ARCHITECTURAL SHEET METAL MANUAL

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.
www.smacna.org

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SEVENTH EDITION – JANUARY, 2012

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FOREWORD

This seventh edition of the Architectural Sheet Metal Manual has many changes and several additions. Changes include new chapters and details on penetrations, additional and revised tables in support of commentary and illustrations, additional commentary and illustrations in support of newer construction techniques, an expanded appendix covering issues that have received industry emphasis since the last edition and many clarifications.

A pair of "fast look-up keys" has been placed in front of the Table of Contents to assist users with the speedier location of information in this 542-page technical document.

Nearly every building constructed is unique. Architectural sheet metal elements can be used to distinguish an otherwise ordinary building. Metal roofs, column covers, domes and spires add character and can be used by skilled designers to make a dramatic architectural statement. Architects and designers can use unique metals, variations of metal finishes, contrasting roof seam types, shaped metal cornices, finials, and other elements that are provided by custom sheet metal to best convey the expressed desires of the most forward-thinking owners.

Sloped roofs are an especially important architectural element and, although there are many proprietary roof systems currently on the market, the unique attributes of custom-fabricated metal deserves the innovative designer's first and last consideration. By their nature, proprietary roof systems are designed for a mass market and a certain degree of architectural uniqueness is lost with the use of packaged systems. Packaged systems typically rely heavily on sealants as weatherproofing and standard package flashing. A custom sheet metal contractor who installs a packaged roof system can provide custom detailing and job-specific flashing that will greatly enhance the roof's overall weathertightness. Custom sheet metal has the inherent advantages of building-specific design, soldered joints, and other beneficial characteristics that can only be realized through the use of custom sheet metal.

In order to provide designers a broader choice in application and design and to reflect local practices as well as varying geographic conditions, this manual often includes alternative methods of design and construction. Not all local area practices are discussed or illustrated as this would be impractical. Deviations from included recommendations may often be permissible, depending upon verification of satisfactory service under conditions other than those covered in this manual. Careful examination of the information herein and local climate conditions will enable designers to select the proper detail for practically any architectural sheet metal requirement.

Designers and owners are strongly encouraged to consult local SMACNA architectural sheet metal contractors about any application of architectural sheet metal. Local architectural sheet metal contractors can offer technical guidance and make suggestions on the choice of metals, the relative economies of different techniques, the practicality of design details, and can otherwise share their experience. You can find a local SMACNA contractor using the online member list at http://www.smacna.org for specific technical and design assistance. Architects can use elements from this manual as a guide in developing an architectural sheet metal section of their project specifications.

Direct reference to this manual by figure or detail number is encouraged.

SMACNA expresses appreciation to the committees and task forces, architects, sheet metal contractors, journeymen sheet metalworkers, manufacturers, and other interested individuals and companies that have contributed time, knowledge and experience in the development of this and former editions. SMACNA's technical staff also gains insight into the need for additions and changes based on the incoming technical inquiries—a service offered to the public via the SMACNA Website Technical Inquiry form—but also an ongoing feedback path for ideas and subject areas of industry interest. Many drawings, much commentary and suggestions have been consigned to further study and, as the association is able to make additional clarification for various applications, it will do so.

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
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CHAPTER RP

ROOF PLANS

TYPICAL METAL ROOF PLAN

The master isometric drawing in this figure contains keys to related components and other Figure Numbers that are listed below. The location of each key on the illustration is generally recognizable as a gutter, downspout, eave, ridge, valley, hip, rake, headwall, roof transition, coping, or other component. Associated Figure Numbers address some aspect of design or installation. Consult the Table of Contents to identify the subject covered by each listed Figure Number and to pursue specific interests. Use of the key system should improve lookup of references and facilitate in achieving a well-designed, coordinated roofing and flashing system.

Item Number	Component	Figure Numbers
1	Hanging Gutter	1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1–12, 1–13, 1–14, 1–15, 1-17, 1-18, 1-19, 1-20, 1-24
2	Built-In Gutter	1-4, 1-5, 1-8, 1-9, 1-21, 1-23, 1-24
3	Scupper/Conductor Heads	1-25, 1-26, 1-27, 1–28, 1–29, 1–30
4	Downspouts	1-31, 1-32, 1-33, 1-34, 1-35, 1-36
5	Formed Metal Copings	3-1, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-9
6	Flashing	4-4, 4-5, 4–6, 4–7
7	Metal Roofs	6-1, 6-4, 6-5, 6-6, 6-8, 6-9, 6–10, 6–15, 6–16, 6–18, 6–22, 6–23
8	Valley Flashing	6-7, 6-10
9	Ridge/Hip Flashing	6–6, 6–9, 6-17
10	Dormer Flashing	6–4, 6-6, 6-9, 6–10, 6-17
11	Roof Penetrations/Skylights	6-17, 8–1, 8–2, 8–3, 9–12
12	Domes	6-22, 12–7
13	Metal Wall Systems	7–1, 7–2, 7–3, 7–5, 7–6, 7–8, 7–9
14	Column Covers	10–1
15	Roof Penetration	8–12
16	Headwall Flashing	6-7, 6-17
17	Roof Rake/Edge	6–4, 6-6, 6–7, 6–10, 6–14, 6–15, 6–16, 6-18, 7–6

Table RP–1 Metal Roof Plan – Fast Lookup Keys to Architectural Elements

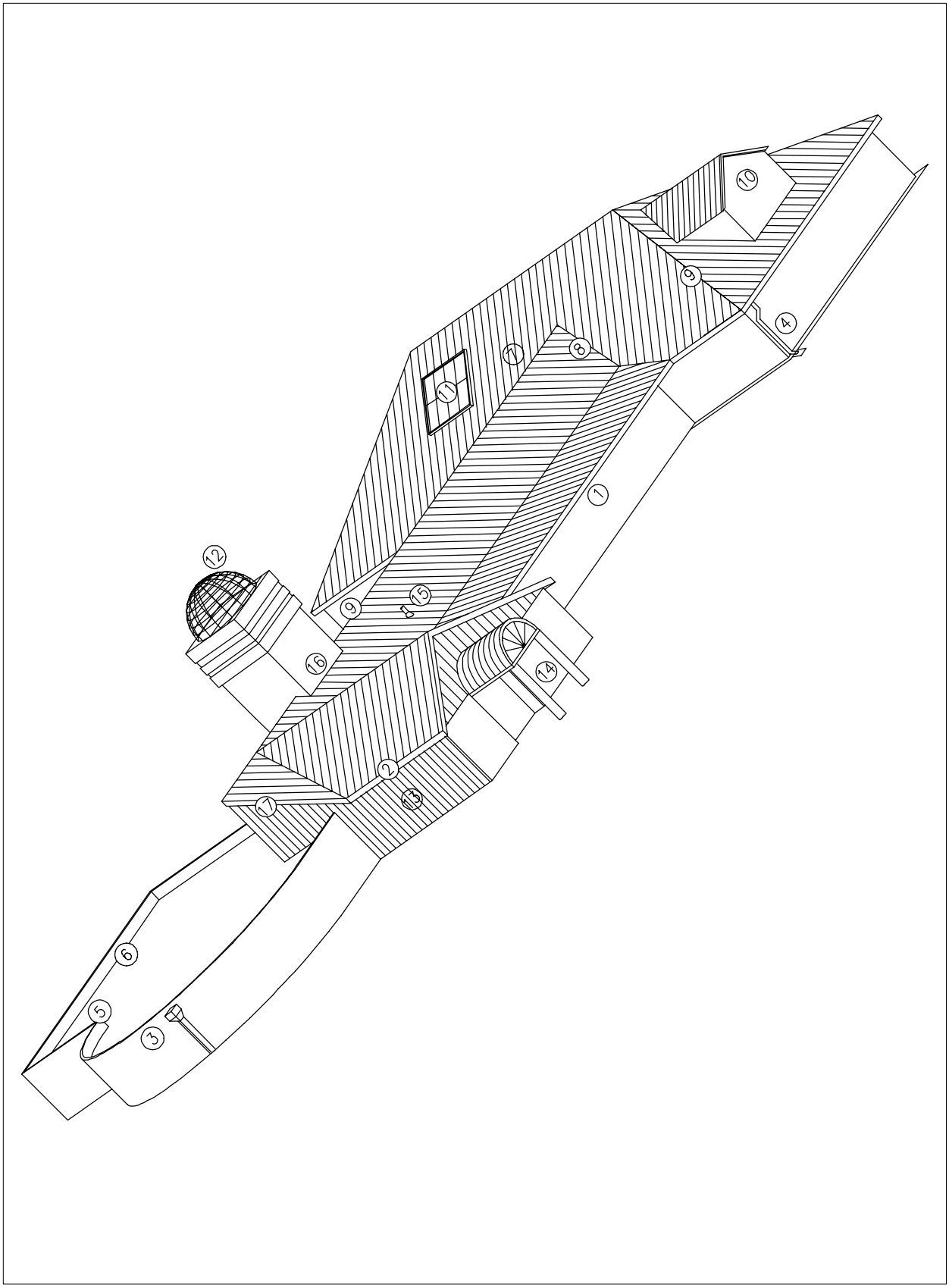

FIGURE RP–1 TYPICAL METAL ROOF PLAN

TYPICAL SHINGLE/TILE/SLATE-ROOF PLAN

The master isometric drawing in this figure contains keys to related components and other Figure Numbers that are listed below. The location of each key on the illustration is generally recognizable as a gutter, downspout, eave, ridge, valley, hip, chimney, roof transition, coping, or other condition. Associated Figure Numbers address some aspect of design or installation detailing. Consult the Table of Contents to identify the subject covered by each listed Figure Number and to pursue specific interests. Use of the key system should speed look up of references and facilitate in achieving a well-designed, coordinated roofing and flashing system.

Item Number	Component	Figure Numbers
1	Hanging Gutter	1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1–12, 1–13, 1–14, 1–15, 1-17, 1-18, 1-19, 1-20, 1-24
2	Built-In Gutter	1-4, 1-5, 1-8, 1-9, 1-21, 1-23, 1-24
3	Scupper/Conductor Heads	1-25, 1-26, 1-27, 1–28, 1–29, 1–30
4	Downspouts	1-31, 1-32, 1-33, 1-34, 1-35, 1-36
5	Formed Metal Copings	3-1, 3-2, 3-3, 3-4, 3-6, 3-7, 3-9
6	Flashing	4-4, 4-5, 4–6, 4–7
7	Roof Transition	4-18
8	Valley Flashing	4-10, 4–11
9	Ridge/Hip Flashing	4-12
10	Dormer Flashing	4–10, 4–12, 4–17, 4-18
11	Roof Penetrations/Skylights	9–12
12	Column Covers	10–1
13	Roof Penetration	8–12
14	Headwall/Chimney Flashing	4–14
15	Roof Edge	4–13, 4–18

Table RP–2 Shingle/Tile/Slate-Roof Plan – Fast Lookup Keys to Architectural Elements

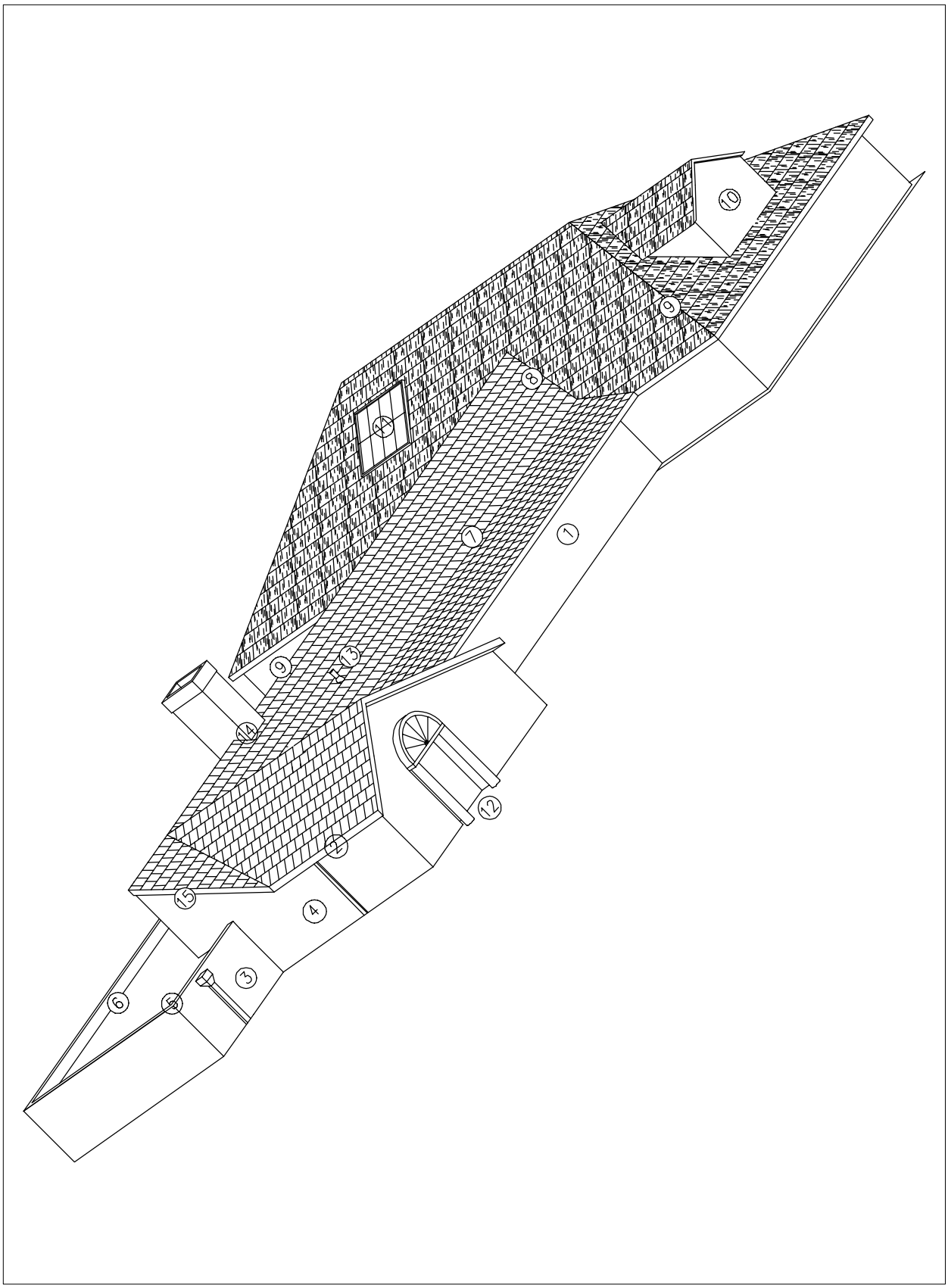

FIGURE RP–2 TYPICAL SHINGLE/TILE/SLATE-ROOF PLAN

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CHAPTER 1

ROOF DRAINAGE SYSTEMS

DESIGN OF ROOF DRAINAGE SYSTEMS

ROOF DRAINAGE

The roof is one of the most essential parts of a building as it protects occupants, contents, and interior of the structure from the elements. Once an architect has determined which kind of roof to use, he must give equal attention to the design of the roof drainage system.

Factors to be considered in the design of roof drainage systems are the area to be drained, size of gutters, downspouts, outlets, slope of roof, type of building, and appearance.

ROOF AREA TO BE CONSIDERED

The design capacity for a roof drainage system depends on the quantity of water to be handled. The quantity of water in turn depends on the roof area, slope, and rainfall intensity.

In considering the roof area, remember that rain does not necessarily fall vertically and that maximum conditions exist when rain falls perpendicular to a surface. Since the roof area increases as pitch increases, it is not advisable to use the plan area of a pitched roof in the calculation of a drainage system.

The true area of a pitched roof often leads to oversizing of gutters, downspouts, and drains. To determine the design area for a pitched roof, use Table 1-1.

Pitch		*B
in./ft	mm/mm	
Level to 3	75/305	1.00
4 to 5	100 – 127/305	1.05
6 to 8	152 – 203/305	1.10
9 to 11	229 – 279/305	1.20
12	305/305	1.30

Table 1–1 Design Areas for Pitched Roofs

*To determine the design area, multiply the plan area by the factor in B column. These areas are then divided by the proper factor given in Table 1-2, thus obtaining the required area in in.^{2} (mm^2) for each downspout. From Table 1-3 select the downspout.

RAINFALL INTENSITY—DOWNSPOUT CAPACITY

Rainfall intensity is usually given in inches per hour for a five-minute duration or one hour duration based on U.S. Weather Bureau records. Table 1-2, based on records through 2002, gives five-minute intensities for selected cities. New Orleans, for example, may have 8.3 in. per hr (211 mm per hr) for a five-minute duration yet record only 4.8 in. (122 mm) in an hour over a 100 year period. These rates correspond to 0.133 in. per min. (3.4 mm per min.) and 0.08 in. per min. (2 mm per min.). Local codes may require that drainage systems only be designed for the latter. It takes 96.15 ft^2 (8.93 m^2) of surface with 1 in. per hr (25 mm per hr) of water to generate 1 gpm (0.063 l per s) flow rate. This is the basis for sizing downspouts and gutters from rainfall intensity.

Plumbing codes typically use the vertically projected roof area for drainage design, and they often use a square foot allowance per square inch of downspout for 1 in. per hr. (25 mm per hr.) rainfall that varies with diameter, for example, 3 in. (75 mm): 911 ft^2 (85 m^2); 4 in. (100 mm): 1100 ft^2 (100 m^2); 5 in. (127 mm): 1280 ft^2 (119 m^2); 6 in. (152 mm): 1400 ft^2 (130 m^2) and 8 in. (203 mm): 1750 ft^2 (163 m^2). Net drainage capacity from using Tables 1-1 and 1-2 should be compared with local code requirements.

DOWNSPOUT SIZING CONSIDERATIONS

To calculate downspout size in square inches (square mm) divide the roof design area by the proper factor given in Table 1–2. Select the downspout from Table 1-3.

In sizing downspouts, the following considerations apply:

a. Downspouts of less than 7.00 in.^{2} (4515 mm^2) cross section should not be used except for small areas such as porches and canopies.

b. The size of the downspout should be constant throughout its length.

c. Downspouts should be constructed with conductor heads every 40 ft (12.2 m) to admit air and prevent a vacuum.

d. Offsets of more than 10 ft (3.0 m) can affect drainage capacity.

e. The gutter outlet capacity should match the downspout capacity.

f. The downspout size must suit the bottom width of the gutter.

g. The attachment through Exterior Insulation Finishing Systems (EIFS) should have sufficient backing.