum, compact storage modules must meet the following requirements:

1. Compact storage modules must meet the requirements in NFPA 13.
2. For floor loading requirements, refer to Chapter 4.

7.11.11 STATIONARY ENERGY STORAGE SYSTEMS

Stationary energy storage systems (ESS) must meet the requirements of NFPA 855, Standard for the Installation of Stationary Energy Storage Systems.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 855:

1. ESS are permitted to be installed in non-dedicated-use buildings if the project team qualified fire protection engineer develops a hazard mitigation analysis (HMA). The HMA must evaluate the anticipated consequences and failure modes outlined in NFPA 855, including addressing fire fighter safety for any incidents that may occur. The HMA must be reviewed and approved by the GSA regional fire protection engineer if the analysis demonstrates the safety of the ESS installation.
2. Electrochemical energy storage systems installed in non-dedicated-use buildings must utilize maintenance free batteries.

7.11.12 PARKING STRUCTURES

Parking structures, including open and enclosed structures must meet the requirements of the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Automatic Sprinkler Protection. Parking structures, including open and enclosed parking structures must be protected throughout by an automatic sprinkler system designed and installed in accordance with NFPA 13.
2. Standpipe Systems. Parking structures must have a Class I standpipe system per NFPA 14.
    a. Class I standpipe systems of the dry type are permitted to be installed in parking structures subject to freezing.

7.11.13 MODULAR ROOMS

Modular rooms (this includes lactation pod/unit) installed or placed indoors must comply with the requirements in the IBC.

SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC.

1. Sprinkler Protection. If the room or space where the modular room is to be located is currently protected by an automatic fire sprinkler system, then the modular room must be protected by the building’s automatic fire sprinkler system in accordance with the requirements of NFPA 13.

2. Audible and Visual Notification Appliances

    a. An occupant within the modular room must be able to be alerted of a fire or other emergency in accordance with the requirements in NFPA 72.

        i. Existing fire alarm notification devices serving the area containing the modular room can be utilized or additional notification devices can be added that provide the minimum notification performance with respect to the occupant within the modular room with the door closed.

        ii. The occupant within the modular room must have the ability to be alerted to a fire or other emergency via audible and visual notification.

        iii. GSA Regional Fire Protection Office should consider equivalencies or alternative designs as appropriate to address the audible alarm signal sound pressure levels and the photometric characteristics of the visible notification appliance within the modular room.

3. Means of Egress Reliability

    a. The installation of the modular room must not obstruct exits, the access thereto, the egress therefrom, or the visibility thereof.

    b. The means of egress must continuously be free of all obstructions or impediments.

4. Separation Distance Between Multiple Modular Rooms. The minimum separation distance between each modular room is 18 inches.

7.11.14 SLEEP PODS

Sleep pods installed in indoor locations are not permitted.

7.11.15 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

See Chapter 8 for fire protection requirements for EVSE projects.

7.12 REQUIRED DESIGN GUIDES AND MANUALS

7.12.1 U.S. COURT FACILITIES

For special fire protection and life safety requirements for U.S. Court facilities refer to Chapter 8 and the U.S. Courts Design Guide.

7.12.2 U.S. MARSHALS SERVICE SPACE

For special fire protection and life safety requirements for U.S. Marshals Service space, refer to the USMS Requirements and Specifications for Special Purpose and Support Space, Volumes I, II, and III.

7.12.3 LAND PORT OF ENTRY FACILITIES

For special fire protection and life safety requirements for land port of entry facilities, refer to the Land Port of Entry Design Standard.

7.12.4 GSA CHILD CARE CENTERS

For special fire protection and life safety requirements for GSA child care centers, refer to the GSA Child Care Center Design Guide (PBS-140).

7.13 HISTORIC STRUCTURES

For an overall fire protection plan and to emphasize the project team's responsibility to address fire protection and to preserve the historic integrity of historic structures, the project team must explore alternative approaches outlined in state rehabilitation codes, International Existing Building Code, and national performance-based codes to resolve conflicts between prescriptive code requirements and preservation goals. In addition, the requirements, and recommendations in NFPA 914 must be considered for rehabilitation projects in historic structures. The project team must also evaluate the U.S. Department of Housing and Urban Development Guideline on Fire Ratings of Archaic Materials and Assemblies, which provides test data on the fire resistance of a variety of historic materials, and the GSA publication titled Fire Safety Retrofitting in Historic Buildings.

7.13.1 RESPONSIBILITY

The GSA regional fire protection engineer is the AHJ for all fire protection and life safety requirements who must exercise professional judgment to assess the acceptability of alternative compliance solutions. Early and frequent coordination between the architects, state historic preservation officer, regional historic preservation officer, preservation specialists, external review groups, and the project team's fire protection engineer is needed for timely resolution of conflicts between fire safety and preservation.

7.13.2 IMPACT ON HISTORIC FABRIC

Before the design development submission for a project in a historic building, the project team fire protection engineer must consult with the GSA regional historic preservation officer and the GSA regional fire protection engineer regarding the impact of the fire protection design features as required within this chapter on the historic fabric.

7.13.3 FIRE PROTECTION ALTERNATIVES FOR CONSIDERATION

Listed below are fire protection alternatives for the project team's fire protection engineer to consider when designing a project in a historic building:

1. New stair enclosures in historic buildings should be designed to minimize visual impact on significant spaces, including historic lobbies and corridors. Cross-corridor doors must be designed to provide maximum height and width clearance and avoid visually truncating the corridor. Oversized hold-open doors will achieve this end in most circumstances. For more ornamental spaces, accordion-rated doors may be used. Transparent treatments, such as rated glass assemblies or historic doors modified to incorporate rated glass, should be considered when barriers must be kept closed to maintain a rated enclosure. Nonprescriptive compliance solutions, such as modification of historic door assemblies, must be approved by GSA's regional fire protection engineer.

2. New fire-rated doors in preservation zones should be designed to resemble historic doors in panel detailing and finish. True-paneled fire doors are preferred for replacement of original paneled stair or corridor doors.

3. In historically significant spaces, sprinklers must be carefully placed to minimize damage to ornamental materials. Develop detailed drawings for architecturally sensitive areas, showing precise sprinkler locations and finishing notes as necessary to ensure proper installation. Sprinklers should be centered and placed symmetrically in relation to ornamental patterns and architectural features defining the space, such as arched openings.

4. Sprinklers and escutcheons should match original architectural surfaces or hardware. Oxidized brass or bronze heads are recommended for use in deeply colored (unpainted) woodwork. In elaborately decorated ceilings, heads should be camouflaged by custom coating and omitting escutcheon plates. In such cases, low-profile, quick-response sprinklers are preferred.

5. In historically significant spaces, smoke detectors should be placed to minimize destruction of ornamental surfaces. Where ceilings are elaborately embellished, explore alternative detection products and approaches such as air sampling detection, projected beams, low-profile spot detectors, recessed installation, or custom-coating detector housings to blend with ornamental finishes. Application of special finish treatments outside of the standard factory process must be coordinated with, and approved in writing by, the manufacturer to ensure that UL labels and detector performance are not compromised. Smoke detector housings should be removed before application of special finishes.

7.14 MASS NOTIFICATION SYSTEMS

Mass notifications systems are emergency voice communications systems that can be used to broadcast nonfire emergencies such as severe weather, biological/chemical spills, terrorist acts, etc. to occupants within a single building, to multiple buildings, or throughout a campus. Mass notification systems use audible and visual notification appliances, similar to fire alarm and emergency communication systems; however, the appliances may be used to direct occupants to remain in the building for their safety, rather than evacuate or relocate as they would normally do in a fire emergency.

Mass notification systems may merely be simple extensions to fire alarm and emergency communication systems, involving additional audible and visual devices. This would typically be for systems installed within a single building. Mass notification systems become more costly and complex when installed to serve multiple buildings or a campus, as these installations involve additional wiring, multiple command centers and the possibility of exterior audio and visual devices. Because of these variances, every mass notification system project needs to be evaluated individually and involve the GSA regional fire protection engineer. It should also be noted that a good time to install a mass notification system is when a new fire alarm system is being installed, since mass notification systems generally use the same equipment contained in a fire alarm and emergency communication system.

Regardless of the scope, a mass notification system must be designed in accordance with NFPA 72. However, the following special requirements take precedence over the requirements in NFPA 72:

1. Mass notification system control equipment must be integrated with the fire alarm and emergency communication system control equipment.

2. Occupant emergency notification must use fire alarm audio-visual appliances (e.g., speakers and strobes).
3. Nonfire alarm notification appliances are permitted to be used for exterior building broadcasting announcements.
4. Mass notification systems must have the capability of generating both automatic prerecorded and manual (live voice) emergency messages via the audible notification appliances, including speakers that are installed in elevator cars and exit stairways.
5. Live voice emergency messages must override any automatic prerecorded message.
6. Mass notification messages are permitted to over-ride the fire alarm and emergency communication system if approved by the GSA regional fire protection engineer.
7. Visual notification appliances must be the same type as used for the fire alarm system visible notification appliances; however, they must not be identified by the word “fire.”
8. Additional means for notifying occupants of a nonfire emergency (e.g., emergency message displays, scrolling text message displays, video displays, or text messaging) are permitted provided they are approved by the GSA regional fire protection engineer.
9. The building fire alarm and emergency communication system must have manual over-ride capabilities at the main fire alarm and emergency communication control equipment and USMS Command and Control Center where appropriate. Additional locations are permitted if approved by the GSA fire protection engineer.
10. An abnormal condition of a mass notification system component must not adversely affect the performance of the fire alarm and emergency communication system and vice versa.

7.15 CARBON MONOXIDE DETECTION

Carbon monoxide detection must be installed per the requirements in the IBC, IMC, and NFPA 72.

7.16 PERFORMANCE-BASED DESIGN

GSA encourages the use of performance-based design for new construction and major repair and alteration projects. Performance-based design is an engineering approach to fire protection design based on established fire safety objectives and functional statements, analysis of fire scenarios, and assessment of designs based on those objectives and functional statements. Performance-based design differs from traditional prescriptive design in that specific methods for achieving compliance with the design intent are established by the project team, subject to the GSA regional fire protection engineer’s concurrence, and a life safety solution is developed that is tailored to the specific building, fire, and occupant characteristics contained within the building being assessed. Information on performance-based designs can be found in the International Code Council Performance Code, Society of Fire Protection Engineers (SFPE) Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings, and the SFPE Handbook of Fire Protection Engineering.

7.17 COMMISSIONING FIRE PROTECTION AND LIFE SAFETY SYSTEMS

When total building commissioning is required as part of the project, the commissioning process must verify that the fire protection and life safety systems and equipment perform in compliance with the owner's project requirements, basis design, and applicable GSA adopted codes and standards.

The commissioning team must include a qualified fire commissioning provider (FCxP) to perform all fire protection and life safety commissioning activities. The FCxP must be an independent commissioning provider contracted by GSA, or by a firm subcontracted by the Construction Manager as Advisor (CMa), but not solely by the construction contractor itself. Additionally, the FCxP cannot be associated with equipment manufacturers, suppliers, or installers of any such equipment provided as part of the project. The FCxP must have a minimum of five years' experience in facility construction, inspection, acceptance testing, or commissioning as it relates to fire protection and life safety systems. In addition, the FCxP must understand installation, operation, and maintenance of all fire protection and life safety systems proposed to be installed in the project, with particular emphasis on integrated testing of fire protection and life safety systems. The qualifications of the FCxP must be reviewed and approved by the GSA Fire Protection Program Office prior to selection.

Commissioning of fire protection and life safety systems must meet the procedures, methods, and documentation for the commissioning of active and passive fire protection and life safety systems and their interconnections with other building systems in accordance with NFPA 3, Standard for Commissioning of Fire Protection and Life Safety Systems.

7.18 INTEGRATED FIRE PROTECTION AND LIFE SAFETY SYSTEM TESTING

Integrated fire protection and life safety systems must be tested in accordance with the requirements in the IBC and NFPA 4.

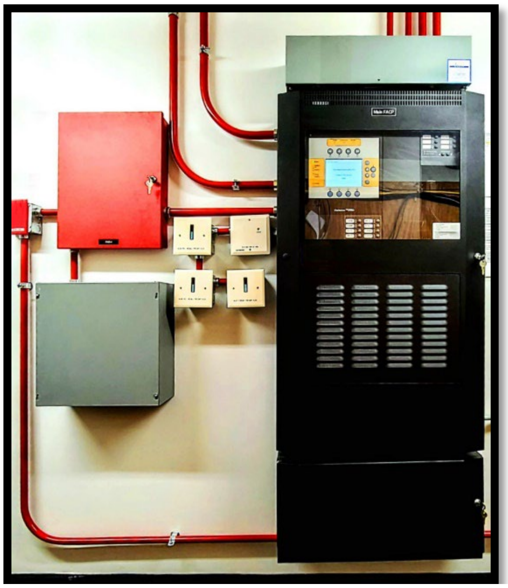


Figure 20:National Support Center Social Security Administration Fire Panel Woodlawn, MD

8

DESIGN STANDARDS FOR SPECIALTY SPACES

8.1 U.S. COURTS

8.1.1 GOALS AND OBJECTIVES

This chapter refers to program and design issues to relate the design intent directly to the technical requirements for the building systems and finishes.

This chapter does not cover issues related to selection of audiovisual, data, or telecommunications systems. (These criteria are developed in the U.S. Courts Courtroom Technology Manual.) Reference is made to these systems in Chapter 8 only regarding the electrical service requirements in the areas where they are being installed.

The following documents should work in conjunction with the P100 for U.S. Courts facilities. If conflicts exist between the Courts facilities standards and a specific program and project requirements, contact the RPMT for resolution.

8.1.2 DESIGN GUIDANCE

8.1.2.1 U.S. COURTS DESIGN GUIDE

The U.S. Courts Design Guide (USCDG) focuses on the functional program requirements, Court and court-related adjacency relationships, finish materials, and specific performance criteria for acoustics and environmental systems, including special heating, cooling, and lighting requirements. The USCDG also addresses security, telecommunications, and audio-visual design requirements.

The USCDG includes a tabular comparison of funding responsibilities for all components of the courthouse and court functional space. (This information is organized into budget requirements for GSA, judiciary, and the judiciary-related executive branch agencies.)

The USCDG refers to technical information related to performance criteria to help illustrate the rationale for the requirements and to establish the standard for level of quality.

8.1.2.2 U.S. MARSHALS SERVICE CRITERIA

Criteria for space controlled by the U.S. Marshals Service (USMS) are found in Requirements and Specifications for Special Purpose and Support Space Manual (USMS Publication 64). Consult the Implementation Plan between the USMS and GSA regarding the appropriate versions of PUB64 to apply. This publication provides the criteria for USMS functional program requirements, spatial relationships, electronic and physical security, and hardware standards and special HVAC requirements within the U.S. Courts and court-related spaces.

These documents establish, in detail, the environmental, security, functional, and technical requirements for the USMS spatial accommodations within U.S. Courthouses. They include information regarding secure environments for prisoners being held in preparation for a court appearance, USMS staff facilities, and general building security requirements. GSA is responsible for power to the electronic security devices, but the design consultants should understand that the USMS security contractor provides infrastructure requirements related to physical security within the functional area dedicated to the USMS and the U.S. Courts. P100 indicates general requirements, but the USMS Publication 64 is the standard the design team must follow.

8.1.3 GENERAL REQUIREMENTS

8.1.3.1 PLANNING FOR FUTURE REQUIREMENTS

Courthouses are designed for the 10 year requirements of the tenant agencies. The AE must provide information or narrative on how the 30 year expansion need can be accommodated on the site or within the building.

8.1.3.2 PLANNING FOR ACCESSIBILITY

All U.S. Court facilities must be accessible to persons with physical challenges.

Table 8-1 outlines the accessible standards that apply specifically to courts and highlights instances where policy or preferences developed by GSA, in conjunction with the Judicial Conference of the United States, differ from ABAAS. Adaptability requires that dimensional consideration be included in the original design to incorporate accessible elements at a later time. Wherever ramps or platform lifts are provided for access to a raised area, railings must be provided as required.

Table 8.1 Accessibility Requirements

Space	Accommodation
COURTROOM	
Circulation routes	Clearance and turning radius for wheelchairs throughout the courtroom.
Public seating	Number of wheelchair spaces and location are set by ABAAS
Litigant and counsel tables	Height clearance at table(s) and circulation space requirements of ABAAS.
Jury box	One wheelchair space along the general circulation path at the box. (If located on a tier, provide a ramp or lift.)
Witness stand	Comply with clear floor space and maneuvering requirements of ABAAS. Permanent ramp or platform lift to provide access. (Adjacent space is required for an interpreter.)
Judge’s bench	Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for future platform lift.)
Courtroom clerk, bailiff, and court reporter stations	Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for a future platform lift.)
Lectern	Include an adjustable platform with a height variation between 710 mm and 760 mm (28 in. and 30 in.) above the floor. Knee space at least 685 mm (27 in.) high. The lectern must be at least 760 mm (30 in.) wide and 480 mm (19 in.) deep.
JURY & ANCILLARY FACILITIES	
Jury assembly room	Must be located on accessible route. Refer to ABAAS for number of wheelchair spaces. ABAAS also determines requirements for listening devices, kitchenette-type service units, and associated vending and seating areas.
Jury deliberation rooms	One space at tables. Clearance provided at coat storage and dedicated toilet rooms. Portable assistive listening system (provided by judiciary) may be used if there is more than one deliberation room.
Attorney/witness rooms, attorney work rooms and conference rooms	Provide proper clearance for circulation and height at tables for wheelchairs.
Grand jury suite	Refer to ABAAS for the number of wheelchair spaces and listening devices. Clearance provided at coat storage, service unit, and toilet rooms. Witness stand with wheelchair turning radius clearance.
USMS FACILITIES	

Space	Accommodation
Holding areas	Each classification (Main Detention and Courtroom Holding) must have one cell to accommodate wheelchair clearances and an appropriate toilet plus lavatory in accordance with ABAAS.
Visitor booths and attorney/prisoner areas	At least 5 percent, but no less than 1 percent, of booth/areas must provide clear floor space, maneuvering clearances, and counter height dimensions for a wheelchair on both sides in accordance with ABAAS.

8.1.3.3 INFRASTRUCTURE

Electrical outlets, wiring, conduit, or raceways to support sound and visual communication equipment for persons with physical challenges will be provided by GSA. Electrical service may be required for transcription services, telephone handset amplifiers, telephones compatible with hearing aids, closed caption decoders, text telephones (TTYs), or other devices to assist those with hearing or visual impairments.

8.1.3.4 ACOUSTIC PLANNING REQUIREMENTS

Acoustical performance is of the utmost importance in courthouse design. The design team must include an acoustic consultant who must develop the appropriate information at each stage of the design process to assure the courts and GSA that sound and vibration issues have been properly addressed. The USCDG and USMS PUB64 have specific guidance and requirements for the acoustic performance of each courthouse facility space. The design must provide these acoustic requirements. The finished space performance will be tested against these specific requirements. Where detailed criteria are not provided, the requirements of P100 will be followed.

8.1.3.5 BUILDING ENCLOSURE SYSTEMS

The baseline standard for exterior materials of U.S. Court facilities is precast concrete with limited stone, brick, or other durable materials attached to the precast. Fundamental construction standards for most of the exterior building systems are discussed in Chapter 3.

Specific additional provisions for U.S. Court facilities include:

- Vehicular sallyport doors that meet USMS requirements
- Appropriate (ballistic-resistant) glazing at various levels of a facility per tenant requirement or request and funded by the requesting agencies
- Physical and electronic security design features at vulnerable areas that will decrease risk of attack to occupants or escape of prisoners
- Courthouses are Facility Security Level IV

8.1.3.6 INTERIOR WALL SYSTEMS

Most interior wall partitions will be composed of gypsum board on metal studs except for USMS detention spaces. There may be instances in the general building construction where concrete masonry is used if building elements, including elevator, or plumbing shafts, are stacked systematically floor upon floor.

8.1.3.7 CEILING SYSTEMS

USCDG outlines interior finishes for the Judiciary. Final selection of finishes must be dependent on the budget and the Judiciary finishes cap and tenant improvement budget.

Chapter 3 of this document outlines the general parameters for selection of a ceiling system in typical office spaces. There are several types of spaces with custom ceiling system requirements, which may include courtrooms, public spaces, office and conference spaces of the courts or other agencies, and detainee areas. In historic buildings, acoustical requirements should be satisfied using removable finishes and features so that original ornamental surfaces may be maintained.

8.1.3.7.1 COURTROOMS

In courtrooms, acoustic characteristics and aesthetics are the main considerations in the selection of a ceiling system. The ceiling design and materials must enhance the acoustic performance of the well area. (Ideal reverberation time in a courtroom is 0.6 to 0.7 seconds. See Chapter 14 of the USCDG.) This will involve the use of reflective and absorptive materials in the space. Review the USCDG for the maximum ceiling height.

8.1.3.7.2 DETAINEE AREAS

In detainee areas, security and durability are the main considerations in the selection of a ceiling system. Finishes must meet USMS Publication 64 for these spaces.

8.1.3.8 FIXED AND MOVABLE FURNITURE

Components to be provided by GSA in U.S. Court facilities include fixed and limited movable furniture and millwork required for the operations of the courts in courtrooms, grand jury rooms, hearing rooms, jury assembly rooms, and public transaction counters. See the USCDG.

In general, built-in furniture must be designed with integral cable raceways plus conduits sized for future expansion and change. Built-in furnishings must also include access panels to permit easy cable and wiring changes.

All items to be provided by GSA within the baseline rent charges are assumed to be included within the anticipated construction budget. An allowance is provided in the project budget for lecterns, counsel tables and counsel chairs. Any cost above the allowance is the responsibility of the Courts.

Refer to USMS Publication 64 for a detailed description of USMS fixed and movable furniture requirements in U.S. Court facilities.

8.1.3.9 SIGNAGE AND GRAPHICS

GSA supplies all court-related signs in public corridors of the building and life safety and public convenience (restrooms) within the functional tenant areas of the courts. Signage requirements within the tenant dedicated spaces, related to their function, are provided by the tenant agency. See tenant agency requirements. The design team is responsible for designing all GSA-supplied signage and graphics.

The following signage must be furnished by GSA under the design team contract, and any remaining requirements will be determined and provided by the tenant agencies.

8.1.3.9.1 IDENTIFICATION AND INFORMATION SIGNAGE

- Building identification/seal/cornerstone

- Division/department, tenant agency identification
- Courtroom/room/area identification
- Special function identification—library, media center, cafeteria, etc.

8.1.3.9.2 DIRECTIONAL SIGNAGE

- Main directory at building entrance—graphic plan
- Floor directory on each floor—graphic plan
- Directory of building occupants with suite locations
- Directional signage for building access by persons with physical challenges
- Directional signage for parking/restricted entrances
- Directional signage for service vehicles

8.1.3.9.3 REGULATORY/SECURITY SIGNAGE

- Signage for core functions—restrooms, stairs, telephones, and other elements on ABAAS-accessible path to building services
- Signage for controlled access areas—judicial and staff areas; if admission to controlled areas is based on acceptable identification, instructions for operating the call button/camera must be provided at the controlled door
- Signage for dedicated systems/facilities—elevators, stairs, staff restrooms (identification as dedicated and regulations for use must be stated)
- Signage for special locking arrangements

8.1.4 MECHANICAL SYSTEMS

This section focuses on technical requirements for the mechanical engineering systems that must be provided in buildings designed to serve the U.S. Courts. Specific requirements are presented for all special or unique spaces used by the U.S. Courts and court-related agencies, including spaces designed to accommodate the U.S. Marshals Service.

U.S. Court facilities require a variety of space types, each with its own set of specific requirements. In addition, court functions require flexibility in the time of operation and control of dedicated HVAC systems. See the USCDG. All criteria in this section are mandatory.

8.1.4.1 HVAC SPECIFIC DESIGN CRITERIA

Outdoor winter temperature equal to ASHRAE 1-percent design dry bulb and coincident wet bulb.

Outdoor summer temperatures equal to ASHRAE 99-percent design dry bulb/97.5 percent wet bulb.

- Indoor air in courtrooms: 24° +/- 1°C (75° +/- 2°F) in summer and 22° +/- 1°C (72° +/- 2°F) in winter.
- Maintain 45 to 50 percent relative humidity for summer conditions and 25 to 35 percent relative humidity for winter conditions.
- All materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire-resistance-rated wall assemblies must meet the requirements of the International Building Code.

- Do not use duct lining. Ductwork must be acoustically designed as described in Chapter 5 and the USCDG.
- HVAC systems must be designed to provide optimum flexibility in scheduling the use of courtrooms and chamber areas.

8.1.4.2 GENERAL CRITERIA

The selection of the HVAC systems, equipment, and source of energy must be in accordance with the guidelines and procedures established in Chapter 5.

The courtroom HVAC system must be designed so that courtroom thermostats can be reset from the building automation system to precool the courtrooms to 21.1°C (70°F) before scheduled occupancy.

Trial jury suites (when located adjacent to a courtroom), judges' chamber suites (when located adjacent to a courtroom), attorney/witness rooms, attorney work room, and courtrooms must be placed on the same system with separate zones having related thermostats and the design must account for variation in occupancy load.

Humidification must be provided as specified in Chapter 5.

The HVAC systems must be zoned in such a manner that the requirements of the special areas can be satisfied by efficient use of the systems and equipment.

To allow flexible and efficient use of the HVAC systems for hours of activity occurring at times other than standard building operations and to satisfy specific requirements in a U.S. Court facility, the central plant equipment (chillers, boilers, cooling towers, pumps, AHUs, etc.) must be designed using redundant equipment of various sizes to satisfy the requirements of differing number and sizes of zones. The design strategy must optimize and minimize energy consumption during these operational events. The design narrative must describe how this will be done. The HVAC design must allow submetering of utilities and equipment to permit the facility manager to allocate cost of operation beyond standard hours of operation.

The HVAC system design for the courtroom, judge's chamber suite, and the jury deliberation room, which compose a single "court set," must be designed to allow the HVAC system to operate after standard building operations hours in an efficient manner.

The design must include winter humidification for areas in the building with custom millwork.

8.1.4.3 COURTROOMS/CHAMBERS AIR DISTRIBUTION

See the USCDG for air exchanges per hour. Systems must be designed to meet these requirements when spaces are fully occupied, unless otherwise noted. If the courtroom is served by a fan system dedicated to more than one courtroom, the return air from each courtroom and its associated areas must be ducted directly to the unit.

Return air from the chamber suites must be ducted directly toward the return air shaft for a minimum distance of 4.5 meters (15 ft.). Ductwork will be treated to meet the acoustical courtrooms/chambers design criteria.

8.1.4.4 MECHANICAL SYSTEM DIFFUSERS AND VENTS

Mechanical system diffusers and grills in public and staff areas must be secure from tampering, particularly in areas that provide some degree of seclusion and privacy (restrooms, attorney-client visitation rooms, etc.). Refer to USMS Publication 64 for more information, especially, detention areas.

8.1.5 FIRE PROTECTION AND SECURITY SYSTEMS

Refer to Chapter 7, Fire Protection, for all fire protection and life safety system requirements.

All security systems must be connected to emergency power. In addition, any security hardware (e.g., electronic locks, card readers, magnetic locks) that is installed on exit doors and exit access doors must meet the requirements of the National Fire Protection Association 101, regarding function, design, operation, and maintenance. This includes, but is not limited to, any security hardware being installed on exit stair doors, building perimeter exit doors, and elevator lobby enclosure doors, as well as any door in the means of egress.

8.1.6 ELECTRICAL SYSTEMS

GSA will provide emergency power for life safety systems and critical building infrastructure. Normal and emergency building distribution systems must be designed to comply with Chapter 6.

Uninterruptible power systems (UPS) must be provided to serve security, emergency smoke evacuation, and any other critical systems and be connected to the emergency power distribution system. Additional systems must be provided by the tenants for any specific tenant related requirements.

8.1.6.1 NUMBER OF OUTLETS

The number of outlets provided must be in accordance with Chapter 6, the USCDG, and USMS PUB64

8.1.6.2 SERVICE AND DISTRIBUTION

Emergency and normal electrical panels, conduits, and switchgear must be installed separately at different locations. Electrical distribution must also run at separate locations.

8.1.6.3 EXTERIOR CONNECTION

Conduit and feeders must be installed on the exterior of the building to allow use of a trailer-mounted generator to connect to the building’s electrical system. This must be regarded as a tertiary source of power for systems in the building where operational continuity is critical. (An operational plan must be in place to provide this service quickly when needed.)

8.1.6.4 COORDINATION WITH TELECOMMUNICATIONS SYSTEM DESIGN

As described in USCDG and the judiciary's space program, data/telecommunications closet must be located near the judges’ chambers, courtrooms, and court offices to contain judiciary network equipment. The use of cable trays rather than conduits must be considered. This space may require air exchange or air-conditioning as specified by the USCDG.

8.1.6.5 LIGHTING SYSTEMS

Illumination levels, lighting types, and lighting controls in specific court functional areas are provided in the USCDG. In all other spaces, illumination levels and lighting controls must be provided as specified in Chapter 6.

8.1.6.6 AUDIOVISUAL REQUIREMENTS IN U.S. COURT FACILITIES

Refer to the Administrative Office of the United States Courts publication, Courtroom Technology Manual, and other tenant requirement documents.

8.1.7 SECURITY DESIGN: AGENCY RESPONSIBILITIES

Courthouse security is the joint responsibility of the Judiciary, U.S. Department of Homeland Security - Federal Protective Service, USMS and GSA (see Memorandum of Agreement regarding Court Security, 2019). Decisions regarding security planning and design for courthouses are made by individual agencies, the local Court Security Committee (CSC), or for multi-tenant buildings, the Facility Security Committee (FSC). The FSC is responsible for identifying a court's specific security requirements and developing a security plan for judicial facilities and operations throughout the district. See the USCDG, USMS Publication 64, GSA Office of Mission Assurance (OMA) requirements, FPS requirements, and the Federal Courthouse Physical Security Best Practices Desk Guide 2023. All security systems and equipment must be consistent with the recommendation in ISC Physical Security Criteria for Federal Facilities and GSA Interpretation of ISC RMP; the ISC Security Level Determination; USCDG; USMS Publication 64 Requirements and Specifications for Special Purpose and Support Space Manual Volumes 1-3, GSA OMA specifications and FPS requirements. The CSC/FSC must be informed and review all security-related design decisions.

The USMS Management Support Division, Office of Construction Management (OCM) is responsible for design considerations involving secure prisoner movement, holding cell and interview facility requirements, and USMS-occupied office and support space. The Judicial Security Division, Office of Security Systems (OSS) Team is responsible for the planning, design, and installation of all electronic security systems in spaces occupied by the judiciary and the USMS. The OSS team will also participate in the design of any site and facility security features, such as perimeter protection, parking areas, guard booths, screening areas, etc. The USMS OSS team develops scopes and contracts for the work of the USMS national physical security contractors for renovation projects, and with GSA through an assisted acquisition process for new courthouse construction.

Refer to the MOA, USCDG, USMS Publication 64 and the Federal Courthouse Physical Security Best Practices Desk Guide 2023 for explanations of security design and installation responsibilities.

The functional planning criteria, including security-related issues as outlined in the documents referenced above, are to be incorporated into the conceptual design. These criteria will support the development of the technical drawings, specifications, and other information needed to incorporate the security components into the project, whether by the GSA contractor or by USMS.

8.1.8 BATTERY BACKUP

Coordinate with Pub64 on areas that require battery backup to maintain camera and direct visual surveillance in the event of power failure.

8.2 LPOE (FUTURE)

8.3 MAILROOMS

Mail Rooms for GSA facilities must be designed in accordance with the ISC Risk Management Process. For additional guidance see the GSA Mail Center Security Guide 5th Edition – 2023, United States Courts Design Guide – Latest Edition and USMS Publication 64. The Facility Security Committee will be responsible for establishing mailroom security measures.

8.4 INDOOR FIRING RANGES

The design, renovation, repair or alteration, and modernization of an indoor firing range must meet the minimum standards of the GSA Indoor Firing Range Policy and Criteria, and the GSA Indoor Firing Range Cyclical Maintenance and Repairs Memorandum, dated 7/31/2019. Access document through RPMT.

8.5 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

EV chargers must be installed for government-owned vehicles (GOVs/federal fleet vehicles) for any project significantly modifying or installing parking lots or parking garages, including resurfacing. EV charging station order of preferred installation locations are: (1) Outside Surface Parking Areas, (2) Roof Level of Parking Structure, and (3) All Other Parking Structure Locations.

Reference Table 8.2, Baseline performance represents the P100 minimum requirements. The higher tiers represent higher performance levels which may be required by tenant agencies depending on their missions. EVSE requirements are tenant specific. An individual facility may house multiple tenants and tenants may have multiple vehicle types. Therefore, a combination of tier levels may be required for a single facility/project. Where no tenant policy exists, forecast the quantity of GOVs and the usage patterns of those GOVs to determine the appropriate tier levels.

Table 8.2 - Vehicle Charging		
Charger Quantities. Based on GOV Fleet Program Requirements		
Baseline		1 charging port for every 2 GOVs with 1 accessible charging facility
Tier 1		1 charging port for every 1 GOV with 1 accessible charging facility
Tier 2		> 1:1 ratio to allow for visiting EV charging with 1 accessible charging facility
Tier 3		N/A
Charger Types. Based on GOV Fleet Program Requirements		
Baseline		Mid Power AC Level 2 Charger: Minimum 6.6 kW at 208v or 7.2 kW at 240v
Tier 1		High Power AC Level 2 Charger: 8.0 kW - 20.0 kW range
Tier 2		Direct-Current Fast Charger (DCFC): Uses a 3-phase AC electric circuit but delivers direct current (DC) to the vehicle.
M & V		Not applicable
Plans & Specs		Yes
Calculations & Analysis		Provide analysis on quantity and capacity of chargers selected and how they relate to vehicle predicted usage patterns or tenant policy. Note: for level 2 and level 3 chargers, provide an accessible charging facility for each level of charging in one charging station
References		UL 1741, UL 2202, UL 2594, UL 9540
Basis of Design		Describe EV charging system requirements and how power sharing and/or charge management will be incorporated.
Construction Verification		Verify charge management controls for each charger.

8.5.1 EV CHARGING

An EV charger delivers an electrical current to the vehicle via a charging port. A charging port is defined as the cord and connector that attaches to the vehicle. Requirements include:

1. EVSE, including EV charging stations, must comply with the requirements in National Fire Protection Association (NFPA) 70, National Electrical Code.
2. EV charging stations must be listed and labeled in accordance with UL 2202, Standard for Electric Vehicle (EV) Charging System Equipment.
3. EVSE equipment must be listed and labeled in accordance with UL 2594, Standard for Electric Vehicle Supply Equipment.
4. EVSE equipment with vehicle-to-grid capability must be listed in accordance with UL 1741 Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, Supplements A and B.
5. Wireless power transfer equipment for transferring power to an electric vehicle must be listed and labeled in accordance with UL 2750, UL LLC Outline of Investigation for Wireless Power Transfer Equipment for Electric Vehicles.
6. Energy storage systems (ESS) must meet the requirements of NFPA 855, Standard for the Installation of Stationary Energy Storage Systems. All stationary ESS, including mobile energy storage system equipment that utilize lithium-ion batteries are required to be listed in accordance with UL 9540, the Standard for Safety of Energy Storage Systems and Equipment.
    a. ESS that are not listed in accordance with UL 9540 must be documented and verified as meeting the provisions of NFPA 855 using the equivalency requirements, where technical documentation provided shows the ESS that is proposed results in a system that is no less safe than a system meeting the construction and performance requirements of UL 9540. If non-listed equipment is to be evaluated for compliance with UL 9540, the evaluation and documentation as part of a field evaluation at each site conducted by an approved third-party certification organization must be provided to the RPMT to distribute and be reviewed by the respective GSA Regional Project Team (e.g., electrical engineer, fire protection engineer, etc.), prior to any ESS being utilized.
    b. The requirements contained in NFPA 855 applies to all lithium-ion battery energy storage systems (BESS) greater than 20 kWh.
    c. If a mobile BESS will be charged and stored for longer than 30 days at a specific site location, it is no longer considered temporary and must be treated as a permanent outdoor ESS installation in accordance with the requirements in NFPA 855.
    d. All EVSE having a supplemental BESS must be reviewed by the respective GSA Regional Fire Protection Program Office prior to any EVSE having a supplemental BESS being utilized.
7. Chargers must be located as close as possible to their electrical supply service while also assuring that the charging port is conveniently located for vehicle charging.

8. All EV charging stations must be installed in accordance with the manufacturer's recommendations.
9. Where applicable, EV charging stations must meet the lateral force-resisting requirements in the IBC and ASCE/SEI 7-22.
10. All EV charging stations must not operate if the EV's battery management system indicates a fault condition.
11. In case of an electrical malfunction, the EV charging station must automatically disconnect itself from the electrical power supply.
12. Network capable chargers must be utilized and must be FedRAMP authorized.
13. Chargers must be Open Charge Point Protocol (OCPP) compatible.
14. All EV charging stations located within a parking structure must meet the wiring practices for damp locations in accordance with the requirements of the latest edition of NFPA 70.
15. Wall mounted EV charging stations must be installed on non-combustible walls and ceiling mounted EV charging stations must be installed on non-combustible construction materials.
16. For outside surface parking areas, maintain a free space that does not have any vegetation (e.g., plants, trees, branches, shrubs, etc.) and combustible and flammable materials within a minimum of 10 feet in each direction, measured from the outer circumference of the EVSE and the designated parking space.
17. Electric receptacles for all EV charging stations must be provided with ground-fault circuit-interrupter protection.
    a. The ground-fault circuit-interrupter indication and reset must be installed in a readily accessible location.
18. Charging cords associated with EVSE must not interfere with pedestrian traffic or present tripping hazards.
19. EV charging stations must be protected against vehicle impact by vehicle barriers in accordance with the requirements in the IBC. Curbs, bollards, wheel stops, and/or equipment setbacks should be used to prevent vehicles from damaging EVSE.
20. Lighting around the charging station must be provided for both safety and the reading of equipment instructions.
21. If the charger is to be in an enclosed structure, provide adequate ventilation as required by the manufacturer.
22. A metering strategy must be incorporated to separate vehicle charging from building usage.
23. Each charger must be labeled to indicate the panelboard and circuit number from which it is electrically fed.
24. When main electrical equipment or distribution branches serving parking areas are upgraded, ensure they are appropriately sized to incorporate future vehicle charging for the entire GOV fleet.

8.5.2 GOVERNMENT OWNED VEHICLE (GOV) REQUIREMENTS

Federal fleet EVSE build-outs must minimally include:

- Complete and operational charging ports.
- Quantity and configuration of chargers and ports must be designed to accommodate tenant vehicle types and usage. Chargers must be minimally capable of 6.6 kW at 208v or 7.2 kW at 240v with one charging port being installed for every 2 GOVs. Note that higher capacity chargers and vehicle ratios may be needed as outlined in Table 8.2.
- Power sharing allows multiple charging ports to share a single branch circuit and must be incorporated, where appropriate (e.g., where vehicles have a high overnight dwell time).
- Charge management capabilities must be included to limit expansion of the power distribution system and to limit exposure to peak demand charges. Common elements to include under charge management are delayed charging, staggered charging, and avoiding time-of-day peak rates.
- Limited chargers may be added to the Emergency Power Supply System (EPSS) where required by tenant policy and spare capacity is available. Where spare EPSS capacity is not available, a stand-alone Battery Energy Storage System (BESS) could be considered.

8.5.3 PRIVATELY OWNED VEHICLE (POV) REQUIREMENTS

Where no tenant policy on the number of POV EVSE requirements exists, provide the following EVSE infrastructure:

- For lots with fewer than 50 POVs, install infrastructure for two charging ports.
- For lots with 50-100 POVs, install infrastructure for six charging ports.
- For lots with greater than 100 POVs, install infrastructure for a quantity of charging ports representing 6% of the planned POV parking.

8.5.4 EVSE INFRASTRUCTURE

Infrastructure for each EV charging station, including both GOVs and POVs must include:

- One power conduit between the nearest electrical room (or otherwise approved location) and each charger. Where empty conduit is provided for future use, the minimum conduit size must be 2-1/2 inches for circuit runs up to 100’ and 3 inches for longer runs.
- A minimum 1-inch communications conduit between an approved network switch location (or otherwise approved location) and each charger must be included for any installation not using cellular communications or when the future communications method is unknown.
- Power conduits at the charging station must terminate in a concrete traffic rated hand-hole enclosure.
- Communication conduit, where needed, must terminate in an independent concrete traffic rated hand-hole enclosure.
- All conduits must be provided with pull string and be sealed with waterproof plugs at both ends.
- Traffic rated hand hole enclosures are not required in locations not exposed to vehicular traffic.

- Underground conduit installation requirements can be found in Part 6.5.4 of this document.

8.5.5 EVSE ACCESSIBLE CHARGING REQUIREMENTS

GSA facilities must provide an Accessible Charging Station (ACS) with mobility and reach range features when installing Electric Vehicle (EV) charging stations. Refer to the U.S. Access Board (USAB) website USAB website link for further details regarding accessible components.

- An ACS is not reserved to vehicles for people with disabilities unless the ACS is replacing an existing accessible parking space.
- Per Chapter 1, The Architectural Barriers Act Accessibility Standard, if local accessibility standards exist, GSA must follow the most stringent code requirements between the local standards and the P100.
- Signage to denote reserved (dedicated to vehicles for persons with disabilities) ACS to comply with signage consistent with accessible parking. Signage for non-reserved ACS to denote the availability of mobility features specific to the ACS.

8.5.5.1 ACS COMPONENTS

ACS components must include mobility and accessible reach range features as follows:

- Charging space configuration:
    - Standard Charging Space - 11’-0” w x 20’-0” with 5’-0” side aisle and accessible route to building entrance and clear floor areas to access charger and ports.
    - Hands Free Charging Space - 9’-0” w x 18’-0” with 5’-0” side aisle and accessible route to building entrance and clear floor areas to access charger.

Charger/Port:

- All transaction elements to be within accessible reach ranges per ABAAS CH.3
- Communication interface to support sight and hearing impaired
- Ports: Maximum force to lift cord and connect the port to vehicle must be between 5 lbs-10 lbs and include a cord support frame.

8.5.5.2 ACS SITE REQUIREMENTS

ACS site requirement options are as follows:

1. Site Option 1 - Provide one (1) ACS for each separate parking facility being served and each separate level of charging (Level 1, Level 2, or DC fast Charge) in that area.
    a. Position as the nearest charging space with an accessible route to the building entrance.
2. Site Option 2 - Provide one (1) ACS open to all vehicles (Government Owned Vehicles (GOV) and Privately Owned Vehicles (POV) open to all and nearest the building entrance and have one level of charging.

3. Site Option 3 - Provide one (1) ACS replacing an existing accessible parking stall at the same stall location and size.

    a. This option is only used when hands free charging is provided and there are two or more accessible parking spaces present.

Table 8.3 Vehicle Accessible Charging Exceptions

Condition	Exceptions
GOV - new construction and alterations GOV and POV - tenant initiated alterations	EVSE serving buses, trucks, delivery vehicles, emergency/law enforcement vehicles (as generally described in ABAAS F208.1 Exception) located in a particular parking facility are not required to provide an ACS for those vehicles only. EVSE proposed use for persons with a specifically assigned space may not be accessible.
POV - new construction (infrastructure only)	N/A

8.5.6 EVSE FIRE PROTECTION

8.5.6.1 PARKING STRUCTURES AND AUTOMATIC SPRINKLER PROTECTION.

Automatic fire sprinkler protection must be provided throughout parking structures where EV charging station(s) are installed or placed. See Chapter 7 for fire protection requirements for parking structures.

8.5.6.2 PARKING STRUCTURES AND STANDPIPE SYSTEMS.

A Class 1 standpipe system must be provided at an accessible location where EV charging station(s) are installed or placed within a parking structure or on the roof level of a parking structure. See Chapter 7 for fire protection requirements for parking structures.

8.5.6.3 INSTALLATION OR PLACEMENT OF ELECTRIC VEHICLE SUPPLY EQUIPMENT

8.5.6.3.1 LOCATION OF OUTDOOR SURFACE PARKING AREAS.

The designated location for outdoor surface parking areas for the installation or placement of EVSE must meet one of the following requirements:

The horizontal separation distance, measured at a 90-degree angle from the designated Electric Vehicle (EV) parking area to the exterior wall of a building, must be equal to or greater than 25 feet, or

The horizontal separation distance, measured at a 90-degree angle from the designated EV parking area to the exterior wall of a building constructed of combustible materials or containing unprotected openings must be equal to or greater than 30 feet, or

The horizontal separation distance, measured at a 90-degree angle from the designated EV parking area to the exterior wall of a building, must be at a distance acceptable to the GSA Fire Protection Program Office, with respect to fire exposure to any potential hazards, or

The horizontal separation distance, measured at a 90-degree angle from the designated EV parking area to the exterior wall of a building, incorporates an alternative approach or method that achieves a level of safety deemed acceptable to the GSA Fire Protection Program Office.

8.5.6.3.2 MANUAL POWER SUPPLY DISCONNECTING MEANS

All Level 2 and Level 3 EV charging station installations must be provided with a manual disconnecting means to disconnect the power supply to the EV charging stations in an easily accessible location to allow safe shutdown of equipment.

- The proposed location must consider whether the manual disconnecting means will remain accessible by fire department personnel if an EV is on fire when connected to the EV charging station.
- Appropriate signage must be provided on the EV charging station denoting the location of the manual disconnecting means.
- Appropriate signage must be provided at the manual disconnecting means denoting which EV charging station(s) will be disconnected from their power supply.

8.5.6.4 PARKING STRUCTURE ENTRANCE(S) SIGNAGE FOR EV CHARGING STATIONS.

Each entrance to a parking structure must be provided with signage indicating the presence and locations of EV charging stations.

The signage must be installed in a position at each entrance to the parking structure that is visible from a vehicle entering the parking structure.

The signage must indicate that EV Charging Stations are present and the parking level(s) where the EV charging stations are located.

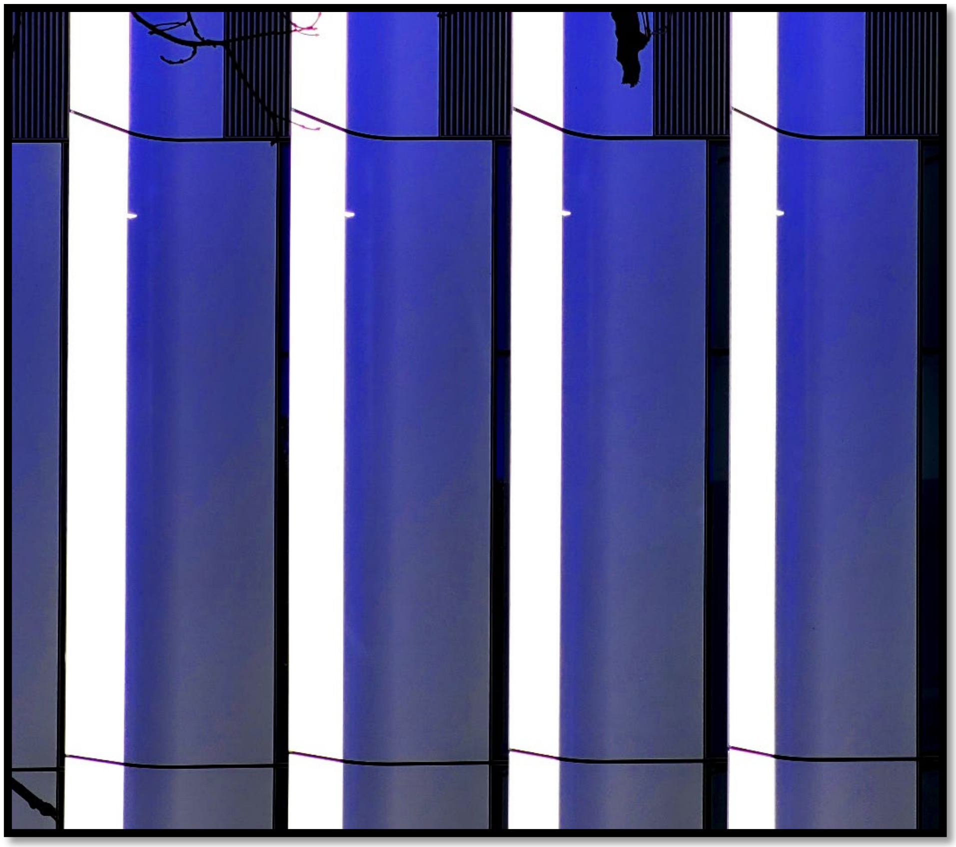


Figure 22: Facade of U.S. Department of Transportation Volpe Center Cambridge, MA

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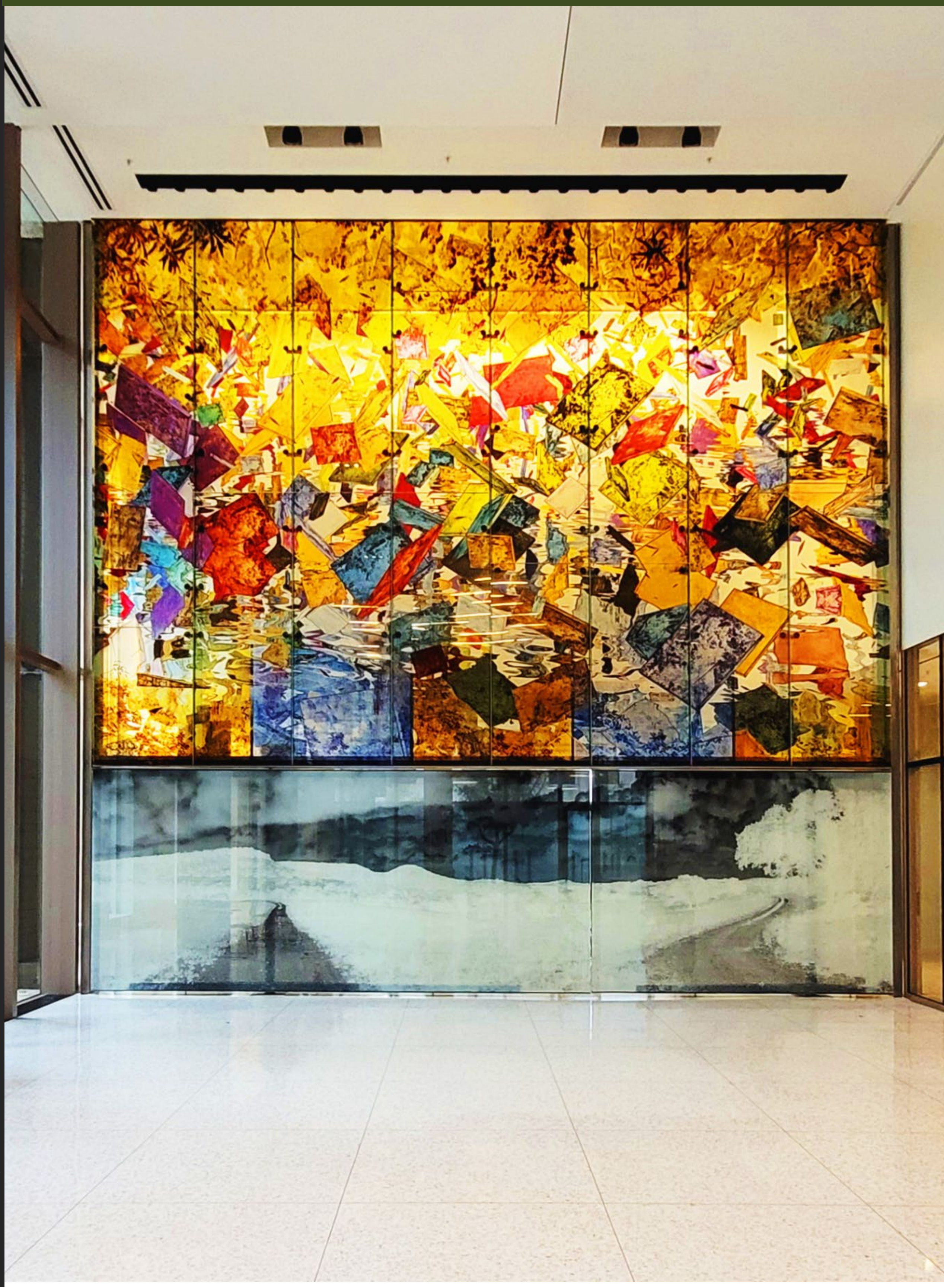

Figure 23: U.S. Courthouse Interior Austin, TX

A.1 GENERAL SUBMISSION REQUIREMENTS

The submission requirements listed in Appendix A are specific to showing compliance to P100. Project managers, subject matter experts, and others on the PBS team have developed this matrix so design teams can provide the appropriate information to show compliance. Additionally, the design submission requirements have been developed to ensure a rational, well-documented design process and to facilitate reviews by GSA staff, tenant agencies, and local regulatory agencies or review boards as the design develops.

The submission requirements listed here apply to all projects based on their funding code. The submittal matrix is a minimum baseline and additional requirements may be included in the project contract based on the client, building type, location, function, or nature of the work to be performed. For all projects other than BA 51 New Construction, submission requirements apply to the work identified in the project scope.

The project team is still held to the standard of care to produce a set of documents to record the development of the project as it proceeds through design phases as well as a fully constructable set of documents for construction. The submission matrix identifies the specific items that must be present with each submission.

Submission requirements listed in the matrix will be submitted by PDF or similar format that can be read on electronic devices without the need for specialized software. The project scope may define other submission requirements.

A.1.1 BIM (BUILDING INFORMATION MODEL) REQUIREMENT

GSA requires BIM modeling through all phases of major new-construction, new design, and major renovation projects. Fully detailed information is required for all areas of the work. New work in an existing building without a whole-building BIM model must provide a minimal model of the existing property to locate and indicate tie-ins of the new work within the existing environment.

The Building Information Models will be the native source of all plans, tables, data, CAD files and other artifacts submitted to GSA by the designer and Contractor. CAD files must follow PBS CAD Standards. All BIM submissions must comply with the GSA BIM Program Requirements (the BIM Standard) and GSA Common Data eXchange (CDX), and the exported COBie data as described by the GSA COBie Playbook. GSA supports efforts towards interchangeability of information and requires an Industry Foundation Classes-based submission for each native-format submission.

The designer and contractor must use an approved GSA BIM Execution Plan as the basis for their project planning. At a minimum all model objects must be at LOD 300 at final construction documents in a software version approved by GSA. The designer and contractor must comply with the Model Life-Cycle Development Timeline as defined in the GSA BIM Standard.

The COBie Delivery submittals (required by the GSA BIM Standard and COBie Playbook) are required from the construction contractor at 30%-, 60%- construction fiscal-completion, also at Substantial Completion and final closeout. Construction-team and Office of Facilities Management approval is required for each milestone and at final closeout.

A.1.2 GEOGRAPHIC INFORMATION SYSTEM (GIS) STANDARDS

Obtain these from GSA’s GIS website.

A.1.3 SPATIAL DATA MANAGEMENT

Plans that are provided at each submission stage must contain assignment data and space boundaries that are in compliance with these BIM requirements and National Business Space Assignment Policy.

A.1.4 DOCUMENT SECURITY REQUIREMENTS

All Controlled Unclassified Information (CUI) building information must be handled as described in GSA Order PBS 3490.3 CHGE 1, Security for Sensitive Building Information Related to Federal Buildings, Grounds, or Property.

Within any electronic or printed document, pages containing CUI building information must have the following marking imprinted or affixed:

At the top of the page, CENTERED, in BOLD BLACK LETTERS the letters:

"CUI" [+ optional dissemination marks]

At the bottom of the image area, (and above title block information if horizontally arranged):

CUI

PROPERTY OF THE UNITED STATES GOVERNMENT
This is controlled unclassified information. Do not remove the CUI marking.
Properly destroy or return documents when no longer needed.

The following mark must be affixed to the bottom of the first page of any information (such as the cover page on a set of construction drawings or landing page for an electronic model) containing CUI marked as required by the paragraph above:

CUI

PROPERTY OF THE UNITED STATES GOVERNMENT
This is controlled unclassified information. Do not remove the CUI marking.
Properly destroy or return documents when no longer needed.
Controlled by: GSA [Records@GSA.gov]

The previous two statements must be prominently labeled in bold type in a size appropriate for the document or portable electronic data storage device or both, if applicable. On a set of construction drawings, for example, the statements must be in a minimum of 14 point bold type or equivalent. The CUI markings must be used regardless of the medium through which the information appears or is conveyed. Discuss the designation of BIM models with the RPMT. See the CUI Quick Tips for more information. Revit and AutoCAD versions of various templates with CUI markings will be made available to awarded projects.

The construction drawings, plans, and specifications are to be disseminated only to those requiring the information necessary for design, construction bidding, construction coordination, or other GSA procurement competition processes.

A.1.5 SEALS

Each sheet of the construction documents must bear the seal and signature of the responsible design professional (specification, calculations and narratives cover page only). In addition, each design professional must comply with any seal, stamp, and/or signature requirements in accordance with state, district, or territory law. Electronic submissions may have digital signatures and seals.

A.1.6 DRAWINGS

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A.1.6.1 DRAWING SIZE

All drawings of a single project must be a uniform standard size, as designated by the American National Standards Institute (ANSI) below. International Organization for Standardization (ISO) or architectural-sized sheets may also be approved for use.

Table A.1 Drawing Sizes

Type	Size (in)	Size (mm)
ANSI A	8.5 x 11	216 x 279
ANSI B	11 x 17	279 x 432
ANSI C	17 x 22	432 x 559
ANSI D	22 x 34	559 x 864
ANSI E	34 x 44	864 x 1118

A.1.6.2 DRAWING SCALE

All drawings are to be created at full scale and printed at a selected scale. The drawings or views (such as details) must include numeric and graphic scales. The scale selected must be appropriate for high resolution and legibility to include reduced copies (such as half-sized).

There are nine preferred metric scales: 1:1 (full size), 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, and 1:1000. Other scales may be used as needed (such as 1:2 half full size).

A.1.6.3 CODE SHEET

Provide a certification that the project team has minimally met the codes required for this project. List all specified codes with issuance dates and standards with issuance dates by each discipline. A professional seal and signature are required for each of the disciplines listed. The intent is to formally recognize the responsibility for compliance

A.1.7 SPECIFICATIONS

A.1.7.1 FORMAT

Specifications must be organized in accordance with Construction Specification Institute (CSI) *MasterFormat - Division/Section/Page Format.* Each page must be numbered sequentially. Specifications will be provided in both electronic and bound editions. Electronic versions must be provided in PDF and native format. The project manual must include a Table of Contents, Instructions to Bidders, GSA provided Division One Specifications and Construction Specifications.A.1.7.2 Editing

The design team is responsible for the editing of all specification sections, including any Government-furnished guide sections, to reflect the project design intent, GSA policy requirements, and federal law. Technical specifications must be carefully coordinated with drawings to ensure that everything shown on the drawings is specified.

A.1.8 DESIGN NARRATIVES AND CALCULATIONS

- PDF Narratives must be produced as indicated in the requirements matrix for each design discipline.
- Narratives explain the design intent and document decisions made during the design process (systems, materials, components, etc.)
- Must be revised at each stage to reflect the most current state of design

- Calculations accompany narratives where required to support technical analysis and include code reference, standards, and any other sources used for calculation.
- Drawing where calculations are used must be referenced.
- Each sheet of calculations must start with a summary sheet showing all assumptions, referencing applicable codes, and listing the conclusions.

Specification language that is not applicable to the project must be deleted.

A.1.9 TURNOVER DOCUMENTS

Electronic and hard copy documentation on all building systems must be provided for the guidance of the building engineering staff and long-term asset management. Documents must show the actual elements that have been installed, how they performed during testing, and how they operate as a system in the completed facility. Examples are as follows:

- Final P100 Performance Matrix
    - Contractor "redline" as-built drawings and specifications (including building/site actual measurements, changes to details, actual panel schedules, etc.) as required by the construction contract.
    - Design team's final "record" drawings to include final changes to design and contractor noted as-built conditions.
    - Operating manuals with a schematic diagram, sequence of operation, and system operating criteria for each system installed. Custom-written operating manuals; minimum standard should be submission of Word documents.
    - Training materials and videos.
    - Equipment maintenance manuals with complete information for all major components.
- In addition, asset data and documentation, including special data and documentation as to engineering, calculations, record drawing information, and visual media, must be provided to document the configuration, engineering assumptions, actual material/sizes installed for future maintenance, repairs, and improvements.
- Prior to acceptance for design completion or substantial completion, all required submittals and deliverables must be verified by a government representative as received and complete, such as:
    - Drawings: design, redline, and record drawings
    - Submittals, fabrication, and shop drawings, including:
    - Equipment schedules
    - Equipment (or other) data sheets, product literature, minimum standard should be submission of PDFs, allows for regional supplementation
    - Equipment inventories, testing, adjusting, and balancing (TAB) reports, and commissioning functional performance test (FPT) results to be submitted as electronic data tables (Excel or Access files are acceptable), including fields specified in the specifications
    - BAS point and device data must be submitted as electronic data tables, to include necessary unique identification information such as point numbers, device ID numbers, network numbers, etc., as well as English-language descriptions and location information
    - All test records and
    - Fire Sprinkler and Alarm Systems: Calculations (including energy, structural, lighting, fire alarm system voltage drops and battery requirements, fire sprinkler hydraulics, etc.).

All electronic media must be readable by GSA's current software versions and optimum file sizes of desktop media, such as Acrobat, Microsoft, AutoCAD DWG format, BIM native and Industry Foundation Classes format, video media, electronic photo (e.g., ".jpg"), and Webcam archive data.

Electronic data must be provided to the Government via the GSA electronic project management system (Kahua) and on CD-ROM or secured flash-drive, unless otherwise specified.

As-built BIM files must be delivered in accordance with As-Built Documentation specifications in P100, BIM Program & Standards Requirements, project specifications and contract documents.

BIM and COBie Submissions must be compliant to the GSA BIM Standard, GSA Common Data eXchange, and the GSA COBie Playbook.

For all software installed in support of installed equipment, provide backup CDs with all files necessary to reinstall software, all user and programming support manuals, and all files produced for the specific installation (e.g., graphics files, DDC program files).

A.1.9.1 BUILDING HANDOVER TO OPERATIONS AND MAINTENANCE

Contractor will hold meetings with the building operations and maintenance group to train them on operations, turnover documents, and contract close out documents including warranty information.

A.1.10 COST AND SCHEDULE MANAGEMENT REQUIREMENTS

All deliverables and supporting practices must be provided at various stages of the project's life cycle in compliance with the P120.

A.2 PERFORMANCE MATRIX

At the beginning of each project, the RPMT and client must define the performance requirements of the project. The required performance matrix, Figure A.2.1, allows for these decisions to be documented and included as project requirements.

Minimum requirements above baseline for land port of entries are indicated in the matrix. Any performance below the indicated minimum will require a P100 waiver.

For renovation or alteration projects, the matrix includes a Not Applicable (N/A) for systems/items that are not included in the project scope.

The project team should review the matrix and look for opportunities to increase performance where life cycle cost benefits can be demonstrated.

The Performance Matrix will be included with all concept review submissions so reviewers, peers, and others are clear on the required performance of the project. The final constructed performance aspects will be updated in the matrix and submitted with the turnover documents.

See the GSA P100 website for the P100 Performance Matrix.

2024 P100 Performance Matrix	Place an **X** for each requirement					
Attribute	Baseline	Tier 1	Tier2	Tier 3	N/A	Notes (Describe how design meets performance or any waivers from a requirement)
Site Supports Neighborhood Connectivity, Walkability, and Transportation Access						
Collaborative Design Process						
Design Process Considers Input of Local Officials						
Design for Public Use						
Interior						
Exterior						
2.4 Landscape Performance Requirements						
Site Performance						
Site Materials						
Site Soils						
Vegetation						
Pollinators						
3.1 Enclosure Performance Requirements						
Envelope – Natural Hazard						
Seismic Resistance						
Windborne Debris Resistance						
Envelope – Serviceability						

A.3 DEFINITIONS

A.3.1 SUBMITTAL DEFINITIONS

PEER REVIEW

The peer review, arranged through the Office of Architecture and Engineering, is required for all new construction projects and major repair and alteration projects with significant changes to the building aesthetic or systems. Designs must be presented to the PBS Commissioner, chief architect, chief engineer, key GSA project team members, and Nationally Selected Peers for approval. See Design and Construction Excellence: Policy and Procedures for the peer process.

CONCEPT DESIGN REVIEWS

Concept Design Reviews take place before each peer review and before the Commissioner’s Concept Presentation. Design Reviews verify that concept options are compelling and viable from the perspectives of siting, design, programming, engineering systems, performance, budget, and schedule. Design Reviews further provide GSA with the opportunity to consider and document how design choices may affect building functionality. In all, they assure that peer reviewers and GSA’s partner agencies are presented with design solutions that are as principled as they are executable. Comments from the Design Review must be addressed satisfactorily before the subsequent peer review or Commissioner’s Concept Presentation can be held. Outstanding substantive comments will be listed in the Commissioner’s Readiness Checklist to be addressed by the Chief Architect and the Assistant Commissioner for Project Delivery.

CONCEPT

A submission that will demonstrate that the space program has been accomplished, including any adjacency and functional requirements. This submission will also show that the proposed project is compatible with the project authorization and complies with the criteria and requirements of P100.

PRELIMINARY CONCEPTS

The preliminary concepts submittal consists of three or more distinctly different architectural design schemes at a working level. The submission must include massing models, site context, and sufficient narrative to allow comparison and selection of a design direction for preparation of a final design concept. Building systems, materiality, and fenestration appropriate for each of the conceptual designs must be defined in order that they can be evaluated early for effectiveness and efficiency related to operation, maintenance, and energy consumption. Submission requirements in the delivery matrix apply to all three schemes as applicable.

FINAL CONCEPTS

The final concept must show that the developed scheme can achieve the program, the requirements of P100, the space requirements and the budget. Major materials, both interior and exterior, structure, fenestration, and building systems must be well defined. Life cycle costing of the proposed building systems must be accomplished to determine the most cost-effective alternatives.

For major projects, a presentation is made to the Commissioner of the Public Buildings Service for final approval.

VALUE MANAGEMENT

Value management (VM) is a continuous process throughout the project, but its greatest emphasis should be in the early stages of the project (concepts and design development) per the PBS P-120.

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GSA policy is to have an independent VM consultant facilitate a value management study with an independent team, including participation by the design team and the design estimator throughout the study and implementation process. The design team must be part of this effort and incorporate the VM consultant's recommendations that were approved by GSA into the design as part of the scope of work.

VALUE MANAGEMENT (ANALYSIS STAGE)

The DD-phase VM study is conducted to focus on the subsystem and detail level elements of the design. These elements include but are not limited to the following:

- Material selections
- Specific building systems selection and design
- Proposed design details
- Overall layout options within overall building shell
- Phasing and scheduling plans
- Structural loads and elements
- Major constructability issues
- Site paving, grading, and utilities
- The DD phase study generally takes three to five days. The DD phase study is held after receipt of the draft DD phase submission of the documents. The final design development submission is prepared upon agreement of all implemented VE proposals.
- As the project is developed the focus will shift to detailed aspects of the earlier decisions during design development.
- Diagrams, narratives, and sketches with calculations to demonstrate the life-cycle cost effectiveness of the system must be prepared and received during this phase.
- This approach requires a diligent effort and commitment by all project team members early in the project to systems and materials that make sense economically and allow quality and durability.

DESIGN DEVELOPMENT

This submission reflects a more comprehensive project design developed from the selected final concept design. This submission will finalize the selection of type, size, and other material characteristics of all systems. Systems are not only structural, mechanical, fire protection, and electrical, but all other building components such as envelope (wall, window, and roof), interior (flooring, ceiling, and partitions), toilet and service rooms, elevators, and so on. The submission will consist of a combination of drawings, narrative, and calculations.

This submission is not preliminary construction documents. Design discipline must not start work on construction documents until the project directive has been approved.

CONSTRUCTION DOCUMENTS

A set of detailed and coordinated submissions that become the basis to construct the project. The construction documents must be complete, coordinated between disciplines, readable, and buildable, with no room for unreasonable additional interpretation. They must be produced in a general fashion that any construction contractor nationwide can understand. Designs must be illustrated to distinguish between existing construction and new work. They must be clear enough to result in a single interpretation of a specific set of data or facts. Language used in the specifications must be consistent and complementary to notes on the drawings. The documents must avoid using terms that the design specialist may know, but which have nothing to do with the purchase and installation of a product.

CODE ANALYSIS

Code criteria must be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in each phase meet the code requirements.

AS-BUILT DOCUMENTS

The As-Built BIM and COBie submissions must comply with the GSA BIM Standard, the GSA Common Data eXchange (CDX) and GSA COBie Playbook as well as contract-level requirements.

DATA AND OPERATIONS MANUAL

An operations manual/system must be prepared, and training provided for the building Operations and Maintenance personnel describing the design objectives and how to operate the building. The manual/system must include as a minimum: as-built drawings, environmental regulatory operating licenses/registrations/permits for each piece of equipment, equipment data, model numbers for the equipment, parts lists, equipment options, operating manuals for each piece of equipment, testing and balancing reports and certifications, maintenance schedules, videos, and warranty schedules. The manual/system must be reviewed and certified complete by the RPMT before submission to the facility manager. Consideration should be given to incorporating this information into the building automation system.

DESIGN AWARDS

Every two years GSA recognizes outstanding projects through its biennial Design Awards program. Designers are required to submit each new construction project for consideration. Design Excellence projects at historic properties are also eligible for submission.

A.3.2 PROJECT DELIVERY METHODS

DESIGN-BUILD (D/B)

A construction delivery method where the design and construction services are provided by a single entity under one contract.

DESIGN-BID-BUILD (D/B/B)

Project delivery method where the design and construction are delivered by two separate entities. A design firm provides 100% design documents, and contractors submit bids to complete the project.

DESIGN-BUILD-BRIDGING (D/B/BRIDGING)

A hybrid of Design-Build and Design-Bid-Build. An architect or engineer designs the first 35% of the project. Design-Build firms then provide proposals based on the initial design package to complete the design and construction. The initial 35% package acts as a “bridging” document between the initial project concept and the design-build phase. The benefit of bridging is that it provides a higher level of documentation upon which design-build firms can provide their proposal.

CONSTRUCTION MANAGER AS CONSTRUCTOR (CMC)

A delivery method where the architect and the construction contractor are selected at the beginning of the project. This enables construction to commence before 100% design completion, potentially reducing costs and overall project schedule. Two separate contracts are maintained between the design team and the constructor.

A.3.3 FUNDING CODES

- BA51 New Construction
- BA53 Lease Construction

- BA54 Minor Repairs and Alterations
- BA55 Major Repairs and Alterations
- BA61 Operating Funds (including work performed under operations and maintenance contracts)
- BA63 Energy Rebates
- BA64 Historic Preservation
- BA80 Reimbursable Work Authorization
- ESPC Energy Savings Performance Contract including utility projects

A.4 SUBMITTAL MATRIX

The submittal matrix is provided to document the baseline submittal requirements for the four project delivery methods and funding codes described above. Project teams must still provide the standard of care for a fully constructible set of documents. The matrix identifies items that GSA requires to validate that the project is moving forward while meeting the requirements of P100. Additional submittal requirements may be included in the project contract.

The matrix is first organized by delivery type. Select the project delivery method and a new window will appear with all the deliverable phases. Select the deliverable phase and a window will appear with all the required deliverables. Each deliverable phase is identified with funding codes which indicates if that project type has required deliverables.

The submittal matrix can be found at www.gsa.gov/p100.

A.5 SURVEYS AND GEOTECHNICAL REPORTS

A.5.1 SITE SURVEY

Site surveys are generally prepared for GSA projects involving sitework. The survey may be contracted separately by GSA or may be included in the scope of the design team for the project. The guidelines given here apply in either case. In cases where GSA contracts for the survey directly, the design team may be requested to review the scope of work for the survey and recommend modifications to the technical requirements to suit the specific project site.

The criteria listed here are not absolute; they should be modified by the civil engineer to suit the conditions of the project. All surveys must be prepared and sealed by a surveyor licensed in the state where the project is located.

A.5.1.1 GENERAL REQUIREMENTS

Surveys should generally contain the following information:

- Locations of all permanent features within limits of work, such as buildings, structures, fences, walls, concrete slabs and foundations, above-ground tanks, cooling towers, transformers, sidewalks, steps, power and light poles, traffic control devices, manholes, fire hydrants, valves, culverts, headwalls, catch basins or inlets, property corner markers, and benchmarks.
- Location of all adjacent and abounding roads or streets and street curbs within limits of work, including driveways and entrances. Type of surfacing and limits must be shown. For public streets, right-of-way widths and centerlines should also be shown.
- Location of all trees, shrubs, and other plants within limits of work. For trees, caliper size should be shown; dead trees should be indicated.
- Location of all overhead telephone and power lines within the limits of work and their related easements.

- Based on existing records, location of underground utilities, such as gas, water, steam, chilled water, electric power, sanitary, storm, combined sewers, and telephone, must be shown. Sizes of pipes (I.D.), invert elevations, inlet, or manhole rim elevations must be indicated. Where appropriate, information should be verified in the field.
- Based on existing records, location of underground storage tanks or other subsurface structures.
- Topography field criteria must include such items as 300 millimeter or 600 millimeter (1 to 2 ft.) contour intervals plotted on a grid system appropriate to the scale of the survey; elevations at top and bottom of ditches and at any abrupt changes in grade; periodic top-of-curb and gutter elevations, as well as street centerline elevations; elevations at all permanent features within the limits of work; ground floor elevations for all existing buildings.
- Bearings and distances for all property lines within the limits of work.
- Official datum upon which elevations are based and the benchmark on or adjacent to the site to be used as a starting point.
- Official datum upon which horizontal control points are based.
- If there are not already two benchmarks on the site, establish two permanent benchmarks.
- Elevations of key data points of all building structures and improvements directly adjacent and across the street from the project site during both wet and dry season.
- Delineate location of any wetlands or floodplains, underground streams, or water sources.

A.5.2 GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT

On most GSA projects geotechnical investigations will take place at three separate stages: during site selection, during building design, and during construction. The geotechnical report must be available to all contractors so that there will be a common reference on which to base their bids. Also, the report would subsequently function as the basic reference for evaluating "changed conditions" or "differing site conditions" during construction and, therefore, need be of sufficient detail, number of borings, groundwater, and contamination evaluations to support the design and mitigate large changed conditions issues.

A.5.2.1 PURPOSE

The purpose of the geotechnical investigation during building design is to determine the character and physical properties of soil deposits and evaluate their potential as foundations for the structure or as material for earthwork construction. The investigation must also determine the hydrological capacities of the soil. The type of structure to be built and anticipated geologic and field conditions have a significant bearing on the type of investigation to be conducted.

The investigation must therefore be planned with knowledge of the intended project size and anticipated column loads, land utilization, and a broad knowledge of the geological history of the area.

The guidelines given here are not to be considered as rigid. Planning of the exploration, sampling and testing programs, and close supervision must be vested in a competent geotechnical engineer and/or engineering geologist with experience in this type of work and licensed to practice engineering in the jurisdiction where the project is located.

Analysis of Existing Conditions. The report must address the following:

- Description of terrain
- Brief geological history
- Brief seismic history
- Surface drainage conditions

- Groundwater conditions and associated design or construction problems
- Description of exploration and sampling methods and outline of testing methods
- Narrative of soil identification and classification, by stratum
- Narrative of difficulties and/or obstructions encountered during previous explorations of existing construction on or adjacent to the site
- Description of laboratory test borings and results
- Plot plan, drawn to scale, showing test borings or pits
- Radon tests in areas of building location
- Soils resistivity test, identifying resistivity of soil for corrosion protection of underground metals and electrical grounding design
- Boring logs, which identify:
- Sample number and sampling method
- Other pertinent data deemed necessary by the geotechnical engineer for design recommendations, such as:
    - Unconfined compressive strength
    - Standard penetration test values
    - Subgrade modulus
    - Location of water table
    - Water tests for condition of groundwater
    - Location and classification of rock
    - Location of obstructions
    - Atterberg tests
    - Compaction tests
    - Consolidation tests
    - Triaxial compression test
    - Chemical test (pH) of the soil
    - Contamination

Engineering Recommendations Engineering recommendations based on borings and laboratory testing must be provided for the following:

- Recommendations for foundation design, with discussion of alternate solutions, if applicable, include:
- Allowable soil bearing values
- Feasible deep foundation types and allowable capacities, where applicable, including allowable tension (pull-out) and lateral subgrade modulus
- Feasibility of slab on grade versus structurally supported floor construction, including recommended bearing capacities and recommended subgrade modulus (k)
- Discussion of evidence of expansive soils and recommended solutions
- Lateral earth design pressures on retaining walls or basement walls, including dynamic pressures
- Design frost depth, if applicable
- Removal or treatment of contaminated soil
- Discussion of potential for consolidation and/or differential settlements of substrata, with design recommendations for total settlement and maximum angular distortion
- Use and treatment of in-situ materials for use as engineered fill
- Recommendations for future sampling and testing
- Recommendations for pavement designs, including base and sub-base thickness and subdrains

- Recommendations for foundation and subdrainage, including appropriate details
- Discussion of soil resistivity values
- Discussion of soil hydrological capabilities
- Discussion of radon values and recommendation for mitigating measures, if required

Figure 24: Altmeyer Federal Building
Woodlawn, MD

A.6 LIFE CYCLE COST ANALYSIS REQUIREMENTS

A.6.1 LCCA GENERAL REQUIREMENTS

A.6.1.1 LCCA LEGISLATION REQUIREMENTS

Subpart A of Title 10 CFR §436 establishes Methodology and Procedures for determining the life cycle cost effectiveness of new building alternatives and existing building modernizations, retrofits and replacement alternatives.

Alternative building designs for new Federal buildings and existing building modernizations, retrofits and replacements must be evaluated based on life cycle costs. The alternative design which results in the lowest life cycle costs must be deemed the most cost-effective. Life cycle cost-effective means that the proposed building or alternative has a lower life-cycle cost than the life-cycle costs of the baseline building or baseline alternative, as described by 10 CFR §436.

10 CFR §433.100 (5)(ii) requires the life cycle cost of Federal design alternatives and proposed systems to be lower than the life cycle cost of the ASHRAE 90.1 baseline building and systems.

Life Cycle Cost = Initial Investment + Energy + Water + OM&R + Replacement – Residual Value

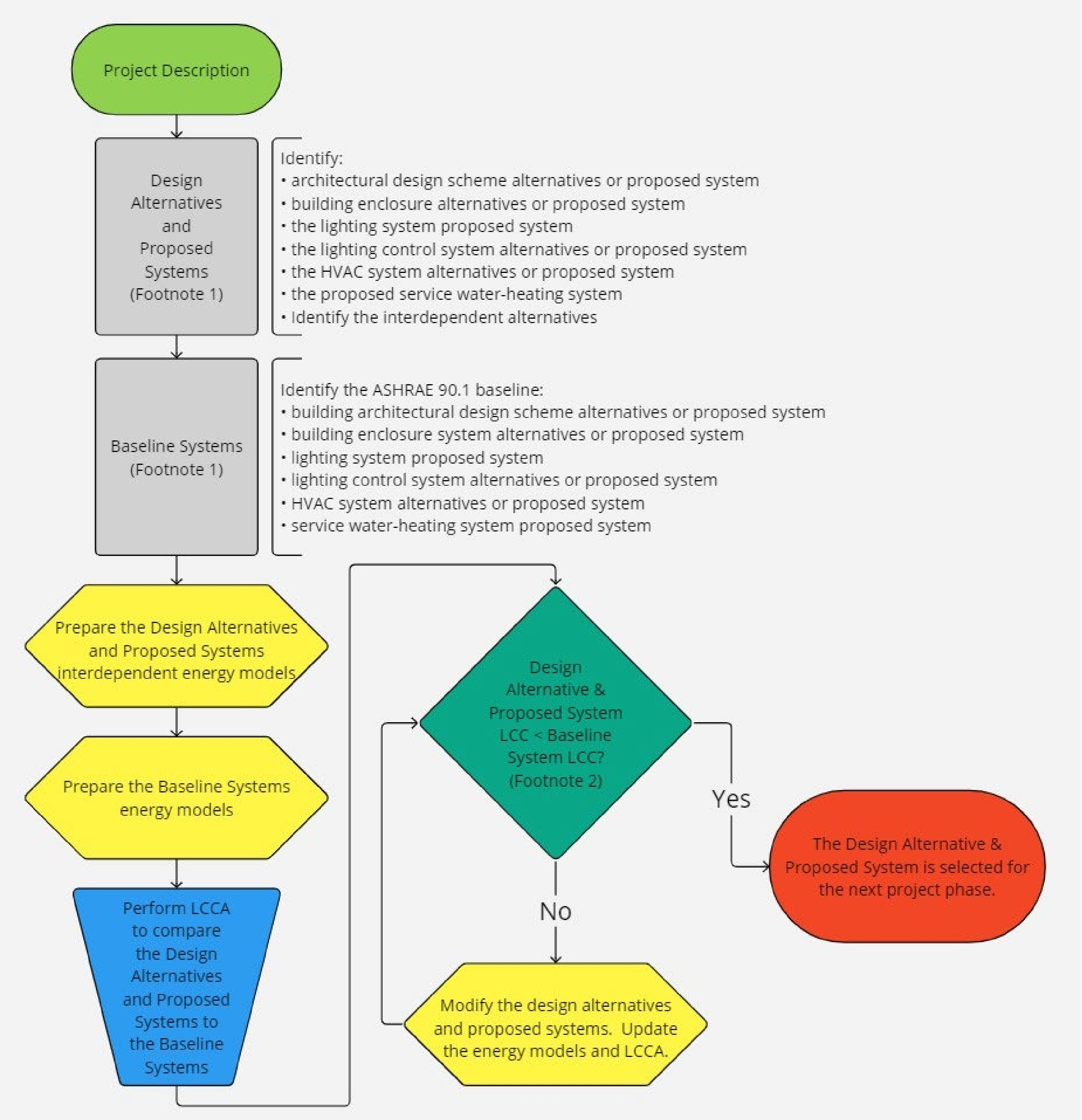
where: All costs are converted to present values by discounting.

The LCCA study period is generally the expected life of the retrofit, replacement, modernization, new building, or 40 years, whichever is shorter. See 10 CFR §436 for the LCCA study period requirements.

Figure 25: Land Port of Entry
Derby Line, VT

A.6.1.2 LCCA SUMMARY FLOWCHART

The flowchart below provides a summary of the life cycle cost analysis process.



Footnotes

1. See the LCCA DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE REQUIREMENTS tables for the LCCA requirements for each project phase for the four project delivery methods and funding codes.

2. Life cycle cost of design alternatives and proposed systems are less than the life cycle cost of the baseline building and systems.

A.6.1.3 LCCA DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE REQUIREMENTS

Table A.6.1 Delivery Method: Design Bid Build; Design Build Bridging; Construction Manager as Constructor			
Funding Code:	BA51 New Construction, BA55 Major Repair and Alterations		
Project Phase [3]			
Preliminary Concept	Concept Development	Final Concept	Design Development 100%
Proposed Design and Alternatives			
• Three distinctly different architectural design schemes • Proven life cycle cost effective building enclosure system • Lighting system for each architectural design scheme One ASHRAE 90.1 Appendix G PRM for: • Lighting control system for each architectural design scheme [1,2] • HVAC system for each architectural design scheme [1,2] • Service water-heating system for each architectural design scheme	• Architectural design scheme • Three building enclosure system alternatives[2] • Lighting system • Three lighting control system alternatives [2] • Three HVAC system alternatives [2] • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system
Baseline Systems			
One ASHRAE 90.1 Appendix G PRM baseline for: • Each architectural design scheme • Enclosure system for each architectural design scheme • Lighting system for each architectural design scheme • Lighting control system for each architectural design scheme • HVAC system for each architectural design scheme • Service water-heating system for each architectural design scheme	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system

Footnotes

1. **The proposed system must be the ASHRAE 90.1 Appendix G PRM baseline system for the Preliminary Concept phase.**
2. **If the project scope of work is not a new building or retrofit of the existing architectural design scheme, then provide three proposed building enclosure system alternatives, three proposed HVAC system alternatives and three proposed lighting control system alternatives in the Preliminary Concept phase instead of the Concept Development phase.**
3. **Update the LCCA as the design progresses for the CD 65%, CD 95%, and CD Final project phase submissions.**

Table A.6.2 Delivery Method: Design Build			
Funding Code:	BA51 New Construction, BA55 Major Repair and Alterations, BA80 Reimbursable Work Authorization, ESPC		
Project Phase [2]			
Pre-Award Concept (min 3 offerors)	Post-Award Concept	Final Concept	Design Development 100%
Proposed Design and Alternatives			
One each: • Architectural design scheme • Proven life cycle cost effective building enclosure system • Lighting system • ASHRAE 90.1 Appendix G PRM baseline lighting control system [1] • HVAC system • Service water-heating system	• Architectural design scheme • Three building enclosure system alternatives • Lighting system • Three lighting control system alternatives • Three HVAC system alternatives • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system
Baseline Systems			
One ASHRAE 90.1 Appendix G PRM baseline for: • building • enclosure system • lighting system • lighting control system • HVAC system • service water-heating system	One ASHRAE 90.1 Appendix G PRM baseline for: • building • enclosure system • lighting system • lighting control system • HVAC system • service water-heating system	One ASHRAE 90.1 Appendix G PRM baseline for: • building • enclosure system • lighting system • lighting control system • HVAC system • service water-heating system	One ASHRAE 90.1 Appendix G PRM baseline for: • building • enclosure system • lighting system • lighting control system • HVAC system • service water-heating system

Footnotes

1. **The proposed system must be the ASHRAE 90.1 Appendix G PRM baseline system for the Preliminary Concept phase.**
2. **Update the LCCA as the design progresses for the CD 65%, CD 95%, and CD Final project phase submissions.**

Table A.6.3 Delivery Method: Design Bid Build; Design Build Bridging; Construction Manager as Constructor			
Funding Code:	BA80 Reimbursable Work Authorization, ESPC		
Project Phase [3]			
Final Concept	Design Development 100%	CD 65%	CD 95%
Proposed Design and Alternatives			
• Three distinctly different architectural design schemes • Proven life cycle cost effective building enclosure system • Lighting system for each architectural design scheme One ASHRAE 90.1 Appendix G PRM for: • Lighting control system for each architectural design scheme [1,2] • HVAC system for each architectural design scheme [1,2] • Service water-heating system	• Architectural design scheme • Three building enclosure system alternatives[2] • Lighting system • Three lighting control system alternatives [2] • Three HVAC system alternatives [2] • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system
Baseline Systems			
One ASHRAE 90.1 Appendix G PRM baseline for: • Each architectural design scheme • Enclosure system for each architectural design scheme • Lighting system for each architectural design scheme • Lighting control system for each architectural design scheme • HVAC system for each architectural design scheme • Service water-heating system for each architectural design scheme	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system

Footnotes

1. **The proposed system must be the ASHRAE 90.1 Appendix G PRM baseline system for the Final Concept phase.**
2. **If the project scope of work is not a new building or retrofit of the existing architectural design scheme, then provide three proposed building enclosure system alternatives, three proposed HVAC system alternatives and three proposed lighting control system alternatives in the Final Concept phase instead of the Design Development 100% phase.**
3. **Update the LCCA as the design progresses for the CD Final project phase submissions.**

Table A.6.4 Delivery Method: Design Bid Build; Design/Build; Design Build Bridging; Construction Mgr as Constructor			
Funding Code:	BA54 Minor Repair & Alterations, BA61 Operating Funds for the purpose of Repair & Alterations		
Project Phase			
Design Development 100%	CD 65%	CD 95%	CD Final
Proposed Design and Alternatives			
• Three distinctly different architectural design schemes • Proven life cycle cost effective building enclosure system • Lighting system for each architectural design scheme • ASHRAE 90.1 Appendix G PRM baseline lighting control system for each architectural design scheme [1,2] • ASHRAE 90.1 Appendix G PRM baseline HVAC system for each architectural design scheme [1,2] • Service water-heating system for each architectural design scheme	• Architectural design scheme • Three building enclosure system alternatives[2] • Lighting system • Three lighting control system alternatives [2] • Three HVAC system alternatives [2] • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	• Architectural design scheme • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system
Baseline Systems			
One ASHRAE 90.1 Appendix G PRM baseline for: • Each architectural design scheme • Enclosure system for each architectural design scheme • Lighting system for each architectural design scheme • Lighting control system for each architectural design scheme • HVAC system for each architectural design scheme • Service water-heating system for each architectural design scheme	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system	One ASHRAE 90.1 Appendix G PRM for: • Baseline building • Building enclosure system • Lighting system • Lighting control system • HVAC system • Service water-heating system

Footnotes

1. **The proposed system must be the ASHRAE 90.1 Appendix G PRM baseline system for the Final Concept phase.**
2. **If the project scope of work is not a new building or retrofit of the existing architectural design scheme, then provide three proposed building enclosure system alternatives, three proposed HVAC system alternatives and three proposed lighting control system alternatives in the Design Development 100% phase instead of the CD 65% phase.**

A.6.2 DOCUMENTATION REQUIREMENTS

LCC studies, whether small or large, need to be carefully and clearly documented to keep track of the evaluation process, create a decision record, and have information easily accessible for future studies. The format should be simple and easy to understand. The extent of the documentation should be related to the complexity of the decision and in proper proportion to the scale of the overall project. The LCCA report must include the following:

A.6.2.1 PROJECT DESCRIPTION AND SCOPE

- General information
- Types of decisions to be made
- Constraints

A.6.2.2 COMMON PARAMETERS

- General information
- Study period
- Base date
- Discount rate
- Inflation
- Operational assumptions
- Local utility energy and water cost rates/schedules

A.6.2.3 DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE SYSTEMS

A list of design alternatives, proposed systems and baseline systems must be provided in accordance with the requirements for each project phase. The list of design alternatives, proposed systems and baseline systems must be arranged by building system type and include the architectural design schemes, building enclosure systems, lighting systems, lighting control systems, HVAC systems, and service water-heating systems. Provide a table identifying each combination of interdependent design alternatives. Provide the following:

- Narrative for each alternative and baseline
- Technical criteria and design features
- Rationale for including alternatives in the LCCA
- Rationale for excluding alternatives from the LCCA
- Non-monetary considerations

When a chosen design alternative or proposed system is not the lowest life cycle cost, provide a justification in the narrative. Such a justification may relate to mission requirements, sensitivity/uncertainty in the analysis, resiliency requirements, or operation and maintenance considerations not quantitatively included in the LCCA.

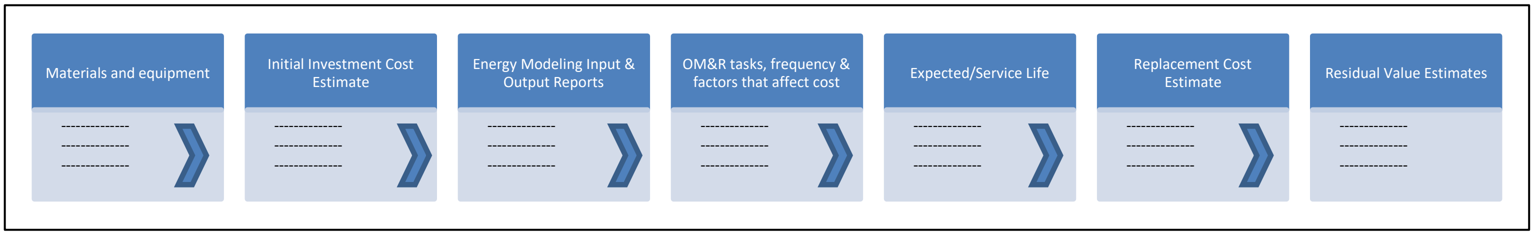
When selecting design alternatives and proposed systems, give preference for equipment and materials with lower complexity and OM&R requirements. Do not include alternatives and proposed system with known costs prior to the LCCA that exceed the potential savings based on historical information and engineering judgment. When such alternatives and proposed systems are considered but not included in the LCCA, identify those alternatives and proposed systems, and provide an explanation.

A.6.2.3.1 MATERIALS AND EQUIPMENT

Materials and equipment lists must be provided for each design alternative, proposed system, and the baseline system. The materials and equipment list must include a description, size, type, quantity, R value, efficiency, manufacturer, model number, etc. Sufficient information must be included to document the data entered in the cost estimates and energy modeling input and output reports. The materials and equipment names/labels must be consistent in all the LCCA documents:

- Initial investment cost estimates
- Energy modeling input and output reports
- OM&R tasks, frequency and factors that affect cost
- Materials and equipment expected/service life
- Replacement cost estimates
- Residual value estimates

If different material and equipment names/labels are used within the LCCA documents, then a matrix must be provided identifying the materials and equipment names/labels and the equivalent names/labels used within the other documents.



A.6.2.4 INITIAL INVESTMENT COSTS

An initial investment cost estimate must be provided for each design alternative, proposed system, and baseline system list of materials, equipment, and specifications. Provide a narrative explaining how the material, equipment and specification list was used to develop the cost estimate. Provide a matrix listing the material, equipment, and specifications and the corresponding initial investment cost estimate line-item data.

The initial investment cost estimate must meet GSA P120 requirements; Planning & Concept – Unit Costs – UNIFORMAT, Design Development/DiD – Unit Costs – UNIFORMAT, Construction Drawings – Labor, Material & Equipment Breakout – Masterformat – Level 5/6, Level 3 Summary. The basis for the unit costs and quotes must be well documented and included in the supporting data of the cost estimate. Quotes for material and equipment may be obtained from local suppliers or contractors. The same initial investment cost estimate data set must be used to develop the initial investment cost estimate for each design alternative to get consistent and comparable results.

Only design alternative initial investment costs that are relevant and significant to the outcome of the LCCA decision should be included in the initial investment cost estimate. Costs are relevant if the initial investment costs change from alternative to alternative. If initial investment costs are approximately the same for each design alternative, then the initial investment costs can be eliminated from the LCCA. Costs are significant when they are large enough to make a credible difference in the LCCA of a design alternative. Identify design alternative nonrelevant and insignificant initial investment costs that do not affect the LCCA decision and are excluded from the initial investment cost estimate.

A.6.2.5 ENERGY MODELING

Energy modeling must be provided for each design alternative, proposed system, and baseline system for each combination of interdependent design alternatives, proposed systems, and baseline systems. As per NIST Handbook 135, section 7.4: Determining the optimal design or energy efficiency for several interdependent systems within a facility generally requires a simultaneous energy analysis to properly account for the interaction among the systems. This interaction occurs when the use of one system affects the energy use of other systems in the same facility.

For each design alternative, the proposed system and baseline system determine the effect on building energy use and building water use by completing energy modeling and water use calculations. Each alternative proposed system and baseline system should be evaluated and identified if the alternative affects energy use or water use. If a design alternative does not affect building energy use, then the alternative does not have to be included in the energy model and the water use calculations. Individual building subsystem alternatives for example, interior finishes, that do not affect a building's energy use, can be evaluated independently.

The energy modeling must be completed in accordance with ASHRAE 90.1 Appendix G, Performance Rating Method energy modeling requirements. Energy modeling input and output documentation must be provided in accordance with ASHRAE 90.1 section G.1.3.2 Application Documentation items a through q. A summary table must be provided showing the annual energy use by type and total energy use from the energy modeling calculations for each mutually exclusive design alternative including the ASHRAE baseline systems. Energy modeling calculations are not required for proposed systems and design alternatives that do not significantly influence the cost of energy consumed.

A.6.2.6 WATER USAGE AND DISPOSAL CALCULATIONS

Water usage and disposal/treatment calculations must be provided for each combination of interdependent proposed systems, design alternatives, and baseline systems. A table showing the annual water usage and disposal/treatment for each combination of interdependent proposed system, design alternative and baseline systems must be provided.

A.6.2.7 OM&R COSTS

The design alternatives, proposed systems, and baseline systems equipment and materials manufacturers OM&R manuals must be used to determine the OM&R tasks and frequency. The following ASHRAE Applications Handbook Chapter 38 Owning and Operating Costs, Section 3, Factors Affecting Maintenance Costs must be evaluated and documented for each OM&R task:

- Quantity and type of equipment
- Equipment location (height above floor/grade, above ceiling) and access (including access restrictions)
- System run time
- Critical systems
- System complexity
- Local conditions
- Geographical location
- Equipment age
- Available infrastructure

OM&R costs must be determined from contractor and vendor quotes provided for the OM&R list of tasks, frequency and the ASHRAE Factors Affecting Maintenance Costs. Applying simple cost per unit of building floor area is unreliable, does not address the factors that affect OM&R costs and must not be used as the basis to determine OM&R costs. The following OM&R cost documents must be provided for the design alternatives, proposed systems, and baseline systems.

- Table listing the materials, equipment, and specifications data and the corresponding manufacturers OM&R manual name, equipment/material name and model number.
- Copies of the manufacturer's OM&R manual pages showing the manual name, material/equipment name and model number and the OM&R tasks and frequency.

- Table listing the materials, equipment, and specifications data (size, type, quantity, etc.), the OM&R tasks, and frequency from the OM&R manuals and the ASHRAE Factors Affecting OM&R Costs.
- Contractor and vendor quotes for each item listed in the materials, equipment, and specifications OM&R task, frequency and ASHRAE Factors Affecting Costs list.
- Table listing the materials, equipment, and specifications data (size, type, quantity, etc.), the OM&R tasks, and frequency from the OM&R manuals, the ASHRAE Factors Affecting OM&R costs and the contractor/vendor quoted cost.

If other accurate and reliable OM&R cost data sources, other than vendor quotes, would like to be considered for use as the OM&R cost data, then submit the OM&R cost data information to GSA for review and approval. The OM&R cost data must account for the OM&R maintenance tasks and the ASHRAE factors affecting OM&R cost.

A.6.2.8 REPLACEMENT COSTS

A replacement cost estimate must be provided for each design alternative, proposed system, and baseline system list of materials, equipment, and specifications with an expected/service life less than the LCCA study period. Provide copies of the materials, equipment, and specifications manufacturers data or industry technical data identifying the expected /service life. Provide a table listing the expected/service life of the materials, equipment, specifications for each proposed system, design alternative and the baseline systems. Provide a narrative explaining how the material, equipment and specification list was used to develop the replacement cost estimate. Provide a matrix listing the material, equipment, and specifications, the expected/service life, and the corresponding replacement cost estimate line-item data.

The replacement cost estimate must meet GSA P120 unit-price cost estimate requirements. The basis for the unit costs must be well documented and included in the supporting data of the initial cost estimate. Quotes for material and equipment may be obtained from local suppliers or contractors. The basis for the quotes must be well documented and included in the supporting data for the initial cost estimate. The same replacement cost estimate data set must be used to develop the replacement cost estimate for each design alternative to get consistent and comparable results.

Only design alternative replacement costs that are relevant and significant to the outcome of the LCCA decision should be included in the replacement cost estimate. Costs are relevant if the replacement costs change from alternative to alternative or if the expected/service life is different from alternative to alternative. If replacement costs are approximately the same for each design alternative and the expected/service life is approximately the same for each design alternative, then the replacement costs can be eliminated from the LCCA. Replacement costs are significant when they are large enough to make a credible difference in the LCCA of a design alternative.

Identify design alternative nonrelevant and insignificant replacement costs that do not affect the LCCA decision and are excluded from the initial cost estimate.

A.6.2.9 RESIDUAL VALUE

Provide a table listing the residual value, net of any disposal costs of the design alternatives, proposed systems, and baseline systems from the list of materials, equipment, and specifications with an expected/service life longer than the LCCA study period.

The residual value of a system (or component) is its remaining value at the end of the study period, or at the time that it is replaced during the study period. Residual values can be based on value in place, resale value, salvage value, or scrap value, net of any selling, conversion, or disposal costs. The residual value of a system at the end of its expected useful life is likely to be small or even negative (due to removal or disposal costs) if the system needs complete replacement or the facility is being demolished. However, for systems with expected lives extending beyond the end of the study period, the residual value should be based on their value in place, not on their "salvage" value as if they were to be removed from the building at that point. A facility system that is functioning in place adds significant value to the building and this value should be reflected in its residual value. There are numerous methods in estimating this value that may be appropriate depending on the application. It is recommended that you consider values that can be quantified using market-based data.

A.6.2.10 NIST BUILDING LIFE CYCLE COST (BLCC) PROGRAM

The most recent version of the NIST BLCC program must be used to perform the life cycle cost analysis calculations. If the purpose of an LCC analysis is primarily to evaluate the energy savings for a particular building or building system, the analysis must be conducted using the FEMP LCC criteria according to 10 CFR §436A. However, if a project involves energy usage and the energy-related and non-energy-related parts of the investment cannot be broken out, then the analyst must submit a recommendation for approval to GSA whether to use OMB Analysis criteria or FEMP Analysis criteria.

FEMP Analysis, Energy Project: The criteria used as defaults in this module follow FEMP's life cycle costing rules according to 10 CFR §436 subpart A as they apply to energy and water conservation and renewable energy projects funded by agencies from direct appropriations.

OMB Analysis, Non-Energy Project: This OMB module is designated to perform life-cycle cost analyses subject to OMB Circular A-94, when the purpose of the evaluation is not primarily to assess energy-related savings. This module supports analyses that are subject to the life cycle costing guidelines of OMB Circular A-94 for the following types of projects: (a) cost-effectiveness, lease-purchase, internal government investment, and asset sales, and (b) public investment and regulatory analyses.

Water resource projects are subject to Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.

The BLCC Input Data Listing, Detailed LCC Analysis, Cash Flow Analysis, Summary LCC, Lowest LCC, and Comparative Analysis reports must be included as part of the LCCA documentation for each design alternative, proposed system, and ASHRAE 90.1 baseline building and systems.

A.6.2.11 INTERPRETATIONS

Provide narratives and tables presenting the data for the baseline and each alternative for the following: 1) LCCA comparisons, 2) Sensitivity analysis, and 3) Uncertainty assessment.

Figure 26: Beekeeping at the Rudman U.S. Courthouse Concord, NH

B.1 REFERENCES

B.1.1 LIST OF REFERENCE PUBLICATIONS AND WEBSITES

All references are to the edition in effect at the time of solicitation of the design team contract for the project, unless noted otherwise.

INTRODUCTION

The following references apply to all P100 chapters.

Publications

- 1962 Guiding Principles of Federal Architecture
- Hallmark of the Productive Workplace
- 42 USC §4151 et seq., Architectural Barriers Act Accessibility Standard (ABAAS)

Websites

- Center for Workplace Strategy
- 3D-4D Building Information Modeling
- Building Commissioning Guide

CHAPTER 1 GENERAL REQUIREMENTS

General Requirements

The following references apply to all P100 chapters.

Publications—General Federal

- 40 USC §581(h), Public Buildings Cooperative Use Act of 1976
- Energy Policy Act of 2005
- National Historic Preservation Act of 1966 as amended (NHPA)
- 40 CFR, Protection of Environment
- Federal Management Regulation (FMR), based on the Public Buildings Amendments of 1988, Title 40, Subtitle II, Part A, Chapter 33, Section 3312
- 36 CFR §67, Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings
- 29 CFR §1926, Safety and Health Regulations for Construction, Section 1926.62, Lead (including lead-based paint)
- 29 CFR §1910 Occupational Safety and Health Standards, Section 1910.146(b)—Definition of "Confined space"
- Executive Order 13502, Use of Project Labor Agreements for Federal Construction Projects, February 6, 2009
- Planning for Federal Sustainability in the Next Decade
- EPA Comprehensive Procurement Guidelines (CPG) (recycled products)
- USDA BioPreferred Program
- DOE Guidance for Electric Metering in Federal Buildings DOE/EE 0312
- Food, Conservation and Energy Act of 2008

- FMR Part 102-76 (Design and Construction), Subpart C (Architectural Barriers Act)
- 36 CFR §1191 Appendices C and D (ABA Chapters 1-10)

Publications Related to Specific GSA PBS Programs

General

- PBS Pricing Desk Guide
- PBS National Business Space Assignment Guide
- GSA Order PBS 3490.3, Security for Sensitive Building Information Related to Federal Buildings, Grounds, or Property
- Agency Space Allocation and Reduction Policies
- National Park Service Preservation Briefs
- ADM 1020.3 GSA Procedures for Historic Properties

Accessible Design

- 36 CFR §1191 Appendix C and D, Architectural Barriers Act Accessibility Standard (ABAAS)

Federal Courthouses

- U.S. Courts Design Guide
- U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space, Volumes 1-3, Publication 64
- MOA for Court Security 2019
- GSA Federal Courthouse Physical Security Best Practices Desk Guide 2023
- FPS VSS Guidelines & Specifications
- FPS IDS Guidelines and Specifications
- GSA OMA EPACS Guidelines
- GSA Courthouse Visitor's Guide, February 2003
- GSA Courthouse Project Handbook, August 2004

Art in Architecture and Fine Arts

- GSA PBS Art in Architecture Program, Policies and Procedures
- GSA PBS Fine Arts Program Policies and Procedures

Childcare Centers

- Child Care Center Design Guide (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)
- Interagency Security Committee Appendix C: Child Care Level of Protection Template (FOUO)

Design Excellence

- GSA PBS Design Excellence Policies and Procedures
- GSA PBS Policy on Design Excellence in Leasing

Land Ports of Entry

- United States Land Port of Entry Design Standard

Security

- The Risk Management Process: An Interagency Security Committee Standard, and the General Services Administration Facility Security
- GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process
- GSA Alternate Path Analysis and Design Guidelines for Progressive Collapse Resistance

Sustainability

- Guiding Principles for Sustainable Federal Buildings

Publications

- American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA):
- Z10-2005, American National Standard—Occupational Health and Safety Management Systems
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
- Standard 62.1—Ventilation and Acceptable Indoor Air Quality
- ASHRAE Handbook of Fundamentals
- ANSI/ASHRAE Standard 140: Method Of Test For Evaluating Building Performance Simulation Software
- International Code Council (ICC)
- International Building Code (IBC)
- International Fire Code (IFC)
- International Green Construction Code (IgCC)
- International Mechanical Code (IMC)
- International Plumbing Code (IPC)
- International Property Maintenance Code (IPMC)
- International Fuel Gas Code (IFGC)
- International Private Sewage Disposal Code (IPSDC)
- International Zoning Code (IZC)
- International Wildland-Urban Interface Code (IWUIC)
- International Existing Building Code (IEBC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)
- National Fire Protection Association (NFPA)
- NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 101: Life Safety Code
- NFPA 70: National Electrical Code
- American Institute of Architects (AIA)
- AIA Document E202 – Building Information Modeling Protocol Exhibit
- Uniform Plumbing Code (UPC)

Additional Websites

- International Code Council
- Whole Building Design Guide

APPENDIX

- Sustainable Facilities Tool
- Project Management Preservation Checklist
- GSA Technical Preservation Guidelines

CHAPTER 2 COMMUNITY PLANNING AND LANDSCAPING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 2.

Publications

- 33 USC §1251 et seq., Federal Water Pollution Control Act (Clean Water Act)
- GSA PBS Site Selection
- GSA PBS Order 1095.8A, Floodplain Management
- GSA PBS NEPA Desk Guide
- GSA PBS Sustainability Matters
- U.S. Army Corps of Engineers Wetlands Delineation Manual
  American National Standards Institute (ANSI)
- American Standard for Nursery Stock/American National Landscape Association (ANLA)

Additional Websites

- Environmental Program
- Access Board
- NEPA
- EPA Low Impact Development (LID) Literature Review and Fact Sheets
- USDA Invasive Species
- Crime Prevention Through Environmental Design—CPTED
- SITES/LEED Synergies

CHAPTER 3 ARCHITECTURE AND INTERIOR DESIGN

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 3.

Publications

- Fine Arts Policies and Procedures, Appendix F
- PBS Order No. 3490.2, Document Security for Sensitive but Unclassified Paper and Electronic Building Information, Section 7.d.(1.)
- American Architectural Manufacturers Association (AAMA)
  - 1502.7, Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections
  - 101/I.S.2/A440-05, Standard/Specification for Windows, Doors, and Unit Skylights (includes AAMA/WDMA 101/I.S.2/NAFS)
  - 1600 Voluntary Specification for Skylights
- American Iron and Steel Institute (AISA)
  - S220, North American Standard for Cold-Formed Steel Framing – Nonstructural Members
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
  - Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
  - Standard 160: Criteria for Moisture-Control Design Analysis in Buildings
  - Standard 202: Commissioning Process for Buildings and Systems

- American Society of Mechanical Engineers (ASME)
    - A17.1 Safety Code for Elevators and Escalators
    - A18.1 Safety Standard for Platform Lifts and Stairway Chairlifts
- American Society of Testing and Materials (ASTM)
    - C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
    - C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
    - C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
    - C1371, Standard Test Method For Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
    - C1396, Standard Specification for Gypsum Board
    - E90, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building
    - E336, Standard Test Method for Measurement of Airborne Sound Insulation in Buildings
    - E903, Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
    - E1007, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures
    - E1130, Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
    - E1414, Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
    - E1918, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
    - E1946, Standard Practice for Measuring Cost Risk of Buildings and Building Systems
    - E1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque
    - E2396, Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Roof Systems
    - E2397, Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems
    - E2398, Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
    - E2399, Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
    - E2400, Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
- American National Standards Institute (ANSI)
    - ANSI/ASSE Provision of Slip Resistance on Walking/Working Surfaces
- Architectural Woodwork Institute (AWI)
    - Standards (for grades of interior architectural woodwork, construction, finishes, and other requirements)
- Brick Industry Association
    - Technical Notes on Brick Construction

- Indiana Limestone Institute (ILI)
    - ILI Handbook
- Marble Institute of America
    - Dimension Stone Design Manual
- National Concrete Masonry Association (NCMA)
    - TEK Manual for Concrete Masonry Design and Construction
    - Annotated Design and Construction Details for Concrete Masonry
- National Glass Association with GANA (NGA)
    - Heavy Glass Door Design Manual
    - Laminated Glazing Reference Manual
    - Engineering Standards Manual
- National Roofing Contractors Association (NRCA)
    - Architectural Metal Flashing and Condensation and Air Leakage Control, current edition
    - Membrane Roof Systems, current edition
    - Metal Panel and SPF Roof Systems, current edition
    - Steep-slope Roof Systems, current edition
    - The NRCA Waterproofing Manual, current edition
- Precast/Prestressed Concrete Institute
    - Architectural Precast Concrete
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
    - Architectural Sheet Metal Manual
- Steel Door Institute (SDI)
    - SDI 122-99 Installation and Troubleshooting Guide for Standard Steel Doors and Frames
- Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)
    - TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces

CHAPTER 4 STRUCTURAL AND CIVIL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 4.

Publications

- Interagency Committee on Seismic Safety in Construction (ICSSC)
- American Society of Civil Engineers
- ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
- ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings

CHAPTER 5 MECHANICAL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 5.

Publications

- American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
    - Handbook of Fundamentals
    - Handbook of Refrigeration
    - Handbook of HVAC Applications
    - Handbook of HVAC Systems and Equipment

  - Standard 15: Safety Code for Mechanical Refrigeration
  - Standard 52.2: Method of Testing: General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
  - Standard 55: Thermal Environmental Conditions for Human Occupancy
  - Standard 62.1: Ventilation and Acceptable Indoor Air Quality
  - Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings
  - Standard 100-2006: Energy Conservation in Existing Buildings
  - Standard 105-1999: Standard Method of Measuring and Expressing Building Energy Performance
  - Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC Systems
  - Standard 113-2005: Method of Testing for Room Air Diffusion
  - Standard 135-2016: BACnet: A Data Communication Protocol for Building Automation and Control Networks
  - Standard 140: Method Of Test For Evaluating Building Performance Simulation Software
  - Guideline 0-2005: The Commissioning Process
  - Guideline 4-2008: Preparation of Operating and Maintenance Documentation for Building Systems
  - Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems
  - Guideline 29-2007: Guideline for Risk Management of Public Health and Safety in Buildings
  - Guideline 36-2021: High-Performance Sequences of Operation for HVAC Systems
- American National Standards Institute (ANSI)
  - ANSI Z 223.1., National Fuel Gas Code
- American Society of Plumbing Engineers (ASPE)
  - ASPE Data Books
- American Society for Testing and Materials (ASTM)
  - ASTM E-84, Surface Burning Characteristics of Building Materials
- Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA)
  - HVAC Duct Construction Standards: Metal and Flexible HVAC Air Duct Leakage Test Manual
  - Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
  - Seismic Restraint Manual Guidelines for Mechanical Systems
- National Fire Protection Association (NFPA)
  - NFPA 70, National Electrical Code
  - NFPA 101, Life Safety Code
  - EIA/TIA Standard 569
  - Commercial Building Standard For Telecommunications Pathways and Spaces (and related bulletins)
- Underwriters Laboratories (UL)
  - UL 710, Standard for Exhaust Hoods for Commercial Cooking Equipment

Additional Websites

- ENERGY STAR Certified Products
- FEMP Designated Products

CHAPTER 6 ELECTRICAL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 6.

APPENDIX

Publications

- ANSI/NETA ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- ANSI/NETA ECS, Standard for Electrical Commissioning Specifications for Electrical Power Equipment and Systems
- ANSI/NETA ETT, Standard for Certification of Electrical Testing Technicians
- ANSI/NETA MTS, Maintenance Testing Specifications for Electrical Power Equipment and Systems
- ASME: American Society of Mechanical Engineers
- ASME A17.1, Safety Code for Elevators and Escalators
- ASTM: American Society for Testing and Materials
- ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- BICSI, (Building Industry Consulting Service International) Telecommunications Distribution Methods Manual
- BICSI, Wireless Design Reference Manual
- DesignLights Consortium (DLC) Technical Specifications
- ETL: Electrical Testing Laboratories
- FAA: Federal Aviation Agency
- Federal Information Processing Standard 175, Federal Building Standard for Telecommunication Pathways and Spaces
- IEEE Standard 1547, Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power System Interfaces
- IEEE Standard 1789, IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers
- IEEE Standard 2030.5, Standard for Smart Energy Profile Application Protocol
- IES: Illuminating Engineering Society of North America
- IES Lighting Library
- IES G-1 Guideline for Security Lighting for People, Property, and Public Spaces
- IES RP-1, American National Standard Practice of Office Lighting
- IES RP-5, Recommended Practice for Daylighting
- IES RP-8, Roadway Lighting
- IES RP-20, Lighting for Parking Facilities
- IES LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IES LM-80, Measuring Lumen Maintenance of LED Light Sources
- IES LM-83, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- IES TM-15, Luminaire Classification System for Outdoor Luminaires
- IES TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources
- IEEE: Institute of Electrical and Electronics Engineers
- ICEA: Insulated Cable Engineers Association
- NEMA: National Electrical Manufacturers Association
- NETA: International Electrical Testing Association
- NETA/ANSI EIT , Standard for Certification of Electrical Testing Technicians
- NETA/ANSI ECS, Standard Electrical Commissioning Specifications for Electrical Power Equipment and Systems

- NETA/ANSI ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- NFPA: National Fire Protection Association
- NFPA 70, National Electrical Code
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems
- NFPA 855, Standard for the Installation of Stationary Energy Storage Systems
- NICET EPT-NICET Electrical Power Testing Certification Requirements
- UL: Underwriters' Laboratories
- UL50, Enclosures for Electrical Equipment for Types 12, 3, 3R, 4, 4X, 5, 6, 6P, 12, 12K, and 13
- UL67, Panelboards
- UL 96, Marking and Application Guide Lightning Protection
- UL1558, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- UL1598C, Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
- UL1741, Standard for Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources
- UL9540, Energy Storage Systems and Equipment
- UL9540A, Battery Energy Storage System Test Method
- UL 24480, Design Guideline for Promoting Circadian Entrainment with Light for Day-Active People
- 10 CFR §431.196 Transformer Efficiencies

Additional Websites

- ENERGY STAR Certified Products

CHAPTER 7 FIRE PROTECTION

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 7.

Publications

- American Society of Mechanical Engineers (ASME)
- ASME A17.1, Safety Code for Elevators and Escalators
- American Society for Testing Materials (ASTM)
- ASTM E-2073, Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings
- Code of Federal Regulations (CFR)
- 36 CFR §1228, Subpart K—Facility Standards or Record Storage Facilities
- International Code Council (ICC)
- International Building Code (IBC)
- International Fire Code (IFC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)
- National Archives and Records Administration (NARA)

- NARA Directive 1571
- National Fire Protection Association (NFPA)
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
- NFPA 14, Standard for the Installation of Standpipe and Hose Systems
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 75, Standard for the Protection of Information Technology Equipment
- NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
- NFPA 101, Life Safety Code
- NFPA 170, Standard for Fire Safety Symbols
- NFPA 214, Standard on Water-Cooling Towers
- NFPA 232, Standard for the Protection of Records
- NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 914, Code for Fire Protection of Historic Structures
- Society of Fire Protection Engineers (SFPE)
- SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design for Buildings
- SFPE Handbook of Fire Protection Engineering
- Underwriters Laboratories (UL)
- UL 1994 Standard for Luminous Egress Path
- Marking Systems

B.2 ACRONYMS AND ABBREVIATIONS

AAMA	American Architectural Manufacturers Association
ABA	Architectural Barriers Act of 1968
ABAAS	Architectural Barriers Act Accessibility Standard
ACM	Asbestos-Containing Material
AHJ	Authority Having Jurisdiction
AHU	Air-Handling Unit
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALS	Assisted Listening System
ANLA	American National Landscape Association
ANSI	American National Standards Institute
ARCSA	American Rainwater Catchment Systems Association
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society of Testing and Materials
ATS	Automatic Transfer Switch
AWI	Architectural Woodwork Institute
BAS	Building Automation System
BFE	Base Flood Elevation
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BIS	Building Information Specialist
BIMr	Regional BIM Manager
BLCC	building life cycle cost
BMC	building monitoring and control
BOMA	Building Owners and Managers Association International
BPP	Building Preservation Plan
CATV	cable television
CCMG	Central Courthouse Management Group
CCT	Correlated Color Temperature
CD	construction document
CFR	Code of Federal Regulations
CISA	Climate-Informed Science Approach
CPG	Comprehensive Procurement Guidelines
CPTED	Crime Prevention through Environmental Design
CRI	color rendering index
CSI	Construction Specifications Institute
CSC	Court Security Committee
CxP	Commissioning Provider
CUI	Controlled Unclassified Information
DC	direct current
DD	design development
DDC	direct digital control
DFE	Design Flood Elevation
DNL	Day-Night average noise level
ECS	Electrical Commissioning Specifications
EIA	Electronic Industries Alliance
EISA	Energy Independence and Security Act of 2007
EPAct	Energy Policy Act of 2005
EPR	Ethylene Propylene Rubber
ESPC	Energy Savings Performance Contract
ESS	Energy Storage Systems
FAR	Federal Acquisition Regulation
FAS	Federal Acquisition Service
FC	Foot-candle
FCxP	Fire Commissioning Provider
FDC	ASCE 24 Flood Design Class
FEMP	Federal Energy Management Program
FFRMS	Federal Flood Risk Management Standard
FIIC	field impact isolation class
FMR	Federal Management Regulation
FPS	Federal Protective Service
FPT	functional performance test
FSC	Facility Security Committee
FTE	full-time equivalent
GFI	ground fault interrupt
GSA	General Services Administration
Gsf	gross square feet
HB	heat balance
HET	high efficiency toilet
HEU	high efficiency urinal
HVAC	heating, ventilating, and air conditioning
IAPMO	international association of plumbing and mechanical officials
IBC	International Building Code
ICC	International Code Council
ICSSC	Interagency Committee on Seismic Safety in Construction
IEBC	International Existing Building Code
IESNA	Illuminating Engineering Society of North America
IG	isolated ground
IGE	independent government estimate
ILI	Indiana Limestone Institute
IMC	intermediate metallic conduit
IRC	international residential code
IRMA	inverted membrane roof assembly
ISC	Interagency Security Committee
ISO	International Organization for Standardization

ISR impact sound rating
LCC life-cycle costing
LCCA life cycle cost analysis
LED light-emitting diode
LEED Leadership in Energy and Environmental Design
LID Low impact development
LPD lighting power density
LPW lumen per watt
LRFD load resistance factor design
MBI Modular Building Institute
MCC motor control center
MERV minimum efficiency reporting value
MRL machine-roomless
NAEYC National Association for the Education of Young Children
NARA National Archives and Records Administration
NC noise criteria
NCMA National Concrete Masonry Association
NEII National Elevator Industries, Inc.
NEPA National Environmental Policy Act
NESHAP National Emission Standards for Hazardous Air Pollutants
NETA International Electrical Testing Association
NFIP National Flood Insurance Program
NFPA National Fire Protection Association
NFRC National Fenestration Rating Council
NHPA National Historic Preservation Act
NIC noise isolation class
NIST National Institute of Standards and Technology
NRCA National Roofing Contractors Association
OAVS outdoor air ventilation system
OMB Office of Management and Budget
OSHA Occupational Health and Safety Administration
P100 Public Buildings Service PBS 100
PBS Public Buildings Service
P140 Child Care Center Design Guide
PCI Precast Concrete Institute
PDU power distribution unit
PF power factor
PV photovoltaic system
PWM pulse width modulation
QA quality assurance
QC quality control
R&A repairs and alterations
RAF raised access floor
RC room criteria
RH relative humidity
ROD record of decision
RPMT regional project management team
RTS radiant time series
SAA sound absorption average
SB Smart Building
SCAQMD South Coast Air Quality Management District
SDI Steel Door Institute
SDM Spatial Data Management
SFO solicitation for offers
SFPE Society of Fire Protection Engineers
SITES Sustainable Sites Initiative
SLC signaling line circuits
SMACNA Sheet Metal and Air Conditioning Contractors' National Association
STC sound transmission class
TAB testing, adjusting, and balancing
TBC Total Building Commissioning
TDS total dissolved solid
TFM transfer function method
THD total harmonic distortion
TI tenant improvement
TIA Telecommunications Industry Association
TTY text telephone
UL Underwriters Laboratory
UPS uninterruptible power supply
USC U.S. Code
USCDG U.S. Courts Design Guide
USMS U.S. Marshals Service
UST underground storage tank
VAV variable air volume
VFD variable frequency drive
VM Value Management
VOC volatile organic compound
XLP cross-linked polyethylene

C.1 SUMMARY OF CHANGES FROM THE 2022 ADDENDUM

Section Number	Section Title	Summary of Change
Throughout	Standards	Removal of dates as latest version is designated
	Updating P100	New section on updating P100
1.1	Purpose of the Facilities Standards	Clarified the use of links throughout P100
1.2	Application of P100	Updated funding codes and information
1.2.1	Repair and Alterations	Clarified when to use and added abandonment in place requirements
1.3.2	Environmental Protection	Clarified applicable requirements
1.3.9.2	Critical Action Facilities	Updated flood requirements
1.3.9.3	Mission Critical Facilities	Added Data Center requirements
1.3.10	Prohibition of Forced or Child Labor	New section covering labor laws
1.4.8	ASHRAE 90.1	Clarified requirements
1.5.2	Zoning and Related Issues	Clarified use of local requirements
1.6.4	Security	Deleted section as information was in 1.4.7 Interagency Security Committee Risk Management Process for Federal Facilities
1.7.2	Special Exposures	Added information related to weather events
1.7.4.1.2	Asbestos Pre-alteration Assessments	Updated section
1.8.1	Construction Sign	Clarified requirements for rigid sign
1.8.3	Building Information Modeling (BIM)	Updated section
1.8.5.4	Turn-Over	Updated training requirement
1.9.1	Energy Net-Zero	Updated references
1.9.1	Water Net-Zero	Updated section to increase requirements and update references
1.9.1	High Performance Building Technologies	Updated section to increase requirements and update naming
1.9.1	Construction Personnel	Deleted Section
1.9.2	Sustainability Performance Attributes	Replaced Sustainability Section
1.9.2.1	Energy Net-Zero	New section
1.9.2.2	Water Net-Zero	New section
1.9.2.3	GSA's Pilot to Portfolio	Renamed and updated section
1.9.3	Sustainability Requirements	New section
1.9.3.1	Conservation, Efficiency, Renewables	New section
1.9.3.3	LEED Certification	Updated section with carbon free electricity
1.9.3.4	Decarbonization	Updated section with new requirements
1.9.3.5	Electrification	New section
1.9.3.6	Energy Usage	Renamed section and deleted 2030 Challenge for Carbon Neutral Buildings
1.9.3.6.3	Energy Model	Updated to include future typical meteorological year
1.9.3.7	Life-Cycle costing	Clarified requirements and references Appendix A.6 LCCA

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Section Number	Section Title	Summary of Change
1.9.3.8	Grid-Interactive Efficient Buildings	Updated section to a requirement
1.9.3.10	Sustainable Materials	New Section and deleted GSA Buy Clean Product Standards
1.9.3.10.1	Holistic Approach of Regenerative Materials	New section
1.9.3.10.2	Salvaged Materials	New section
1.9.3.10.3	Low Embodied Carbon Concrete	Moved from Structural and updated section
1.9.3.10.4	Environmentally Preferable Asphalt	Moved from Structural and updated section
1.9.3.10.5	Sustainable Wood – Responsible Sources	New section
1.9.3.10.6	Per- and Polyfluoroalkyl Substances (PFAS)	New section
1.9.3.11	Sustainable Construction	New section
1.9.3.11.1	Construction Site Decarbonization	New section
1.9.3.11.2	Off-Site Construction	New section
1.9.3.11.3	Construction and Demolition waste	Updated references and included salvage
1.9.3.11.4	Green Credentialed Construction Personnel	Updated section to a requirement
1.10.1	Management of Climate Related and Extreme Weather Risks	Updated section
1.10.2	Thermal Resilience	Updated section with weather extremes
2.1	Community Planning Performance Table	Renamed section
2.1	Sustainable Locations	Updated references
2.1	Collaborative Design Process	Updated section and references
2.2	Community Planning Performance Requirements	Renamed section and clarified requirements
2.2.2	Collaborative Design Process	Updated section
2.3.1	Process Criteria	Updated section
2.3.2.1	Exterior Connections and Gathering Spaces	Updated section to include passenger loading
2.5.3.1	Precipitation	Updated section to nature based
2.5.3.2	Water use	Updated section with rainwater catchment requirements
2.5.4	Soil and Aggregates	Renamed section
2.5.4.3	Aggregates	New section
2.5.5.1.1	Documenting Existing Vegetation	Updated section to protect existing trees
2.5.5.1.4	Tree Replacement	Updated section to account for local standards
2.5.5.2	Introducing New Vegetation to the Site	Updated section to prioritize natives and wildlife value
2.5.6.1	Pollinator Nesting	Expanded requirements to more pollinators
2.5.7	Extreme Heat	New section
2.5.8.1	Sustainable Site Maintenance	Updated requirements to include local facility managers

APPENDIX

Section Number	Section Title	Summary of Change
2.5.9	Parking Lot Design	Renamed section
2.5.9.1	Parking Lots	Renamed and updated section and references
Chapter 3	Architecture and Interior Design	Reorganized the chapter to put like items with each other
3.1	Envelope-Natural Hazard, Flood Resistant	Deleted section
3.1	Water Penetration Resistance	Updated requirements for designated facilities and references
3.1	Moisture and Condensation Control	Updated requirements and references
3.1	Air Tightness	Updated requirements
3.1	Thermal Performance	Updated references
3.1	Building Enclosure Commissioning	Updated requirement to include mission critical
3.1	Enclosure Service Life	Updated requirement to include mission critical
3.2.1.3	Flood Resistant Design and Construction	Deleted requirement and references chapter 4
3.2.3.1	Fenestration	Updated testing requirement
3.2.3.2	Roofing and Horizontal Waterproofing Membrane System	Updated references
3.2.3.5	Green Roofing Systems	Updated design and media requirements
3.2.4.1	Moisture Control Opaque Assemblies	Updated requirements for marine environments
3.2.4.2	Condensation Resistance–Fenestration	Updated section
3.2.5.2	Enclosure Air Tightness (all six sides of the building)	Updated section
3.2.6	Thermal Performance	Updated section to address thermal breaks/bridging
3.2.7	Building Enclosure Commissioning	Updated requirements
3.2.9	Enclosure Service Life	Updated testing requirements
3.3.4.1	Connections, Fasteners, and Miscellaneous Metals Exposed to Weather	Updated for marine environments
3.3.4.4	Sealants	New section
3.3.5	Masonry and Concrete Materials	Updated requirement and service life
3.3.6	Fenestration Systems	Updated section
3.3.6.1	Windows	Updated aluminum and historic requirements
3.3.6.2	Window Frames	Updated thermal breaks
3.3.7.1	Roofing Design	Updated service life
3.3.7.1.1	Cool Roofs	New section
3.3.7.2	Re-Roofing	Updated service life
3.3.7.4	Insulation	Updated thermal calculations
3.3.7.7	Skylights and Sloped Glazing	Updated condensate requirement
3.3.7.8	Roof Fal Protection	Renamed section
3.3.8.2	Air Barrier Testing	Updated testing requirement

APPENDIX

Section Number	Section Title	Summary of Change
3.3.12.11	References	Updated references
3.4.4	Vertical Transportation	Added goals and responsibilities
3.4.4.4	Machine RoomLess (MRL)	Eliminated hydraulic mrl
3.4.5	Family/Single Occupancy Restrooms	Updated requirements and added adult changing station
3.4.6	Lactation Rooms	Added PUMP legislation and updated station table
3.4.7	Bird-Safe Design	Increased the floor height requirements and locations
3.6	Interior Construction Performance Attributes	Updated requirements related to service life
3.6.1.3	Glazed Aluminum Doors	Updated requirement for fire and ballistic rating
3.6.1.4	All Glass Entrances	Updated safety requirement
3.6.1.8	Aluminum Framed Interior Lights	Updated requirement for fire rating
3.7.27	Acoustical Ceilings	Updated certification requirements
3.8.1.1	Interior Coatings (Paint)	Updated for moisture resistance
3.8.2.2	Architectural Exterior Coatings	Deleted Section
3.9.1.2	Closed Offices versus Open Plan	Updated sound masking for hearing impaired
3.9.1.4	Absorption and Isolation	Renamed section, updated rating, and added door requirements
3.9.1.5	Parameters Used in Acoustical Design	Updated rating
4.1	Seismic	Updated risk category
4.1	Wind	Updated risk category
4.2.1.1	Live Load	Updated location requirements
4.2.1.2	Seismic Load	Updated references
4.2.1.2.2	Non-Structural Components	Updated section
4.2.1.3	Wind Load	Updated references
4.2.1.4	Snow Load	New section
4.3.8	General	Updated submission requirements
4.3.9	Special Durability Requirements	New section
4.3.10	Forced Entry Resistance	New section
4.3.11	Storage of Ammunition and Explosive or Hazardous Materials	New section
4.3.12	Delegated Designs	New section
4.3.13	Inspections and Certifications	New section
4.4	Security	Updated references
4.5.1	Blast design Requirements	Updated references
4.6	Flood Resistant Design Requirements	Replaced Flood Mitigations with new section
4.7.1	Flood Resistant Design Requirements	Replaced Flood Mitigations with new section
4.8.1	Site Grading and Draining	New storm and drainage requirements
4.8.2	Site Utilities	Added water recycling

APPENDIX

Section Number	Section Title	Summary of Change
4.8.4	Pavements	Updated requirements for coal tar sealant
4.8.5	Low Embodied Carbon Concrete	Moved to chapter 1
4.8.6	Environmentally Preferable Asphalt	Moved to chapter 1
5.1	Humidity Control	Updated M&V requirements
5.1	Cooling Robustness (redundancy)	New section
5.1	Heating Robustness (redundancy)	New section
5.1	Filtration	Updated for smoke requirements
5.1	HVAC Operational Efficiency	Updated requirements
5.2.8	Treating Biological Growth in Water systems	Updated referenced requirement
5.3.2	HVAC Systems	Updated electrification requirements
5.3.2.1	Chiller Plant	Updated cooling load requirements
5.3.2.6	Roof-Mounted Equipment	Updated what equipment is allowed
5.3.2.7	Controls/Building Automation Systems	Updated for existing systems
5.3.2.8	Coordination of Digital Control Systems	Updated security measures
5.3.2.9	Building Automation System Software	Updated to include smart building systems
5.3.2.10	Building Automation System Controllers	Updated requirement for rapid spanning tree protocol
5.3.2.12	Integrated Sequences of Operations (ISOO)	Updated requirements for sensors
5.3.2.13.2	Occupancy Counting	Updated requirements for security and safety
5.3.2.17	Connectivity to the GSA Network and IP Addressable Devices	New section
5.3.2.17.1	Occupancy Counting	New section
5.3.2.17.2	Rapid Spanning Tree Protocol (RSTP)	New section
5.3.2.17.3	IPv6	New section
5.3.2.17.4	Vulnerability Patching	New section
5.3.2.17.5	Smart Building Review of Projects (SB Sign-off process)	New section
5.3.3.4	Cooling and Heating Coil	Updated for marine environments
5.3.3.6	Hydronic, Steam, Natural Gas, and Fuel Oil Piping	Updated cooling coil requirement
5.3.3.13	Air Source Heat Pump Condenser Discharge	New section
5.3.4.3	Duct Construction	New section
5.3.4.4	Flexible Duct Connectors	New section
5.4	Plumbing	Updated for electrification, conservation, and legionella.
5.4.5	Plumbing Piping	Updated materials and exterior responsibility
5.4.6	Isolation Valves	New section

Section Number	Section Title	Summary of Change
5.4.7	Hose Bibbs	New section
5.4.8	Floor Drains	Updated location requirements
5.4.9	Overflow Pans	New section
5.4.10	Gas and Fuel Oil Piping	Deleted section
5.5.1	Accessible for Maintenance	Updated for heat rejection
5.6	Alterations in Existing Buildings	Added replacement in kind restrictions
6.1	Lighting Quality - Interior	Updated for tunable requirements and circadian lighting
6.1	Lighting Use - Interior	Updated tier requirements
6.3.1.6	Parking Structures	Updated references
6.3.1.8	Exit Stair Illumination and Photoluminescent Materials	Updated references and photoluminescent requirements
6.3.1.10	Luminaires	Updated for drop ceilings
6.3.2.2	Solid State Luminaires and Retrofit kits	Updated references and requirements
6.4	Transformers	Updated efficiency requirements
6.4	Building Automation System - Interface from Electrical Systems	Updated BAS protocol requirements
6.4	Surge Protection Devices	Updated main switchgear requirements
6.5.1.1	Design Intent	Updated bracing requirements
6.5.2.1	Electrical Design Publications and Standards	Updated references
6.5.4.3	Direct Buried Conduit	Updated pvc and conduit requirements
6.5.4.4	Concrete-Encased Ductbank	Updated requirements
6.5.4.6	Manholes	Updated size requirements
6.5.6.1.3	Medium Voltage Transformers	Updated requirements for Network transformers
6.5.6.2.1	Main Switchgear	Updated cover requirements
6.5.7.8	Floodplain Clearance	References Chapter 4
6.5.8.3	Elevator and Other Vertical Transportation Power	Updated requirements
6.5.9.3.6	Communications Rooms	Updated busbar requirement
6.5.9.6.1	Conduits	Updated conduit system requirements
6.5.9.8	Electric Vehicle Supply Equipment (EVSE)	References new Chapter 8 section
6.5.11	Emergency and Standby Power Systems	Updated EPSS requirements
6.5.11.1	Classification of Emergency Power Supply Systems (EPSS)	Updated requirements for IR Cameras
6.5.11.1.2	Required Standby System	Updated ancillary heat requirement
6.5.11.2	Generator System	Updated fuel source requirements
6.5.11.2.1	Service Conditions	Updated flood and other requirements

Section Number	Section Title	Summary of Change
6.5.11.2.4	Automatic Transfer switches	Updated bypass source requirements
6.5.12.3	Harmonic Mitigation - Transformers	Updated requirements
6.5.16.1	Requirements	Updated references
6.5.16.2.2	Marking Access to Roofs	Renamed section and updated requirements
6.5.16.9	Required: PV System Approval	Updated reviewers
7.1.3.1	Project team Fire Protection Engineer	Updated qualifications and requirements
7.4.1	Special Requirements	Updated requirements
7.5	Interior Finishes	Updated labeling requirements
7.6	Fire Alarm and Emergency Communication Systems	Updated network requirements
7.6.1	Manual Fire Alarm Boxes	Updated warning requirements
7.6.2	Waterflow Switches	Reduced waterflow switch requirements
7.6.5	Visual Notification Appliances	Updated requirements
7.7	Water Supply for Fire Protection	Updated water flow requirements
7.7.1	Fire Pumps	Updated manual pump shutdown requirements
7.8	Automatic Sprinkler and Standpipe Systems	Reduced requirements
7.8.2	Sprinkler Piping	Updated construction requirements
7.8.6	Fire Department Hose Outlets	Updated pressure reducing valves requirements
7.9.5	Portable Fire Extinguisher	Updated location requirements
7.10	Elevator Systems	Updated section
7.10.2	Occupant Evacuation Elevators	Updated monitor requirements
7.11.2	Information Technology Equipment Rooms	Updated section
7.11.11	Station Energy Storage Systems	Updated storage systems requirements
7.11.12	Parking garage	New section
7.11.13	Modular Rooms	New section
7.11.14	Sleep Pods	New section
7.11.15	Electric Vehicle Supply Equipment (EVSE)	New section
7.15	Carbon Monoxide Detection	New section
8.1.2.2	U.S. Marshals Service Criteria	Revised requirements for PUB64
8.1.3.4	Acoustic Planning Requirements	Included additional requirements in PUB64
Table 8.2	Typical Interior Fixed Furniture Elements	Deleted table
8.1.6.4	Coordination with Telecommunications System Design	Clarified location and other requirements
8.1.7	Security Design: Agency Responsibilities	Section rewritten with new requirements
8.1.8	Battery Backup	References PUB64 for specific requirements

APPENDIX

Section Number	Section Title	Summary of Change
8.3	Mail Rooms	Updated guidance document
8.4	Indoor Firing Ranges	Updated requirements
8.5	Electric Vehicle Supply Equipment (EVSE)	New section
A.1.1	BIM (Building Information Model) REQUIREMENT	Updated section
A.1.4	Document Security Requirements	Updated section
A.1.9	Turnover Documents	Updated section
A.6	Life Cycle Cost Analysis Requirements	New section
B.1	References	Updated references

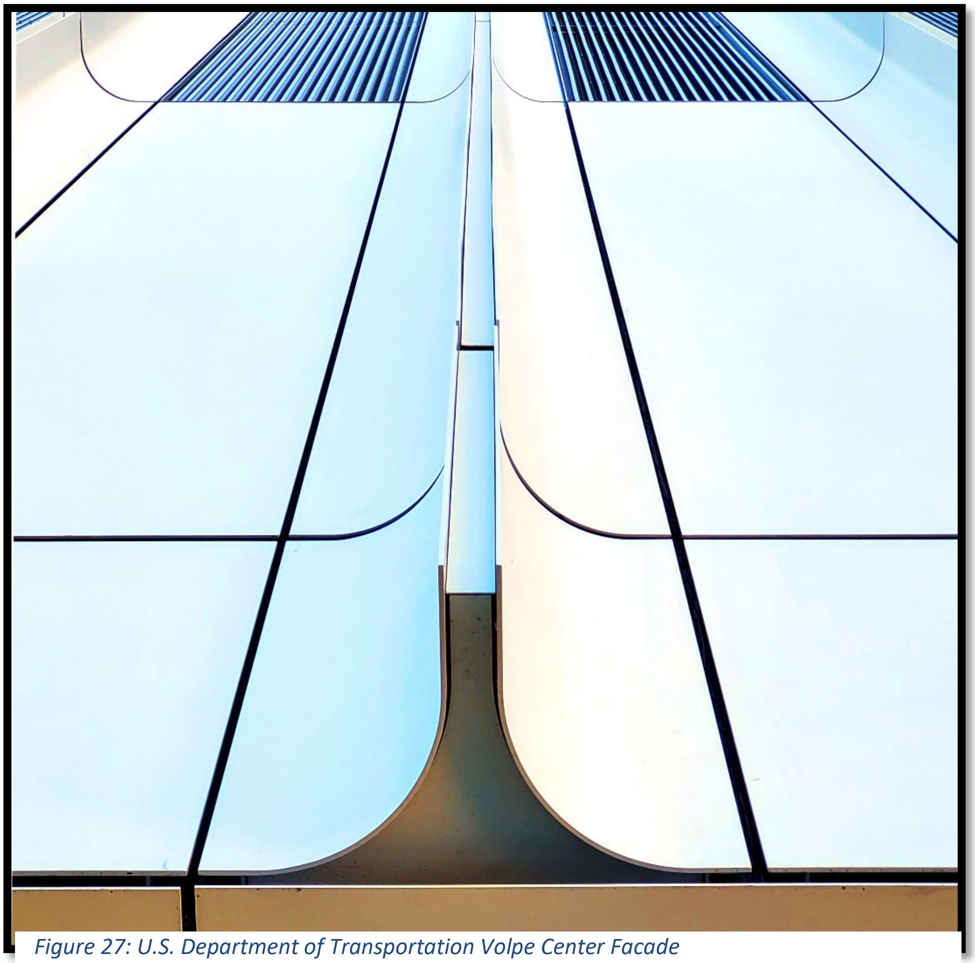

Figure 27: U.S. Department of Transportation Volpe Center Facade Cambridge, MA

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