DIVISION 7
THERMAL AND MOISTURE PROTECTION

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SECTION 7.1 DAMPPROOFING

7.1 A Products:

1. Asphaltic emulsion based – equal to Sonneborn "Hydrocide 700 Mastic" or Karnack "955-Heavy Trowel."
2. Interior Coating – "Thoroseal" by Standard Drywall Products Co.
3. Admixture – "Thoroguard" by Standard Drywall Products or approved equal anti-hydra admixture.
4. Grout – "Thoroplug" by Standard Drywall Products Co. or approved equal.
5. Exterior drainage membrane – "A-H Seamless Membranes" by AntiHydro International Inc. or approved equal.

7.1 B Reference:

Joseph Lstiburek, Builder's Guide – Moderate Climates, © 1998 Building Science Corp., EEBA and Shelter Source, Chapter 4 – Foundations.

7.1 C Execution: (see Builder's Guide, Figures 4.2, 4.8, 4.11 et al.)

1. New concrete footings – as a capillary break across top of footing, either apply one troweled-on coating of asphaltic emulsion dampproofing according to manufacturer's instructions or secure an impermeable membrane.

2. New foundation walls at exterior – Install one troweled-on coating of asphaltic emulsion dampproofing according to manufacturer's instructions. Apply only at temperatures above 40° F. in dry weather. Apply mastic from footing up parged foundation wall to point of grade or start of stucco. Backfill with care to prevent damage to dampproofing, providing membrane protection course when necessary to prevent such damage. Where existing

foundation walls are exposed, parge and apply dampproofing as above. Dampproofing may be omitted where draining rigid glass fiber insulation is used.

3. Basement drainage (new construction) – install perforated perimeter drain on outer side of footing and below the level of floor slab. Surround the perforated drain with coarse gravel (no fines); protect the gravel with filter fabric. Pipe to drainage system. Above it, face the below-ground portion of the basement wall with draining rigid glass fiber insulation (or drainage membrane with filter fabric).

SECTION 7.2 THERMAL INSULATION

7.2 A General:

1. Section includes –
   a. Batt and cellulose thermal insulation in exterior wall, roof and floor cavities
   b. Rigid insulation in exterior walls
   c. Crawlspace vapor retarder.
   d. *Exterior insulation and finish systems* (EIFS)

2. Related sections –
   a. Steel Framing 5.1
   b. Rough Carpentry 6.1
   c. Air Sealing 7.10
   d. Ductwork and Pipe Insulation 15.2

3. Definition of thermal boundary – Uninterrupted thermal insulating barrier enclosing entire heated space of building. Basements and connected crawlspaces are usually unintentionally heated and defined within the thermal envelope. Other crawlspaces may be excluded from the thermal envelope only with explicit written authorization of PHDC/RDA.

4. Storage and handling – All insulation shall be delivered to the site in manufacturer's original container, clearly marked and identified with brand, applicable standards, type and R-value. Protect materials from weather.

5. Quality assurance – Install all materials in accordance with manufacturer's specs.

7.2 B Products:

1. Cellulose – Shall conform to interim safety standard 16 CFR Part 1209.

   a. Approved low moisture wet-spray: R-Pro Wall System
   b. Loose fill cellulose: R-3.2 per inch.
   c. Dense-packed cellulose: Density not less than 3 and not more than 5 lb/cubic foot installed

2. Glass fiber – Preformed glass fiber batt, faced or unfaced as indicated, width conforming to construction application.

   R-11, 3-1/2 x 16 inch batt, kraft-faced

   R-13, 3-1/2 x 15 inch high-density batt, kraft-faced

   R-19, 6 x 15 inch batt, kraft-faced

   R-19, 6 x 16 inch batt, kraft-faced

   R-30, 10 x 16 inch batt, unfaced

3. Rigid insulation –

   a. Foil-faced polyisocyanurate (R-Max, Tough-R, Thermax)
   b. Foil-faced glass fiber board (Owens Corning et al.)
   c. Extruded polystyrene "XPS" ("blue board," "pink board" – Owens Corning et al.)
   d. Rigid glass fiber draining insulation board (Insul-Drain by Owens Corning)

4. Exterior insulation and finish systems – complete system including expanded- or extruded-polystyrene board insulation, mechanical fasteners, reinforcing mesh, synthetic stucco, and aperture details, all provided or certified for use by the same EIFS manufacturer: Dryvit Sytems, Parex, Senergy, Simplex, Sto Corp., US Gypsum.

   System shall be designed with a drainage plane behind the foam insulation: Dryvit MD System, Senergy CDsystem, US Gypsum InsulScreen or approved equivalent. EIFS dependent on a perfect face seal for moisture exclusion shall not be used.

5. Staples – galvanized or bronze flattened 1/2 inch shank wire staples.

6. Support wire – 12 gauge galvanized soft-annealed, mild steel wire.

7. Prefabricated batt hangers –

8. Vapor barrier – Polyethylene film 6 mil thick.

9. Vapor barrier tape: 3M #8086.

10. Adhesive – As recommended by insulation manufacturer. Shall not damage insulation or vapor barrier.

7.2 C Execution:

1. Insulate entire thermal boundary as specified.

2. Special requirement for exterior insulation and finish system – The system shall be installed by certified EIFS applicators trained by its manufacturer. Flashing, sealing and termination details shall be pre-approved by the architect and prime contractor. Joints shall be sealed with silicon or other low-modulus sealant.

3. Special requirement for steel framing – *De-rating due to thermal short*. Insulation installed between metal framing (that portion of insulation with thickness equal to framing member depth) shall be de-rated by 50%. Where insulation method is not prescribed below, provide additional insulation outside (on the cold side of) the framing to achieve required minimum total thermal resistance.

4. Special requirements for pipes and ductwork –

   a. General: Building insulation shall be installed such that all wet piping and ductwork remain within the building thermal envelope.

   b. Walls and chaseways: Install minimum R-13 of insulation uncompressed on cold side of heating pipes and ducts. Two-inch rigid glass fiber board, fit tight at studs and butt joints, may be substituted for R-13 glass fiber where mechanicals leave insufficient clearance for full thickness batts. Insulate remainder of cavity to either side of mechanicals.

5. Existing construction with intact interior finish –

   a. Roof cavity: Dense-packed cellulose in all portions that cannot be air-sealed. Insulate remainder with loose fill cellulose to R-30.

   b. Walls and floors: Dense-packed cellulose.

6. Walls –

   a. General:

      1) Insulation requirement – Achieve effective R-13 minimum with batts or cellulose unless stipulated otherwise.

      2) Exterior frame walls – Insulate full depth of stud cavity.

      3) Studded-out exterior masonry walls –

         a) Glass fiber batt: R-13 minimum if distance from masonry to interior stud face is less than 4-1/2 inch, R-19 if greater and whenever steel studs are used (see *Metal stud walls* below).

b) Cellulose: permitted only where masonry has new outer course of hard face brick or moisture-resistant stucco.

4) Fitting batts – Cut batts 1 inch longer than stud cavity. Staple top to underside of firestop or top plate and press-fit between studs with stapling tabs left folded. Install wrinkle free and flush with stud face to minimize convection within stud cavity. Cut batts 1/2-inch wider than non-standard width stud bays to provide snug fit. (For walls studded out with metal studs, see "Metal stud walls" below.)

5) Exterior corners fully insulated – Provide continuous insulation at outside corners and where partition walls abut outside walls. See Section 6.1 D 3 (c), Stud Framing.

6) Exterior walls between floors – When new ceilings, other than on the top-floor, are erected below the joists, insulate exterior walls to R-13 between the new ceiling and floor sheathing above. Install insulation without gaps.

b. Metal stud walls:

1) Comply with all other minimum insulation requirements.

2) Glass fiber batt – Width shall equal full center to center spacing of studs.

3) Wet-spray cellulose – Install to full depth of wall cavity without voids behind studs or inside stud channels. Flanges of studs and runners shall be scraped free of insulation prior to installation of drywall.

4) New frame walls – Insulate stud bays to full depth. Use R-11 batts with insulating exterior sheathing (polyisocyanurate or XPS), R-5 minimum.

5) Studded-out exterior masonry walls –

a) Glass fiber batt: Use R-19 batts the full width of the center-to-center stud spacing, slit to fit around the stud C-section so that approximately 40% of the batt thickness is in the space between the masonry and studs. The edges of adjacent batts shall meet in this space.

b) Cellulose: Install without voids to full depth of wall cavity.

c. Basement and crawlspace:

1) Basement walls (new construction) – In owner-occupied single-family dwellings where the floor-to-ceiling height is 6 feet or more, insulate to R-10 minimum.

a) Interior: in unfinished spaces, install a foil-faced glass fiber board (FSK), approved for exposed use, over the full height of the exterior (non-party) wall. In finished space, use any approved non-hygroscopic insulating material.

b) Exterior: Where insulation is placed on the exterior of the basement wall without foundation drainage, use either 2-inch draining rigid glass fiber or 2-inch extruded polystyrene extending from the top of the footing to the top of the foundation wall. Where insulation is part of an exterior foundation drainage system, comply with manufacturer's specifications. In either case, provide protective membrane above ground and appropriate termite barrier detail.

c) Integral: Where a concrete block wall is not insulated on either side, insulate all hollow cores in the block with expanded polystyrene foam inserts from a level 3 feet below grade to the top.

2) Basement walls (existing construction) – Insulate finished basement exterior walls with any approved non-hygroscopic insulating material.

3) Basement-under-porch partition – Construct partition, with hinged door, to separate excavated areas under porches or sidewalks from the main basement space. Insulate partition wall with R-13 foil-faced glass fiber board.

4) Crawlspace vapor barrier – Cover ground of all dirt crawlspaces with 6-mil polyethylene film and lap up wall one foot above grade.

5) Crawlspace perimeter – Insulate wall of crawlspaces under heated living areas with foil-faced glass fiber board, R-10 minimum. Completely air seal exterior crawlspace perimeter prior to insulating. Embed board 1-foot into crawlspace soil. On walls perpendicular to joists, wedge top tight against joist. On walls parallel to joists, affix with adhesive approved for use with glass fiber.

6) Slab-on-grade (new construction only) – a floating-slab design should be used unless structural considerations dictate an anchored slab.

a) Floating slab: Separate the edge of the floor slab from the perimeter wall with continuous 2-in. extruded polystyrene insulation, which then continues 2 ft. downward or 2 ft. inward horizontally. Insulation thickness at slab edge may be reduced to as little as 0.75 in. where necessary to avoid a gap between slab and wall-base trim.

b) Anchored slab: When the slab cannot be thermally isolated from the perimeter wall, insulate outside surface of perimeter wall to R-10 minimum.

7. Floors –

a. Insulation requirement: Use R-19 batt minimum or blow in cellulose to full depth of floor cavity.

b. Overhangs: Insulate portion directly above exterior wall to full depth of floor cavity.

c. Bay over existing porch: Install insulation against all exterior surfaces including retrofit air barrier, ends of joist bays and sides of outboard joists.

d. Support open batt: Where exterior sheathing or finish is not installed immediately below floor batt, support batt with approved wire or hangers spaced 10 inches on center. Attach wire to joist with staple or "J" nail.

8. Ceilings –

a. Insulation requirement: Achieve R-30 with glass fiber batt or loose fill cellulose. Batt should be unfaced if necessary to conform to ceiling finish where lower part of batt is compressed by width of stud.

b. Chimneys and vents: Maintain combustible materials at least 2 inches from hot surfaces, or as required by code.

c. Wood-framed ceilings:
   1) Glass fiber – Install batts, width equal to center-to-center joist spacing, compressed at the bottom to fit between joists, without gaps in space above joists.
   2) Cellulose – Blow loose fill to required depth.

d. Metal-framed ceilings: top flanges shall be covered with a continuous layer of loose-fill cellulose or glass fiber batts. That portion of insulation installed between metal framing members shall be derated by 50%.
   1) Glass fiber – batt insulation shall be applied in two perpendicular layers. The lower layer shall be kraft-faced, inserted between members and be the same width as C-C joist spacing, and have same thickness as members (exception: insulation shall be permitted to be 1/2 in. thinner than joist web). The upper layer shall be a minimum 23 in. wide R-19 unfaced glass fiber laid cross-wise over joists. Top layer shall laid flat without gaps between courses. All gaps between perimeter of framing and masonry walls, including party walls, shall be stuffed with glass fiber.
      exception: Suspended grid ceiling systems may be insulated with one layer of kraft-faced 23-inch wide glass fiber batts, R-30 minimum, installed without gaps.
   2) Cellulose – Blow loose fill to required depth to achieve R-30.

e. Low clearance: Where low rafters cause glass fiber batt to be compressed vertically, insulate between rafters as necessary to achieve R-30. Install batts in two layers or blow cellulose.

SECTION 7.3 ASPHALT SHINGLES

7.3 A General:

1. Colors – provide a minimum of 3 colors for selection on all projects, and get owner's approval on color choice prior to start of work.

2. Product Delivery, Storage and Handling – Deliver materials to jobsite packaged with manufacturer's labels intact and legible. Store materials on raised platforms and protect with coverings at outdoor locations. Do not stack bundles more than 3 ft. high.

7.3 B Products:

1. All roofing shingles shall be square tab butt strip shingles conforming to standards of ASTM D225-70 type I and Federal Specification SS-S-300B type II, UL 790, Class C, 3 tab, approx. 12 inches by 36 inches, minimum weight 235 lbs per square.

   Approved products: Bird & Son "Windseal"
   CertainTeed "Sealdon"
   GAF "Standard Self Sealing"

2. Asphalt saturated roofing felt – ASTM D226, 15 lb., organic, unperforated, 36 inches wide.

3. Hip and Ridge Shingles – same manufacturer, type, weight and color as roofing shingles.

4. Mineral Surfaced Roll Roofing – ASTM D249.

5. Nails – galvanized 10 ga. annular thread, 3/8 inch head, 1 inch minimum lengths or; staples may be employed conforming to the following: zinc coated, 16 gauge, semi-flattened to an elliptical cross section, and long enough to penetrate 1/2 inch through decking. The staple crown must bear tightly against shingle but must not cut shingle surface, and the crown of the staple must be parallel to the tab edge.

6. Bituminous Plastic Cement – FS-SS-C-153 type I.

7. Roof Edging – Painted aluminum.

7.3 C Execution:

1. Install asphalt shingle roofs only on roofs having a slope of 3-1/2 in 12 or greater.

2. Repair damage to neighboring roofs caused during demolition or new roofing work with materials of type and quality to match existing.

3. Assure that prerequisite metal flashings have been installed. Perform all work to standards and requirements established in Asphalt Roofing Manufacturers Association printed stan-

dards for this type work. Install aluminum step flashing at intersections between shingle roofing and vertical faces. Step flash and counterflash at masonry surfaces.

4. Install new asphalt shingles in strict accordance with manufacturer's instructions regarding underlayment, covering, nailing, weathering and installation of flashings, edges and roof accessories.

5. Shingle sides of dormers to match roof.

6. Install roof edging prior to beginning roofing work.

SECTION 7.4 BUILT-UP ROOFING

7.4 A General:

1. Submit manufacturers product data and installation instructions for approval.

2. Minimum temperature for application is 35° F. Do not install roofing on damp, wet, or frosty surfaces.

3. Guarantee – Contractor shall provide written 5 year guarantee against defective materials and workmanship on all roofing installations. Guarantee shall be in no way contingent upon manufacturers warranties or reservations concerning qualifications or certification of the roofing contractor. The guarantee shall be provided by the General Contractor, and not by the roofing subcontractor nor the manufacturer of the roofing materials. The guarantee shall cover all roofing and flashing, and shall not be contingent upon maintenance or re-coating of the roof within the 5 year period.

4. Standards – Installation shall conform to standards in National Roofing Contractors Association "A Manual of Roofing Practice," most recent edition.

5. Ensure roof deck is structurally sound to support the live and dead load requirements of the roofing system and sufficiently rigid to support construction traffic.

6. Decks shall be firm, clean, smooth, and dry.

7.4 B Products:

1. Provide a 10-year bondable built-up roofing system with asphalt bitumen and glass fiber felt from a national manufacturer of roofing products.

2. Asphalt bitumen – ASTM D312, Type III.

3. Ply Sheets – Asphalt saturated, 15 lb. glass fiber felt, ASTM D2178.

4. Base Ply – Asphalt saturated and coated 30 lb. glass fiber felt, ASTM D2178.
5. Aluminum coating – Type 3 cellulose fibered, ASTM A-2824.
6. Cant strips – Preformed fiberboard.
7. Asphalt plastic cement – Asphalt roof cement compatible with roofing products, ASTM D2822.
8. Nails – Large head non-ferrous or galvanized barbed roofing nails.
9. Cap flashing – Mineral surfaced, 90 lb. asphalt roll roofing, glass fiber felt, ASTM D3909.
10. Vents – Passive "mushroom" vents, 12- or 16-inch dia. Do not use turbine vents.
11. White acrylic elastomeric roof coating – Liquid-applied acrylic white coating, must conform to all aspects ASTM D6083 (not just "performance"). Must be warranted by manufacturer for at least 10 years.

7.4 C Execution:

1. Install all roofing systems in strict accordance with manufacturer's printed instructions.
2. Remove any trash, debris, grease, oil, water, moisture, and contaminates which may affect bond of roofing to surface.
3. Inspect exposed roof decks and repair any rotted or deteriorated roof boards. Cracks greater than 1/4 inch and all knotholes shall be covered with sheet metal nailed securely to the deck.
4. When existing roofing is removed completely, or roof is installed on new sheathing, roofing shall consist of a base sheet, three plies of felt hot mopped, and hot mopped top coating.
5. When existing roof is not removed, roofing shall consist of three plies of felt hot mopped, and hot mopped top coating; base ply is not required.
6. Application of base ply – Apply base ply with 2 inch side and end laps. Mechanically fasten at 9 inches o.c. max. at side laps, and 18 inches o.c. max. staggered in two rows 12 inches from each edge. Roofing nails or other fastening system approved by the roofing manufacturer may be used on wood or plywood decks. To minimize wrinkles and buckles allow time for base ply to relax unrolled prior to attachment. Cold temperatures will increase time required for base ply to relax.
7. Application of plies – Embed three plies of glass fiber felt in shingle fashion, starting from the low point of the roof. Each ply should lap 24-2/3 inches into uniform solid moppings of hot asphalt, using 25-45 lb. per 100 sf per ply. Starter plies of 12-inch and 24-inch widths are necessary at beginning and end of job to maintain roofing thickness.

8. When applying roofing, keep the mopping within 6 ft. of the roll. Keep the mop full, and flow asphalt in front of the roll. Do not scrub with mop.

9. Cant strips – Apply cant strips at intersections of roof deck with vertical surfaces. Secure fiberboard cant strips with plastic cement or hot steep asphalt.

10. Flashing – Extend the built-up roofing plies a minimum of 2 inches above the cants and adhere to the wall curb or parapet with hot asphalt. At all parapets, install 90 lb. mineral surface roll roofing as cap flashing, mopped in solid with hot asphalt over cant strip onto roof surface. At party walls extend cap flashing down onto both adjacent roofs.

11. Asphalt top coating – Coat entire roof surface with a uniform mopping of hot asphalt at a rate of 15 to 20 lb. per 100 sf.

12. Clean-up – Thoroughly remove all debris, including old roofing and slag. Under no circumstances leave slag or debris on adjacent properties. Clean all asphalt drips from adjacent surfaces and sidewalk.

13. Aluminum coating – mix well and apply coating to clean, dry roof surface. Use 2 coats if necessary for complete coverage.

14. White elastomeric acrylic coating - Inspect and repair all flashing, counterflashing and drains. Remove or alleviate all “ponding” areas. Pressure wash roof surface with surfactant cleaning agent, paying particular attention to “oily” areas. Apply in sunny weather at ambient temperatures greater than 50° F. Apply two coats, each 8 to 10 mils thick. First coat must dry before application of the second coat (2-10 hours depending on temperature, humidity and amount of sunlight). No rain may occur during drying period. All perimeter areas should be “backrolled” using 3/4" nap, exterior rough surface rolling pad. (Do not “sludge” coat.) All other surface areas should be sprayed or rolled with coating. All surfaces on roof should be covered, including all vertical surfaces, flashing and members. Drains should not be covered.

15. Vents – Comply with building code requirement for ventilation of each roof (net free vent area = roof area/300).

SECTION 7.5 MODIFIED BITUMEN ROOFING

7.5 A General:

1. Submittals – Submit product data for sheet membrane, flashings, and sealants with temperature range for application of membrane. Submit fastener certification and pull-out test results. Submit manufacturers installation instructions.

2. Quality Assurance –

   a. Membrane manufacturer: A company specializing in modified bitumen membranes with more than 5 years of experience.

b. Applicator: A company specializing in modified bitumen roofing installation, with more than 5 years of experience.

c. Underwriter's Laboratories, Inc. (UL): Class C fire Hazard Classification.

3. Environmental Requirements – Deliver products to site and store materials in a weather-protected environment clear of ground and dry.

4. Warranty –

a. Provide a 10 year manufacturer's warranty on roof.

b. Furnish a 5-year contractor's warranty.

7.5 B Products:

1. Provide a compatible assembly of products that are recommended by manufacturers to be fully compatible with substrates, flashings, and related materials.

2. Modified Bitumen Membrane – Provide 160 mil modified bitumen cap sheet.

Acceptable manufacturers: ARC Rhoflex (Firestone) GAF Tarmac Garland

3. Base Sheets – Install heavy duty glass fiber base sheets manufactured by or approved by the same manufacturer as the cap sheet.

4. Vents – Passive "mushroom" vents, 12- or 16-inch dia. Do not use turbine vents.

5. Accessories –

a. Accessories shall be made by or approved by the roofing manufacturer.

b. Cant strips shall be rigid fiberboard.

c. Fasteners shall be screw or peel rivet type with plastic plates.

d. Where termination bars are required, they shall be aluminum 1/8 inch thick x 1 inch wide.

e. Stacks or pipes penetrating the roof shall be flashed with aluminum collars with rubber gaskets.

7.5 C Execution:

1. Inspection –

a. Verify the roof openings and penetrating elements through the roof are solidly set and all nailing and cant strips are in place. Verify that the deck is solid and secured.

b. Do not apply roofing to damp, frozen, or dirty surfaces, or to surfaces unacceptable to the manufacturer, installer, architect, or PHDC/RDA. Beginning installation means acceptance of the substrate by the contractor.

2. Fire Safety –

a. The contractor shall meet all the fire safety requirements of OSHA, the City, and the manufacturer of the roofing materials.

b. During application, the contractor shall require that a designated person on each crew be assigned to conduct a fire watch. This individual shall be trained in the use of fire extinguishing equipment and shall have a phone for calling the fire department in the event of a fire. He/she shall watch for smoldering materials or fires on all areas of the roof, try to extinguish them when the fire is within the limits of the fire extinguishing equipment available, and sound the alarm.

c. After application, a fire watch shall be continued on a daily basis after torch welding applications are completed. The job foreman or other designated person shall carefully walk the entire area of application at the end of the work day, checking for smoldering material. A fire watch shall be maintained during breaks in the work day and for two hours after the last torch is shut off for the day.

3. Surface Preparation –

a. Fully prepare the surface for each component of the roofing system. Remove all existing roofing and flashing materials unless otherwise directed. Remove all materials from the roof by means of an approved chute to a truck or dumpster. Provide legal disposal. Patch all holes and gaps in the roof sheathing. Maintain the watertight integrity of the roof at all times.

b. Install non-combustible, fire-resistant cant strips.

c. Install roof drains.

4. Application of base sheets –

a. Install a coated glass fiber base sheet over the roof deck according to manufacturer' instructions.

b. Mechanically fasten base sheet to roof deck at the rate of 1 fastener per 2 sq. ft.

5. Application of membrane –

a. Install modified bitumen membrane according to the roofing manufacturer's printed instructions.

b. Lay out the modified bitumen cap sheet roll in straight course to be followed, starting at the low end of the roof to insure that laps are toward surface of the coiled part of the roll and progressively unroll it, pressing down with the foot to insure bonding. After the major portion of the roll has been bonded, re-roll the first 6 feet and bond it in a similar fashion. Repeat this operation on subsequent rolls with overlaps of 4 inches on the sides and 8 inches on the ends. Give each lap a finishing touch by passing a trowel against the seam to insure a smooth, tight seal. If any gaps are found, they shall be reheated and re-sealed.

6. Base Flashing –

a. Install 2 plies of modified membrane cap sheet at all intersecting vertical walls, parapets, curbs, etc. Torch apply both plies. Terminate all base flashings at counterflashings or a metal termination bar.

b. Prime and strip all metal flanges with one ply of modified bitumen cap sheet, torch applied.

7. Vents – Comply with building code requirement for ventilation of each roof (net free vent area = roof area/300).

8. Protection of roofing – Upon completion of roofing, including associated work, take appropriate measures for surveillance and protection of roofing during remainder of construction period.

SECTION 7.6 FLASHING AND SHEET METAL

7.6 A Quality Assurance:

The work of this section shall conform to standards and guidelines for work of this type contained in the "Architectural Sheet Metal Manual" by the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and "Copper and Common Sense" by Revere Copper and Brass Inc.

7.6 B Products:

1. Metal Flashing – All metal flashings shall be galvanized ASTM A526 commercial quality min. 28 ga. or aluminum ASTM B209, alloy 3003, temper H14, finish AS-C22A41, .020 inch min. thickness. Metal Flashings exposed to view such as at roof edges, gravel stops and eave flashing shall be prefinished aluminum. Concealed flashings may be galvanized or aluminum. Forming of exposed flashings shall be neatly done to consistent, tight fitting and self-lapping configuration. All flashings at roof edge, vents, curbs and other roof protrusions shall be preformed to appropriate shapes; vent and similar flashings shall

be cap and counter flashed. Flashings shall be asphalt coated if in contact with dissimilar metal. Fastener shall be of an alloy appropriate for use with the flashing material.

2. Through-wall flashing – Through-wall flashing shall be copper fabric laminate 3 oz. copper with asphalt impregnated cotton fabric both sides, or shall be 30 mil PVC modified flexible plastic sheets similar to Sandell "Copper-Fabric Flashing" or Nervastral "Nervastral 300".

3. Window and Door flashing – Integral with unit or .032 inch aluminum.

4. Gutters and Downspouts –

   a. Gutter: 5 inch style K (o.g.) aluminum .027 inch thick, prefinished color similar to Alcoa with all necessary brackets, outlet boxes, end caps, gutter guards, joining sections, mitered section, hangers, and straps as necessary for a completely finished job.

   b. Downspouts: 3 inch x 4 inch corrugated aluminum, .027 inch thick, prefinished color similar to Alcoa with all necessary elbows and fasteners, OR 2 inch x 3 inch corrugated PVC with metal-to-vinyl adapter below gutter outlet, Rain Master 2200 or equal.

      Provide removable leaf strainer at neck of downspout.

7.6 C Execution:

1. Install flashing where required to provide weatherproof enclosure in accordance with conventional and specified standards and in accordance with manufacturer's printed instructions.

2. Provide expansion joints in long lengths of exposed metal flashing. Seal all seams, corners, boxes and turnings at all joints in flashing material.

3. At roof penetrations, install preformed type of cap and counter flashing in accordance with manufacturer's recommendation.

4. Provide new eave boxes where required of size to suit drainage requirements, with apron and cap flashing to suit downspout size. All seams in eave box fabrication shall be soldered.

5. Downspouts shall be mechanically fastened to walls at no smaller interval than 8 ft. vertically and no less than one fastener per piece. Cement downspouts at boot fitting.

6. Repair flashing and sheet metal work at neighboring structures when damaged either in demolition or in the performance of the new work with materials matching the quality and type of the existing damaged elements.

7. Repair of sheet metal work at cornices and bays of existing structure: Repair shall match quality, material, type, workmanship and configuration of the existing sheet metal.

SECTION 7.7 DRAINAGE PLANE

7.7 A When required:

For all frame construction, a continuous drainage layer is required behind the exterior cladding. See Joseph Lstiburek, *Builder's Guide – Moderate Climates*, © 1998 Building Science Corp., EEBA and Shelter Source, Appendix I: Rain and Drainage Planes

7.7 B Products:

1. Flexible systems –

   a) 15-lb or heavier asphalt-impregnated sheathing paper

   b) vapor-permeable synthetic membrane: Tyvek (DuPont), Typar (Reemay), Amowrap (Tenneco), Barricade (Simplex), Pinkwrap (Owens Corning)

2. Rigid systems –

   Foil-faced polyisocyanurate foam insulation or a foil facing integral with sheathing, and approved tape

3. Sealing tapes –

   a) For use on synthetic membrane – as approved by membrane manufacturer

   b) For use on foil – 3M 8086 or Contractor Sheathing Tape; DuPont Contractor Tape; Benjamin Obdyke Inc. Gap Wrap or approved equal

4. Adhesive membrane strip – MiraDri 860/861 self-adhering membranes or approved equal

7.7 C Compatibility: Housewrap-type synthetic membranes are prohibited –

1. Unless there is an air gap between the membrane and the exterior cladding (e.g. with face brick, siding). They may be used behind stucco or wood siding only if an intermediate air space is provided by furring strips or channels.

2. Over oriented strand board (OSB).

7.7 D Execution:

1. Location: Fasten drainage layer to exterior surface of sheathing.

2. Installation of flexible drainage layers:

   a) Install according to manufacturer's instructions.

   b) Lap horizontal joints shingle fashion to drain water to exterior. *Synthetic membrane only:* tape joints to exclude air.

   c) Lower termination: To drain water to the exterior, provide aluminum flashing at bottom of drainage layer where it terminates above a projection (such as a roof or a step in the plane of the wall). Lap material over flashing to drain water to exterior.

   d) Openings: Wrap drainage material around all penetrations and openings for full depth of framing. Provide head flashing above all penetrations and openings. Lap material and flashing to drain water to exterior.

3. Installation of rigid drainage layers:

   a) Install according to manufacturer's instructions.

   b) Joints: Tape all joints with approved foil tape.

   c) Lower termination: To drain water to the exterior, provide aluminum flashing at bottom of drainage layer where it terminates above a projection. Tape flashing to exterior surface with approved adhesive membrane strip.

   d) Openings: Cover sill framing with adhesive membrane strip and lap over rigid drainage material. Provide head flashing above all penetrations and openings. Tape flashing to exterior surface with approved adhesive membrane strip.

SECTION 7.8 PREFORMED SIDING

7.8 A General:

1. Standards –

   a. Aluminum siding shall meet FHA Minimum Property Standards 4900.1 and 4910 and AAMA Specifications 1402.3.

   b. Vinyl siding shall comply with the regulations set forth in ASTM standard specification for Rigid Polyvinyl Chloride (PVC) Siding #D369 Class 2.

2. Color – Contractor shall provide a selection of a minimum of 7 standard manufacturer's colors for use on each project, and shall secure the owner's approval of color prior to each installation.

3. Installer shall have a minimum of 5 years established experience in the work of this trade.

7.8 B Product:

1. Aluminum – equal to Alcoa "single 8 inch Horizontal Siding, Smooth Texture – .024 inch thick 7N" with 38-inch styrofoam drop-in backing, tabs, nails, caulking, window flashings, drips, starter strips and matching metal for field forming. All exposed parts shall be prefinished to match the color of the selected siding.

2. Vinyl – equal to Wolverine Technologies "Vinalside Classic" solid vinyl siding, 0.44 inch nominal thickness, minimum weight 35 lb. per square, with all required accessories. All exposed parts shall be prefinished to match the color of the selected siding.

7.8 C Execution:

1. Install siding in strict accordance with manufacturer's instructions.

2. Match architectural configuration and detail of substrate to be covered to the greatest possible degree.

SECTION 7.9 ROOF ACCESSORIES

7.9 A Products:

1. Skylights –

   a. New: double-glazed, as called for in construction documents.

   b. Existing single-glazed: add permanent glazing panel at ceiling level. If skylight is operable, then the interior glazing panel shall also be operable and shall form a tight seal when closed.

2. Roof hatches shall be metal covered wood box type construction on raised curb with hook at interior. Design and construction shall match conventional industry standards.

7.9 B Execution:

1. Mount all skylights and roof hatches on flashed wooden curb. Height of curb shall be 8 inches minimum.

2. Repair of existing skylights and roof hatches: Repair shall match quality material and workmanship of the existing installation.

3. All work on skylights and hatches shall conform to latest building code requirements.

SECTION 7.10 SEALANTS

7.10 A Products:

1. For interior use –

   a. Foam sealant at air barrier penetrations: Non-expanding one-part polyurethane foam.

   b. Caulk for air-sealing, interior trim *(surfaces to be painted):* White pigmented siliconized acrylic rated by the manufacturer to last 25 years or more. Shall meet ASTM standard C834-76.

   c. Caulk for air-sealing, interior trim *(already-painted or wallpapered surfaces):* Clear siliconized acrylic rated by the manufacturer to last 25 years or more.

2. For exterior use –

   a. Colors: where sealant is visible on exterior, provide matching color at storm door, windows and siding. Provide gray or "mortar" color at brick and masonry openings and elsewhere.

   b. Sealant at doors and windows: One part Urethane Sealant II-S-00230C Type 2 class A, ASTM C920-79 Type S Grade NS Class 25.

      Approved products: Chem Caulk – 900
      Pecora Dynatrol – 1
      PRC – 6000
      Tremco Dymonic
      Sonneborn NP-1

   c. Sealant at aluminum siding: OSI Rubber, Butyl Rubber Caulk TT-S-001657 Type-1.

      Approved Products: Chem Caulk – 300
      Pecora BC – 158
      PRC – 2000
      Tremco – Butyl

d. Sealant at vinyl siding: to meet siding manufacturer's specification for compatibility.

3. General –
   a. Primer: As recommended by sealant manufacturer.
   b. Backer Rod: compressible polyethylene foam strip.

7.10 B Execution:

1. Install caulking using gun applied cartridge type sealant at all locations requiring sealing, and at least at the following locations:

   a. At doors, windows and other exterior openings.

   b. At backing at flashings, fascias, and thresholds.

   c. At aluminum siding work.

2. Joints which exceed 3/8 inch in depth shall be filled with backer rod or other effective caulk-backing material before caulk is applied. Caulk shall not be used to seal joints which exceed 3/8 inch in width.

3. Clean loose materials, install priming and backer rod where required, seal the joint to full depth, even with adjoining surfaces, and tool completed joint with thumb or spatula. Remove excess materials promptly.

SECTION 7.11 AIR-SEALING

7.11 A General:

1. Related sections –

   a. Steel Framing 5.1
   b. Rough Carpentry 6.1
   c. Thermal Insulation 7.2
   d. Sealants 7.9
   e. Use of Blower Door 7.11
   f. Plumbing and Drainage 15.2
   g. Venting of Water Heaters and House Heaters 15.6
   h. Ductwork 15.8
   i. Electrical 16.1

2. Definitions –

   a. Air barrier: Building elements which prevent the migration of air between zones.

b. Zone: An air space, within which air movement is permissible or desirable, but which is intentionally separated from other spaces. (See 7.11.C.3 for examples.)

c. Outer air seal: Exterior air barrier, including shell and air sealing measures, intended to prevent infiltration of outside air into framing cavities and spaces within the thermal boundary.

d. Inner air seal: Interior air barrier, including interior building finish and air sealing measures, intended to prevent transfer of air between building interior and framing cavities.

e. Intermediate air seal: Measures performed to subfloor, framing voids, shaftways, chaseways, and penetrations to isolate, or impede air flow between, zones as required.

f. Top floor ceiling air barrier: Continuous air barrier, terminating at exterior sheathing or masonry, intended to prevent the transfer of air between roof cavity and all zones below, including building interior and framing cavities.

g. Thermal boundary: See section 7.2.

h. Unconditioned space: Space enclosed by building shell but outside thermal boundary.

i. Conditioned space: All space within thermal boundary.

j. Sealing measure: Sealant, rigid or spray-applied blocking, or a combination of blocking and sealant as appropriate.

7.11 B Products:

1. Rigid blocking –

   a. Lumber, plywood
   b. Radiator reflector board: foil-faced foam
   c. Foam insulating board: polyioscyanurate, extruded polystyrene
   d. FSK-faced rigid glass fiber

2. Spray-applied blocking –

   a. Expanding foam
   b. Damp-spray cellulose

3. Sealants: As listed in section 7.9

4. Gaskets: Silicone, EPDM, or neoprene bulb

5. Fire-resistive materials –

   a. Sealant: RTV silicone firestop caulk
   b. Sheet metal: .032 inch pre-finished aluminum
   c. Concrete board: nominal 1/2-inch thick Durock, Eternaboard, Utilicrete

7.11 C Execution:

1. Firestops – Provisions of this section do not supersede firestopping or smoke barrier requirements of this or any other applicable code.

2. Blower door test – Sealing measures shall be judged adequate when structure passes all portions of blower door test. Note that there are minimum and maximum allowable airflows.

3. Zones requiring separation by air sealing (note that firestop requirements may apply to air-sealing materials) –

   a. Finished interior, basement, and ductwork.
   b. Framing voids and chaseways.
   c. Attic or roof cavity and the outdoors to which it is vented.
   d. Framing cavities in projecting construction (bays).
   e. Any part of basement or crawlspace specifically defined as outside the thermal boundary.

4. Outer air seal –

   a. Basement and crawlspace:

      1) Exterior walls – seal unintentional wall openings of basements and crawl-spaces within thermal boundary.

      2) Space outside thermal boundary – Seal all openings between conditioned and unconditioned spaces (see Definitions, part A).

      3) Basement-under-porch partition: weathersrip partition door.

   b. Roof cavities and attics:

      1) Unconditioned – For cavities outside thermal boundary, do not seal to outside unless otherwise required.

      2) Conditioned – For cavities enclosed within thermal boundary (i.e. un-vented with roof deck and exterior walls insulated), seal to outside.

c. Exterior walls (not covered in a. or b. above):

1) Masonry and sheathing – Seal all cracks, gaps and unintentional openings.

2) Fenestration – Frames and sills shall be sealed to rough openings.

3) Bay over porch – Seal underside of bay framing to separate bay from porch roof space.

5. Intermediate air seal (framing) –

a. Top floor ceilings: Seal cavities of perimeter stud walls and partitions at ceiling level. Note: failure to provide firestop or top plate at ceiling level may increase cost of air sealing.

b. Dropped ceiling between apartments: Seal cavities of perimeter stud walls and partitions at ceiling level.

c. Bays and projections:
1) Cantilevered joists – Block and seal joist bays where projecting through exterior wall.
2) Roof cavity – Seal opening into bay roof at exterior wall.

d. Bathtub at exterior wall: Seal exterior wall cavity from space under tub.

e. Subflooring: Above basement and crawlspace, seal subfloor to exterior sheathing or masonry.

f. Chaseways: Seal all openings into attics, roof cavities, basements and crawl-spaces.

g. Framing penetrations:

1) Piping subject to movement – All seals around soil stack, stack vent, and domestic water piping shall employ resilient materials. Rigid foam shall not be used.

2) Hot pipes and ducts – Seals around all hot water, hydronic, or steam piping, and uninsulated warm-air ducts shall employ resilient materials rated for the service temperature.

h. Chimneys and vents: Use approved noncombustible materials within 2 inches of chimney, B-vent, or flue carrying combustion products, or follow appliance manufacturer's directions.

i. Electrical devices: Seal cable knockouts from back of box unless box is provided with device and cover designed to prevent infiltration.

j. Abandoned flues, conduits and chases: Remove or seal to prevent air movement between zones.

6. Inner air seal –

a. Sealing drywall to framing:

1) Top-floor ceiling – Seal interior finish to wall framing at ceiling level to prevent air transfer between vented roof cavity and wall cavities below.

a) Ceiling method: Caulk edges of ceiling finish to all top plates, runners, and firestops prior to installing wall finish. For ceilings finished prior to framing walls, caulk to exterior masonry.

b) Wall method: Install approved drywall gasket, caulk, or panel adhesive to top plates, runners, and firestops before installing interior finish.

b. Openings for mechanicals: In top-floor ceilings and all exterior walls, caulk penetrations of interior finish for electrical devices, pipes, register boots, etc.

c. Prioritizing inner air sealing measures: Where necessary to comply with whole house infiltration (blower door) test limits, caulk trim to interior finish in the following order of priority:

1) All bathrooms

2) Exterior walls on top floor.

SECTION 7.12 USE OF BLOWER DOOR – PROCEDURES AND TESTING

7.12 A General:

1. Section includes –

a. Whole-house infiltration test.
b. Top-floor ceiling air barrier test.
c. Duct system exterior leakage test.

2. Applicability – Rehab and new construction, gross floor area 3500 square feet or less between firewalls.

3. Certification – Operator performing tests shall be certified by PHDC/RDA.

4. Test results shall be submitted to PHDC/RDA.

5. Related sections –

a. Air sealing 7.10
b. Space heating – general 15.5
c. Ductwork 15.7

6. Definitions –

a. Pascal: Unit of pressure. One inch water column = 249 Pascals (Pa).
b. cfm_{50}: Cubic feet per minute at a pressure difference of 50 Pa.

7.12 B Instrumentation:

1. Blower door kit – Variable speed fan rated 4000 cfm at 50 Pa min., expanding frame, calibrated flow sensor.

2. Micromanometer – Digital pressure gauge accurate to 0.5 Pa.

3. Pressure pan – Shallow box, one face open and gasketed, with pressure tap for testing registers.

7.12 C Execution:

1. Whole-house infiltration (blower door) test –

a. Multi-family with separate outside entryways: Where no one entryway gives access to all units, treat each portion of the building served by its own entryway as a separate building.

b. Procedure:

1) Set up – Erect blower door in common entry, place exterior windows and doors in winter position, open basement and apartment doors to common area, fill traps with water or seal, close basement vents. (See "Measuring Air Tightness with a Blower Door" and "#2 Air Sealing" in the OHCD/ PHDC/ RDA *ResourceEfficient Rehabilitation Implementation Guide*, and separate guideline "Testing Roof cavity Pressure to Verify Integrity of Top-Ceiling Air Barrier.")

2) Measurement – Depressurize building to 50 Pa, read cfm_{50} air flow. If fan cannot reach 50 Pa, calculate cfm_{50} = cfm * (50/pressure)^0.65, or use "can't reach 50" table.

c. Allowable limits:

1) Row house or other connected building – flow *shall not exceed* 2400 cfm, or 3 cfm per square foot of finished space, whichever is larger. Notify Inspector if flow *is less than* 1800 cfm, 1 cfm per square foot, or 900 cfm per unit, whichever is larger.

2) Single house or free-standing building – flow *shall not exceed* 2000 cfm, or 2.5 cfm per square foot, whichever is larger. Notify Inspector if flow *is less than* 1400 cfm, 0.75 cfm per square foot, or 700 cfm per unit, whichever is larger.

d. Correcting failure: If maximum flow limit is exceeded, continue air sealing according to requirements of Section 7.10.

2. Top-floor ceiling air barrier test – Conduct test on all roof cavities outside thermal boundary.

a. Procedure: Depressurize building to 50 Pa. Measure pressures between roof cavity, building interior, and outside. Sum of pressures from interior to roof cavity, and from roof cavity to outside shall be within 1 pascal of pressure from inside to outside.

b. Allowable limit: Cavity pressure with respect to outside shall be less than 10% of house pressure (5 Pa with building at 50 Pa).

c. Correcting failure: If cavity pressure limit is exceeded, identify and caulk openings in interior finish responsible for passage of air from building interior to attic or roof cavity.

3. Duct system exterior leakage test –

a. Procedure: Depressurize house to 50 Pa with basement and furnace room doors open. Place pressure pan over each register individually and measure pressure with micromanometer.

b. Allowable limit: Register pressure shall not exceed 1.5 Pa.

c. Correcting failure: if register pressure limit is exceeded, repair duct leakage. Restore any damaged interior finish to original condition.