

SECTION 00 20 00

EXTERIOR BUILDING ENVELOPE

PART 0 - PURPOSE

- A. Describe broad guidelines for design of schools.
- B. Establish materials qualities and applications.
- C. Describe materials and conditions which do not easily fit into specific specification sections.
- D. See specific sections of Design of Construction Standards for additional requirements.

PART 1 - EXTERIOR FINISH MATERIALS

- A. Walls:
 - 1. Durability - Hard, durable, low maintenance materials such as brick, pre-cast concrete, etc.
 - 2. Maintenance - Cleanable materials - removal of graffiti may be necessary.
 - 3. Texture - Avoid any high relief texture or projecting elements which would assist in the climbing of building walls.
 - 4. Height - Exterior walls 14' height (min.)
 - 5. Parapet Caps:
 - a. Sheet metal sloped to interior of roof. (preferred assembly), or;
 - b. Pre-cast or stone caps sloped to interior of roof w/ sealant joints (DPS approval required).
 - c. Do NOT use masonry wash caps or unit masonry caps.
 - 6. Below Grade Protection:
 - a. Membrane Waterproofing shall be applied to all below grade walls enclosing an occupied space. A/E to select appropriate system dependent on site conditions.
 - b. Multiple Systems - where both dampproofing and waterproofing are specified, clearly indicate the extent of each.
 - c. Membrane Waterproofing must be protected prior to backfill. Apply manufacturer's recommended protection board.
 - d. Dampproofing shall be applied to all foundation walls, grade beams etc. where utility trenches or crawl spaces are adjacent.

PART 2 - DOORS:

- A. Exterior doors shall be painted hollow metal (steel).
- B. See section 08 80 00 for glazing materials.

PART 3 - BUILDING ENTRIES

- A. Lighting - Provide Security Lighting
- B. Durability - Provide break-resistant materials
- C. Below Grade Entries - Avoid exterior stairs to below grade entries. Exterior stairs to below grade entrances shall be enclosed with doors at grade level.

- D. Avoid steps at all public building entries. Utilize ramps where possible.
- E. Recessed Entries should be provided at major building entries to provide wind shelter. Construct entries for wall stops on doors.

PART 4 - ROOFING SYSTEMS

- A. Roofing systems preferred by DPS, in order of preference:
 - 1. Built-up
 - 2. Fully adhered EPDM
- B. Fully detail the roofing system. Details shall be custom designed to address the specific conditions present on the building, including corners, changes in direction and differences in adjacent roof elevations. Manufacturer's standard details shall not be assumed to be adequate for the needs of DPS. Although details need to be acceptable to the manufacturer, details may be different than the manufacturer's standard details.
- C. Where included in the scope of services, the A/E shall provide daily construction observation reports to DPS.
- D. Equipment support systems
 - 1. Rooftop equipment shall be mounted to curbs that are flashed in to the roof system. Roof curbs shall be specified in appropriate specification sections.
 - 2. Rooftop conduits shall be fastened to sheet metal triangle stands. Stands shall be mechanically fastened to 2'x2'x2" concrete pavers. Pavers shall be set on modified rolled roofing pads. One stand for every ten foot (10') of conduit and no more than one paver per stand. Supports shall not penetrate the roof membrane.
 - 3. Gas lines and electrical conduit over 2" shall be fastened to Unistrut stands. Stands shall be mechanically fastened to 2'x2'x2" concrete paver. Pavers shall be set on modified rolled roofing pads. One stand for every ten foot (10') of gas line and no more than one paver per stand. See photo at end of section.
 - 4. A/E shall coordinate minimum heights and clearances with applicable codes.
 - 5. All condensing lines, supply lines and electrical lines need to be run through separate cone jacks, or a dog house. No pitch pans. See photos at end of section.
- E. At base-flashing details where the roof deck/roof framing is not supported by the higher wall, a wall expansion joint detail shall be used. This shall be achieved using a wood curb of continuous elevation, with 8" minimum height above high point of adjacent insulation elevation, including any crickets/saddles that intersect the perimeter in question. Wall expansion joint detail shall be sealed using a single-ply membrane drape and sheet metal cover, as directed in Section 07 60 00.
- F. Exhaust all other options prior to approving or designing a pitch pan.
- G. A/E shall lay out all roof penetrations and shall provide clear documentation of the acceptable minimum separation between penetrations, considering flashing requirements.
- H. Permanent walkway pads are required around the perimeters of major rooftop mechanical equipment (exhaust fans excepted) and at roof access points.

PART 5 - ROOF AND WALL SPECIALTIES AND ACCESSORIES

- A. Specify all roof accessories required for the completion of the project.
- B. Roof curbs are specified elsewhere.
- C. Fully coordinate roof scuttle hatch layouts, locations, and details, including the relationships between ladders and scuttle hatches.

PART 6 - ROOF ACCESSORIES

- A. Indicate sizes and locations of roof curbs in the contract documents.

- B. Each curb shall be fabricated such that base plate follows slope of roof deck and top surface of metal construction provides a level top surface for nailer and subsequent mounting of mechanical equipment. Coordinate equipment orientation with roof slope direction to ensure proper fabrication.
- C. Design roof framing to be continuous below the perimeter of each opening.
- D. Field or custom fabricated wood roof curbs are acceptable if designed and detailed by the A/E.
- E. Roof curbs shall have a minimum height of 12" above finished roof surface.
- F. No penetrations allowed through the top of metal curb caps. All condensating units, exhaust units shall be anchored to Uni-Strut, the Uni-Strut to be fastened to the sides of curb.
- G. Coordinate fire protection for roof curbs with building code requirements. Curbs commonly requiring fire protection include those at kitchen exhaust hoods and roof scuttle hatches.

PART 7 - FLASHING AND SHEET METAL

- A. Design sheet metal to shed water.
- B. Sheet metal coping caps shall be used at the top of parapet walls and masonry walls.
 - 1. Caps shall be sloped to the roof interior. Provide adequate pitch and edge detail to prevent drainage onto exterior face of building.
 - 2. Provide continuous clip at exposed face.
 - 3. Provide 45-degree hemmed drip edge at bottom of exposed face.
 - 4. Provide continuous solid support under copings.
- C. Reglets and counterflashing
 - 1. At masonry parapets, cast reglet into masonry joint and use cotton weep ropes and weep tubes to facilitate removal of moisture from wall cavity.
 - 2. At surfaces other than masonry, two-piece, surface mounted reglet and counterflashing shall be used to terminate completed base flashings, termination bars (EPDM system), and 3-course treatments (BUR system).
 - 3. Wherever possible, maintain constant reglet elevation at entire roof perimeter (avoid stepping reglet).
 - 4. Reglet elevation shall consider minimum flashing height required at high point of any insulation elevation, including any crickets/saddles that intersect the perimeter details.
- D. Edge metal shall have raised (gravel stop-style) edge to prevent water from draining onto exterior face of building.
 - 1. Provide continuous clip at exposed face.
 - 2. Provide 45-degree hemmed drip edge at bottom of exposed face.
- E. Expansion joints shall be detailed using metal covers. Use of bellows-style covers is not approved, unless absolutely necessary. If used, bellows-style covers shall be installed only after watertight, continuous; single-ply membrane drapes are installed over the joints.
- F. Pre-manufactured fascia systems
 - 1. Pre-manufactured fascia systems are not recommended for use with built-up roof systems.
 - 2. Specify pre-manufactured fascia system at single-ply roof system.
 - 3. Verify the required face height and specify the model number accordingly.
 - 4. The pre-manufactured fascia system shall be supplied by the membrane manufacturer, and shall be included under the total system warranty.
- G. Joint type at each roof related sheet metal component shall be indicated in the detail drawings.

- H. Specify galvanized or stainless steel for all components that require field soldering or welding. Pre-finished steel cannot be specified where a solder or weld joint is required. Examples include pitch pans, pipe jacks, and scupper inserts.
- I. For most situations, specify pre-finished steel for components where soldering or welding of joints is not required, including counterflashings, copings, edge metal, fascia extensions, expansion joint covers, control joint covers, etc. Galvanized steel shall be used for associated concealed cleats.
- J. Gutters and downspouts are not recommended but may be used when necessary.
 1. Minimum one downspout per 50 lineal feet of gutter, or oversize gutter by 25% for every additional 10 lineal feet of downspout separation.
 2. Provide overflow at header.
 3. Open front downspout style is preferred. Space braces far enough apart to prevent inadvertent creation of a ladder.
 4. Design, detail, locate, and install to discourage vandalism and unauthorized roof access.
 5. Surface discharge onto sidewalks or pavement is prohibited.
- K. Prohibited materials: Plastic, PVC, lead, zinc, and “weathering” type materials.

PART 8 - ROOF AND DECK INSULATION

- A. Report selected insulation types and systems at Design Development Phase. Roof insulation thicknesses affect design of adjacent building components (i.e. through-wall flashings, window sills, door thresholds, wall penetrations, rooftop equipment/piping, etc.). It is the intent of DPS to prevent the need to redesign major adjacent components due to roof insulation thicknesses not being accommodated.
- B. All roof decks shall be numbered “001”, “002”, etc. Each distinct roof shall have a unique number. For existing roof decks, use deck numbers previously established by DPS.
- C. Conduct sufficient research to specify insulation by thickness. Insulation shall not be specified by R-Value. This will ensure all bidders are basing their pricing on the same information, and eliminates the potential for interpretation-based arguments. The minimum insulating value of the roofing assembly shall be R-38.
- D. Roof slope
 1. Roof design shall provide 1/4” per foot roof surface slope for all roofing systems.
 2. Coordinate roof framing to create slope by use of the roof framing system where possible.
 3. Minimize the use of tapered insulation to provide field slope. Use tapered insulation to provide crickets/saddles and drain sumps.
 4. Saddles and crickets shall be of same material as the base insulation materials.
 5. Crickets/saddles shall be designed to provide 1/4” per foot minimum slope on the finished roof surface.
 6. Provide crickets at the upslope side of all rectangular penetrations greater than 2’-0” in width.
- E. Roof drainage
 1. Locate roof drains in sunny roof areas wherever possible.
 2. Roof drains shall discharge into the storm sewer wherever possible. If surface drainage is necessary, consult with Denver Wastewater Management.
 3. Overflow drainage provisions shall be incorporated such that no more than the code-required maximum limit of ponding is possible on any portion of the roof before the overflow drainage system begins to prevent additional ponding. A/E shall engineer the entire overflow capacity in accordance with governing building codes.

4. Overflow drainage may be provided either by overflow scuppers or by separate drainage system, designed to meet building code requirements.
 5. Ponding water requirements by Denver Wastewater Management may necessitate greater water depths prior to overflow drainage mechanisms becoming operational. These requirements would also require an increase in the roof structure's load carrying capacity. Avoid ponding of water on roof unless it is unavoidable. Utilize site ponding where practical if retention of water is required. No roof ponding of water for retention purposes shall be permitted without the prior written approval of DPS.
 6. Sump pans shall not be used for roof drains. Drain bowl rim and underdeck clamp shall bear directly on the roof deck. A neat, round opening of the minimum size needed shall be cut in the steel deck at each roof drain location. Circular openings in roof deck shall be supported by the roof structure.
 7. Primary drain and overflow drain shall both be located within a common rectangular flat area (4' x 4' square recommended), with tapered insulation on all four sides to provide a smooth transition to the primary roof insulation system. Tapered insulation within drain areas shall be factory fabricated, not field cut. Slope on sides of transition shall not exceed 1" per foot. Minimum insulation thickness at drain rim shall be 1". Ponding is not allowed adjacent to drains.
 8. Overflow drain clamping ring shall be set level with roof surface elevation, in same 4' x 4' flat area as primary roof drain. In no case shall overflow drains be sumped below the surrounding roof elevation unless the primary roof drain is contained within the same sump area.
 9. Top of overflow standpipe shall be no more than the code-required elevation above roof level and no less than 2" above roof level. Top of overflow standpipe elevation shall be measured from roof elevation at top of drain sump, not flat area within bottom of drain sump.
 10. Overflow drainage may be provided at roof edges where roof slopes and layout permit. Gravel stop edges or perimeter parapets less than 4" in height, located along the perimeter of lowest roof elevation, may be used to provide all or part of the necessary overflow drainage provision. Provide adequate detailing to assure that roof edge overflows operate only under overflow conditions.
 11. Where upper roofs drain onto lower roofs, provide splash blocks on a pad.
- F. Use multiple layers of insulation as opposed to a single layer. Joints between layers shall be staggered.
 - G. Under-deck roof insulation is not recommended. If use is allowed for a specific project-related requirement, the A/E shall design the roofing system to prevent condensation.
 - H. Determine whether current building code requires gypsum board within the roof insulation assembly.
 - I. Specify demolition, removal and disposal requirements where re-roofing is required.

PART 9 - MASONRY AND MORTAR

- A. Mortar:
 1. In general, specify the weakest mortar that will meet project requirements.
- B. Masonry Grout:
 1. High-lift grouting (over 4'-0" per lift) shall not be designed without cleanouts at the bottom of each grouting lift. Temporary cleanouts must not be visible in finished construction. Cleanouts not required for self-consolidating grout.
- C. Cold and Hot Weather Requirements:
 1. Specify cold and hot weather requirements.
- D. Inspections by others do not relieve the A/E of contract requirements.
- E. Avoid grouted masonry where exterior face brick forms one or more sides of the grouted surface.

- F. Bullnose
 - 1. Avoid bullnoses at door jambs where resilient base is to be applied. (return to jamb is too small to maintain base adhesion). Frames or other trim should extend 1/2" beyond face of masonry so base can abut.
- G. All masonry exposed on the interior of the building shall have a dense, smooth surface which is easily cleanable and is resistant to marring.
 - 1. Wire cut, ribbed, or otherwise heavily textured or uneven brick or concrete masonry shall not be used in interior applications.
 - 2. Interior concrete masonry units exposed and unpainted in the finished construction shall be dense, smooth, ground face units.
- H. Structural glazed tile masonry units may be used under special circumstances and in limited applications and review with DPS.
- I. Glass unit masonry, thin brick veneer, and surface bonded masonry are prohibited.

PART 10 - CONCRETE

- A. Provide chamfers at top of foundation and at all outside corners of exposed formed concrete surfaces, including structural and architectural concrete.
- B. Formwork shall be tight at joints and corners to prevent leakage.
- C. Form oil is prohibited where stucco, plaster or paint is to be applied to formed concrete surfaces.
- D. Inspection by Owner's Testing Agency does not relieve A/E of contract responsibilities.
 - 1. Observe concrete pours.
 - 2. Observe formwork and reinforcing prior to concrete placement.
- E. Coordinate design of exterior flatwork, walks and paving with other Division 32 standards.
- F. Use of pigmented and stained concrete is prohibited.
- G. Special floor slab design requirements
 - 1. Provide a membrane vapor barrier below the slab to prevent the migration of moisture up through the slab.
 - 2. Design sloping requirements to floor drains and provide indications on the drawings showing the complete thickness of the slabs in these areas.
 - 3. Refer to standard Section 03 35 00 for coordination of floor slab curing requirements with manufacturer's requirements for all flooring materials
- H. Specify concrete finishes for all interior concrete whether covered with finish flooring or left exposed.
- I. Compound shall be resistant to de-icing chemicals.
- J. Specify a finished clear sealer for all interior slabs that are to remain exposed in the finished work (Exception: Mechanical chases).
- K. Scarification shall be accomplished by sandblasting or shotblasting of slab prior to installation of flooring.
- L. Exposed aggregate and other heavy/rough exposed finishes are prohibited.
- M. Use of pigmented sealers and concrete stains is prohibited.
- N. Use of non-dissipating curing and sealing compound is prohibited.
- O. Acid washing is prohibited unless fully extracted.

PART 11 - GROUT

- A. Provide chamfers at top of foundation and at all outside corners of exposed formed concrete surfaces, including structural and architectural concrete.
- B. Coordinate grout strength with project requirements.
- C. Coordinate the manufacturer's recommended practices with the method of application, especially dry pack method.

PART 12 - DAMPPROOFING AND WATERPROOFING

- A. Use waterproofing or dampproofing for basements, elevator pit.
- B. Use dampproofing for foundations.
- C. Exterior applications shall receive protection board (or insulation) prior to back-fill in all cases.
- D. Water repellents are prohibited on masonry surfaces. Other uses of water repellents must be approved by DPS.
- E. Coordinate project specific requirements for both dampproofing and waterproofing with Getotechnical Data as available.

PART 13 - BRICK

- A. Brick is the preferred material for exterior walls. Review other exterior cladding options.
- B. "Modular" size (7-5/8" x 3-5/8" x 2-1/4") brick is preferred.
- C. Matching of existing brick, delivery time, and future availability often determine brick specification criteria.
- D. Exposed brick is strongly discouraged for exterior horizontal applications with upward exposure such as copings, caps, rowlocks, sills, and reveals.

PART 14 - CONCRETE UNIT MASONRY

- A. Concrete unit masonry shall not be used on the building exterior.

PART 15 - METAL WINDOWS

- A. Window sizes should be limited in both width and height so that operable sashes do not become too heavy for the hardware.
- B. Windowsills should be at least 32" above the finished floors, unless approved by DPS.
- C. Tinted or special reflective glazing is not permitted unless approved by DPS.
- D. Provide Hard Coat Low E glazing unless otherwise approved by DPS.
- E. Window Characteristics:
 - 1. IBC 2015 and IECC 2015, triple glazed, energy compliant windows.
 - a) U Factor = .38 maximum for fixed windows.
 - b) U Factor = .45 maximum for operable windows.
 - c) SHGC = .40 maximum.
 - 2. All windows shall be aluminum frame windows with internal storm sash and internal blinds. Max 48" width on glazing and integral blinds.
 - 3. Window finishes to be anodized clear unless approved by DPS.
 - 4. Color finishes (if approved) shall be 50 percent Kynar.

F. Window Types:

1. Classrooms in air-conditioned schools shall have one operable window (or partially operable) per unit. All other windows shall be fixed.
2. Classrooms in non-air-conditioned schools and additions shall have sufficient operable windows to provide for warm weather ventilation of the room. Maintain minimum of 90 percent of original operable configuration for replacement windows.
3. In-swinging hopper windows are preferred for operable sections. Out-swinging vent windows may be used where the projected window does not present a hazard to people walking outside the building. All projected-type vent windows shall have 9" limit stops incorporated.
4. Single-hung or double-hung windows shall have openings limited to 9" in height. Preferred window operation for replacement double hung windows is a sash-balanced operation where the lower sash is counterbalanced by the upper sash through a pulley and cable system. When the lower sash is raised, the upper sash shall lower. The sash-balanced system cannot be used when the upper and lower sash sizes do not match.
5. Casement windows are to be avoided, except in historic buildings and when approved by DPS.
6. All vent windows are required to have an ANSI/AAMA 101-97 minimum AW-70 rating. All single-hung and double-hung windows shall have a minimum AW-50 rating.

G. Storefront and Curtain Wall Installations:

1. Storefront and aluminum-framed curtain wall installations shall be reviewed with DPS early in the Project. The use of these systems shall be limited to special areas of the building where the use of hollow metal frames is not appropriate.
2. No exterior doors are to be hung in aluminum storefront or curtain wall installations. Where aluminum framing is approved for the Project and the framing is adjacent to door constructions, the design of the area shall provide for masonry construction to separate the hollow metal door framing and the aluminum framing.

H. Windows will not be equipped with screens except as required hereafter:

1. Provide window bug screens at all operable sashes in:
 - a) Cafeterias
 - b) Kitchens
 - c) Home economics areas

I. The A/E shall review installation details so that surrounding construction does not limit access to operators.

J. Avoid operable sashes that weight more than 60 pounds.

K. Retrofit of historic windows will require individual considerations, and A/E shall coordinate with DPS for window appearance, operation, and hardware.

L. Retrofit Historic Casement/Projected windows shall be AW-70 minimum rating and shall be able to accommodate both historic exterior trapezoid applied muntins as well as internal blinds.

M. Casting Cover system (Historic Panning and Trim) which replicate historic exterior brick mould and interior trim shall be used for installing retrofit windows. Panning and Trim shall be extruded aluminum, minimum 0.125" wall for panning at head and jambs and 0.125" wall minimum at sill for durability, using 0.062" wall minimum for interior trim. "Break Metal" shall not be acceptable method of installation and waterproofing.

PART 16 - WOOD WINDOW RESTORATION

- A. Due to the extent of detail provided in this standard, the A/E may choose to edit this standard and incorporate portions of this standard in the construction documents. To obtain an electronic copy of this standard in Microsoft Word format, contact DPS.

- B. Historic windows shall be designed to maintain the appearance and profile of the original windows. Matching window operations is required for non-airconditioned school.
- C. Air conditioned schools shall have at least one operating window per classroom. Profiles and operation must match existing.
- D. Historic refers to buildings that have been designated by the Denver Landmark Commission as Landmark Buildings.
- E. Buildings that have been designated as “eligible” for landmark designation must be coordinated with City and County of Denver Landmark Commission and are subject to the same guidelines as those buildings that are already designated. The Landmark Commission does not have authority to enforce regulations on buildings which are “eligible” but are not “landmarked”. Consult with DPS for the listing of “landmarked” and “eligible” buildings and for guidance in the approach to restoration of windows in these buildings.
- F. Historic windows in ‘landmarked’ and ‘eligible’ buildings are subject to approvals by the City and County of Denver, the Landmark Commission and the Preservation Architect.
- G. Non-historic wood window restoration shall follow the same general methods and procedures as that of historic window, but need not gain approvals other than from DPS.
- H. Tinted or special reflective glazing may only be used in non-historic windows if specifically approved by DPS.
- I. Use existing glass as much as possible.
- J. Do not use thicker glass for replacement than what is being removed without the written approval of DPS. If for some reason thicker glass is needed, the opening that the glass is installed in shall have both pieces of wood reworked to accommodate the new glass so that all adjustments are not made on one piece of wood. Window weights shall be adjusted..
- K. A complete evaluation survey of the existing conditions of each wood window shall be made to determine the extent of repairs necessary. The evaluation survey may be in the form of a schedule and shall note at a minimum:
 - 1. Window Location
 - 2. Condition of the Paint
 - 3. Condition of the Frame and Sill
 - 4. Condition of the Interior and Exterior trim
 - 5. Condition of the Sash (Including Rails, Stiles, and Muntins)
 - 6. Glazing Problems
 - 7. Window Hardware and Operating System
 - 8. The Overall Condition of the Window
 - 9. Exterior caulking problems. Water entering around the edges of the frame and/or sash or the window
- L. Hazardous materials may be present in existing windows. A/E to coordinate with DPS for method of identification and removal.
- M. An existing window of each type or scope as defined by DPS shall serve as an example/control sample of the quality of repairs to be provided, shall be paid for by DPS, and shall be prepared for inspection and approval by DPS, the Architect, and in Historic Buildings- Approval Agencies.
- N. Epoxy consolidants shall be used only where the existing material is substantial and where deterioration can be completely removed. Replacement of members should be considered wherever the member or any portion of the profile is more than 25% deteriorated.

O. SD, DD, CD Requirements

1. Architect shall provide the following to DPS prior to incorporation into Construction Documents:
 - a) Name of Window Restoration Companies, staff experience, capacity, and number of years in business.
 - b) Product Data and Methods to be Utilized.
 - c) Locations of each window(s) to be repaired.

END OF SECTION 00 20 00