

CHAPTER 9. BUILDING ENVELOPE

PERFORMANCE OBJECTIVES

- 9-1. GENERAL. The building envelope (consisting of walls, roofs, accessory construction, windows, finishes and attachments) of residential and nondwelling buildings shall be consistent with the MPS and provide for:
- a. Protection of interior building components and materials from the entrance of excessive water, moisture, dust and air;
  - b. Health and safety for tenants;
  - c. Strength and stability to carry and withstand anticipated loads;
  - d. Fire resistance;
  - e. Prevention of corrosion, decay and infestation by the use of materials appropriate for local climatic conditions;
  - f. Anchorage to building structure as required;
  - g. Reasonable durability against abuse; and
  - f. Energy efficiency.

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CHAPTER 9. BUILDING ENVELOPE

SECTION 1: MANDATORY STANDARDS

- 9-2. GENERAL.
- a. Construction and installation of materials during rehabilitation shall be accomplished in a manner that does not promote galvanic action. Dissimilar metals shall not make contact without protection to prevent deterioration. All ferrous (iron or steel) pipes shall be protected. Architectural features, such as cornices, railings and shutters, shall be present as designed, in sound condition and anchored.
  - b. Wood elements used on the building exterior, including siding or trim, shall be constructed of naturally resistant species, such as redwood or cedar, or treated for weather and moisture resistance. For technical requirements, see paragraph 10-6.
  - c. Use of brittle or otherwise easily damaged exterior materials shall be restricted to 7 ft. or more above grade where large numbers of children are anticipated or where the probability of damage due to abuse is expected.
- 9-3. EXTERIOR WALLS. Exterior walls shall support imposed live and dead loads and shall be pointed as necessary, and weatherproofed to prevent the entrance of water and moisture.

Openings and projections through exterior walls shall be watertight and flashed where required.

a. Vents, air conditioning sleeves and other openings shall be close fitting and properly caulked or otherwise sealed to prevent excessive air infiltration. Walls shall be free of evidence of buckling, deflection, splitting or settlement. Joint material including caulking and sealants shall function as designed, and shall not have shrunk, dried or pulled away from adjacent members. Exterior walls shall be retrofitted with energy conservation opportunities that are cost-effective, such as:

- o Wall insulation to optimal level;
- o Passive solar retrofit; or
- o Other.

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b. Exterior joints between walls, foundation, roofs, around window and door frames, between wall panels, penetrations through the wall and all other such openings in the building envelope shall be caulked, gasketed, weatherstripped or otherwise sealed with non-staining materials that will remain pliable during use. Thermal conductivity (U-values) for new walls shall meet or exceed requirements of the CABO Model Energy Code, 1983 Edition as referenced in the Minimum Property Standards Section 607-1.1 when cost-effective.

#### 9-4. ROOFS.

a. Low-Sloped Roofing Systems. Low-sloped roofing systems are either built-up roofing (BUR) or non-conventional roofing (single-ply and others) and where the slope is less than 2 in 12. These systems are defined as an assembly of 4 or less interacting components designed to weatherproof and normally to insulate a building top surface. The components of a roof system consist of:

- o a structural deck;
- o a vapor retarder (where required);
- o thermal insulation (where required); and
- o a waterproof membrane.

(1) New or Replacement Low-Sloped Roofing Systems. In the selection of a new or replacement roofing system, the following shall be considered:

(a) Satisfactory record of performance in the location of intended use, which includes durability, i.e., resistance to physical, chemical and biological factors when tested in accordance with accepted material standards.

(b) A single source warranty issued by the membrane

manufacturer for the roof system performance which includes wind blow-off resistance, fire classification and durability, for a minimum of 10 years for labor and materials. The manufacturer shall be liable for the roof system performance warranty. This warranty shall include an evaluation by the manufacturer (or approved representative) of

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the existing roof system for acceptability as a substrate for the new roofing system. Also, the warranty shall include all flashings, seaming (for single-ply and other non-conventional roofs), wood and metal work, sealing, access walks and other work to make a complete watertight roof membrane system. Application of the roof system shall be by contractors approved by the manufacturer. Construction shall be in accordance with the manufacturer's printed specifications, architectural detail and installation instructions.

- (c) As an alternative to replacing or partially replacing a roof with a hot BUR or a single-ply membrane, one of the following cold-applied products may be used for remedial work: recoatings; cutbacks; or emulsions. Coal tar pitch and asphalt are incompatible; therefore, consult with the cold product manufacturer before using these products. There are normally no warranties associated with this remedial work.
- (2) Roof Evaluation Survey. The failure to find and correct minor roof defects and deterioration in the earliest stages is probably the greatest cause of premature roof problems. This is particularly true of BURs built on low-sloped roof decks. Periodic inspection and remedial maintenance can mitigate these problems. Premature roof failure (within the first two years of roof completion) is usually due to improper application, improper storage of building products (especially felts) and improper design; and normal weathering and lack of periodic maintenance may age a roof in a time frame less than the warranted period. Roof evaluation, maintenance, application and repair should be performed by qualified personnel only. Evaluation should be conducted by a roof consultant or a person well versed in roof failure. Manufacturers can supply this service if their product is used. (See subparagraph a(1)(b) regarding roof warranty.) There are non-destructive methods for determining the water content of a roof, i.e., Infra Red capacitance and Nuclear Meter. Minor maintenance and repair work, emergency work (required to provide immediate protection against water damage) is best

performed by PHA staff, if available. Major repairs and reroofing projects should be performed by qualified roofing contractors. Where the deterioration

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of the structural members is found to be extensive and beyond repair as technically determined by an architect/engineer on the PHA's staff or under contract through a roof survey, and/or where repeated and frequent membrane failures justify alternate roofing design, a comparative cost analysis shall be used to determine the best type of roof design for the structure.

(3) Performance Criteria for Low-Sloped Roof Systems.

- (a) Wind. The new roof system (or re-roof system) shall withstand the wind up-lift requirements of the HUD/MPS, i.e., ANSI A-58.1 1982. Tests shall be in accordance with Factory Mutual 1-90 or 1-60 test procedures or equal.
- (b) Fire. A class A fire rating (or local code requirement) shall be achieved via Underwriters Laboratories, Inc. Test procedures shall be in accordance with UL 790 or ASTM E-108 or equal.
- (c) Slope. Positive slope to drain, i.e., 1/2" in 12", shall be attained by use of tapered insulation or separation boards on top of the existing roofing structure or membrane. Resulting top surface shall be a smooth plane; ponding and other depressions shall be eliminated.

- b. Steep Slope Shingle Roofing. Where slopes are greater than 2 in 12, organic or inorganic asphalt shingles shall be used. When strip self-sealing shingles are used, they shall measure approximately 12" x 36". Class "A" (fiberglass) shingles shall weigh a minimum of 240 pounds per square; Class "C" (organic) shingles shall weigh a minimum of 260 pounds per square. All shingles shall carry a 25-year materials warranty, plus a 3-year up-front warranty for labor and materials.

(1) Performance Requirements for Steep Sloped Roofs.

- (a) Fire resistance - shingles shall meet Underwriters Laboratories, Inc., test UL-790 for Class A or Class C fire ratings.

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- (b) Wind resistance - shingles shall meet Underwriters Laboratories, Inc., test UL-997 for wind resistance. Shingles shall resist a full gale force wind, as defined by the Asphalt Roofing Manufacturers Association (ARMA).

- (c) Shingle packages shall be UL labeled and also listed by UL as meeting these requirements.
- (2) Installation. Installation of shingle roofing materials and flashing shall be in accordance with the ARMA roofing manual.
- (3) Reroofing. Depending on local codes, a maximum of three (original and two reroofs or original and one reroof in heavy snow load areas) roofs may be installed before tear-off is mandatory. However, the decision to reroof shall depend on the structural integrity of the supporting roof structure and the condition of the existing shingled roof. Substrate for reroofing shall be firm. If not available, ventilation shall be provided concurrently with the reroofing. Ridge and soffit ventilation is recommended.
- (4) Roofing Underlayment Felts.
  - o Roofing underlayment felts applied to a minimum sloped roof of 4 in 12 shall be 15 pound asphalt non-perforated saturated felt (or equal).
  - o Low-sloped shingle roofs (2 in 12 to 4 in 12) require 2 layers of 15 pound non-perforated saturated felt.
  - o Some local codes may require 30 pound felt regardless of the slope.
  - o Wherever there is a possibility of creating an ice dam along the eaves, the underlayment shall be cemented to the substrate and to each other to a point at least 24" beyond the interior wall line of the building. Ice damming frequently occurs where the slope of the roof is between 2 in 12 and 4 in 12.
- (5) Roof Ventilation. Roof and roof structures shall have natural or mechanical ventilation as required in the HUD MPS. Proper ventilation will prevent dampness and minimize

the effect of conditions conducive to decay, deterioration and excessive heat build-up. Exterior ventilation openings shall be screened to prevent unauthorized entry or the penetration of rodents or other infestation. Roof venting systems shall be in operable condition. Vents shall not be clogged or painted over or missing proper strainers.

- (6) Maximum slope considered suitable for normal shingle application is 21 in 12. Applications above this slope require special nailing and cementing (i. e., Mansard roof). Use manufacturers' instructions.

- c. Roof and Attic Insulation. Existing insulation and its installation shall comply with relevant fire codes and shall be anchored as required. Gaps, holes or other passages shall be effectively filled so that air will not escape from interior spaces into the attic. New or additional roof or attic insulation shall be provided if determined to be cost-effective and shall perform as follows:
- o Meet applicable fire-resistance standards and comply with local fire codes;
  - o Not be toxic when in exposed locations;
  - o Settlement will not reduce insulating material to below agreed upon R value;
  - o Not deteriorate when wet; and
  - o Dry within a reasonable amount of time when exposed to moisture.

NOTE: Light fixtures or electric fans exposed on attic floors for use in spaces below shall have the insulation kept back a minimum of 3 inches.

- d. Drainage from Roof. Buildings shall have a controlled method of disposal of water from roofs to prevent water penetration, property damage or public hazard. Drainage systems shall be connected to available storm sewers or provided with suitable splash blocks or empty at acceptable locations onto landscaped or paved areas. Systems shall be of size and placement to efficiently accommodate anticipated rain and snow. Drains shall be protected from the intrusion of foreign matter. Gutters and downspouts shall be securely anchored to the

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building and shall be free of holes, cracks, rust or material deterioration. Gutter and leader systems, diverters, or other suitable means of systemized drainage shall be present in locations where internal systems are not provided and the following occurs:

- (1) Adequately sized roof overhangs are not present to prevent drainage along exterior wall that could lead to building penetration or staining of walls, windows and doors;
  - (2) Ground erosion or expansion has occurred due to excessive soil saturation;
  - (3) Water drains on uncovered entrance platforms or steps;  
or
  - (4) Drainage patterns create hazardous areas for occupants or public.
- e. Skylights. Where existing, skylights shall be weather-tight and shall be fitted to frames so as not to be a safety hazard to life or property. For technical requirements, see paragraph 9-7. In areas where unauthorized

entry is a problem, skylights shall be secured with tamperproof grills, bars or other means of security. No new skylights are permitted.

9-5. CHIMNEYS. Chimneys shall be in safe and structurally sound condition. Chimneys shall be smoke-tight, capable of withstanding the action of operational temperatures and flue gases, and of sufficient height to allow proper draw for venting as required. Masonry chimneys shall not have major open mortar joints or cracks, permitting smoke or flame to be discharged into the building. Unlined masonry chimneys with deficient mortar or joints shall be either removed or made safe by the installation of a flue liner or corrosion-resistant pipe 1 inch less in diameter than the interior of the chimney.

9-6. EXTERIOR ACCESSORY STRUCTURES. Stairs, platforms and other structures accessible to tenants that extend 24 inches or more above grade shall be continuous, enclosing walls or railings at least 40 inches high. Enclosures of balconies shall be designed to prevent the passage of a spherical object measuring 5 inches in diameter or greater. Porches, balconies, canopies and roof overhangs shall be sloped for

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safe drainage. For technical requirements, see paragraph 9-4. Exterior accessory structures shall be in safe and structurally sound condition, anchored and capable of supporting anticipated loads. All exposed surfaces shall be protected from decay and moisture, and shall be free of splintering, rust and material deterioration.

9-7. WINDOWS. Windows shall have required glazing that is free of holes, cracks or missing portions and shall be supported by frames that provide secure and sealed connections to the wall. Glazing, sashes and frames shall connect securely to limit the infiltration of water, moisture and air in accordance with the HUD MPS. These elements shall be free of splintering, rust or other material deterioration. Operable windows shall be easy to open, hold open, close and lock securely. Weatherstripping shall be durable when in contact with the window sash and shall prevent excessive infiltration of water, moisture, wind, sound, light and dust. Windows shall be retrofitted with energy conservation devices that are cost-effective, such as:

- o Storm windows;
- o Thermal shutters;
- o Caulking;
- o Weathestripping;
- o Window shading;
- o Replacement windows; or
- o Other.

NOTE: Improper fit of window sashes in frames may indicate structural problems. For further information, see Chapter 8.

- a. Security. All operable windows shall have keyless sash locks such as "clam shell" or equivalent interior fastener.

- b. Accessory. Insect screens shall be provided for all operable windows in areas where they are needed and customarily provided. Screens shall be in safe and sound condition, and fit firmly into appropriate frames.

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SECTION 2: PROJECT SPECIFIC STANDARDS

9-2B. RESERVED.

9-3B. RESERVED.

9-4B. ROOFS.

- a. Surface Materials. When replacement is necessary, wood shingles and shakes should be replaced with fire-resistant materials. When repairing or replacing major portions of the roofing system, whenever possible, the color, texture and character of the new material should be compatible or matching to the existing.

b. Reserved.

c. Reserved.

d. Reserved.

- e. Roof Drainage. New gutters and leaders should be consistent with successful existing systems and should be durable and resistant to deterioration by the elements. In determining which material to use, the following should be considered:

- (1) Aluminum is an acceptable gutter/leader material except in locations where aluminum-corrosive vapors (such as those present in salt air and industrial areas) are present. In these cases, plastic (vinyl) systems may be used.

- (2) Exterior wood gutters and leaders should not be used because of leakage and repainting requirements. When the drainage system is an integral part of the roof, the gutter may be lined with aluminum or other durable metal.

- (3) Copper gutters and leaders shall not be used except for repair work of existing systems because they are prime targets for theft.

- (4) A steel boot that extends 72 inches above the ground should be provided when leaders are subject to abuse.

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- (5) The following should be considered when clogging has been a major problem.



- (a) Increase gutter/leader diameters;
- (b) Provide basket strainers at the head of the leader; or
- (c) Provide screens across gutter heads.

(6) Leaders may be connected to underground storm drainage systems or dry walls (when granular soil is present) where soil erosion or flooding has been a problem. The expense of this change makes conversion a possibility only when unsatisfactory conditions are severe and where other diversion methods have proved unsuccessful. The existing storm system must also have the capacity to receive the additional load.

f. Reserved.

9-5B. RESERVED.

9-6B. RESERVED.

9-7B. WINDOWS.

a. Security. In areas where security is a problem, windows affording easy access to the premises, such as ground floor and basement windows, windows opening onto fire escapes, stairways, porches, terraces, balconies right under roofs, etc., may be provided with a better security system than keyless clam shell or equivalent sash locks. Systems may include:

- (1) Security screens, grills, or window guards. Security screens and gates should be easy to open in case of emergency or when used by the elderly or the disabled. Sliding gates which afford excellent protection and can be easily pushed aside or opened for emergency may be provided. These gates should be set in tracks on top and bottom to prevent them from being pulled or pried from the window. When wire mesh is used, the metal should be a minimum of 1/8 inches in diameter and the opening should not exceed 2 inches. The grills should be attached to the window frame with machine or round head bolts which cannot be removed from the outside. If bars are used, they should be a maximum of 5 inches apart and set at least 3 inches into the framing wall.

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NOTE: Mechanisms shall comply with relevant fire codes regarding use of windows for secondary egress. Security screens shall not be permanently fixed when windows are required means of egress or interfere with the ability of residents to open or close windows for ventilation and dwelling unit comfort.

(2) Keyed window locks.

(3) Local window alarms in management, maintenance



as horizontal overhangs for south orientations,  
combination horizontal and vertical overhangs for  
east-west orientations or tinted/reflective glass  
that allows penetration of winter sun.

NOTE: To take advantage of the winter heat gain,  
south-oriented windows should not have tinted  
glass or over-sized overhangs.