ARCHITECTURE & ENGINEERING

OWNER'S BASIC REQUIREMENTS

FOREWORD

Title 17-7-Part 2, Montana Codes Annotated (MCA) mandates construction of new buildings and major renovations for State-owned and new leased buildings to be built and operated based on sound environmental, economic, and fiscal decisions for design, construction, and operation. Specifically, it defines a “High-Performance Building" as one that integrates and optimizes all major high-performance building attributes, including but not limited to energy efficiency, durability, life-cycle performance, and occupant productivity. Buildings constructed under 17-7-213 MCA are required to be maintained and operated as high-performance buildings.

The Owner’s Basic Requirements (OBR) provide planning, design, construction, operations, restoration, and modernization criteria. The OBR apply to all 17-7-202 MCA projects administered by the Architecture & Engineering Division (A&E) and are optional for all other A&E-managed projects at the Project Manager’s discretion.

OBR are living documents and will be reviewed, updated, and made available on the same cycle as the latest adopted version of the High-Performance Building Standards (HPBS).

Agencies may contact the A&E Division for document interpretation and improvements. Recommended changes with supporting rationale should be sent to the A&E Administrator. OBR are effective upon issuance and are posted on the A&E website http://architecture.mt.gov

Revisions:

June 2013: The Minimum Design Standards (MDS) adopted.

March 2015: MDS were edited in response to EO 12-2014 to promote use of Montana wood Products.

March 2019: Minimum Design Standards changed to Owner’s Basic Requirements with consolidation and updates throughout.

SECTION 1: INTRODUCTION

1.1 PURPOSE AND SCOPE

A&E Division's goal is to provide quality buildings that: 1) serve the mission of the client Agency, 2) are cost-effective over the life of the building, and 3) are fiscally responsible to the citizens of Montana. OBR provide technical guidance and outline requirements for typical aspects of architectural and engineering design services. The information in this guide represents the minimum requirements for projects administered by the A&E Division and is applicable to projects administered by other Agencies of the Montana State government. Project conditions and Agency needs may dictate designs that exceed these requirements. The OBR is an addendum to the HPBS.

Designers and their consultants (the Design Team) must use this information to develop plans, specifications, calculations, and construction contract documents unless otherwise directed by the A&E Division Project Manager.

1.2 APPLICABILITY

OBR is mandatory for all 17-7-202 MCA new buildings and major renovation projects administered by the A&E Division and at the Project Manager's discretion for all other A&E-managed projects. In instances where specific portions or elements of OBR are not applicable to 17-7-202 and 17-7-213 new buildings or major renovation projects, the Project Manager may grant waivers.

Documentation of waivers of any OBR elements is required under "Incorporated State A&E's Owner's Basic Requirements" portion of the Checklist in Attachment B of the HPBS for all 17-7-213 projects. Documentation of waivers is not required for non-17-7-202 projects.

For contracting purposes, Project Managers shall ensure each project's scope/program clearly defines what portions of OBR and HPBS are not applicable and such definition shall meet the documentation-of-waivers requirement. Waivers granted through the course of further programming, design, or construction shall also be documented.

1.3 ADDITIONAL REQUIREMENTS

This document establishes OBR to be used in conjunction with the additional requirements in the HPBS for new buildings and major renovations constructed under 17-7-202 MCA.

State Agencies and units of the Montana University System (MUS) may have additional design requirements and standards that guide the design and construction of buildings. Several Agencies, particularly those with secure environments, have strict requirements to be followed regarding control of the Design Team's operations and interface with the Agencies' operations.

The Design Team shall:

- Confirm the currently applicable requirements or regulations with the Project Manager.
- Confirm with the Authority Having Jurisdiction (AHJ) the pertinent local requirements.
- Confirm whether local ordinances may dictate additional requirements affecting the project.

SECTION 2: PLANNING, PROGRAMMING, AND DESIGN SERVICES

2.1 PRE-DESIGN, DESIGN, AND POST-DESIGN SERVICES

The contract and the project's initial program/scope information are essential to delineating project specific requirements. The Performance & Document Requirements on the A&E website and A&E OBR delineate expectations and best practices. Design Teams may request clarification of any of this information from the A&E Project Manager.

2.2 INTEGRATED DESIGN PRINCIPLES

Refer to the latest version of the Whole Building Design Guide, National Institute of Building Science (WDBG).

A collaborative, integrated planning and design team is composed of the client user groups, A&E staff, and appropriate professionals. Together they identify requirements and establish comprehensive performance goals specific to the project and ensure these goals are incorporated into the design, construction, and operation throughout the life cycle of the building.

The Design Team shall refer to the latest adopted version of the HPBS for the implementation requirements of Integrated Design if the program/scope information establishes high-performance requirements.

2.3 DESIGN FOR FUNCTION AND TOTAL LIFE CYCLE COST

Permanent Buildings: Shall be energy efficient and have finishes, materials, and systems selected for low maintenance and low total cost of ownership cost over the life cycle period be set by the Project Manager.

Transitional Construction: Semi-permanent or temporary buildings shall be energy efficient and shall have finishes, materials, and systems selected for routine maintenance based on the expected life, generally between five and 25 years.

2.3.1 TOTAL COST OF OWNERSHIP

When specifically identified and itemized in the Project scope, prepare a Total Cost of Ownership analysis (TCO) in accordance with industry-accepted practices and based on local conditions. TCO must be calculated using accepted industry standards for evaluation and selection of materials, equipment, systems and components.

Each TCO analysis must, at a minimum, address the following elements:

<u>Non-recurring Costs:</u>

- Concept to Bid
- Financing
- Construction/Installation
- Decommissioning/Deconstruction/Demolition/Disposal

<u>Annual Recurring Costs:</u>

- Operations
- Planned and Routine Maintenance
- Repairs and Breakdowns
- Utilities

Periodic Recurring Costs:

- Retrofits/Improvements
- Programmatic Upgrades
- Replacement and Renewal

Base all analysis on the actual conditions expected over the life of the facility including anticipated occupancies, scheduled hours of operation, and process loads. Include modeled energy usage and efficiencies, maintenance costs, repairs, and renovations. Include all costs or savings associated with the utilization of recovered energy, solar heat, solar photovoltaic energy, and other renewable or waste heat applications. Apply all alternative funding, including rebates from utility companies in the TCO. Life expectancies must include replacement and salvage values at the appropriate year of the analysis. See Appendix B-3.

2.3.2 LIFE CYCLE COST ANALYSIS

Life Cycle Cost Analysis (LCCA) is acceptable for selection of building elements, engineered systems, and components. See Section 7 Mechanical and Electrical Systems and Appendix B-3.

2.4 BUILDING ENVELOPE AND SYSTEMS COMMISSIONING

The Design Team shall employ commissioning practices appropriate to the size and complexity of the building and its system components in order to verify performance and ensure that design requirements are met.

2.5 POST-OCCUPANCY EVALUATION

A&E and the client Agency will conduct a Post-Occupancy Building Evaluation (POBE) approximately eleven months after the substantial completion date to assess the building's performance relative to occupant comfort and productivity, operational efficiency, maintainability, cost effectiveness of the investment, and value of sustainable features. The POBE creates a baseline for building performance, identifies opportunities to fine tune building systems, and identifies applied lessons learned for future projects.

The Facility Performance Evaluation (FPE) Guidance Document for Public Facilities from WBDG, referenced in Appendix B-2, will be used in the POBE and modified to fit the specific project. The POBE will be provided to the Design Team prior to the one-year warranty review required for the project. The purpose is to provide the Design Team with additional information to consider during the warranty review and A&E's expectation is that the Design Team will address concerns identified in the POBE in their one-year warranty review report. Include evaluation of effectiveness of features related to sustainable design and third-party certification for projects designed under the HPBS that reach the third-party certification threshold.

2.6 PERCENT FOR ART

Where applicable, for projects that include funding for public art, A&E will strive to transfer funds to the Montana Arts Council (MAC) or other managing entity so that the Design Team can coordinate during preliminary design with the art committee to identify location and concepts for integrating public art into the building. MAC will manage the art selection and placement in coordination with the Design Team and State Project Managers. The construction contract will delineate the contractor's responsibilities, if any, for coordination when the installation is scheduled to take place prior to substantial completion.

2.7 PROMOTE USE OF MONTANA WOOD PRODUCTS

Pursuant to Executive Order 12-2014, construction of all new buildings or expanded State-owned buildings shall consider the use of Montana wood products for structural and aesthetic purposes as well as look for opportunities to demonstrate innovative use of Montana wood products as potential green building materials. Such considerations will be documented for each project. Cost effectiveness over the life cycle of the project must be considered when selecting materials.

Pursuant to Executive order 12-2014, in collaboration with other State agencies, look for viable opportunities on State-owned buildings that are newly constructed or are planning replacement of a thermal or combined heat and power energy system to consider installation of a wood energy system. Where determined to be viable, such considerations will be documented for each project. Cost effectiveness over the life cycle of the project must be considered when determining the viability of wood energy applications.

The Project Manager may select the process of consideration documentation, as appropriate for the project, which may consist of meeting minutes, emails, informal analysis, or formal studies.

2.8 ENVIRONMENTAL ASSESSMENTS/IMPACT STATEMENTS

Projects receiving federal funds requiring a National Environmental Policy Act (NEPA) impact statement shall be structured and scheduled to meet all requirements. Agencies listed in Montana Code Annotated (MCA) Montana Environmental Policy Act (MEPA) statutes and Montana University System (MUS) projects that are not categorically excluded from MEPA by the Montana Board of Regents of Higher Education Policy and Procedures Manual, Policy 1005.1 shall be structured and scheduled to meet all requirements.

SECTION 3: SITE AND CIVIL

3.1 MONTANA PUBLIC WORKS STANDARDS

The Design Team shall comply with requirements of the latest edition of Montana Public Works Standard Specifications, compiled by the Montana Contractors' Association, for design of earthwork, paving and surfacing, and utility systems (water, storm water, sanitary sewer). It is the Design Team's responsibility to determine which specifications are applicable, to coordinate them with the goals and requirements of the project and then document them in the project construction plans and specifications.

3.2 GEOTECHNICAL

Review all existing geotechnical information and reports. If necessary, conduct additional geotechnical investigations or subsurface condition assessments as necessary. Confirm that geotechnical investigations include previously disturbed sites and conditions abutting existing buildings. Compile a geotechnical report including all findings and recommendations. Comply with the recommendations of the reports.

3.3 SITE SURVEY

Review all existing site information and conduct a survey as necessary to identify topography, surface and subsurface utilities, property boundaries, easements, roads, sidewalks, structures, and major vegetation. Review the information to confirm that the necessary data is included for the design and construction project.

3.4 SUSTAINABLE LOCATION AND SITE DEVELOPMENT

Sustainable site selection and site development are fundamental components of sustainable and resilient building practices. Opportunities offered by good site selection are available at the start of a project and in most cases incur no additional cost. Take every opportunity to transform State campuses into more livable, meaningful, and resource-efficient communities.

3.5 SITE SELECTION

Locate projects proximal to users and associated functions in order to improve efficiencies, promote pedestrian and public transportation, minimize travel distance and time, and minimize private vehicle use/dependence.

When appropriate during the site-selection process, give preference to sites possessing the following characteristics that:

- Provide adaptive reuse or renovation of existing underutilized buildings (including historic buildings) that can be cost effectively repurposed or use previously disturbed/developed areas.
- Orient building to maximize energy efficiency, passive solar, and daylighting potential of the building.
- Situate projects in central business districts and rural town centers as appropriate for the specific project.
- Provide sites served by public transportation systems where available.
- Are in close proximity to housing.
- Avoid development of sensitive land resources.
- Conform with local zoning requirements unless variances are obtained. Note that 76-2-402 MCA requires a public comment period.

- Manage parking strategies to encourage co-use of shared parking.
- Avoid constructing occupied structures over contaminants, unless contaminants are mitigated to prevent detrimental impacts.
- Minimize the need to extend utility services. Size systems with thought of future development and as delineated by the Agency's master plan.

3.6 SITE SAFETY

Provide clear access for emergency response vehicles. To the extent feasible, separate vehicular access, including service vehicles, from pedestrian circulation.

Avoid exposed outdoor steps and stairs wherever possible. Provide vertical transitions inside the building or under a covered area whenever possible.

Lay out entrances so that they are readily identifiable and evident in their purpose and relate to other buildings and campus circulation patterns.

Orient building entrances to maximize safety and ease of access. Illuminate walking surfaces for night pedestrian traffic.

3.7 SITE WATER MANAGEMENT

Establish building elevations so that surface water does not enter buildings or accumulate in associated traffic areas. Provide positive drainage away from buildings and manage roof runoff such that water is directed away from the foundation. Incorporate best management practices to minimize or eliminate sediments or pollutants from reaching surface waters and require contractors to obtain required permits before disturbing soils.

Locate projects and new buildings outside the 500-year flood plain. Buildings that are required to be within the 500-year flood plain to meet their intended use must be constructed to be resilient to anticipated flood events.

3.8 ADDITIONAL SITE PARAMETERS

Design the building and site to accommodate building function with minimum disturbance of topography, soils, and vegetation.

Include appropriate areas for deliveries, service vehicles, trash and recycling collection. Maintain adequate vehicular turning radiuses.

Design to provide effective and efficient snow removal. Provide adequate storage areas to pile snow removed from roads, parking, and sidewalks.

3.9 UTILITIES

Confirm reliability, capacity, pressure and volume of utilities including telecommunications are adequate to serve the project; for campus systems confirm that loads are adequately balanced. Include cost associated with utility improvements and distribution networks in the cost of the Work. When upgrading campus networks or coordinating with utility companies include owners anticipated future development in the area in the conversation. When evaluating service reliability, ensure appropriate systems are in place to manage the interruptions in service. Communicate all information to and coordinate all work with the Design Team.

3.10 LANDSCAPE

3.10.1 LANDSCAPE INTERFACE

Careful coordination between the landscape and building design is crucial to effective design and to connect the experience of exterior environments with building interiors.

Include native plants, xeriscape, and dry-scaping. Promote biodiversity to reduce dependence on irrigation, reduce the need for fertilizers and pesticides, and to create interest.

Avoid invasive plant and noxious weed species as listed by the Montana Department of Agriculture and the Montana Center for Invasive Species Management.

Select locations for trees and shrubs that anticipate long term root growth to limit future impacts to building foundations, sidewalks, drive ways, and other elements of the built environment.

3.10.2 IRRIGATION

Provide adequate buffer and design landscape irrigation systems that do not spray into streets and storm gutters or onto the building, primary sidewalks, or entries during their normal operation. Consider that NO IRRIGATION is the best approach.

Disperse collected rainwater to vegetated areas where effective and where soil types allow.

SECTION 4: GENERAL ARCHITECTURE

4.1 SPACE PLANNING CRITERIA

Facility size shall be based on a functional analysis of activities to be accommodated and shall include all functional, technical, and economic considerations, and projected growth. See Appendix A Consultant Services Pre-design, Design, and Post-Design, A-2.2 Project Programming.

4.2 DESIGN FOR RESILIENCE

"Resiliency" means the capacity to adapt to changing conditions and to maintain functionality and vitality in the face of stress or disturbance.

"Resilient design" means the intentional design of buildings, landscapes, communities, in response to programmatic changes, security responses, utility disruptions, extreme weather and natural disasters, and other potential events.

Discuss and confirm with the owner's vulnerabilities, the relative critical nature of the operation of the facility, need for continuity of service and necessary building performance during and after such an event. Integrate design strategies including resistive design, diverse and redundant systems, passive design, and manual controls so the desired operation can function as necessary and secondary damage is mitigated. Refer to concepts suggested by the Resilient Design Institute (see Appendix C)

4.3 DESIGN FOR PRODUCTIVITY

The long-term cost benefits of a properly designed, user-friendly work environment should be factored into any initial cost considerations.

Review and confirm the National Institute for Building Science's recommendation for integrating technologies, assuring reliable systems, designing for changing workplaces, promoting health and well-being providing environmental comfort and supported by other pertinent strategies from the International WELL Building Institute. (see appendix D)

4.4 BUILDING ORIENTATION

Position building site location in compliance with the Agency's master plan for mission and operation. Establish building layout and orientation to optimize site opportunities regarding functional arrangement, access, exterior appearance, views, and other considerations.

Building shape, orientation, and design shall utilize the site's seasonal environmental factors to minimize annual facility energy use and to optimize daylighting. Coordinate building and glazing orientation, architectural shading addressing seasonal solar angles, and prevailing winds to enhance energy performance of the building within the site-specific microclimate.

4.5 ACCESSIBILITY REQUIREMENTS

Comply with the most recent versions of the Accessibility Regulations in force in the location of the project and applicable to the project. Indicate and specify dimensions that recognize field conditions and allow Work to fully comply with the appropriate regulation. The Design Team should strive to exceed the minimum requirements wherever readily achievable.

Comply with Local Building Codes, Montana State Standards, and Federal Standards. When more than one code or standard is applicable to the project, comply with the most stringent access requirement.

For interpretations on access issues and elements, consult the local Building Code Official when IBC accessibility is the issue. Consult Rocky Mountain ADA Center, Colorado Springs, CO, U.S. Access Board, and the Department of Justice for interpretations related to Federal Standards.

Forward all interpretations and exceptions received from access advisory sources to the A&E Project Manager and record all approved exceptions on the Construction Documents in the Building Code/Life Safety Analysis.

4.6 ARCHITECTURAL STYLE AND CHARACTER

Consider and complement the surrounding architectural context, character of architecturally and historically significant facilities consistent with individual agencies, and campus design guidelines. Include constructability, durability, maintainability, and sustainability in consideration of architectural compatibility.

4.7 HISTORIC ARCHITECTURE AND THE STATE ANTIQUITIES ACT

Under the State Antiquities Act, repair or renovation of historic facilities or new construction near historic facilities are reviewed by the State Historic Preservation Office (SHPO). Historic refers to any property 50 or more years of age.

SHPO will provide input regarding compliance with guidelines regarding preservation and rehabilitation. Consultation with SHPO must begin early in design and continue as the design evolves.

4.8 HAZARDOUS MATERIAL AND SAFETY

Comply with 29 CFR Occupational Safety and Health Act (OSHA) in all facilities. Manage asbestos in existing structures in compliance with Department of Environmental Quality (DEQ) asbestos control regulations. Identification of lead and its management during construction is the contractor’s responsibility per 29 CFR 1926.62. Investigate for and manage other hazardous materials as appropriate.

Building systems and components are not allowed to contain asbestos, chlorofluorocarbons (CFC), hydro chlorofluorocarbons (HCFC), Polychlorinated biphenyl (PCB), mercury, or arsenic.

Avoid use of materials and substances that negatively impact health and safety of occupants and the environment.

4.9 RADON

Design all enclosed and occupied buildings to minimize introduction of radon gases. The Environmental Protection Agency (EPA) map of Radon Zones predicts less than 4 pCi/L potential in Yellowstone, Wheatland, Sweet Grass, Golden Valley, Petroleum, and Treasure counties. New construction and renovation projects located in these counties that demonstrate with detailed testing that the building does not present an exposure greater than the EPA limit shall be exempt from this requirement.

Provide passive or active sub-slab depressurization systems where required. Refer to the following EPA documents available from the EPA Radon Information Center, 703 356-5346, and online at http://www.radon.com/

4.10 MOLD

Select materials, manage water including water vapor and condensation, and provide air movement to reduce the likelihood of mold growth. During construction, plan for moisture intrusion prevention and remove wet products subject to mold development. Refer to http://www.wbdg.org/resources/indoor-air-quality-and-mold-prevention-building-envelope for a detailed discussion of moisture management.

4.11 ACOUSTICS

Design to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate to:

- Quantify sound isolation from one space to another.
- Quantify ambient noise levels and management within spaces including HVAC and equipment noise.
- Optimize use of unamplified communication where appropriate but comply with ADA where assistive listening is required.
- Limit transmission of mechanical, reverberation, discharge air, other noise sources.
- Design fans to operate at lower ends of fan curves.
- Mitigate impact of noise generated by building systems on occupied areas in the proximity and comply with local noise ordinances.
- Coordinate acoustical performance with mechanical systems.

See “Suggested Design Values” STC ratings in UFC 3-450-01 guidelines to determine STC ratings of different wall, floor and ceiling assemblies. See UFC 3-450-01, “Noise and Vibration Control” for the acoustical attenuation of the mechanical systems.

Use the services of an acoustic engineer for projects requiring higher levels of acoustical performance that is critical to the function of the space, such as theaters and auditoria.

4.12 STRUCTURAL

Follow geotechnical investigation recommendations for soil bearing capacity, stability, and any other unique characteristics to calculate forces and design vertical and lateral systems to be resilient to anticipated loads over the anticipated life of the building. Design buildings critical to the operation of State government or that serve as refuge in a disaster situation to be able to continue operation after reasonably anticipated emergency/disaster events.

Establish an effective uniform structural grid and size structural components with respect to the loads imposed. Avoid long spans when supporting upper floor loads. Identify situations with low vibration and/or deflection tolerance and locate those functions in areas that are structurally stable. Consider constructability, deconstruction, and cost effectiveness in detailing and sizing members.

4.13 MECHANICAL, ELECTRICAL, and TELE/DATA ROOMS

Design to provide adequate area for mechanical/equipment rooms, electrical rooms, and tele/data rooms. Allow an adequate volume of space for all building distribution systems and provide clear access for regular service and maintenance. Plan for and provide access for removal and replacement of major system components.

Coordinate mechanical equipment room sizing with the mechanical designer and agency maintenance personnel at the earliest appropriate stage of design to ensure inclusion of the required clearances for maintenance, servicing, and safety. Coordinate with the electrical designer and agency IT managers for tele/data room requirements.

Locate mechanical, electrical, and tele/data rooms to minimize long runs of ductwork, electrical wiring, piping, and data cabling.

SECTION 5: SPECIFIC ARCHITECTURAL REQUIREMENTS

5.1 ABOVE-GRADE FINISHED FLOOR ELEVATION

Set finished ground floor elevations with respect to the finished grades. The finished floor shall be placed no less than 8 inches above the finished grade for slab-on-grade construction. The Project Manager shall determine the minimum required height above finished grade required for light frame construction based upon the project type. The finished grade is defined as the final grade elevation adjacent to the exterior, including any planting beds.

5.2 PAINT

Base paint selection on the Master Painters Institute (MPI) Detailed Performance Standards. Back roll or brush field-applied sprayed paint unless not required by the specific application.

Priming is not required for interior structural steel unless it is exposed to moisture or scheduled to be painted.

5.3 CONCRETE

Comply with ASTM International (ASTM) C94 for the design of concrete and American Concrete Institute (ACI) 318 for placement and finishing of concrete. Specify strength, air content, and characteristics of installed work appropriate for a durable installation. Finish exposed surfaces with consideration to safety (slip hazard), durability, and aesthetics.

- Place concrete in as favorable conditions and weather as practical. Concrete installer and supplier shall coordinate to provide mix design that meets specifications and is also appropriate for the conditions at time of placement.
- Do not add air-entraining to concrete that is to be trowel finished.
- Provide a normal weight, moisture cured concrete mix for floor slabs-on-grade or over steel decks with non-permeable floor finishes with a water/cement ratio of 0.4 to 0.45; use a high range water-reducing admixture as necessary.
- Provide a mix design appropriate to the application and sealed to resist absorption of the chemicals at all exterior concrete subject to deicers.
- Space control joints to minimize uncontrolled cracking and avoid oblique sections of concrete that tend to crack and fail.

5.4 MASONRY

Comply with the Brick Industry Association (BIA) Technote 7, Technote 18A, and Technote 21 for specific brick masonry recommendations and other topic-specific technotes as applicable. Coordinate with Rocky Mountain Masonry Institute for technical questions. Use masonry units that are durable and appropriate to the application. Consider large-hole units as they are lighter, use less material, and require less energy to fire.

- Follow BIA Tech Note 18A recommendations for movement joints in brick.
- Follow the National Concrete Masonry Association (CMA) Tek Note 10-2C for movement joints in concrete block. Indicate and detail expansion joints on the construction document drawings.
- Prevent water from accumulating on and entering the top of masonry surfaces including ledges and sills. Provide ample slope and drip edge so water runs off quickly and to minimize water running

down the face of walls. Install thru-wall flashing under caps and sills to prevent moisture intrusion into supporting wall construction.

- Design cavity wall construction to maintain a clear air space from the face of the cavity insulation or sheathing material to the back of the exterior masonry wythe. Design through wall flashing and corrugated plastic head joint weeps at all disruptions of the vertical cavity drainage plane per recommendations of BIA Tech Note 7. Provide masonry vents at top of walls and below continuous shelf angles to promote ventilation.
- Select masonry ties appropriate for the distance from masonry to backup wall structure. See ACI 530 and BIA Technote 21 for additional information.

5.5 EXTERIOR INSULATION AND FINISH SYSTEMS / EXTERIOR FINISH SYSTEMS

Select Exterior Insulation and Finish Systems (EIFS) on maintenance requirements and frequency of recoating. Generally, avoid EIFS when possible due to durability concerns. In severe wind areas, select systems appropriate to the wind exposure. Consider self-cleaning EIFS finish coatings and coatings resistant to fading to reduce maintenance costs.

Use self-draining EIFS systems unless the application does not present a concern for moisture. Do not install Exterior Finish Systems (EFS) or EIFS within 8 inches of grade, or in areas where it will be subject to abuse by moving vehicles, equipment, or mowers. Specify high-impact resistant systems to a minimum of 4 feet above grade and where surfaces may be subject to damage.

Provide specific design details for windows, trim, expansion joints, and drainage planes in EIFS applications in the drawings and specifications.

5.6 ROOFS

Roofs constitute one of the key elements in preserving the integrity of the building and protecting its contents. Maintaining the effectiveness of the water integrity of the roof is critical to avoid disruption of the Agency’s operation, maintain air quality, and prevent damage.

- Design roof systems that move water from the surface to a discharge point and avoid ponding. Design low-slope roofs to slope to flow water to drains efficiently but at least a minimum of 1/4 inch per foot of roof slope to drains. Where required for positive drainage, provide crickets sloped a minimum of twice the slope of the roof.
- Provide crickets at elements that interrupt water flow, such as roof mounted equipment curbs, to direct water around the obstruction.
- For new construction, build primary slope into the roof deck where possible to reduce the need for tapered insulation systems.
- Provide recesses beveled into the insulation at primary drains for proper drainage.
- Design perimeter walls and internal equipment curbs to allow for future re-roofs and additional insulation without modification.
- Design flashings per the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) and as approved by the roof manufacturer. Detail flashings to be watertight without use of caulking wherever feasible.
- Minimize roof-mounted equipment and consolidate locations where feasible. Locate roof access within a reasonable distance of equipment requiring service. Provide walk pads to equipment. Locate equipment away from edge of roof and provide fall protection where required.

- Select roofing and flashing systems that allow for annual inspection, expedient detection of leaks and deterioration, and facilitate required repairs.
- Provide internal roof access to buildings over one story in height.
- In areas identified by the Montana Disaster and Emergency Services (DES) Hazard Mitigation Plan as prone to high winds, hail, or ice storm, select systems resilient to and able to withstand such events.
- Where external gutters are provided, slope and design to minimize accumulation of debris and clogging. Discharge downspouts away from building and walkways, and in consideration of soils reports. Discharge to drywell or storm sewer where available. Consider opportunities for landscape irrigation.
- Install asphalt shingles over ventilated cold attics or well-ventilated cold roofs. Design to avoid ice dam situations. Confirm ventilation is unobstructed and at no point less than code requirements for attic ventilation.

5.7 GYPSUM BOARD CONSTRUCTION

Provide glass mat gypsum (paperless or non-cellulose facing) sheathing for exterior applications, and glass mat gypsum wall board for the interior of exterior walls (see Section 4-9, MOLD). Use cementitious wall board as a tile base for wet and high-moisture areas such as showers and commercial kitchen spaces.

Conform to gypsum board construction details from the Gypsum Construction Handbook, USG Corporation, latest edition, and the Gypsum Construction Guide, National Gypsum Company, latest edition.

5.8 REGIONAL MATERIALS

Utilize regional materials wherever possible. Evaluate the use of regional material usage early in the project when setting goals and establishing the design program. Also, see Section 2-7 Promote Use of Montana Wood Products.

SECTION 6: BUILDING ENVELOPE REQUIREMENTS

6.1 INTRODUCTION

Design the building envelope to control the transfer of heat, air, moisture, light/radiation, and noise. Design each control strategy holistically using an integrated approach to ensure the continuity of air, thermal, vapor, and water barriers. Illustrate the continuity of barriers throughout the building envelope in all design details of the building enclosure.

6.2 FENESTRATION

6.2.1 WINDOWS AND GLAZING

Optimize the window-to-wall ratio to reduce solar radiation energy when using daylighting strategies and controls. Address glare, energy consumption, and comfort issues associated with large window areas.

- Select optimal glazing performance based on Low-E films, appropriate U-factor, Solar Heat Gain Coefficient (SHGC), Visible Transmittance (VT), and Light-to-Solar Gain (LSG) for the glazing. Optimize the emissivity coatings to control both heat gain into the building due to solar radiation and heat loss from the building due to re-radiation, conduction, and convection.
- Use thermally efficient jamb, sash, and tube framing systems.

6.2.2 DOORS

Select exterior doors and frames that reduce conduction of heat energy and control air leakage with appropriate weather-stripping, thresholds, and hardware. Use thermally broken frames.

Coordinate doors with campus keying, building security monitoring and access systems, and anticipate future system changes.

Provide vestibule entrances for high traffic areas.

Coordinate final fenestration design with the mechanical and electrical consultants to comply with overall facility energy requirements and building program goals.

6.3 THERMAL BRIDGING

Design to eliminate all thermal bridges. Be aware of geometric thermal bridging that occurs where the external heat loss area is greater than the corresponding internal area of the thermal envelope. Many geometric thermal bridges are unavoidable; more complex designs have more geometric thermal bridges. Examples of geometric thermal bridging are:

- External wall corners.
- Wall/eave junction.
- Ground floor to external wall junction.
- Around window and door openings and around louvers.

Eliminate construction thermal bridges, i.e., physical materials, gaps, or components that pass through the thermal insulation and conduct heat at a higher rate than the insulation. Carefully design to eliminate or minimize construction thermal bridges. Examples of construction thermal bridges are:

- Roof and floor elements that pass through the thermal envelope to support eaves, balconies, or façade elements.
- Structure within the insulation zone, studs, columns, beams, joists, etc.
- Cantilevered structure passing through the thermal envelope.
- Lintels and shelf angles.
- Brick ties.
- Conductive thru-wall flashings.
- Gaps between insulation boards.
- Steel fasteners and support elements.

Coordinate detailing of all penetrations, attachments, and thru-wall piping and conduits with the structural, mechanical, electrical, and tele-data consultants to comply with overall facility energy use goals.

6.4 INSULATION

Protect all insulation during its service life from weather including rain, ultraviolet solar radiation, mechanical abuse, compression, or accidental or deliberate movement from its location. Coordinate assembly U-Factors with the mechanical consultant to comply with overall facility energy use goals.

6.4.1 CONTINUOUS INSULATION

Integrate appropriate continuous insulation to minimize thermal bridging. Locate the insulation toward the outside (cold) face of the building framing and structural elements. Adjust R-value of continuous insulation where thermal performance is diminished to optimize overall envelope performance. When using continuous insulation in steel stud framed buildings, consider not placing insulation in the stud cavities.

6.4.2 BATT INSULATION

When using manufactured joists and rafters provide full width insulation to ensure that the joist width is totally filled.

6.5 MOISTURE CONTROL BARRIERS - GENERAL

Wrap buildings on all six sides with a moisture control barrier to restrict the movement of water and water vapor from and within the building envelope. Seal all moisture control barrier penetrations.

Establish the specific functions of each type of membrane and its water vapor permeance value or water resistance. Determine each membrane's position relative to the other materials in the envelope assembly to ensure that its properties are correctly selected and a "moisture balance" (more drying than increase in moisture content) will occur in the building assemblies. Provide dew point analyses to identify dew point occurrence based on materials making up the wall or roof assembly based on anticipated interior conditions and exterior climate zone.

6.5.1 WATER-RESISTIVE BARRIERS

Design wall assemblies that incorporate a Water-Resistive Barrier (WRB) on the backup wall beneath the cladding with flashings to direct water out of the assembly. Provide WRB for all claddings, including EIFS.

Provide through-wall flashings under all copings and sills. Provide pan flashing installed in the sill of rough openings for windows, louvers, and other similar conditions in exterior wall assemblies.

Direct moisture out of wall cavities through weep holes. Include continuous flashing at the bottom of the wall cavity and wherever the cavity is interrupted by elements such as shelf angles, lintels, and penetrations.

6.5.2 BUILDING ENVELOPE VAPOR RETARDERS

Follow vapor retarder requirements listed in the International Building Code (IBC) or the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook of Fundamentals.

- Design floor slabs-on-grade to receive non-permeable floor finishes with a vapor retarder rated at 0.05 perms or less, meeting the requirements of ASTM E 1745, Class A with no exception.
- Specify durable slab vapor retarders to withstand construction activity and that terminate around the slab perimeter with all penetrations detailed according to the manufacturer's instructions.
- Design roof assemblies over concrete slabs with a vapor retarder on top of the concrete to control construction moisture released from the concrete curing process.
- Provide vapor retarders under low slope roofing assemblies on roof decks, regardless of construction type where indicated by dew point analysis.

6.5.3 WATERPROOFING

Use waterproofing membranes to protect the interior of the building from water intrusion where hydrostatic pressure due to a high-water table below grade is present or when paving, landscaping, or a vegetated roof present a moisture intrusion potential.

Counteract below-grade transfer of water through walls by damp-proofing or waterproofing on walls, depending on hydrostatic pressure and drainage capacity. Incorporate drainage planes in combination with waterproofing, footing drains, and under slab drainage, based on the recommendations of the geotechnical engineering report.

6.6 AIR BARRIER REQUIREMENTS

6.6.1 NEW CONSTRUCTION

Design and construct the building enclosure with a continuous air barrier to control air leakage in accordance with the requirements of The American National Standards (ANS) Standard 189.1 or ASTM E741. Confirm by testing that the air leakage rate does not exceed 0.25 cfm/ft2 (1.25 L/s-m2).

Specify a durable air barrier that will remain intact and functional for the anticipated service life of the assembly.

Trace a continuous plane of airtightness throughout the building envelope. Seal all air barrier penetrations. Seal and make airtight unavoidable penetrations such as electrical and plumbing fixture boxes.

Enhance air barrier performance by:

- Providing vestibules at high traffic building entrances.
- Compartmentalizing spaces under negative pressure such as boiler rooms and laundry rooms. Provide make-up air for combustion.

- Provide low-leakage dampers and control to close all ventilation or makeup air intakes and exhausts, atrium smoke exhausts and intakes, etc., when leakage can occur during inactive periods. Vents for battery charging rooms are an exception.

Clearly identify all air barrier components of each envelope assembly in the construction documents. Detail the joints, interconnections, and penetrations in the air barrier components in the construction drawings. Include detailed inspection and testing requirements and acceptance criteria in the project specifications.

6.6.2 RENOVATIONS

Establishing an effective air barrier for an existing building may not be practical. When a building is to undergo a major envelope renovation, conduct an infiltration test to identify air leaks. Specify that all identified leaks that can be effectively accessed be sealed using sprayed foam or sealant.

SECTION 7: MECHANICAL AND ELECTRICAL SYSTEMS

7.1 DESIGN CRITERIA

General Parameters Compliance with the latest versions of ASHRAE Standard 90.1 and ASHRAE Standard 62 is required for the elements of the project (architectural, mechanical, and electrical). 17-7-213 MCA requires high-performance buildings to exceed the International Energy Code by 20 percent or to the extent that it is cost effective over the life of the building.

Use ASHRAE Standards to calculate building heating and cooling loads giving special attention to sizing and operating equipment for efficient part-load operation as well as full-load operation. Serve isolated full-year cooling loads, such as server rooms, with stand-alone cooling equipment. Base outdoor air design criteria on weather data tabulated in the latest edition of the ASHRAE Handbook of Fundamentals and on the elevation of the specific site.

Air Intake and Exhaust Place and locate outside air intakes considering the following criteria:

- Comply with the security requirements of the building.
- Design outside air openings to be inaccessible from the ground level.
- Optimize separation distances between ventilation air intakes, exhaust vents, building and site features utilizing ASHRAE standards.
- Design to eliminate outside air pollutants from loading docks, parking lots, and other sources of pollution from entering the building through the outside air intakes.
- Design exhaust systems and outlets to comply with local municipal acoustic code requirements and campus standards.

Indoor Design Criteria / Indoor Design Temperatures Use ASHRAE Standard 55 to specify the combinations of indoor thermal environmental factors and personal factors that will produce thermal environmental conditions acceptable to a majority of the occupants within the space. Incorporate indoor design temperature requirements for year-round conditions, zoning, and system control specific to the type of occupancy in the Basis of Design.

7.2 COMMISSIONING

Commissioning is required of all new buildings and major renovations. The Project Manager will determine what level of commissioning is appropriate for the project and will work with the commissioning agent(s) to identify all specific HVAC, electrical, and/or envelope systems to be commissioned. Use ASHRAE Standard 202 to define the commissioning process and deliverables for each project.

7.3 ENERGY ANALYSIS

Conceptual Energy Analysis: Provide conceptual-level energy analysis/study during programming/schematic design considering building square footage/volume, envelope, and orientation to assist the Design Team's decision-making process.

Conceptual Design Modeling: The use of Energy Modelling Software (EMS) is encouraged to evaluate building siting and building envelope criteria in order to meet building energy use goals established in Owner's Project Requirements (OPR). Develop the Energy Model collaboratively with the project team to optimize Site Location, Building Geometry, Building Envelope R Values, Daylighting, and Solar (Passive and Active). Utilize

ASHRAE 90.1 to develop a baseline HVAC System that will be used to evaluate Building Criteria during preliminary design.

Fuel Types: Connect the building to local utilities for electricity and natural gas, if available. Connect buildings located on campuses to the campus utility systems for electricity, natural gas and/or steam and condensate. Evaluate ground coupled heat pump systems in the conceptual energy analysis, along with other solid fuel options including biomass systems and propane systems to determine the optimal heating plant for the building. Look for viable opportunities for installation of a wood fuel and energy system; and, when it is determined to be viable, coordinate with Montana DNRC Wood Biomass Energy Program to evaluate the economic and technical feasibility of installing a wood energy application.

HVAC System Selection Modeling: Use Energy Modeling Software (EMS) to determine baseline energy use according to ASHRAE 90.1, HVAC System, unless the Project Manager determines that is not appropriate for the project. Use EMS to evaluate alternative HVAC Systems and selected HVAC System for project based on Total Cost of Ownership (TCO) and Life Cycle Cost Analysis (Net Present Value). Use ASHRAE 90.1 to develop the Energy Model and System Performance Requirements.

Design Integration and Optimization: Use the Energy Model to document Energy Conservation Measures (ECMs) based on the selected HVAC system and envelope system to meet the 20 percent below IECC. Produce a Final Energy Analysis Report, including a summary of baseline and alternates, selected HVAC Systems, ECM evaluation, documentation of performance achieving 20 percent below current IECC, and economic feasibility.

7.4 HVAC SYSTEM AND EQUIPMENT SELECTION

Use ASHRAE Handbook Systems and Equipment to optimize and select the HVAC system to be designed and installed in the building. Prioritize HVAC criteria associated with the Basis of Design and define System Constraints and Construction Constraints as outlined by ASHRAE HVAC Systems and Selection. Generate a selection report outlining the Selection Matrix with the recommended HVAC Equipment or System for the project.

7.5 ARRANGEMENT OF MECHANICAL SPACES

Minimum Space Requirements Provide Mechanical Rooms in the building for all primary mechanical equipment, unless waived by the Project Manager. Penthouse mechanical rooms and roof-mounted mechanical equipment will be accessible via permanent stairs and elevators, unless waived by the Project Manager. Cooling towers, air-cooled chillers, evaporative condensers, and exhaust fans may be permitted on the exterior of the building, if approved by the Project Manager. Provide adequate doorways or areaways and staging areas for mechanical rooms to permit the replacement and removal of equipment without the need to demolish walls or relocate other equipment. Provide housekeeping pads that are at least 6 inches wider on all sides than the equipment they support and are 6 inches thick.

Service Access Provide space around all HVAC and hydronic system equipment as recommended by the equipment manufacturer for routine maintenance and component replacement. Provide access doors or panels in all HVAC equipment, ductwork, and plenums as required for maintenance, inspection, and cleaning.

7.6 HVAC SYSTEMS AND COMPONENTS

Air-Handling Units (AHUs): Size AHUs using ASHRAE Guidelines to meet the heating and cooling loads of the space they are serving. Give particular attention to the design of ventilation systems that operate efficiently all year using Variable Air Volume Systems with Variable Frequency Drives. Prepare psychrometric analyses (include chart diagrams) for each AHU application, characterizing full and part load operating conditions.

Provide AHU/coil designs that ensure conditioned space temperatures and humidity levels are within an acceptable range, per programmed requirements, and comply with ASHRAE Standards 55 and 62.

Supply, Return, and Relief/Exhaust Air Fans should be selected on the basis of required horsepower as well as sound power level ratings at full and part load conditions. Size fan motors so they do not run at overload anywhere on their operating curve. Check fan operating characteristics for the entire range of flow conditions, particularly for forward curved fans. Design fan motors and Variable Frequency Drives to operate within their service factor and at a maximum of 60 Hertz. Size fans for future growth in the building to the extent feasible.

Exhaust Fans will be sized to meet current exhaust loads. Design Exhaust Fan Systems to meet current code requirements for acoustic noise levels and to minimize acoustic noise and vibration in the building. Size fans for future growth in the building to the extent feasible.

Filter Sections: Provide air filtration in every air handling system. Provide filter media rated in accordance with ASHRAE Standards 52. Fabricate filter media so that fibrous shedding does not exceed levels prescribed by ASHRAE 52. Select Filters by utilizing the MERV Rating System to select the optimal filter to meet the needs of the building. The filter change-out pressure drop, not the initial clean filter rating, must be used in determining fan pressure requirements. Place differential pressure gauges and sensors across each filter bank to allow quick and accurate assessment of filter dust loading as reflected by air pressure loss through the filter and connect sensors to building automation system.

Terminals: VAV terminals shall be pressure-independent type units. Provide all terminals with factory-mounted direct digital controls compatible and suitable for operation with the building automation system.

Air Delivery Devices: Terminal ceiling diffusers or booted-plenum slots should be specifically designed for VAV air distribution. Booted plenum slots should not exceed 4 feet in length unless more than one source of supply is provided. Minimize “Dumping” action at reduced air volume and sound power levels at maximum cfm delivery. For VAV systems, the diffuser spacing selection should not be based on the maximum or design air volumes but rather on the air volume range where the system is expected to operate most of the time.

7.7 TEMPERATURE CONTROL SYSTEMS

A computer-based building automation system (BAS) that monitors and automatically controls heating, ventilating, and air conditioning is critical to the efficient operation of buildings. Consider integration of a BAS when it is cost effective for the building type and complexity of the systems.

A BAS is not required for every project. Prior to considering including a BAS, evaluate building type, number of pieces of equipment, expectation for monitoring energy use, availability of trained staff, and location of building.

Temperature Controls: Specify Direct Digital Controls in all buildings where feasible and appropriate for the building type and complexity of the system. Supply all controllers with uninterruptible power supplies for storing programming to be maintained during power outages.

Temperature Control Strategies: Night set-back controls must be provided for all conditioned and other appropriate spaces. Utilize ASHRAE Applications: Supervisory Control Strategies and Optimization to develop optimal control sequence to maintain user comfort while reducing energy use in the building.

Variable Frequency Drives (VFDs): All VFDs will be supplied by the temperature control supplier (unless provided with the equipment by the manufacturer) and will communicate with any building automation system.

7.8 METERS

Include metering of all primary and all sub-systems in all projects. Meters will be used for benchmarking and monitoring the energy use after project completion.

7.9 MECHANICAL INSULATION

All ductwork, equipment, and piping will be insulated in accordance with the current version of ASHRAE Standard 90.1. Provide insulation on all cold surface mechanical systems, such as ductwork and piping, where condensation potentially could form. Insulation, that is subject to damage or reduction in thermal resistivity if wetted, shall be enclosed with a water/vapor seal (such as a water/vapor barrier jacket). All pumps and valves shall have removable and reusable insulation jacketing.

7.10 ELECTRICAL ENGINEERING

Power Systems Design: Design Power Systems to meet the National Electrical Code (NEC) and the National Fire Protection Association, NFPA 70.

- Locate Transformers outside the building. Provide pad mounted, fully enclosed, and dead-front installation. Coordinate location with the Architect, Project Manager, and electric utility.
- Include Arc Flash Labeling Requirements according to NFPA 70e at Main and Distribution Panels.
- Size Panels to allow for future growth and changes in use of the building.
- Run all Electrical Wiring in conduit to comply with NFPA 70 requirements.

Fire Alarm Systems: Provide fully addressable Fire Alarm Panels and systems interconnected to the Campus Front-End Fire Alarm Panel if available. The Fire Alarm System will comply with NFPA 72.

Emergency Power Requirements: Design Emergency Power Systems to meet NFPA 110. Backup fuel Type will be determined based on fuel availability and reliability at the building site according to NFPA 110. Specify start-up by a factory certified representative.

Low Voltage Systems: Design Voice and Data Design systems to meet the current needs of the building.

- If the owner installs the voice and data system, provide conduit where necessary for the wire to be pulled.

Lighting Systems Design:

- Utilize modeling software to design and analyze Lighting Systems and to optimize lighting levels to meet the Current Illumination Electrical Society (IES) Standard, ASHRAE 90.1, and requirements of the local, state, and federal, and currently adopted edition of the Building Codes.
- Evaluate and Utilize Daylighting controls if technically feasible.
- Optimize lighting systems for energy conservation, minimize light migration, control flexibility, and maintainability.
- Design exterior lighting to meet IES Standards Lighting for Exterior Environments. Adopt lighting criteria that provides safe lighting levels while avoiding off-site lighting and night sky pollution.

APPENDIX A - CONSULTANT SERVICES, PRE-DESIGN, DESIGN, AND POST-DESIGN

A1 PRE-DESIGN SERVICES

This process involves meeting with the users to review the requirements for a new project and to prepare the initial information/programming document. A&E normally completes this process in collaboration with the client Agency personnel. On larger or more complex projects, an Architect/Engineer may be contracted for Project Programming services to study functional adjacencies, lead the planning process, and provide sketches and other design-related support. Often, a charrette-like process may be used to define the users' requirements.

A2 DESIGN SERVICES

A2.1 COMMITTEES

Some campuses have review committees. The Design Team shall provide adequate documentation for their review including site studies, plans, elevations, and material selection to provide the committee a clear understanding of the design intent. Present the project as required by the campus.

A2.2 PROJECT PROGRAMMING

The Architectural Program or Basis of Design (BOD) is a written document based on the project statement issued by the A&E Division and is developed by the Design Team and the client Agency through an integrated design process that describes the project at the preliminary design stage and is updated at each subsequent stage.

Project success is a function of the quality of the problem definition, communication, participation of all parties involved in the project, and of the critical planning that precedes and defines the solution or design. Success for building design projects therefore begins with a comprehensive program.

The Architectural Program/BOD serves to clarify the project goals identified by the client Agency, to provide a rational basis for design decision making, to ensure that the project reflects the client’s values, to discover additional project goals, and to validate the project goals.

A comprehensive Architectural Program/BOD considers and includes analysis of Regional, Local, Site, and Building conditions, issues, and requirements.

Provide a program that addresses both Qualitative and Quantitative Project Programming issues.

<u>Qualitative Programming</u> consists of written statements defining how elements of the design should perform in terms of Objectives or Performance Requirements (PR). Provide objective and PR discussions that indicate specific ways that a project goal can or might be met related to the quality of the experience, space, system, material, etc.

<u>Quantitative Programming</u> is more specific and measurable than written qualitative statements and refers directly to the physical characteristics of the building or site design including size, shape, physical characteristics, relationships of various spaces, particular furnishings, equipment, materials, and finishes and other pertinent characteristics.

At a minimum the following items should be addressed in both the Qualitative and Quantitative Analysis of the Project:

- Scope of Work - State and summarize the architectural program or scope of work, listing the overall square footage, the function of the facility, and a tabulation of rooms with square footages of each space.
- Type of Construction - Describe the type of construction selected and justify its use relative to building permanency, life cycle cost, functionality, and fire resistance.
- Code Analysis - Provide an analysis of the design relative to pertinent codes to include, as a minimum, the required number of exits, travel distances, egress capacity of exits, and fire area separations.
- Gross Floor Area Calculations - Provide complete area breakdown tabulation for gross and net areas to confirm scope.
- Accessibility - Describe accessibility features included in the project and indicate how the design meets the requirements in ADAS.
- Architectural Compatibility - Identify the design guidelines that pertain to this project and describe how the proposed design incorporates these guidelines.
- Roof System Selection - Indicate the construction of the roof, roof membrane selection, substrate, roof slope, and roof drainage system.
- Thermal Envelope - Describe the types of insulation to be provided and indicate specific "U" values for the wall, roof, and floor construction. Provide a moisture vapor analysis.
- Mechanical – Describe temperature and humidity ranges for each space, or type of space, and its associated controls. Coordinate with building envelope and occupancy.
- Electrical systems - Indicate light levels including variable light levels, switching, and daylight-governed controls. Coordinate with building envelope and occupancy. Coordinate user IT requirements.
- Sustainable Design - Describe the sustainable design features included in the design. Provide an analysis of compliance with the Montana High-Performance Building Standards, Green Globes Rating System, and the U.S. Green Building Council's (USGBC) "Leadership in Energy and Environmental Design" (LEED) Rating System criteria as it applies to the design of the project. Include updated information with each required design submittal.
- Security Requirements - Describe any physical security or hardening requirements, such as controlled access, or notification/management of threats.
- Architectural Acoustics – Include a statement of adherence to the applicable criteria. See OBR section 4-10.
- Demolition or Deconstruction – Describe the extent of any architectural demolition or deconstruction and the items to be salvaged.

A3 CONSTRUCTION DOCUMENTS

A3.1 BOILERPLATE

The Design Team shall coordinate with the Project Manager and client Agency contact(s) in order to complete the boilerplate and advertising request forms. A&E will then prepare the boilerplate and transmit it to the Design Team. The Team must confirm that their Division 1 documents coordinate with the boilerplate and may not change information without written approval of the A&E design Project Manager.

A3.2 SPECIFICATIONS

Design-Bid-Build and other alternate delivery projects have differing specification requirements. In any case, the specifications must be as concise as possible, definitive, and free of ambiguity and omissions that may result in controversy and contractor claims for additional compensation.

The Design Team will develop the Division 1 requirements unless provided by the Owner or Using Agency.

Provide requirements for submittals, LEED required or otherwise, in the specifications in all cases.

A3.3 ARCHITECTURAL DRAWINGS

Drawings must be clear, concise, accurate, and properly noted. They must be coordinated with themselves, the various disciplines, and the specifications. Drawing sheets must be well laid out, consistent and effectively use the space on each sheet. Details need to be thoughtfully and consistently laid out and sized only as necessary to be readable and convey their information. The Architect shall internally review documents or conduct an appropriate third-party review and correct issues before submitting documents for Owner review. Refer to the A&E website link http://architecture.mt.gov/forms/architectengineer.

Confirm drawing size and format requirements with the A&E design Project Manager prior to starting drawings.

- Draw all plans at the same scale, with the same orientation and same sheet location.
- Avoid vague notes such as “see mechanical or structural”; refer to specific locations.
- Verify for accuracy and complete references to the details and sections.
- Show wall sections and details at relative elevations to each other.
- Provide information appropriate to the level of detail.
- Use appropriate line weights and fonts.

Final construction drawings must include, as applicable, but not be limited to the following:

- Title and General Sheets: List all drawings in the set, project name, agency, city, A&E project number, location and vicinity maps.
- Floor Plans: Completely dimension and reference other drawings. Provide square footage calculations for all spaces. Indicate plan orientation. Draw building plans parallel to the sheet border, generally with north upward on the page. All disciplines’ drawings must be consistent in orientation. The site plan and the building plan shall be in approximately the same orientation.
- Building Code/Life Safety Code Analysis: Provide a diagrammatic analysis and indicate code compliance (remoteness of exits, common path of travel, compartmentalization, fire extinguisher locations, etc.) to graphically demonstrate compliance with the Life Safety Code. Coordinate with the fire protection engineer as required.
- Roof Plans: Completely dimension and reference to other details.
- Reflected Ceiling Plans: Fully coordinate with and show coordination of all disciplines.
- Building Elevations: Indicate location of control joints and expansion joints. Fully coordinate with all disciplines; show vents, fixtures, louvers, meters, and units.

- Building Sections and Wall Sections: For all different conditions, identify air barrier, moisture control barriers, and insulation barrier systems.
- Wall Types: Indicate all wall types on the floor plan.
- Air Barrier: Indicate the boundary limits of the air barrier components (pressurization area for air barrier testing) on the plan and section. Indicate the actual area of the pressure boundary (ft.2/m2).
- Interior Elevations: Indicate all different conditions and coordinate with other drawings.
- Door Schedule and Details and Window Types and Details.
- Room Finish Schedule and Finish Notes: Complete for all finishes, interior and exterior.
- Details: Complete for all different conditions, especially the moisture barrier system, flashing details for all wall penetrations, terminations and transitions, and roof ridge, edge, parapet, drainage, and penetration details.

A3.3.1 DIMENSIONING

Provide dimensions on floor plans in enough detail to avoid construction coordination difficulties and so that the contractor can layout the work without multiple computations or referring to other drawings. Provide vertical dimensions on elevations and sections. Minimum required dimensioning guidelines are:

Exterior Dimensions

- Provide overall building dimensions.
- Provide continuous strings of dimensions of column centerlines that extend to exterior building faces.
- Provide a continuous string of dimensions that locate all exterior building wall line breaks. Wall line breaks must also be dimensioned to column centerlines.
- Provide dimensions that show masonry and wall openings. Provide through-wall dimensions.
- Provide vertical dimensions for elevations and sections.

Interior Dimensions

- Dimensions shall be indicative of design intent (e.g. if a door is to be centered on a space, indicate dimensions as “equal-equal”).
- Indicate all statutory dimensions, such as accessibility requirements, egress, etc.
- Provide continuous strings of dimensions through the building in each direction that extend through the exterior wall.
- Dimension masonry walls and stud partitions to one side of the wall. Wall thickness may be indicated with dimensions or by wall types.
- When a dimension string passes through a space that is shown elsewhere at a larger scale, this space may be provided with an overall dimension. The large-scale plan must show additional dimensions. To ensure continuity, take dimensions from the same wall face as shown on the overall plan.
- Where a wall or partition aligns with a column, wall opening, window jamb, or other feature, ensure that all other dimensions to that wall or partition are to the same face. Additionally, if a dimension is to a particular wall or partition face, then all other dimensions to that wall must be to that face.

A3.3.2 CALCULATION OF GROSS BUILDING AREA

Calculate the gross area of a building using the following:

- Enclosed spaces: The gross area includes the total area of all floors, including mezzanines, basements, penthouses, and other enclosed spaces as measured from the exterior faces of the exterior walls or from the centerline of walls separating joined buildings.
- One-Half Spaces: Include one-half of the gross area of paved or finished covered but not enclosed areas.
- Excluded space: attic and crawlspaces areas with ceiling height of less than 7 feet to underside of structure, catwalks, mechanical platforms, and uncovered exterior spaces.

APPENDIX B - REFERENCES

Note: Use the latest adopted version for all references listed below.

B1 ARCHITECTURE & ENGINEERING DIVISION

The A&E web site provides information about the division, consultant selection procedures, contracting requirements, forms used in contracting and project management, Owners Basic Requirements (OBR) and High-Performance Building Standards (HPBS).

B2 WHOLE BUILDING DESIGN GUIDE

The National Institute of Building Sciences Whole Building Design Guide (WBDG) provides additional information and discussion on architectural practice and facility design, including a holistic approach to integrated design of facilities.

B3 TOTAL COST OF OWNERSHIP (TCO) - LIFE-CYCLE COST ANALYSIS (LCCA)

APPA: Leadership in Educational Facilities (APPA) and American National Standards (ANS) Standard APPA 1000-1 Total Cost of Ownership (TCO) for buildings and facilities.

ASHRAE Standard 90.1 Equipment Final Rule Technical Support Document Chapter 6, Life-Cycle Cost and Payback Period Analysis provides processes to evaluate system and component LCCA.

Department of Energy, Energy Efficiency and Renewable Energy (EERE), describes tools for comparing energy system alternatives and evaluating specific conservation measures in performing energy conservation calculations.

B4 UNIFIED FACILITIES CRITERIA

Unified Facilities Criteria (UFC) documents provide planning, design, construction, sustainment, restoration, and modernization criteria, and apply to the Military Departments, the Defense Agencies, and the DoD Field Activities.

B5 ADDITIONAL REFERENCES

- ADA Standards for State and Local Government Facilities Title II, Latest Version.
- 29 CFR 1910, Occupational Safety and Health Standards, Occupational Safety & Health Administration.
- ACI 530, Building Code Requirements for Masonry Structures, American Concrete Institute (ACI) International.
- Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractors' National Association.
- ANS/ASHRAE/IESNA Standard 90.1, Energy Standards for Buildings Except Low Rise Residential, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- ANS/ASHRAE/USGBC/IEC 189.1, Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings.
- Archives of the Center for Invasive Species Management, Montana State University.
- Asbestos Control Program, Department of Environmental Quality (DEQ).
- ASHRAE Standard 160, Criteria for Moisture-Control Design Analysis in Buildings.
- ASTM E779, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
- ASTM E1186, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

- ASTM E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- ASTM E1827, Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door.
- ASTM Manual 40, Moisture Analysis and Condensation Control in Building Envelopes.
- BIA Technical Note 7 Water Resistance of Brick Masonry- Design and Detailing, Brick Industry Association.
- BIA Technical Note 18A, Accommodating Expansion of Brickwork, Brick Industry Association.
- BIA Technical Note 21, Brick Masonry Cavity Walls, Aug 1998, Brick Industry Association.
- Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method Using the Building's Air Handling Systems, CAN/CGSB-149.15-96.
- EIFS Standards & ICC-ES Acceptance Criteria, EIFS Industry Members Association.
- EPA Radon Information Center.
- EPA/402/R-92-014, Radon Measurement in Schools, U.S. Environmental Protection Agency.
- EPA/625/R-92-016, Radon Prevention in the Design and Construction of Schools and Other Large Buildings, U.S. Environmental Protection Agency.
- Executive Order No. 12-2014 Promoting Use of Montana Wood Products.
- Facility Performance Evaluation (FPE) Guide Document for Public Facilities, WBDG.
- General Service Administration, Facility Services Standards for Public Buildings, Mechanical Engineering.
- Gypsum Construction Guide, National Gypsum Company.
- International Building Code, International Code Council.
- Montana Building Codes Bureau, Department of Labor & Industry.
- Montana Multi-Hazard Mitigation Plan and Statewide Hazard Assessment, Disaster and Emergency Services.
- Montana Noxious Weed Program, Department of Agriculture.
- Montana Public Works Standard Specifications, Montana Contractors Association.
- Montana State Historic Preservation Office, Historic Architecture.
- Montana Water Resources Division, Flood Plain Management, Department of Natural Resources.
- Montana Department of Natural Resources & Conservation (DNRC) Forest Products – Wood Energy - Biomass Program.
- MPI Detailed Performance Standards, Master Painters Institute.
- MPI Architectural Painting Specification Manual, Master Painters Institute.
- Recommendations of the Greater Yellowstone Coordinating Committee – Terrestrial Invasive Species Subcommittee for adopting a proactive approach to noxious weed control.
- Resilient Design Institute
- Rocky Mountain ADA Center.
- Rocky Mountain Masonry Institute.
- Secretary of Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings, National Park Service.
- The Difference Between a Vapor Barrier and an Air Barrier, R.L. Quirouette, National Research Council of Canada, Ottawa, Ontario, Canada
- U.S. Green Building Council
- Wood Biomass Energy Program, Montana Department of Natural Resources and Conservation.

- reThink WOOD. Information and resources on wood performance, cost and sustainability.
- WELL Building Standard, International Well Building Institute
- WoodWorks, Resources, education and technical support for the design and construction of non-residential wood buildings.

APPENDIX C - RESILIENT DESIGN

Extracted and modified from the Resilient Design Institute.

C1 RESILIENT DESIGN PRINCIPLES

1. Resilience transcends scales. Strategies apply to individual buildings, communities, and larger regional and ecosystem scales; and, they are applied over immediate and long-term time frames.
2. Resilient systems provide for basic human needs. These Include potable water, sanitation, energy, livable conditions (temperature and humidity), lighting, safe air, occupant health, and equitable distribution.
3. Diverse and redundant systems are inherently more resilient. Redundant electrical, water, and transportation systems improve resilience, but sometimes conflict with efficiency and high-performance building priorities.
4. Simple, passive, and flexible systems are more resilient. Passive or manual-override systems are more resilient than complex solutions that can break down and require on-going maintenance. Flexible design solutions can adapt to changing conditions in the short and long term.
5. Durability strengthens resilience. Strategies that increase durability in building maintenance and operation, building design, infrastructure, and ecosystems enhance resilience.
6. Locally available, renewable, or reclaimed resources are more resilient. Reliance on local resources such as solar energy, annually replenished groundwater, and local building materials, provides greater resilience than resources obtained from hundreds of miles away.
7. Resilience anticipates interruptions and a dynamic future. Adapting to higher temperatures, more intense storms, flooding, drought, and wildfire is a growing necessity. Natural disasters, earthquakes and solar flares, and man-made actions like terrorism and cyberterrorism, also require resilient design strategies.
8. Find and promote resilience in nature. Strategies that protect the natural environment enhance resilience.
9. Resilience is not absolute. Total resilience in all situations is not possible. Implementation requires a short-term and long-term approach to achieve greater resilience.

C2 ACHIEVING RESILIENCE AT THE BUILDING SCALE

- Design and construct (or renovate) buildings to handle severe storms, flooding, wildfire, and other impacts that are expected to result from a warming climate.
- Locate critical systems where they will withstand flooding and extreme weather events.
- Model design solutions based on future climatic conditions. Do not rely solely on past data.
- Create buildings that will maintain livable conditions during extended disruption of power or heating fuel by reducing energy loads and relying on passive heating and cooling strategies (passive survivability).
- Adopt flexible design strategies that facilitate future change, alteration, or expansion to accommodate evolving functional requirements with minimum expenditure of resources. Design flexible buildings and systems that allow adaptation to future uses, unless the buildings have highly specialized functions or where adaptive reuse is unrealistic.
- Design durable buildings with features like rainscreen details, windows to withstand high winds, and interior finish materials that dry out if wet and do not require replacement.
- Create buildings that are easy to maintain.

- Reduce dependence on complex building controls and systems. Provide manual overrides in case of malfunction or temporary power outages.
- Optimize the use of on-site renewable energy.
- Carry out water conservation practices and rely on annually replenished water resources, including harvested rainwater, as the primary or back-up water supply.
- Provide redundant water supplies or water storage for use during emergencies. Provide stand-alone solar electricity or hand pumping options for deep-well pumps where possible. Where no option for on-site water is available, consider gravity-fed water storage.
- Consider optional human waste disposal (composting toilets and waterless urinals) in the event of non-operational municipal wastewater system.
- Use locally available products and skill-sets. Rely more heavily on regionally manufactured goods.
- Specify products and materials that do not off-gas or leach hazardous substances in a flooding or fire event.
- Adopt successful vernacular design strategies prevalent before the advent of air conditioning and central heating. Combine these design strategies with modern materials to optimize the strategy.
- Provide redundant electric systems with back-up power capacity, such as a fuel-fired electric generator with adequate fuel storage or a solar-electric system with islanding capability.
- Provide alternative or human-powered transportation options to access critical services.
- Design vegetated roofs and rainwater bioswales to reduce the urban heat island effect and manage stormwater.
- Design and build physical infrastructures, such as culverts, storm sewers, roadways, and bridges, to handle increased stormwater flows.
- Rely on natural, biological erosion-control solutions that will grow stronger over time.
- Adopt design strategies that recognize and value ecosystems services and protect or restore the capacity of those services, including water filtration, natural erosion-control along streams and rivers, and healthy forests that purify and replenish air.
- Maintain and protect aquifers. Prohibit withdrawals that exceed annual recharge rates and protect against contamination.

APPENDIX D - DESIGN FOR PRODUCTIVITY

D1 DESIGN FOR PRODUCTIVITY

An increasing number of studies suggest that support for communication and collaboration as well as for individual cognitive activity are fundamental aspects of organizational productivity.

Effective and efficient use of space means creating the right environment for concentration, learning, communication, and collaboration—the building blocks of productivity for building occupants. Organizational effectiveness today means using space more wisely. This does not just mean cutting costs. It means designing for flexibility to enable space to change as work groups, activities, and projects evolve.

The National Institute for Building Science identifies five fundamental principles of productive building designs summarized here as:

- Promote Health and Well-Being as Indoor environments strongly affect human health.
- Provide Comfortable Environments to provide the highest achievable levels of visual, acoustic, ergonomic, and thermal comforts.
- Design for the Changing Workplace by providing spaces with flexibility, social support, and technology.
- Effectively Integrate Technological Tools and distribution starts with properly designed pathways and spaces.
- Assure Reliable Systems and sufficient functional space,

These recommendations need to be considered together with other design objectives and within a total project context in order to achieve quality, high-performance buildings. Also, workplace productivity strategies support sustainable design principles, functional programming and functionality, and should be taken on balance for the longevity of all the issues considered.

The WELL Building Standard seeks to implement, validate and measure features that support and advance human health and wellness. It was developed by integrating scientific and medical research and literature on environmental health, behavioral factors, health outcomes and demographic risk factors that affect health with leading practices in building design, construction and management. Categories include air, water, nourishment, light, fitness, comfort and mind.