# NVELOPE NV3

## Thermally broken cladding Support System

# SFS is commited to service

At SFS, positive customer experience is paramount. We blend proactive engineering and holistic add-on services to provide our customers end to end solutions. Feel free to contact us by phone or email, or visit our website, us.sfs.com, where you can easily find a vast array of information at your fingertips.

**Engineering Services**
Our highly creative technical specialists provide a systematic approach. This includes multi-disciplined engineering services which ensure optimal performance of the building envelope.

**Services for façade framing systems**
We are experts in design development, shop drawings and submittal calculations on complex building facades.

**Order Delivery Services**
Our reliable order processes and worldwide delivery network, ensure complete and on-time as ordered service.

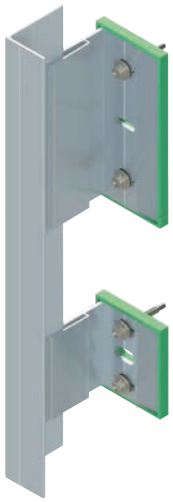
**Digital power tools**
Determine which NVELOPE cladding system is ideal for you with our NVELOPE Design Assist technology. Then use our Budget calculate to quickly and easily estimate the square foot cost of an NVELOPE system and materials.

## Table of contents

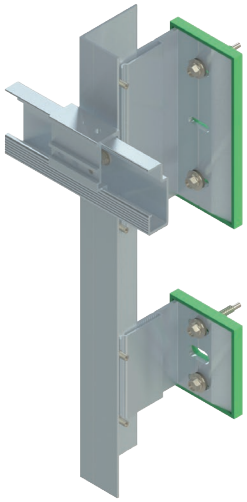

| | |
|---|---|
| NVELOPE systems summary | 3 |
| NV3 system installation guide | 4 |
| Standard NV3 detail sheets | 11 |
| Bracket data sheets | 31 |
| Rail data sheets | 37 |
| Fastener data sheets | 39 |
| NV3 thermal report | 44 |
| NFPA 285 letter/evaluation | 118 |
| Sustainability information | 143 |
| Sample Warranties | 157 |

# NVELOPE brackets, rails and systems

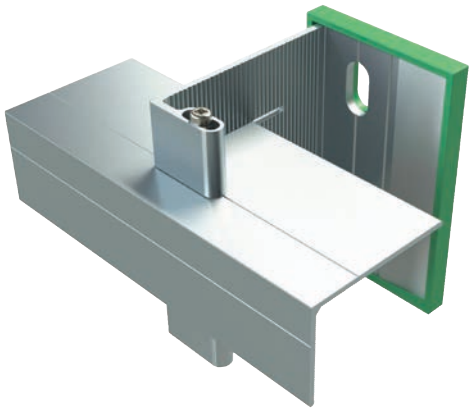
**NV1 – Vertically running rail system**
Adjustable main support system for horizontally-attached rainscreen cladding applications. Mechanical face fastened panels.



**NV3 – Hidden mechanical fastened system**
Adjustable system for hidden fastened applications. Cladding panels mechanically attached.



**NH3 – Horizontally running rail system**
Subframe system used to support vertical elements. Mechanical face fastened panels.



**NVF2F – Floor to floor system**
Brackets and rails provide a vertical back frame system for floor to floor spanning.

# NV3 Installation guide

# Component guide

## NVELOPE rainscreen cladding brackets and framework simplify the complexity of installing facades. NVELOPE systems are designed to provide a vertical support for most facade types. NVELOPE purpose-designed brackets allow for final alignment and adjustment.

### Brackets

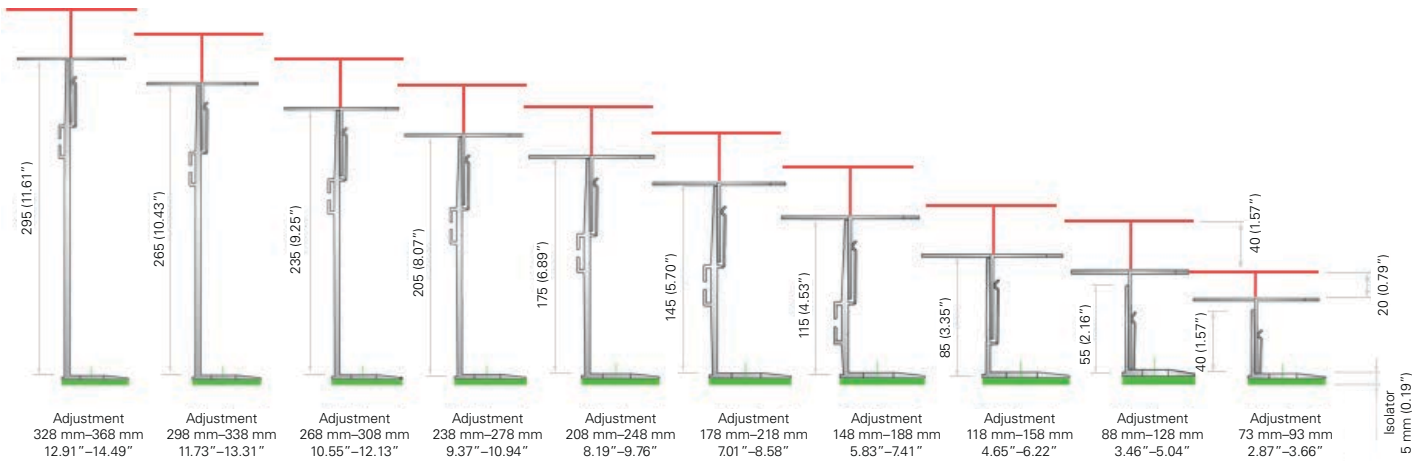
The NVELOPE bracket range includes single and double variations of each bracket size, the difference being the depth of the bracket (75 mm single, 150 mm double). A double bracket is capable of supporting higher cladding loads, and is used in the fixed point location for projects that feature more demanding wind or cladding loads.

The substrate slot variations on NVELOPE brackets are to suit a wide range of substrate materials. For steel and timber substrates 6.5 mm slots are used; for brick, block and concrete, the 11 mm slots are used. The single bracket includes both slot variations so is suitable for all substrates.

| | Min system | | Max system | | | | |
|---|---|---|---|---|---|---|---|
| Size | (mm) | (in) | (mm) | (in) | Single (6.5/11 mm slot) | Double (6.5 mm slot) | Double (11 mm slot) |
| 40 | 47 | 1.85" | 67 | 2.64" | 1582505 | 1521239 | 1521238 |
| 60 | 62 | 2.44" | 102 | 4.01" | 1582506 | 1521247 | 1521246 |
| 90 | 92 | 3.62" | 132 | 5.19" | 1582508 | 1521255 | 1521254 |
| 120 | 122 | 4.80" | 162 | 6.37" | 1582509 | 1521263 | 1521262 |
| 150 | 152 | 5.98" | 192 | 7.56" | 1582510 | 1521273 | 1521272 |
| 180 | 182 | 7.16" | 222 | 8.74" | 1582511 | 1521282 | 1521281 |
| 210 | 212 | 8.35" | 252 | 9.92" | 1582512 | 1521291 | 1521290 |
| 240 | 242 | 9.52" | 282 | 11.10" | 1582514 | 1521300 | 1521299 |
| 270 | 272 | 10.70" | 312 | 12.28" | 1582517 | 1521309 | 1521308 |
| 300 | 302 | 11.89" | 342 | 13.46" | 1582520 | 1521317 | 1521316 |
| 270 (+extension)* | 332 | 13.07" | 372 | 14.65" | 1582517 (+1521188) | 1521309 (+1521187) | 1521308 (+1521187) |
| 300 (+extension)* | 362 | 14.25" | 402 | 15.83" | 1582520 (+1521188) | 1521317 (+1521187) | 1521316 (+1521187) |

*Example to show largest possible cladding zones. Extension piece is compatible with all bracket sizes, and is available as single (1521188) or double (1521187).

### Cavity depths



# Component guide

## Profiles

Generally, profiles are cut to lengths that reflect the height of the panels that are going to be attached to them. Typically story-height profiles are cut so that the panels are located on one set of vertical profiles and do not 'bridge' the expansion gap between two profiles.

These are secured to the bracket using a secondary fastener.

SFS is able to offer an optimized solution, minimizing wastage on site by cutting profiles to length in our factory and delivering precut ready to install directly to the project.

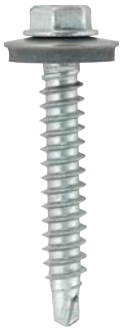
L profile

| Type | Dimensions | Material number |
|---|---|---|
| L Profile | 60 x 40 x 2.2 x 3000 mm (118.11") | 1521357 |
| L Profile | 60 x 40 x 2.2 x 6000 mm (236.22") | 1521375 |
| NV3 Carrier Profile | 3000 mm (118.11") | 1521331 |
| NV3 Carrier Profile | 6000 mm (236.22") | 1521334 |

## Primary fasteners

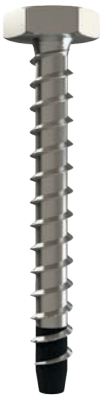
**BMSD2-#14x2**
1673590

**SXW-S16-6,5x52**
1123138



**TCS-3/8x3"-304SS**
1677827

**MMS-Plus-SS-10x80**
1204995



## Secondary fastener

**SDA5/5.5x22**
1507572

*fastener images not to scale

# Component guide

**Hangers**

Our hangers come in adjustable and fixed versions. They also have a second hole to lock panels into their final positions.

The number of hangers needed is determined by calculation, please contact our technical team for assistance.

SFS stocks hangers to suit a range of panel fixings, please get in touch to discuss your requirements.

For hanger installation guidance using the TUF-S fastener range, see our TUF-S Installation Guide.

**NV3 hanger for TUF-S fasteners**
Adjustable 3.5mm: 1549012 | Adjustable 5mm: 1549046
Fixed 3.5mm: 1549015 | Fixed 5mm: 1549047

**Other NV3 hanger styles available**
Get in touch for details

**NV3 hanger adjustment screw**
M6-20SS-A2
1521489

**NV3 locking screw**
#12 x 1–5/8" 304SS bi-metal self-drill
1134478

**TUF-S fasteners**
316SS hidden fastener for: Attachment of HPL or fiber cement panels

# Installation guide

## 1. Secure NVELOPE brackets to substrate

**1.1** Position the brackets as per the approved shop drawings.

**1.2** Secure using the recommended primary fastener.

**Note:** Recommended primary fasteners vary dependent on the wall type. Please contact us for recommendations.

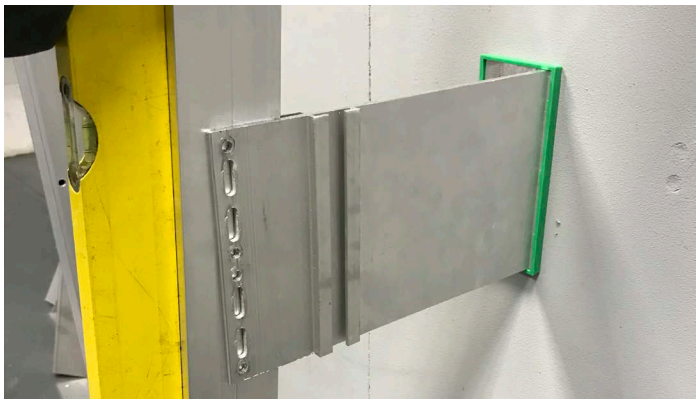
We recommend pull-out tests are carried out for attachment into blockwork and brick.

## 2. Insert profiles into brackets

**2.1** Once the NVELOPE brackets are aligned in correct positions, fit the cut length profiles into the helping hand of the bracket, following the shop drawings.

**2.2** Push the profile into the bracket's helping hand and adjust for line and level.

**2.3** Check for line and level, ensuring a 1/2" (10-12 mm) gap between the ends of rails to allow for expansion.



## 3. Attach the profiles to the brackets

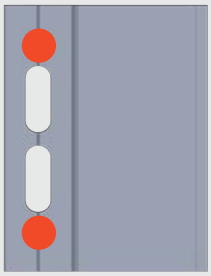
**3.1** Secure the profiles in the correct location using the SDA5/5.5x22 stainless steel fastener. Observe the correct number and attachment location as advised on the shop drawings.

**Note:** Only one bracket per profile should have fasteners in the fixed points (round holes); all subsequent brackets should have fasteners in the sliding points (slots). See Figure 1.

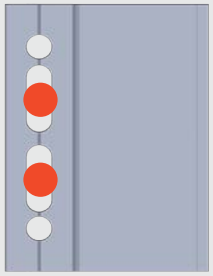
**Get in touch for project specific engineering services**

# Installation guide

**Figure 1**



**Fixed point:** Absorbs dead loads



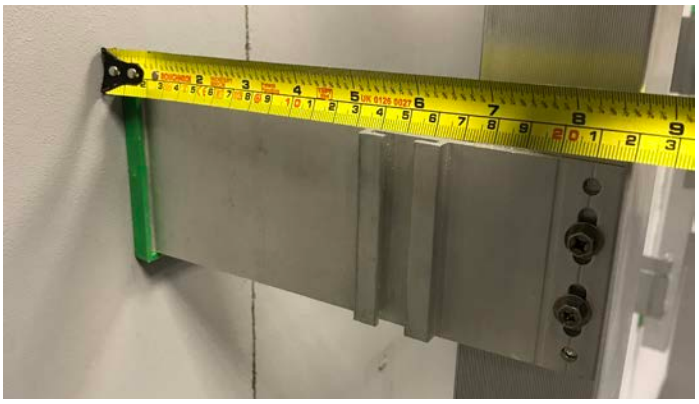
**Sliding point:** Absorbs dynamic loads & expansion

**Contact our technical team: 844-NVELOPE (683-5673)**

## 4. Check over

**4.1** Once all brackets and profiles are installed to an area of cladding, final checks should be carried out:

- On the primary anchor torque settings
- To the line and level of the profiles in relation to each other
- To the number of fasteners and their position in each bracket



## 5. Install NV3 horizontal rail

**5.1** Position the horizontal rail to align with the hanger fitted to the rear face of the panel.

**5.2** Project horizontal datum lines across the elevation, and mark the position of the horizontal rail on to the vertical profile.

**5.3** Affix each horizontal rail to the vertical profile using two SDA5/5.5x22 fixings.

**Note:** Rails can run past the last vertical support by a maximum distance of 11.81" (300 mm). If a rail needs jointing off, cuts of the rail 7.87" (200 mm length) can be used back to back. Please allow room for expansion.

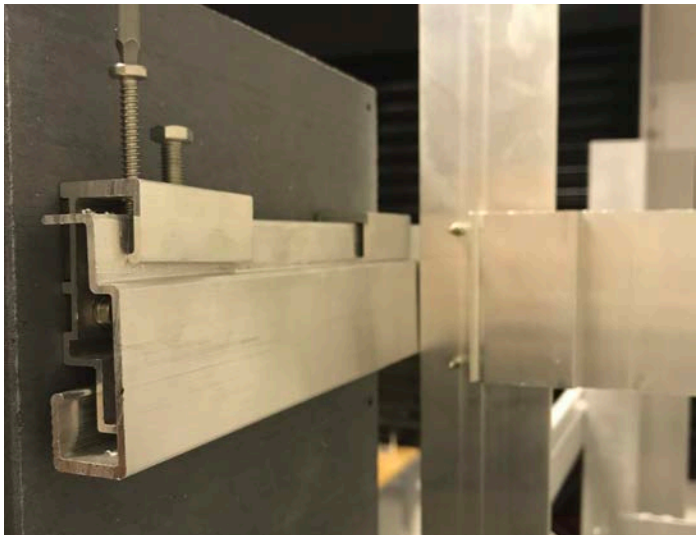
# Installation guide

## 6. Install panels

**6.1** Once the NV3 hangers have been attached to the rear of the panel (following panel manufacturers spacing recommendations), the panel can be positioned on the NV3 horizontal rail, ensuring all hangers align with the corresponding horizontal rail.

**6.2** Position the panel into place and use M6 adjustment bolts to raise or lower the panel into the final position, checking panel gap distance. Adjustable hangers should be located on the top row of hangers only.

**6.2** Once the panel has been adjusted, the locking screw can be inserted and secured into an adjustable hanger, either in the central position or the furthest left or right hanger. Ensure that the chosen location is repeated for all panels.



**Note:** The number of hangers and their vertical position will be specified to suit the size and material of the panels, the dynamic wind pressures (positive and negative), and the cladding load.

For hanger installation guidance using the TUF-S fastener range, see our TUF-S Installation Guide.

# Notes

**Fasteners**

Suitable primary anchors are designed to attach the brackets to a pre-determined grid to suit the cladding panel layout. Stainless steel fasteners also assist in preventing bimetallic corrosion.

The size and type of primary fastener for the connectors will always be determined by the dynamic and dead loads they have to resist. Please get in touch if you need further details.

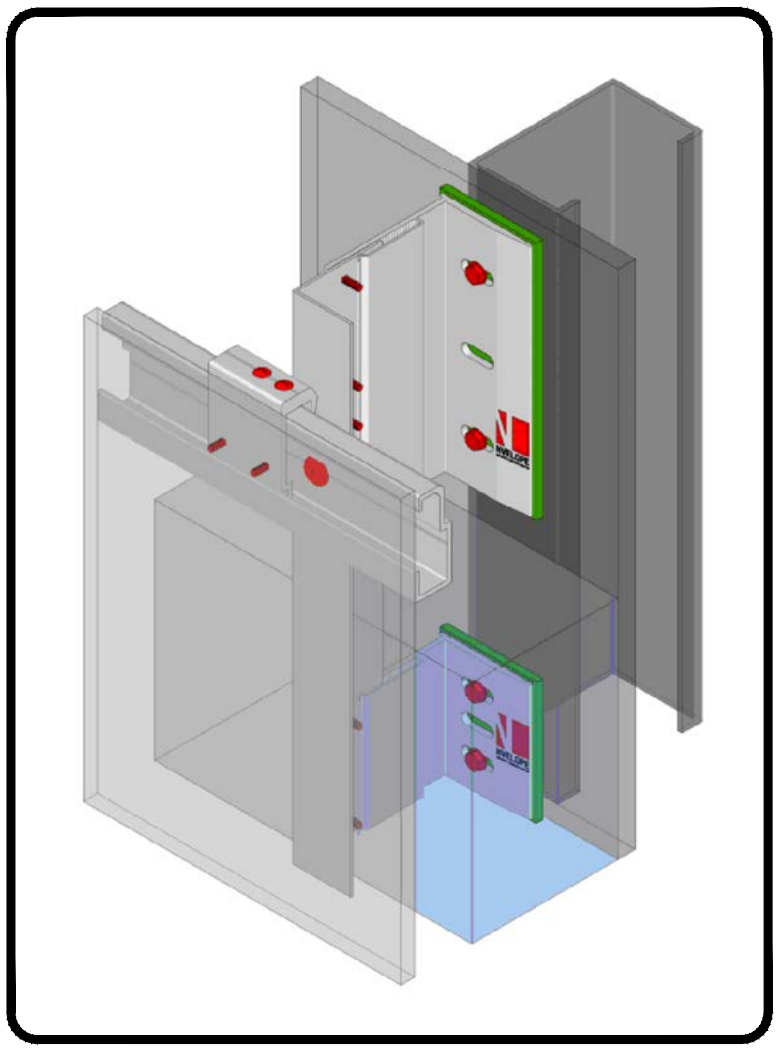
**Insulation**

Where insulation is specified, it should be cut and tightly butted around the brackets and secured with the appropriate fasteners. Sufficient insulation fasteners should be provided to ensure that the insulation cannot block the ventilated cavity.

aluminium support system for

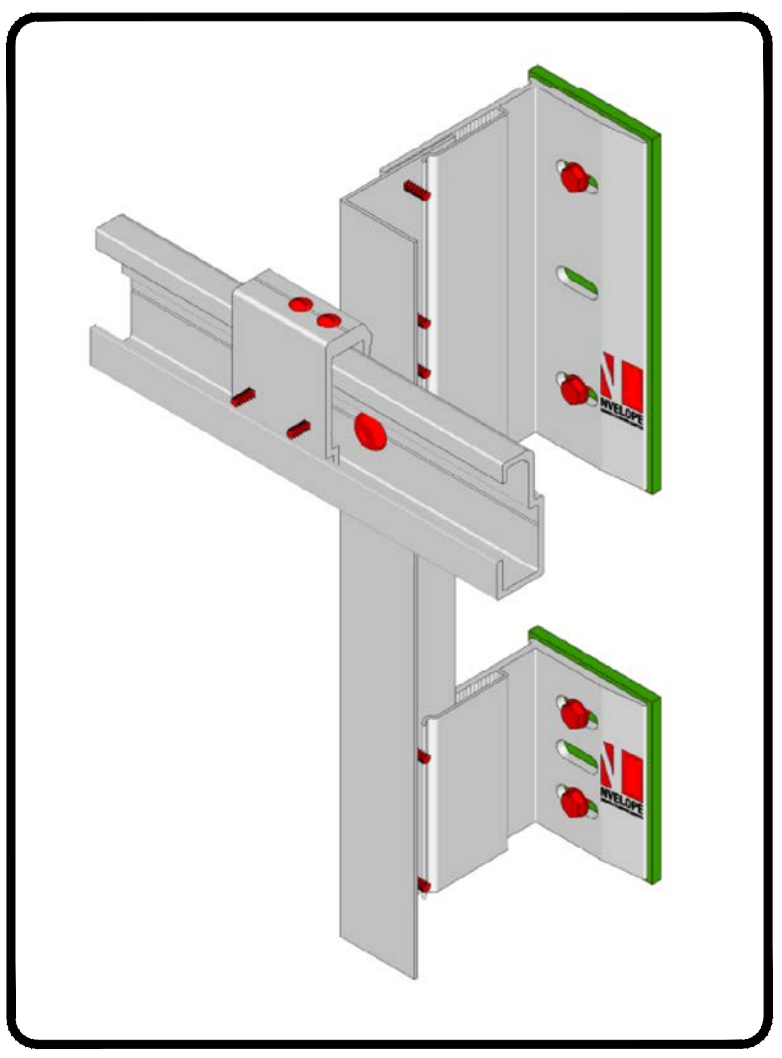
rain screen cladding panels

# NVELOPE SYSTEM NV3



CONTENTS:


NV3–00 NVELOPE system detail sheet
NV3–01 Tolerances for bracket adjustment
NV3–02 Rail and adaptor overview
NV3–03 System fastener overview
NV3–04 System hanger overview
NV3–05 Cladding view locations
NV3–06 Enlarged Elevation – System layout
NV3–07 Section – Base of Cladding
NV3–08 Section – Horz. panel joint
NV3–09 Section – Center panel
NV3–10 Seciton – Rail termination with slip connection
NV3–11 Section – Top of cladding
NV3–12 Section – Window sill
NV3–13 Seciton – Window head
NV3–14 Plan – Window jamb
NV3–15 Plan – Internal corner
NV3–16 Plan – Vertical panel joint
NV3–17 Plan – External corner
NV3–18 Plan – External corner with corner rail
NV3–19 Section – Bracket install guide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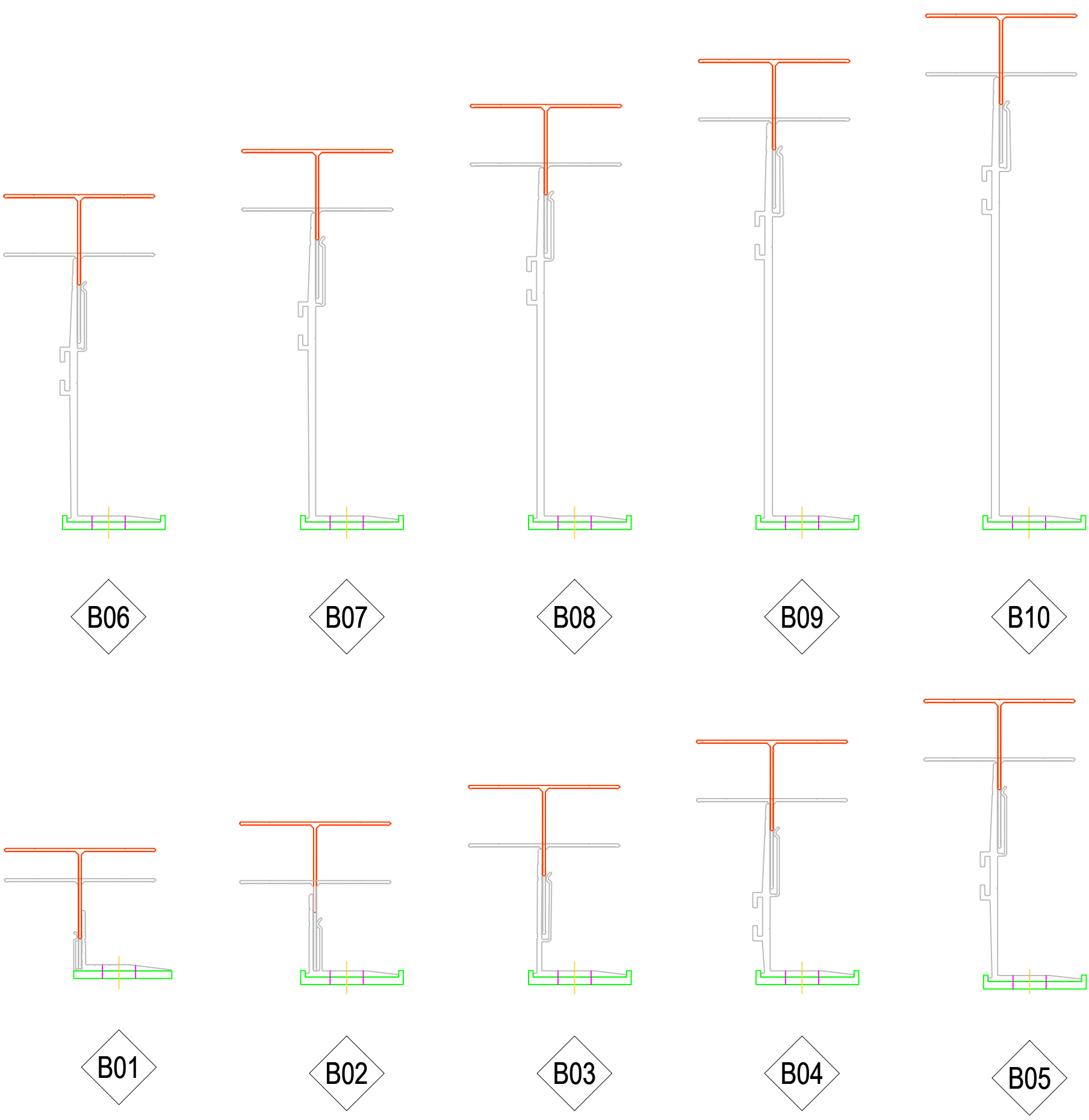
The following detail set was drawn and scaled using millimeter units

| SHEET | SHEET TITLE |
|---|---|
| NV3-01 | Tolerances for Bracket Adjustment |
| | NV3 DETAIL SET |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:2 |

| NO: | BRACKET HEIGHT | MIN CAVITY | MAX CAVITY |
|---|---|---|---|
| B01 | 1.57" (40mm) | 1.85 (47mm) | 2.64 (67mm) |
| B02 | 2.36" (60mm) | 2.44 (62mm) | 4.01 (102mm) |
| B03 | 3.54" (90mm) | 3.62 (92mm) | 5.19 (132mm) |
| B04 | 4.72" (120mm) | 4.80 (122mm) | 6.37 (162mm) |
| B05 | 5.91" (150mm) | 5.98 (152mm) | 7.56 (192mm) |
| B06 | 7.09" (180mm) | 7.16 (182mm) | 8.74 (222mm) |
| B07 | 8.27" (210mm) | 8.35 (212mm) | 9.92 (252mm) |
| B08 | 9.45" (240mm) | 9.52 (242mm) | 11.10 (282mm) |
| B09 | 10.63" (270mm) | 10.70 (272mm) | 12.26 (312mm) |
| B10 | 11.81" (300mm) | 11.89 (302mm) | 13.46 (342mm) |

Brackets come in single or double widths and are made for specific substrates. See installation instructions for more details.



SHEET

# NV3-02

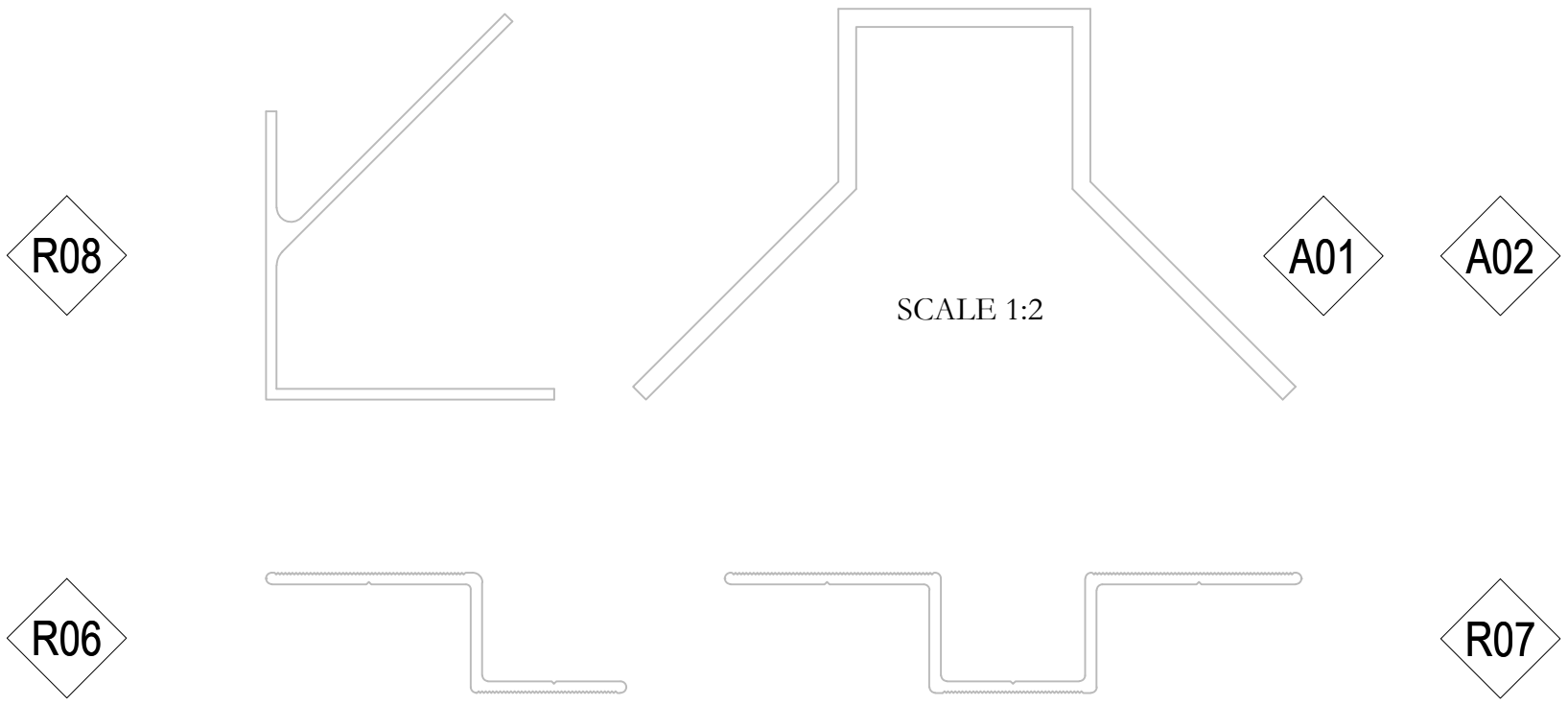
SHEET TITLE

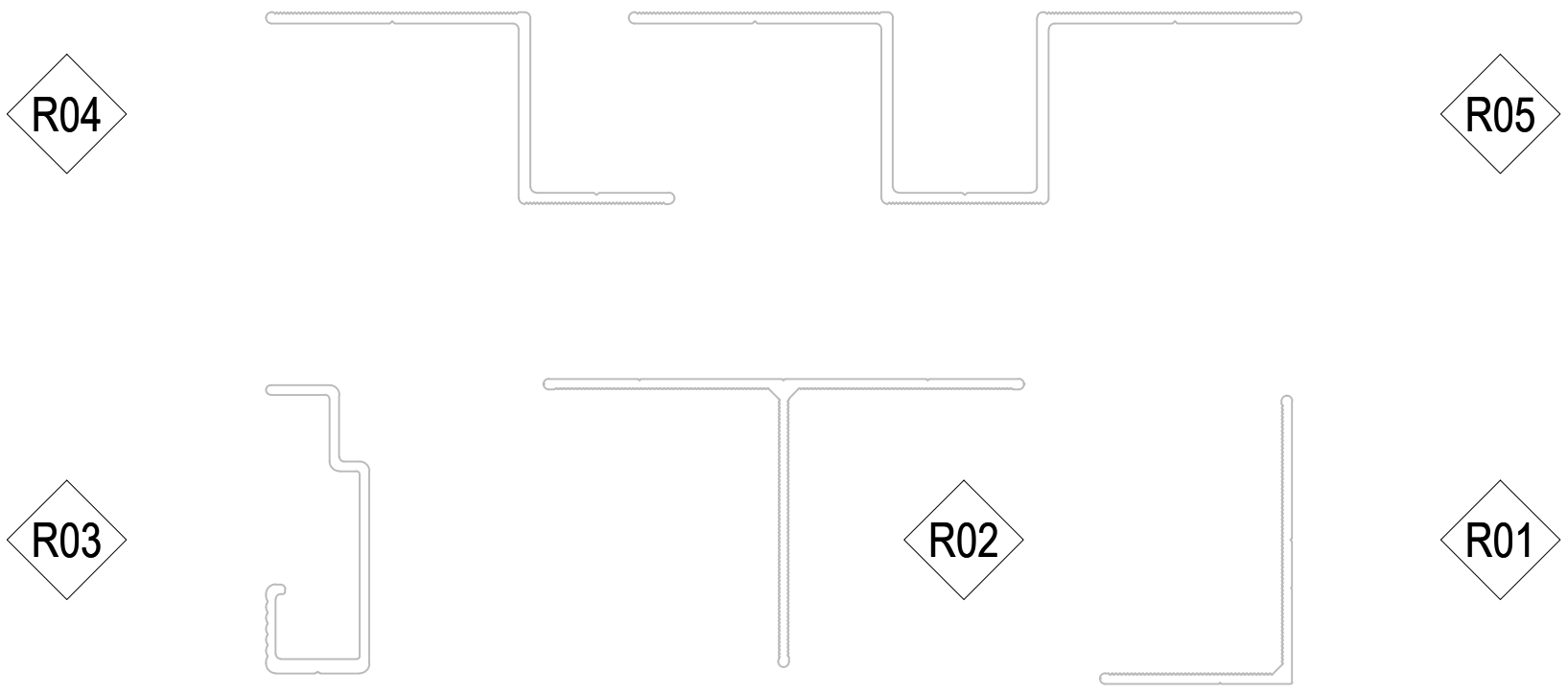
## Rail and Adaptor Overview

# NV3 DETAIL SET

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |

| NO: | DESCRIPTION | HEIGHT | FACE WIDTH (S) | THICKNESS | LENGTH |
|---|---|---|---|---|---|
| R01 | L Rail | 2 3/8 (60mm) | 1 1/2 (40mm) | 0.087 (2.2mm) | 9 10 1/8 (3m) |
| R02 | T Rail | 2 3/8 (60mm) | 3 7/8 (100mm) | 0.087 (2.2mm) | 9 10 1/8 (3m) |
| R03 | NV3 Rail | 2 3/8 (60mm) | 27/32 (21.5mm) | 0.079 (2mm) | 9 10 1/8 (3m) |
| R04 | 1 1/2" Zed Rail | 1 1/2 (40mm) | 2 1/8 & 1 1/8 (55mm / 30mm) | 0.094 (2.4mm) | 9 10 1/8 (3m) |
| R05 | 1 1/2" Omega Rail | 1 1/2 (40mm) | 2 1/8 & 1 1/8 (55mm / 30mm) | 0.094 (2.4mm) | 9 10 1/8 (3m) |
| R06 | 1" Zed Rail | 1 (25mm) | 1 3/4 & 1 1/8 (45mm / 30mm) | 0.094 (2.4mm) | 9 10 1/8 (3m) |
| R07 | 1" Omega Rail | 1 (25mm) | 1 3/4 & 1 1/8 (45mm / 30mm) | 0.094 (2.4mm) | 9 10 1/8 (3m) |
| R08 | Corner Rail | 2 13/16 (71mm) | 2 3/8 & 2 3/8 (60mm / 60mm) | 0.087 (2.2mm) | 9 10 1/8 (3m) |
| A01 | Single Corner Bracket | 4 1/4 (108mm) | 2 3/4 (70mm) | 0.197 (5mm) | 2 15/16 (75mm) |
| A02 | Double Corner Bracket | | | | 5 29/32 (150mm) |

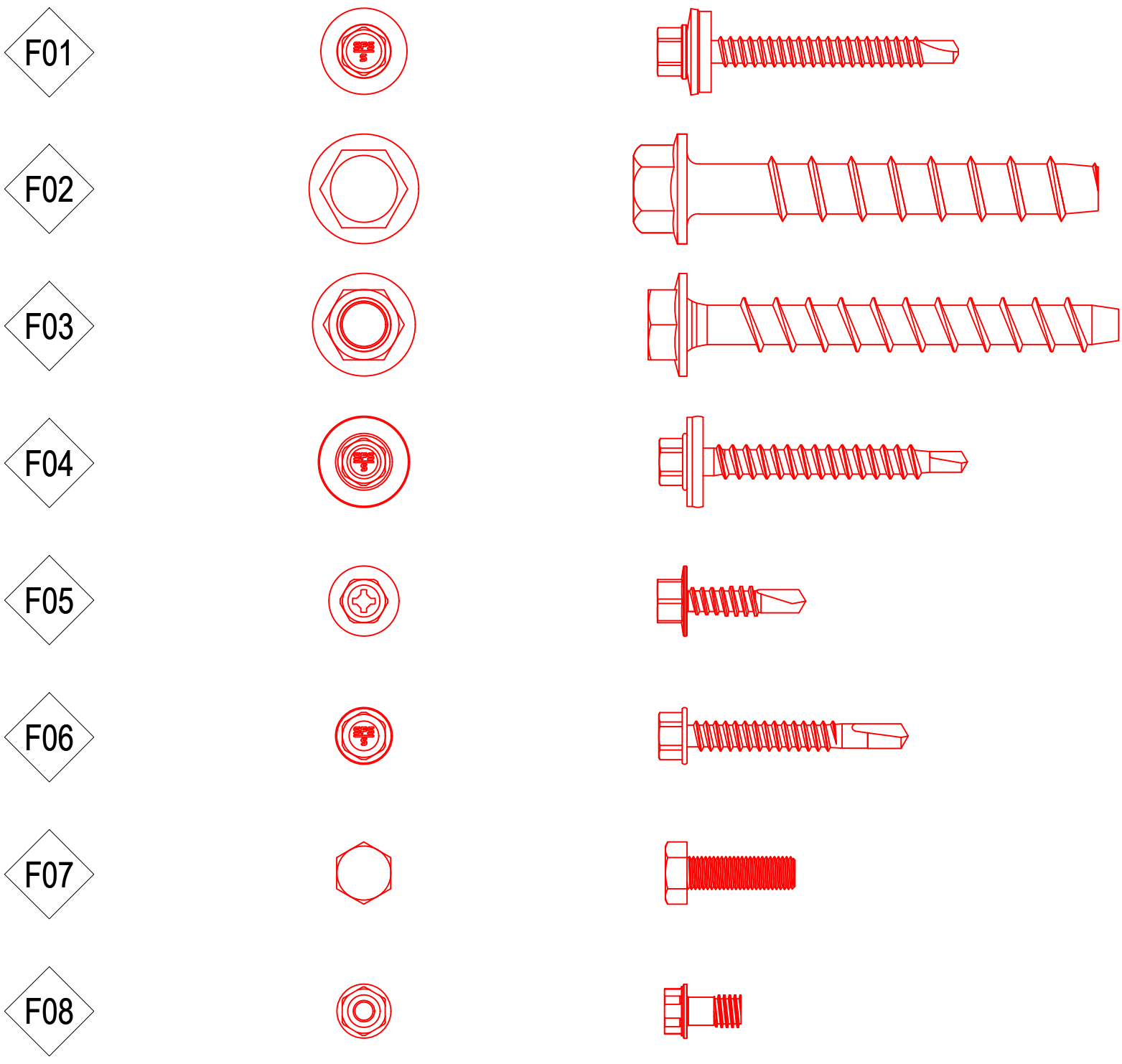


| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-03 | System Fastener Overview | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |

| NO: | TYPICAL USE & APPLICATION | LENGTH | DIAMETER | HEAD/DRIVE | POINT STYLE |
|---|---|---|---|---|---|
| F01 | Nvelope Bracket to Steel Stud Framing | 2 (50mm) | 14 (6.5mm) | 5/16 (8mm) HWH | SD2 Self Drill |
| F02 | Nvelope Bracket to CMU Substrate | 3 (75mm) | 3/8 (10mm) | 9/16 (14mm) HWH | Type B |
| F03 | Nvelope Bracket to Concrete Wall | 3 1/8 (80mm) | 3/8 (10mm) | 33/64 (13mm) HWH | Type B |
| F04 | Nvelope Bracket to Wood Stud Framing | 2 1/16 (52mm) | 14 (6.5mm) | 5/16 (8mm) HWH | SD2 Self Drill |
| F05 | Bracket to Rail & Rail to Rail Connections | 7/8 (22mm) | 12 (5.5mm) | 5/16 (8mm) HWH | SD3 Self Drill |
| F06 | NV3 Hanger Securing Screw | 1 5/8 (41mm) | 12 (5.4mm) | 5/16 (8mm) HWH | SD3 Self Drill |
| F07 | NV3 Hanger Adjusting Screw | 3/4 (20mm) | 1/4 (6mm) | 3/8 (10mm) HH | Type B |
| F08 | NV3 Hanger to Facade Panel | 7/16 (11mm) | 1/4 (6mm) | 5/16 (8mm) HWH | Rivet |



SHEET

# NV3-04

SHEET TITLE

System Hanger Overview

# NV3 DETAIL SET

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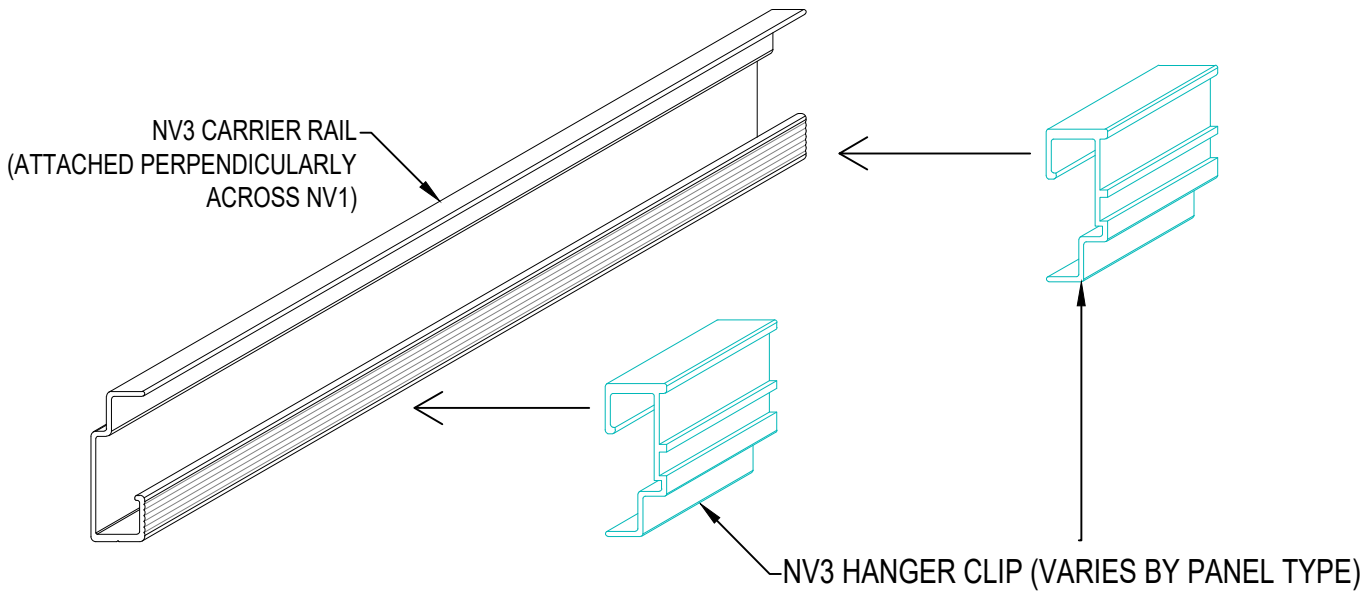


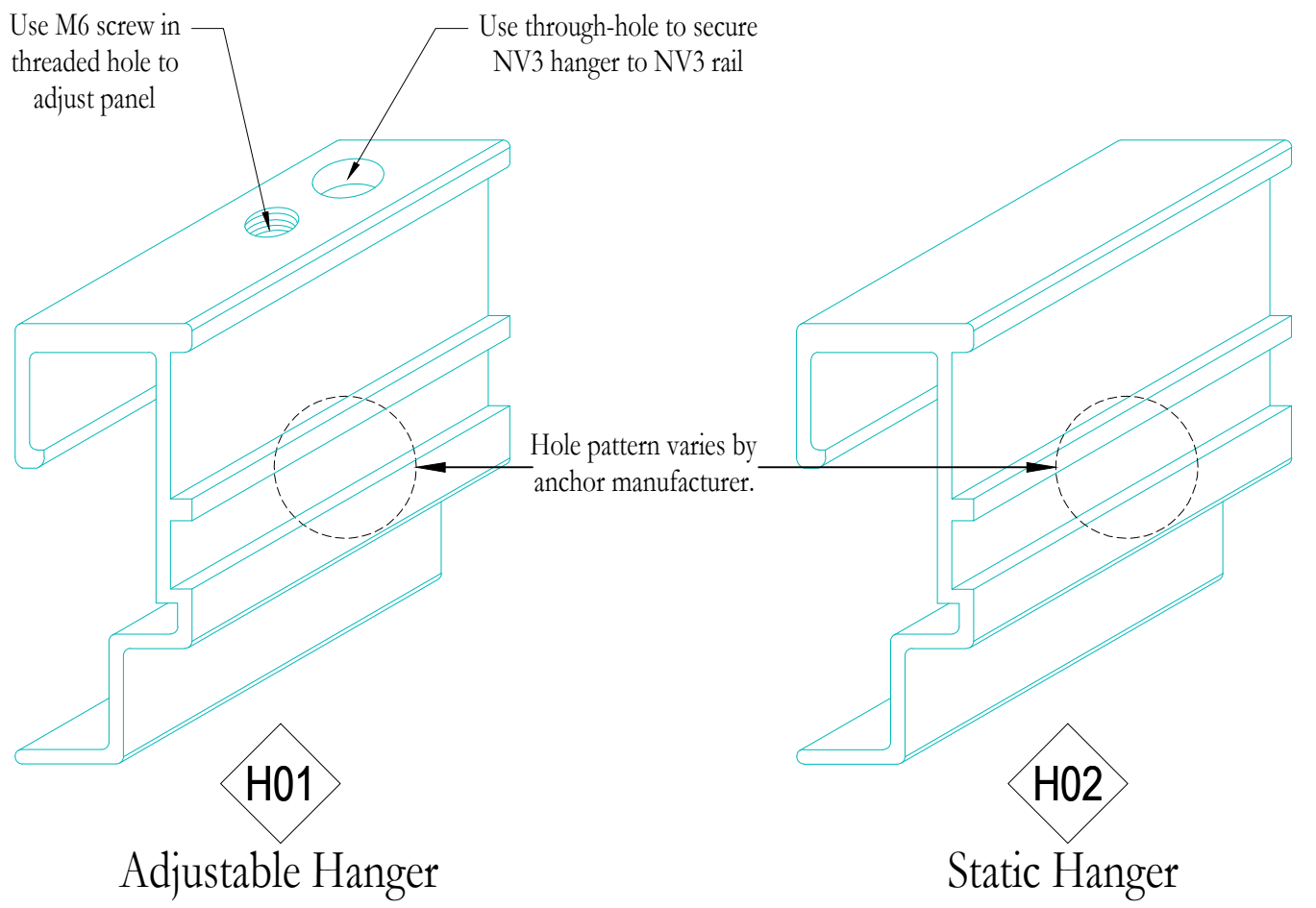


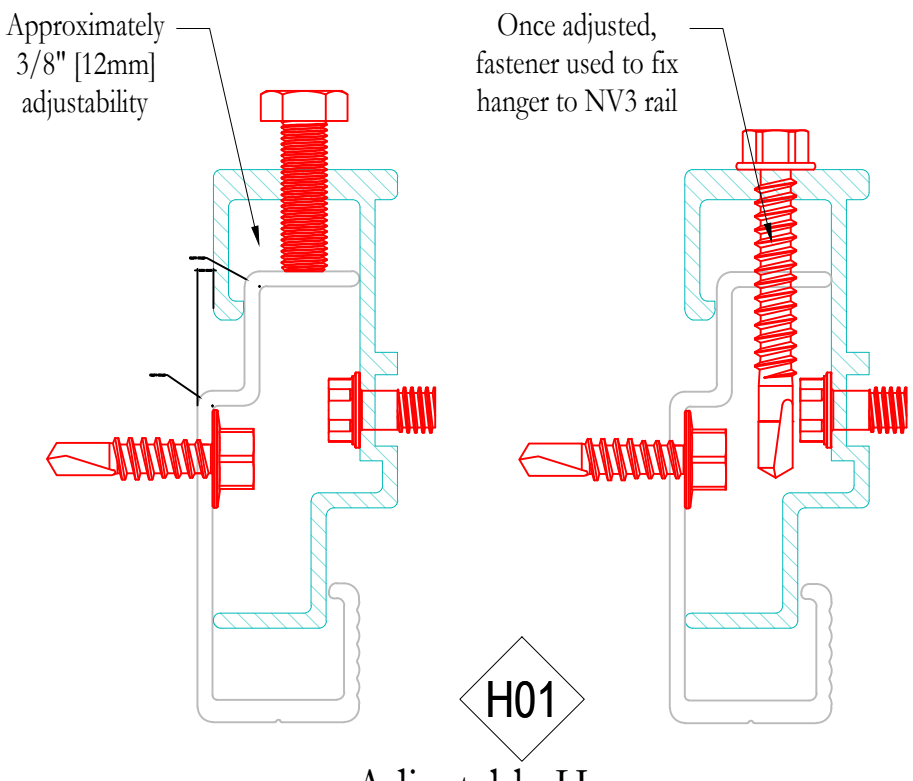

| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-05 | Cladding View Locations | |
| | NV3 DETAIL SET | |

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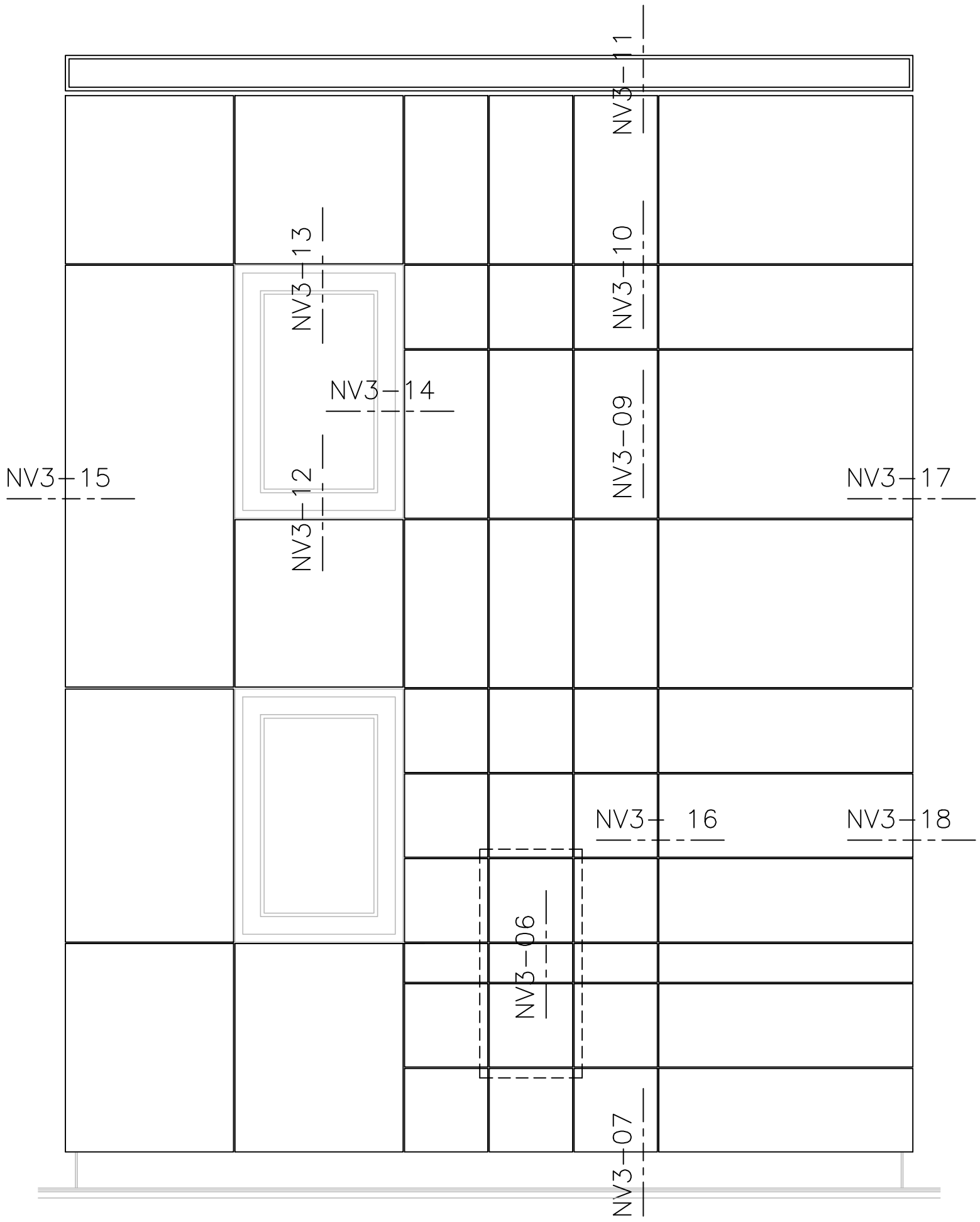

| SHEET | SHEET TITLE |
|---|---|
| NV3-06 | Enlarged Elevation - System Layout |
| | NV3 DETAIL SET |

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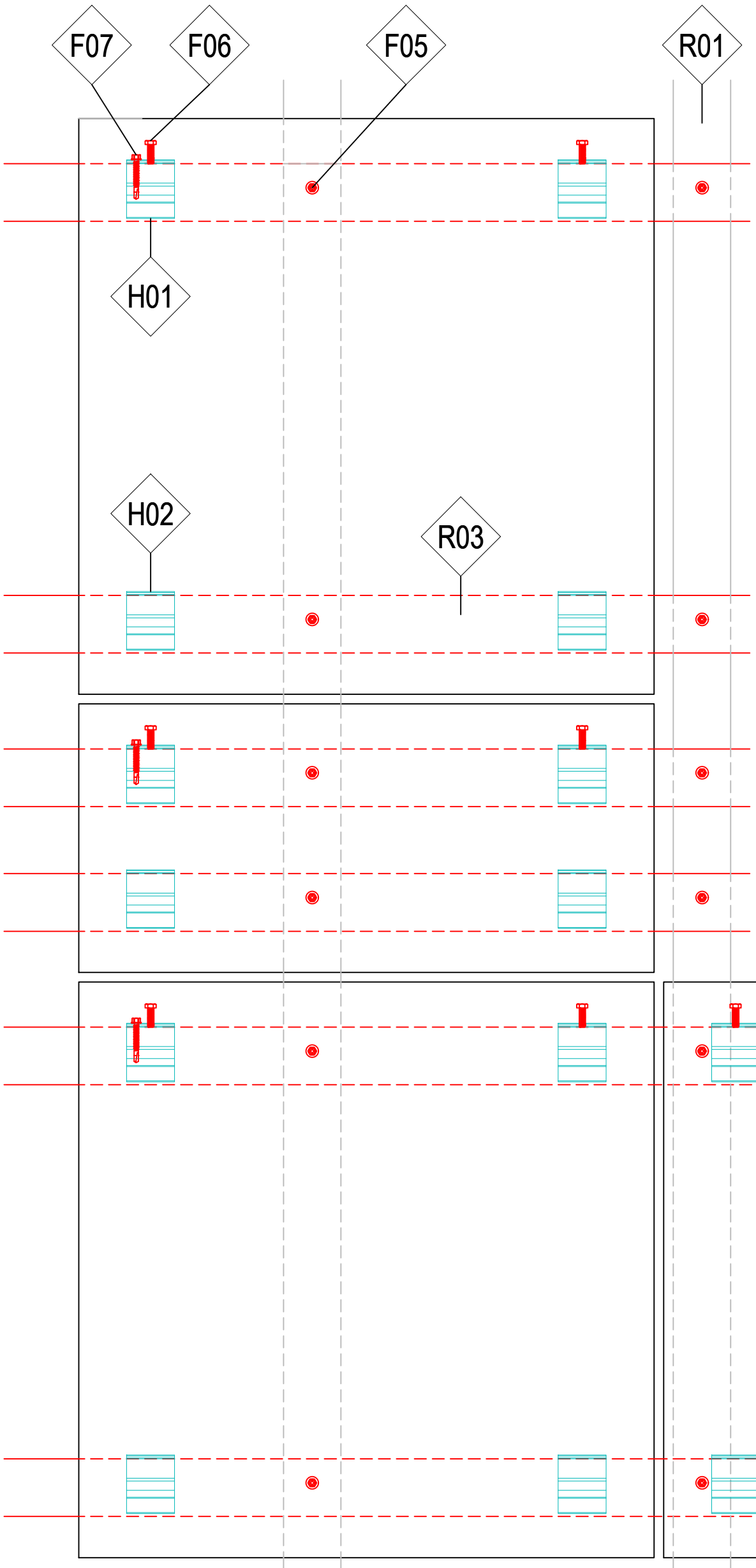
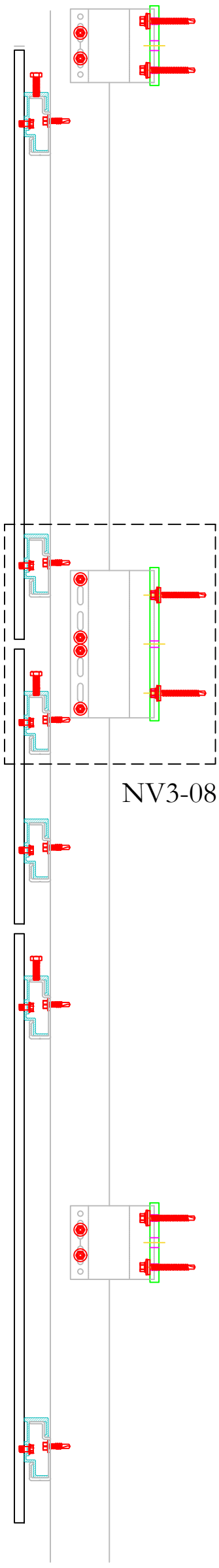
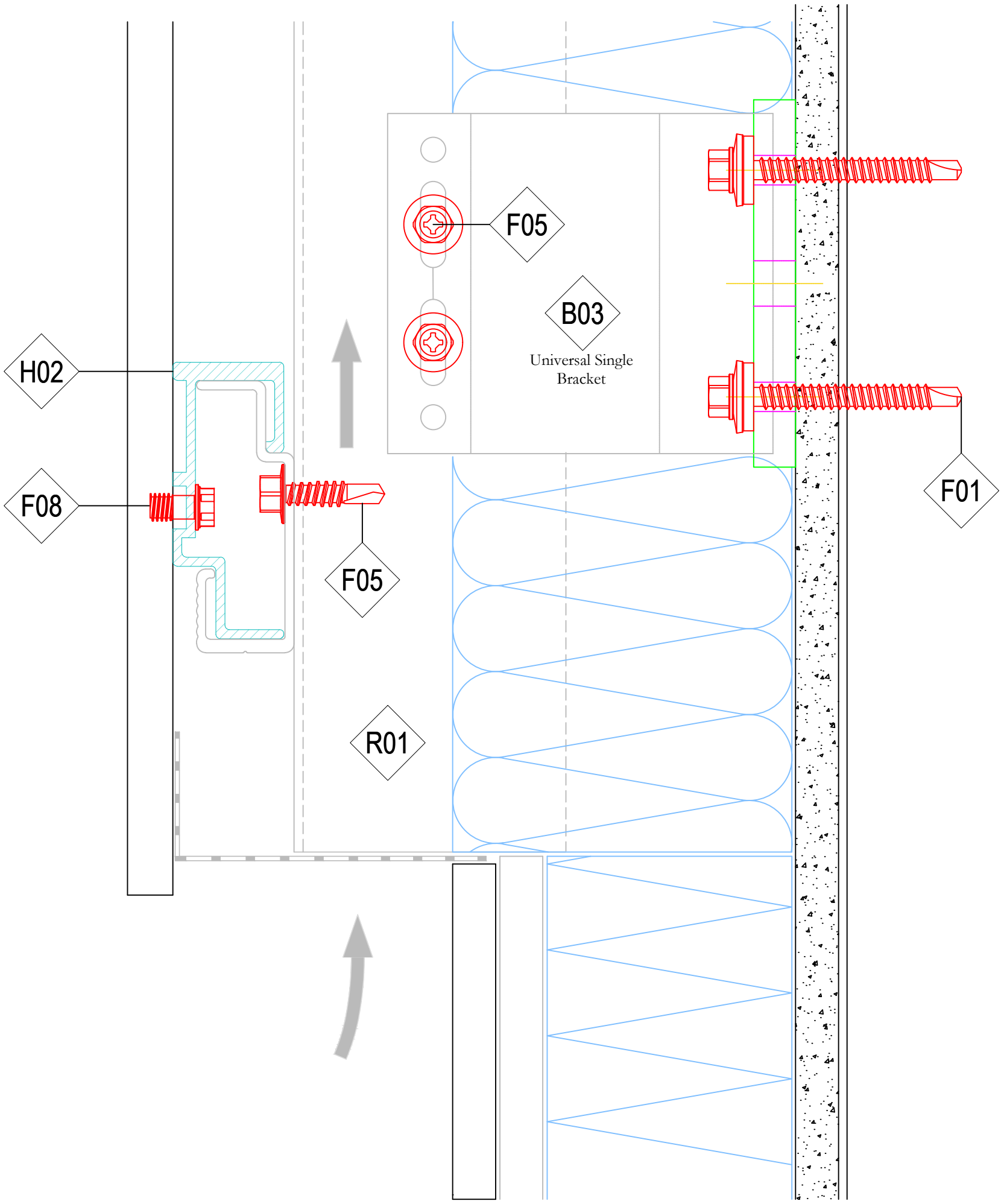


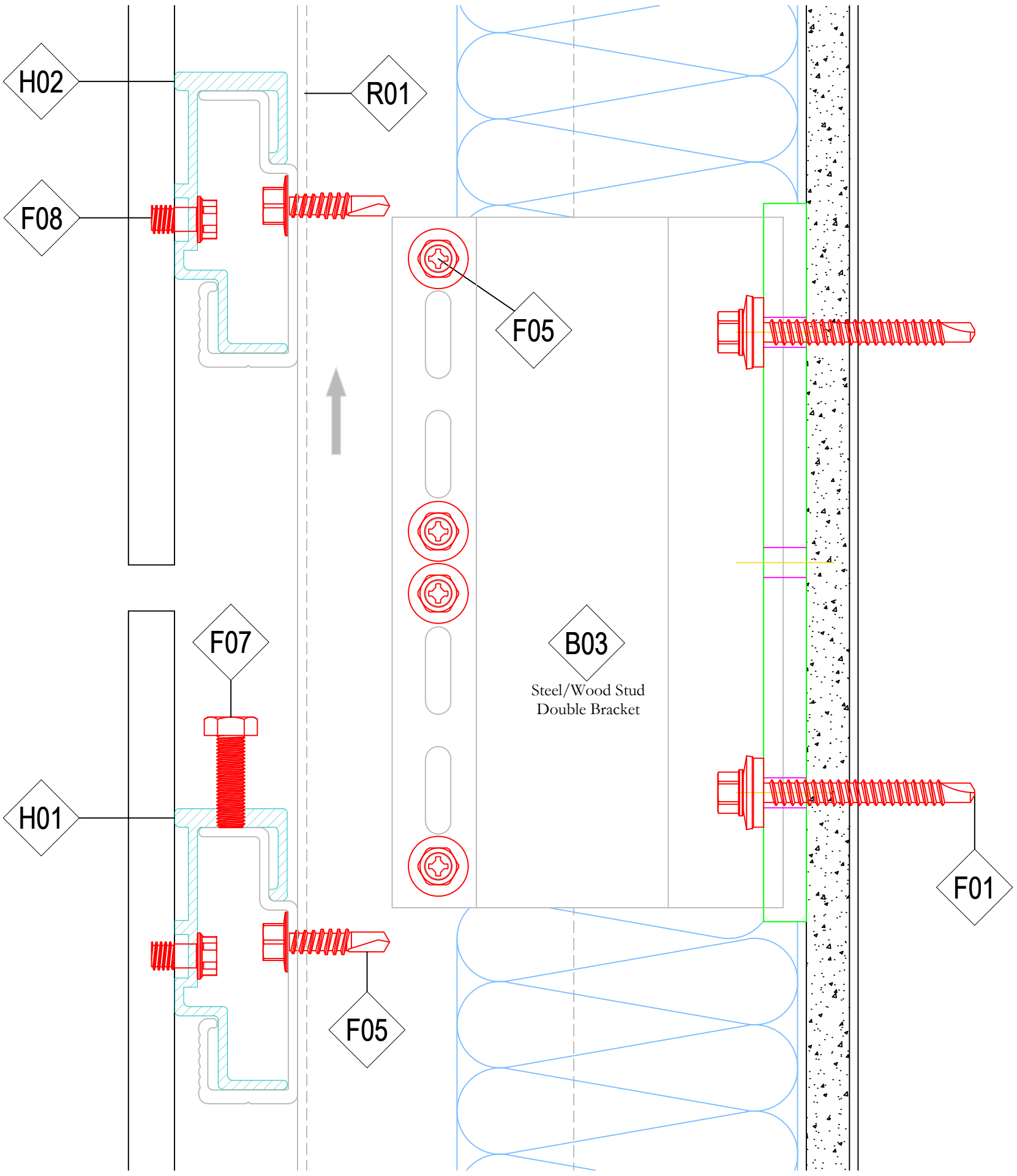
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-07 | Section - Base of Cladding | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |



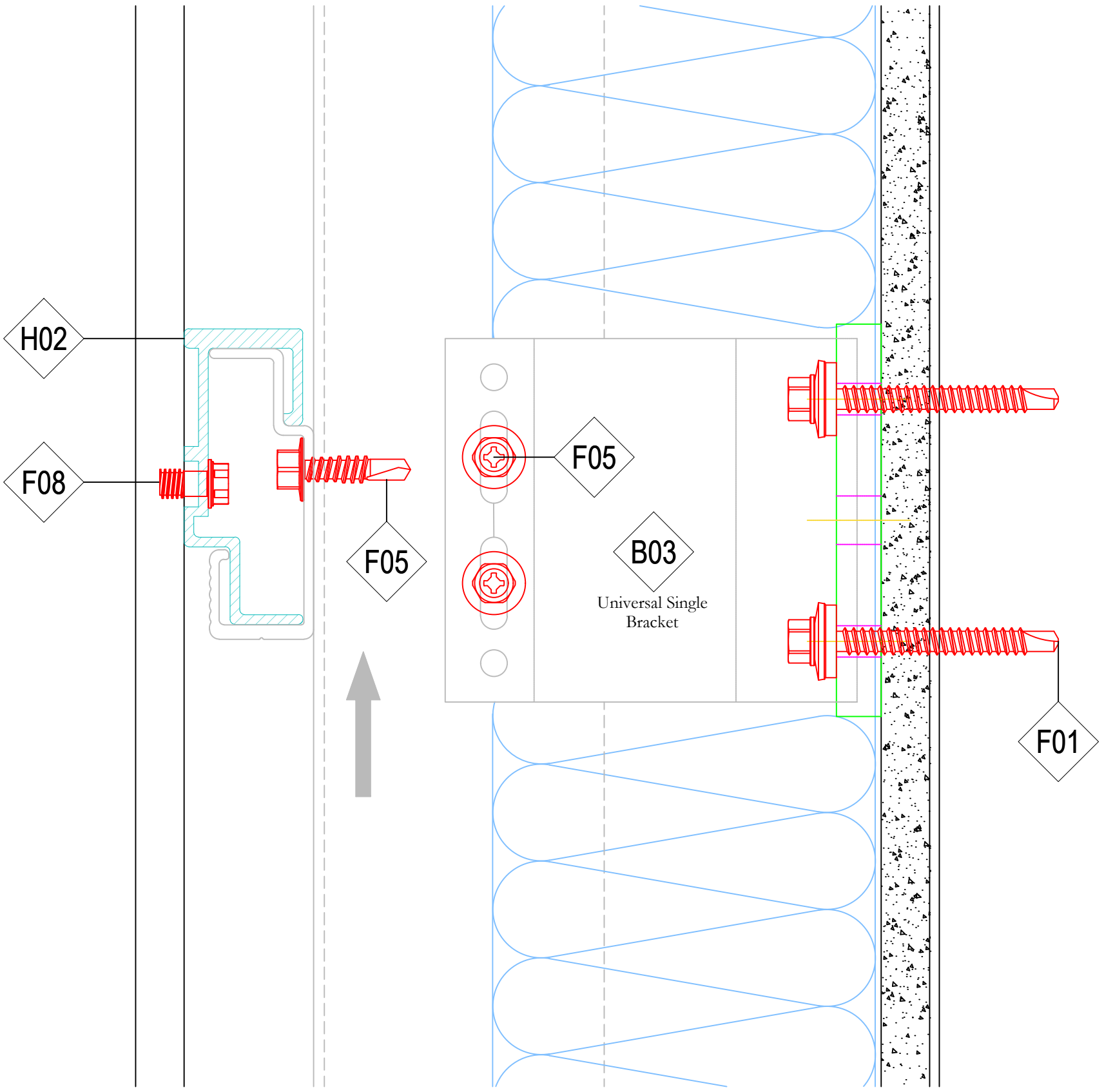
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-08 | Section - Horizontal Panel Joint | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |



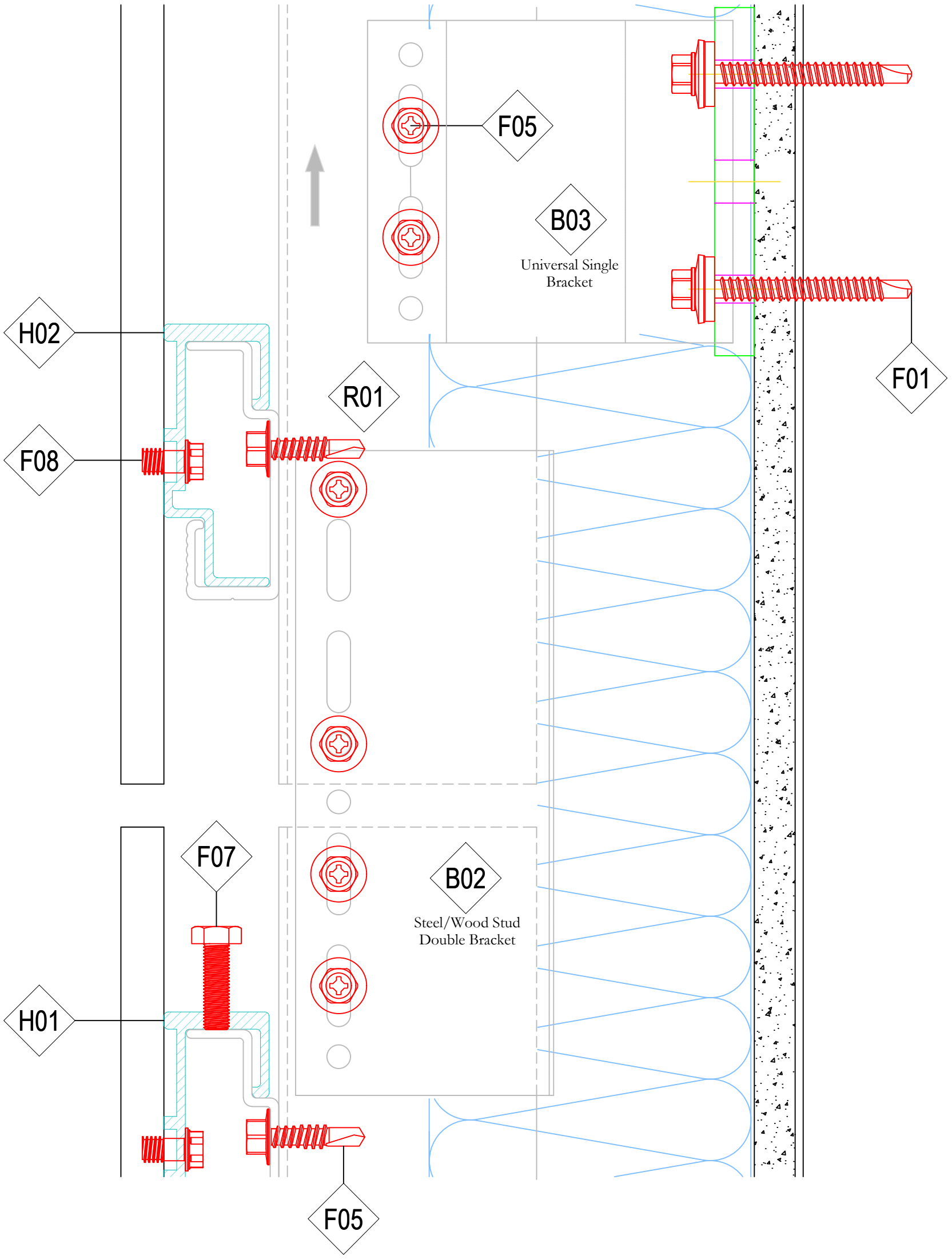
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-09 | Section - Center of Panel | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |



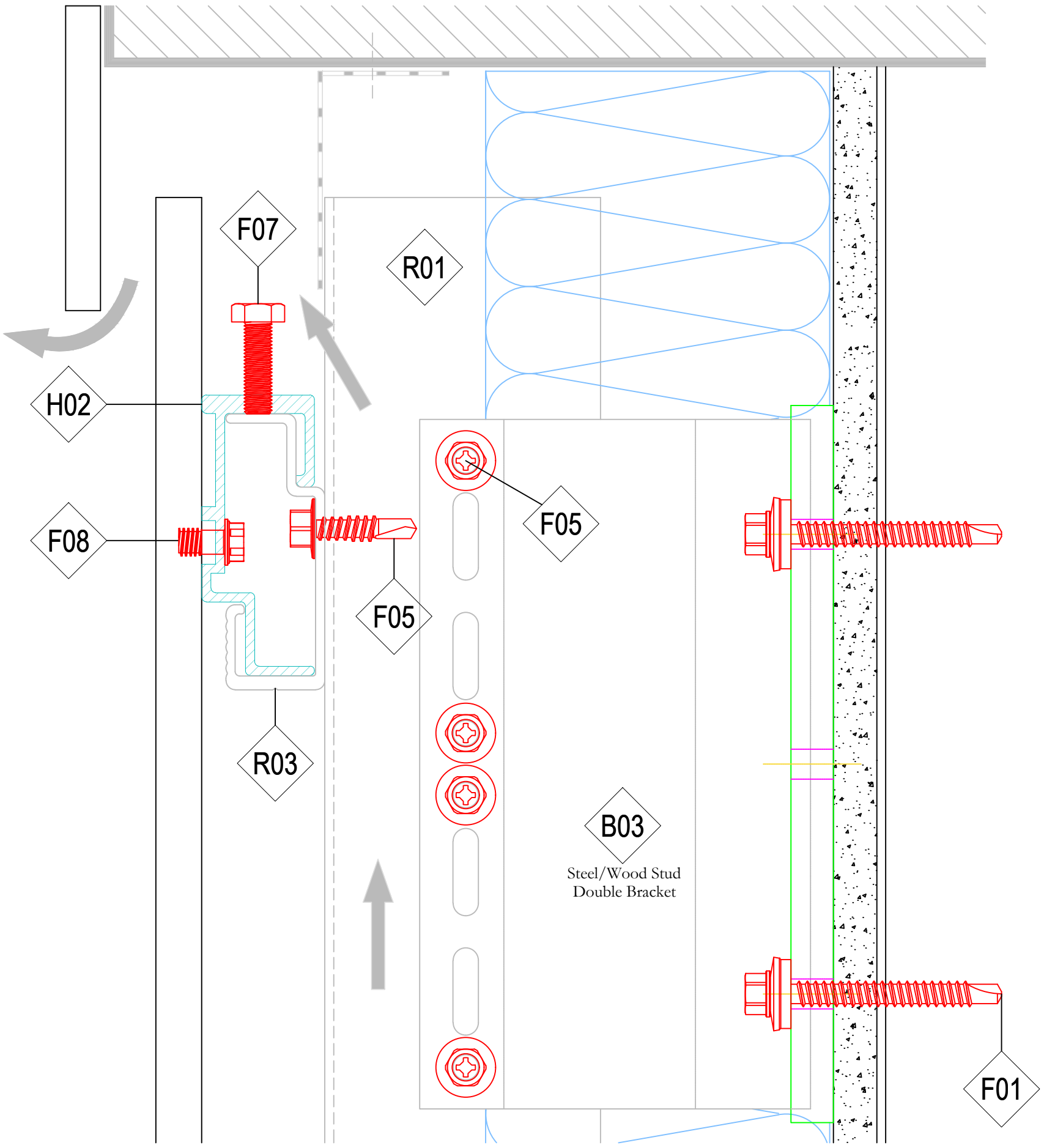
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-10 | Section - Rail Termination with Slip Connect | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |



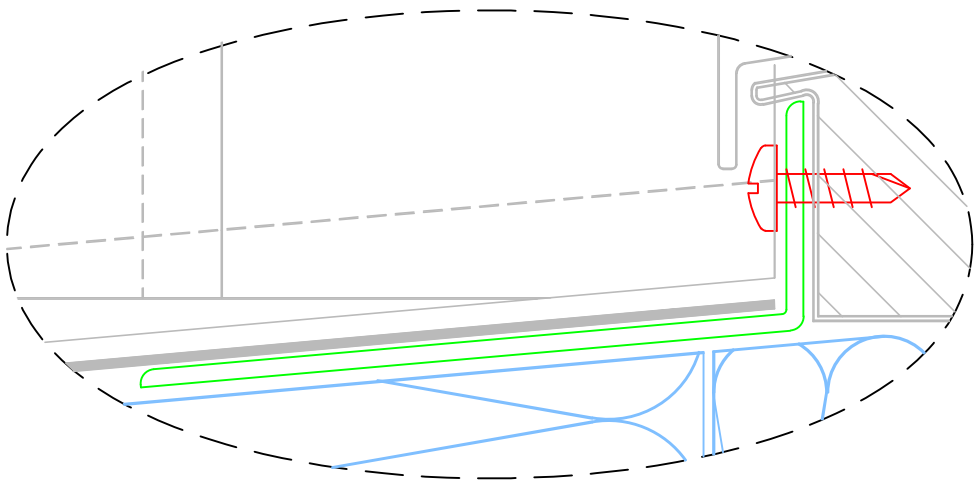
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-11 | Section - Top of Cladding | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |

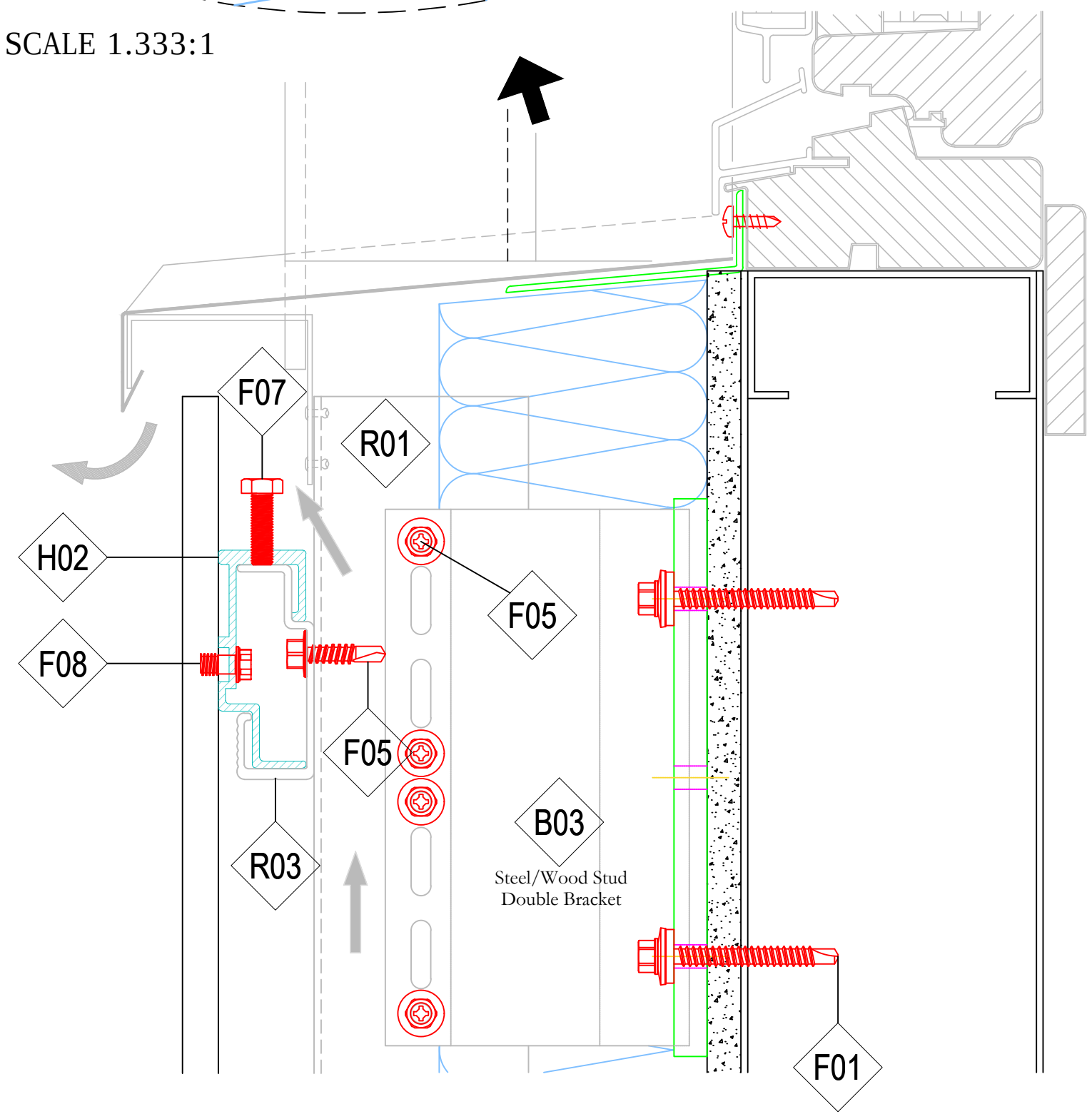


| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-12 | Section - Window Sill | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1.5 |

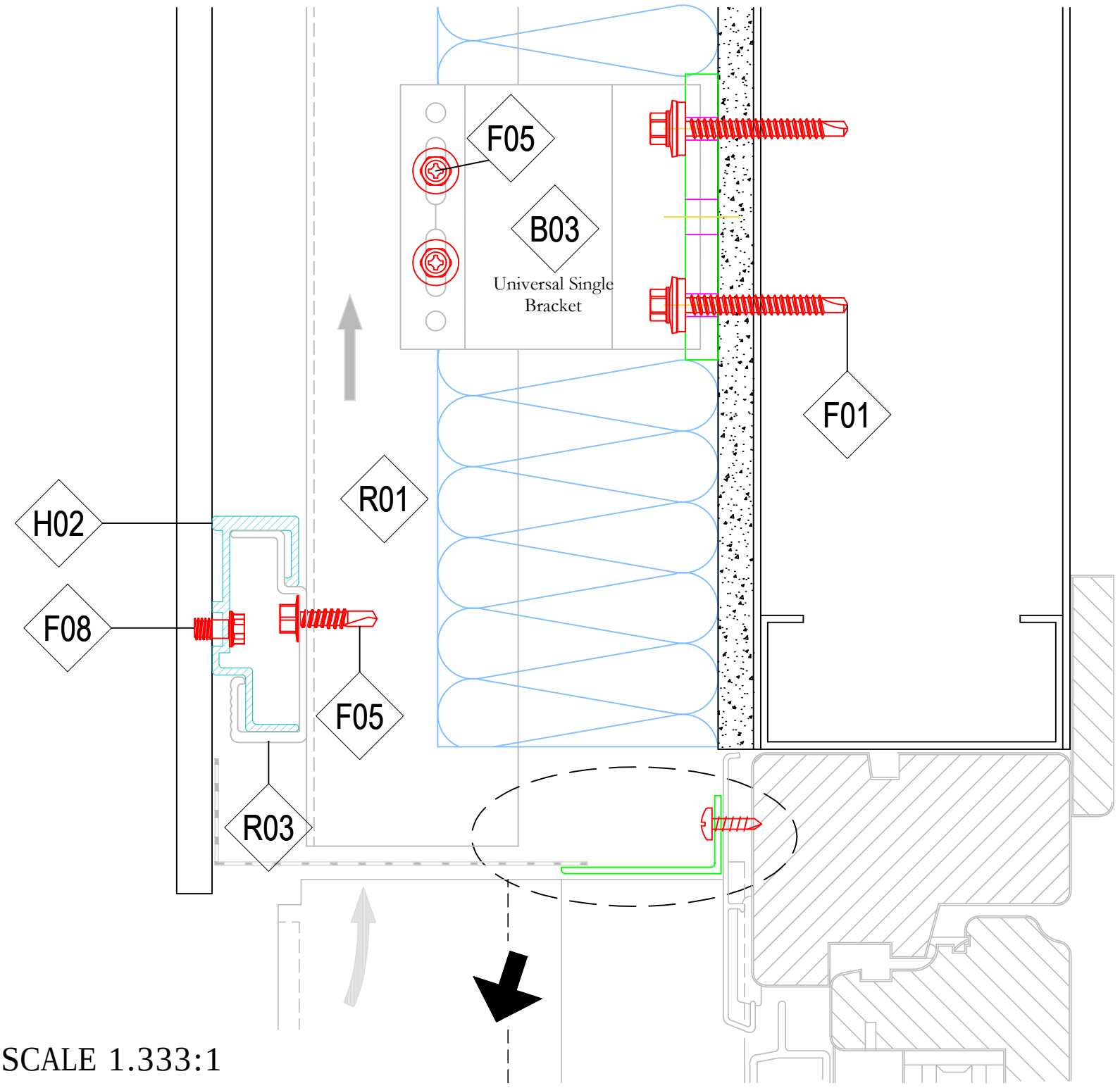


SCALE 1.333:1

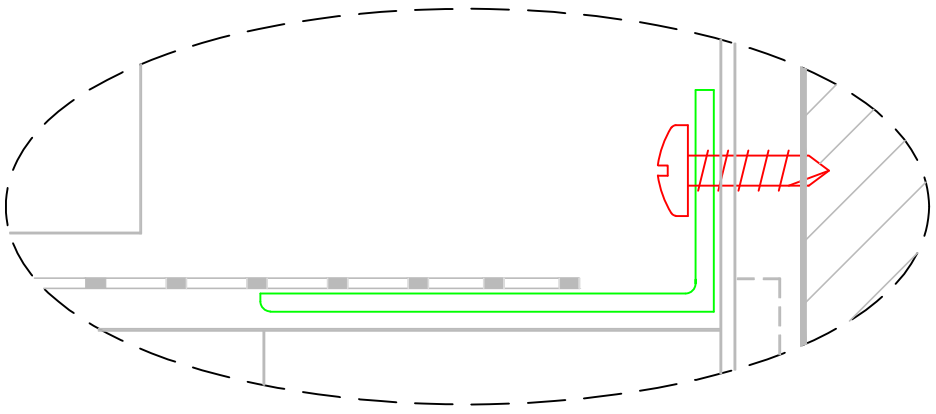


| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-13 | Section - Window Head | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1.5 |

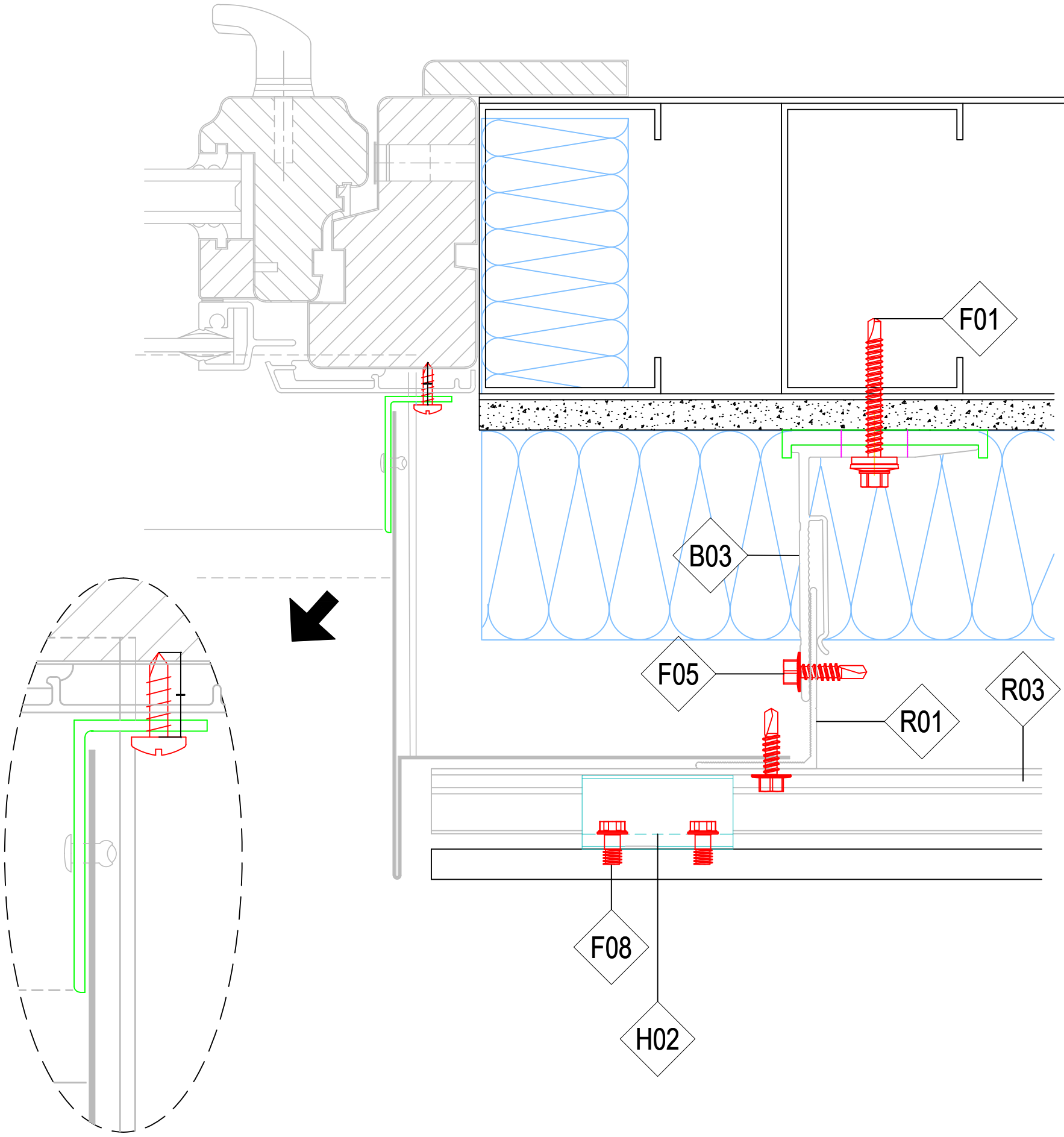



SCALE 1.333:1



| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-14 | Section - Window Jamb | |
| | NV3 DETAIL SET | |

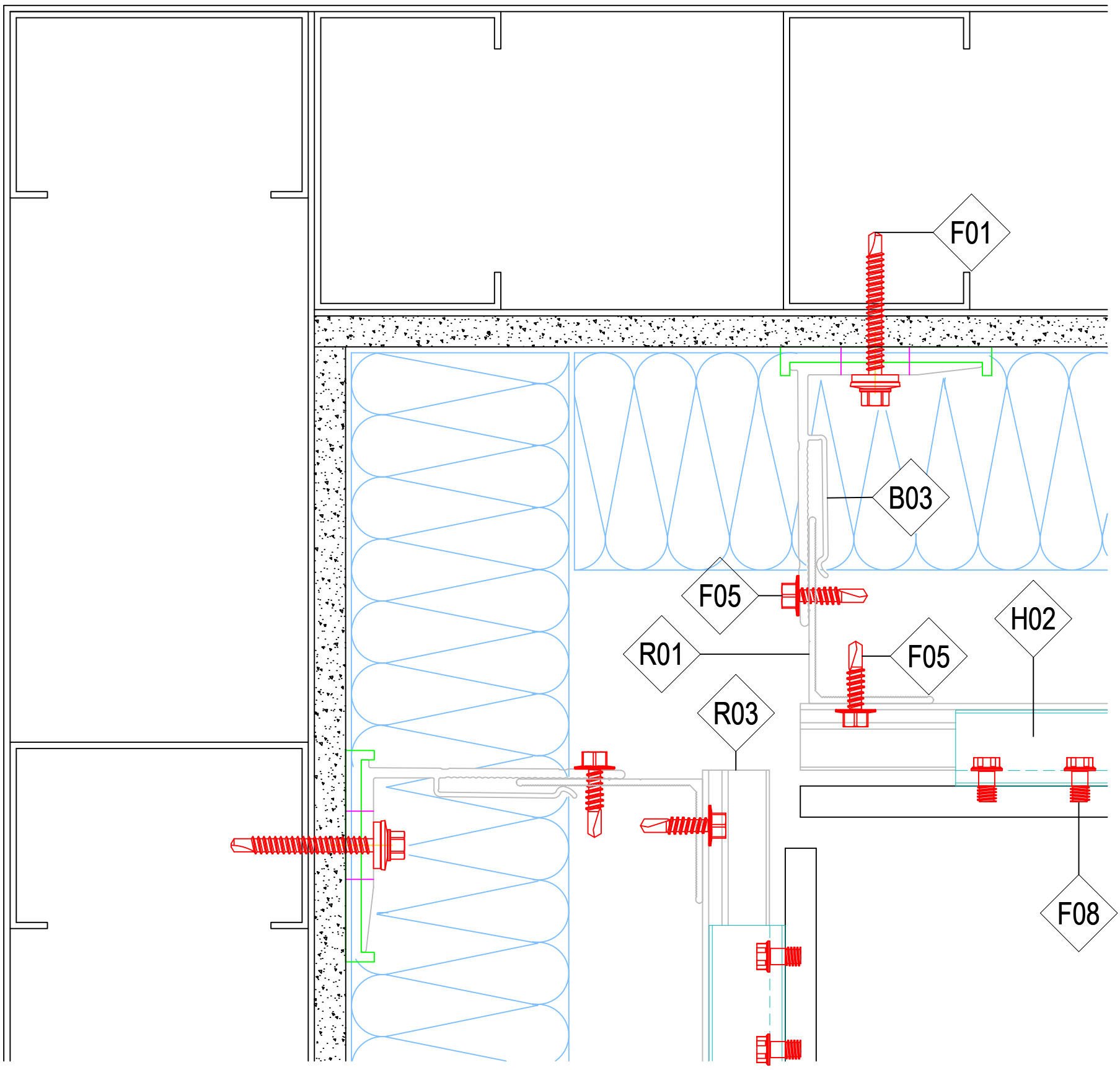
| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1.5 |




SCALE 1.333:1

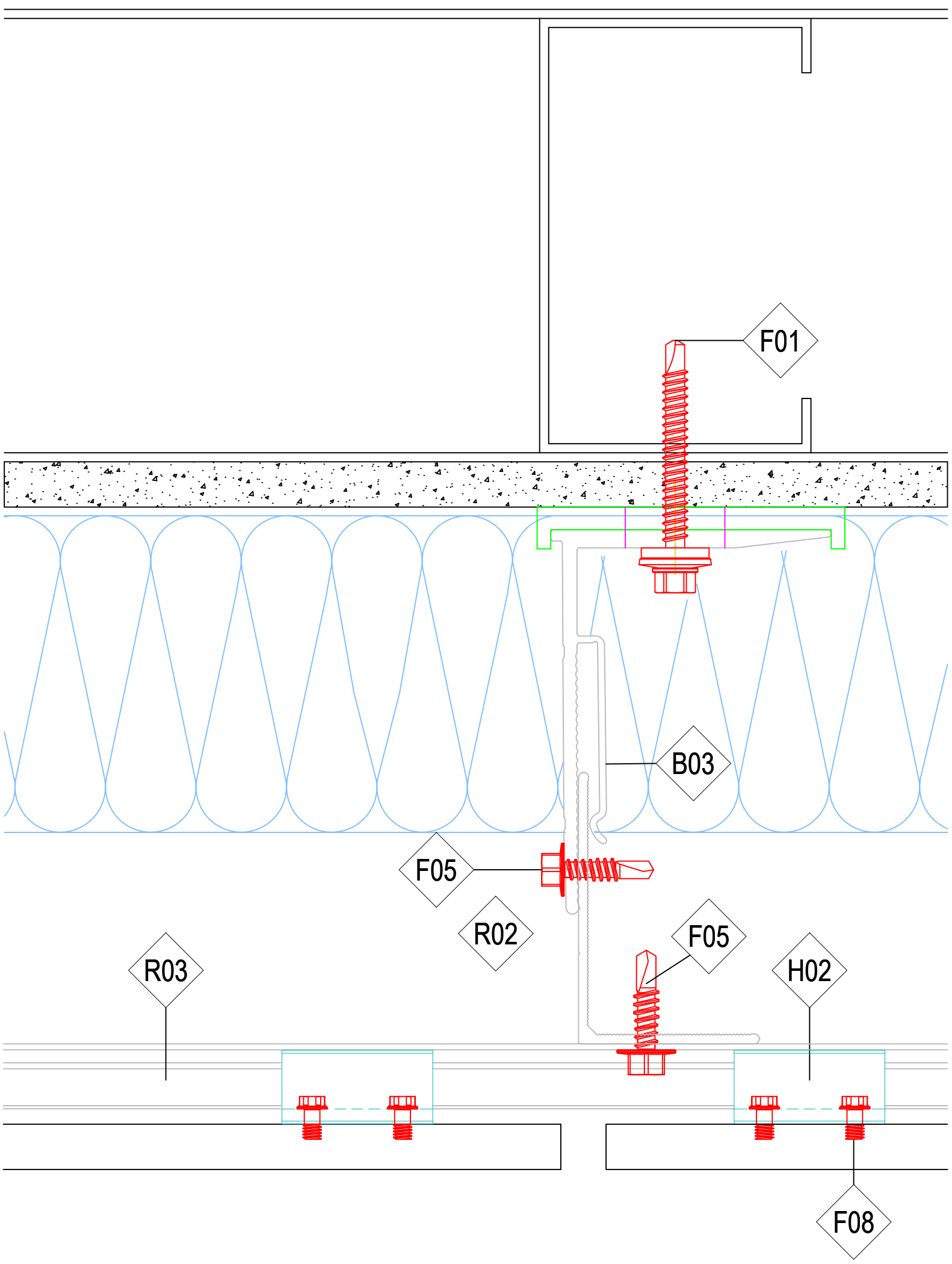
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-15 | Plan - Internal Corner | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1.5 |



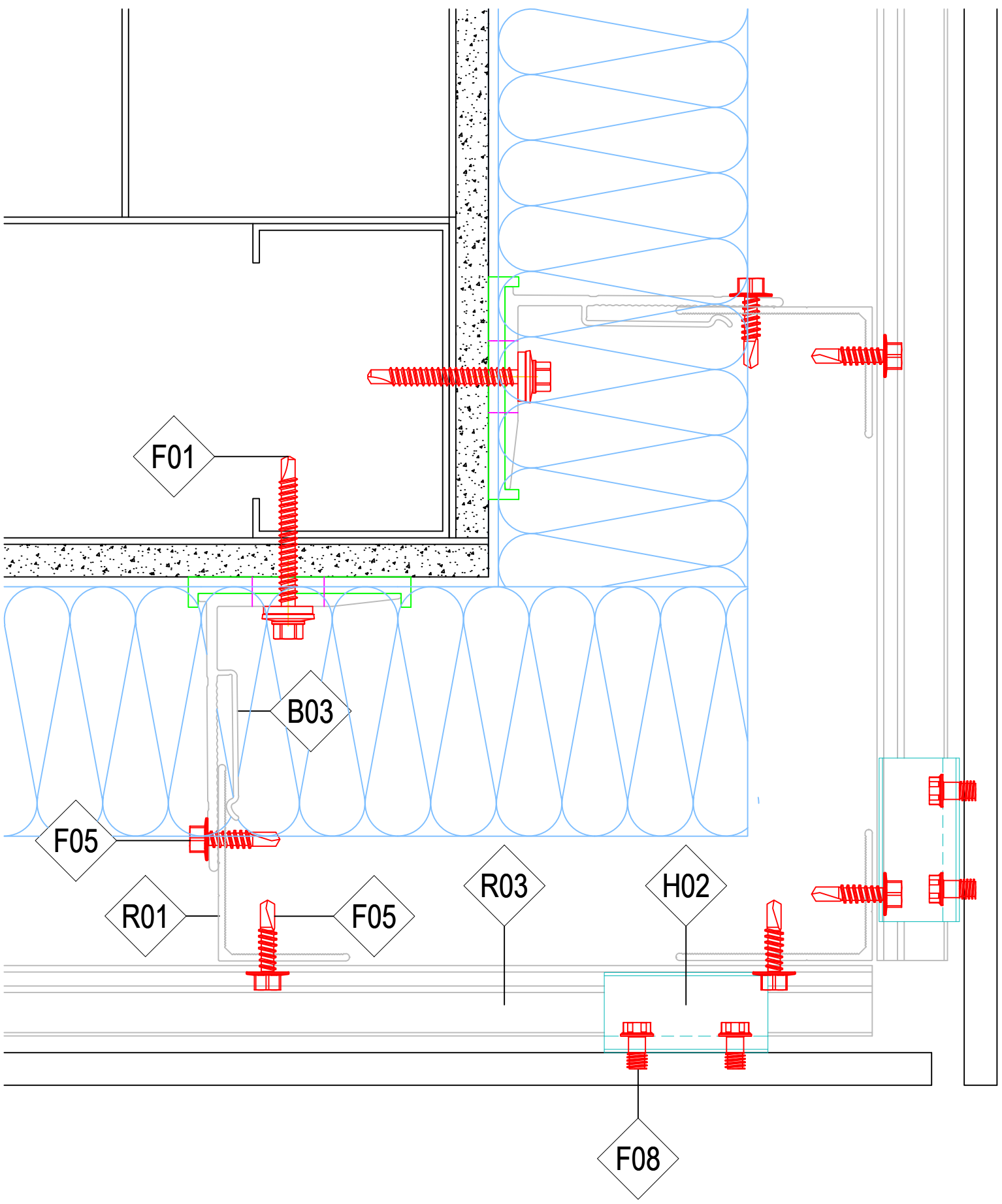
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-16 | Plan - Vertical Panel Joint | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1 |



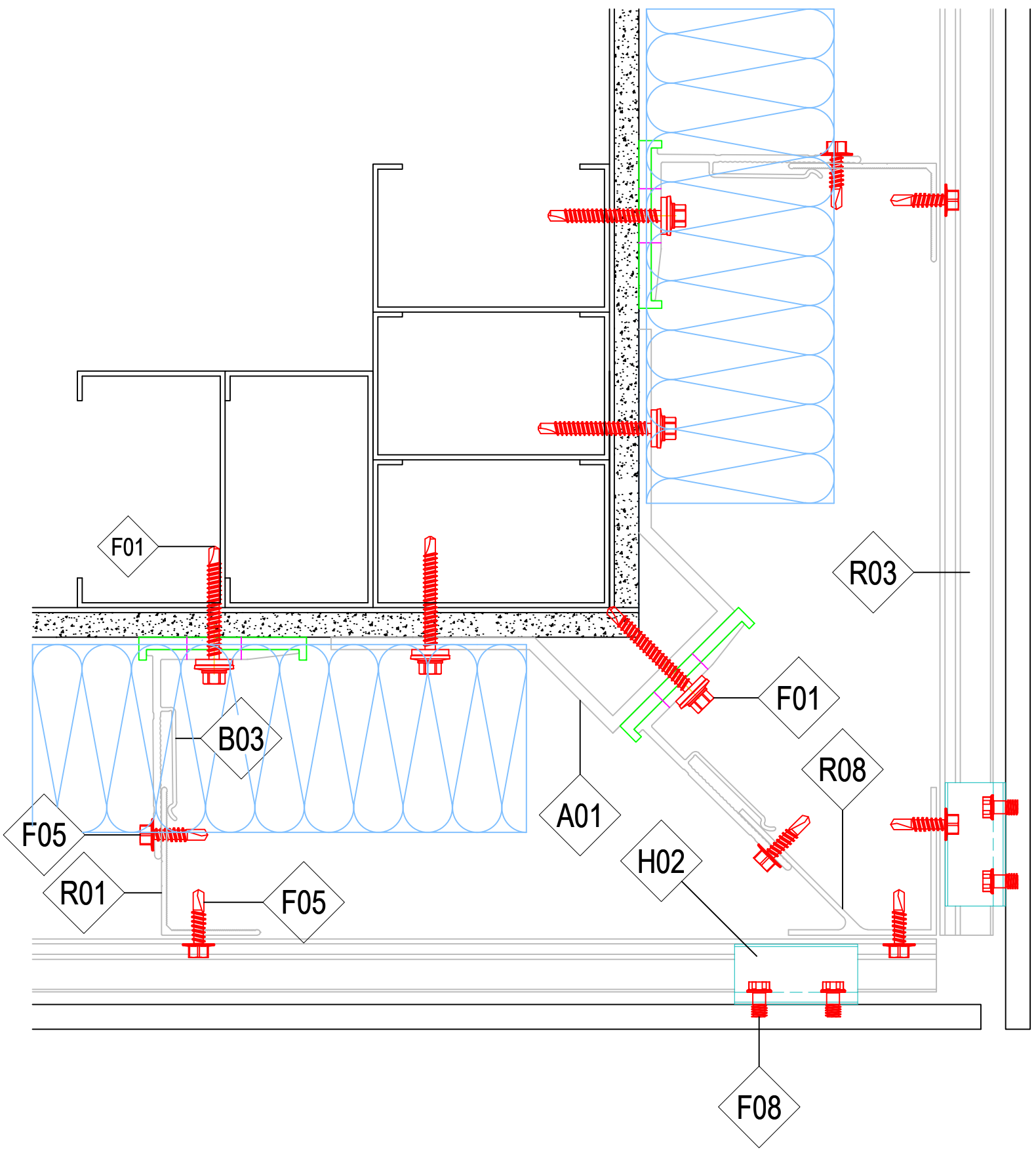
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-17 | Plan - External Corner | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:1.5 |



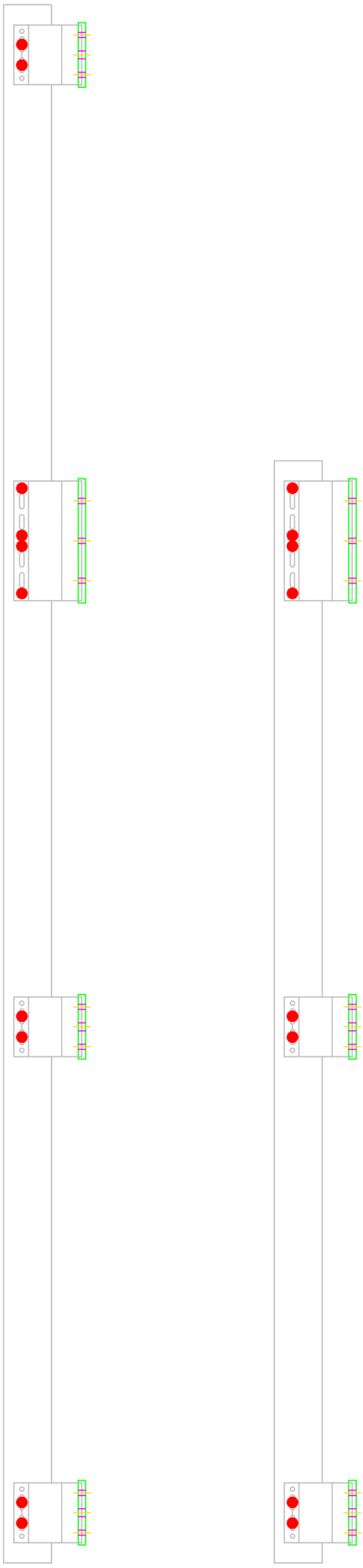
| SHEET | SHEET TITLE | |
|---|---|---|
| NV3-18 | Plan - External Corner with Corner Rail | |
| | NV3 DETAIL SET | |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | 1:2 |



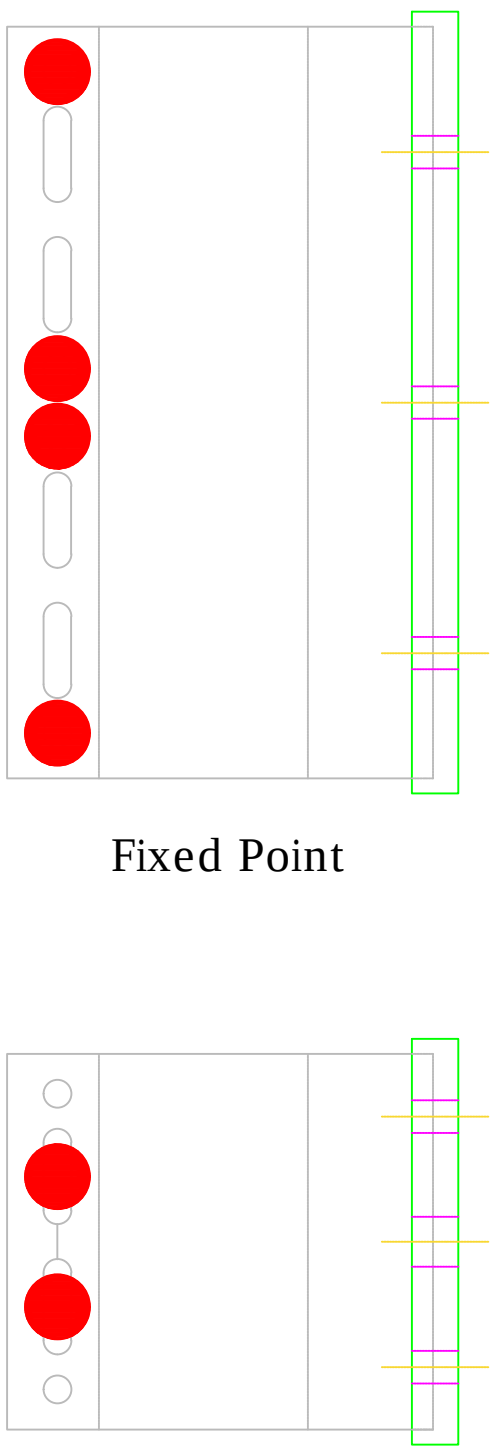
| SHEET | SHEET TITLE |
|---|---|
| NV3-19 | Section - Bracket Install Guide |
| | NV3 DETAIL SET |

| REVISION | DATE | SCALE |
|---|---|---|
| IR | 03.23.2022 | NTS |



Typical Rail Configurations

SDA5-5.5-22 Rail Fastener



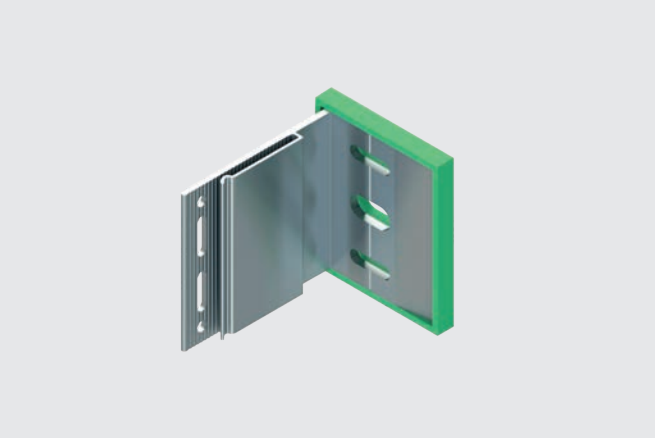
Fixed Point

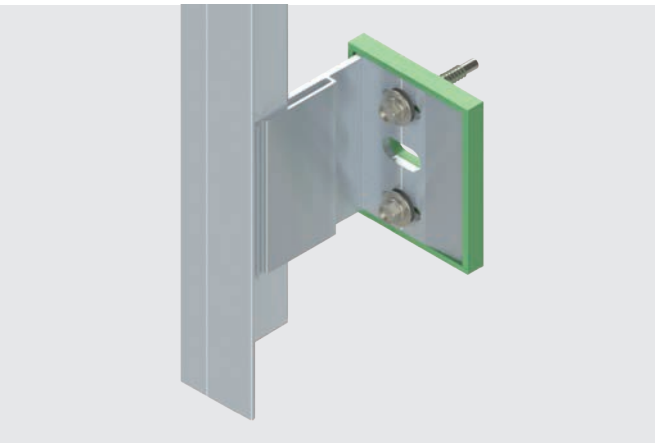


Sliding Point

The following are a representation of installation best practices and are not replacements for project specific engineering. Shop drawings take precedence.

# NVELOPE™ Single Universal Bracket





**Features and Benefits**

- Bracket design allows for rail retainment without additional tools
- Up to 1-½" adjustment range eliminates the need for shims
- Corrosion resistant and 100% recyclable
- Fastener guide marks and integrated thermal isolator to aid in constructabiltiy
- Up to a quarter inch of thermal movement
- Engineered to meet thermal code requirements

**Application**

- Creates a cavity between the architectural cladding and the building for the inclusion of exterior insulation
- Installs directly onto a variety of substrates including steel, wood, concrete and CMU
- Brackets are a component of the NV1 thermally broken subframe system which is used to attach architectural cladding materials utilizing vertically oriented extrusions

**Product Selection**

| Material No. | Bracket Depth (mm) | Cavity Range | | | | Product Code | Carton Wt. (lbs) | Carton Qty. |
|---|---|---|---|---|---|---|---|---|
| | | Minimum | | Maximum | | | | |
| | | (mm) | (in) | (mm) | (in) | | | |
| 1582505 | 40 | 47 | 1.85 | 67 | 2.64 | NV-VB40S | 20 | 150 |
| 1582506 | 60 | 62 | 2.44 | 102 | 4.01 | NV-VB60S | 33 | 150 |
| 1582508 | 90 | 92 | 3.62 | 132 | 5.19 | NV-VB90S | 35 | 120 |
| 1582509 | 120 | 122 | 4.80 | 162 | 6.37 | NV-VB120S | 36 | 80 |
| 1582510 | 150 | 152 | 5.96 | 192 | 7.56 | NV-VB150S | 34 | 70 |
| 1582511 | 180 | 182 | 7.16 | 222 | 8.74 | NV-VB180S | 33 | 60 |
| 1582512 | 210 | 212 | 8.35 | 252 | 9.92 | NV-VB210S | 31 | 50 |
| 1582514 | 240 | 242 | 9.52 | 282 | 11.10 | NV-VB240S | 35 | 50 |
| 1582517 | 270 | 272 | 10.70 | 302 | 12.28 | NV-VB270S | 33 | 40 |
| 1582520 | 300 | 302 | 11.89 | 342 | 13.46 | NV-VB300S | 34 | 40 |



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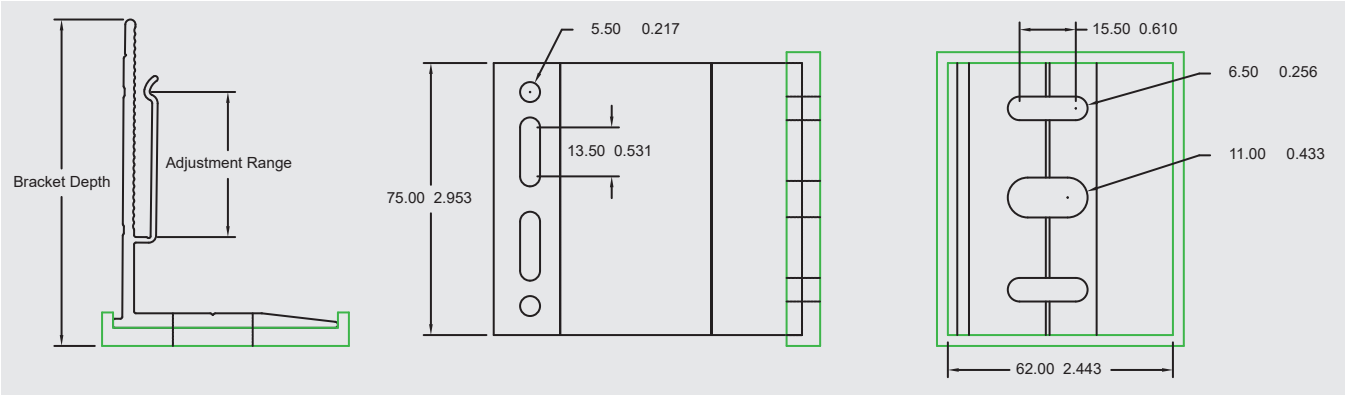
# NVELOPE™
# Single Universal Bracket




**Product Specifications**

Bracket Material: 6005A-T6 aluminum
Isolator Material: Polypropylene
Isolator Thickness: 5mm

**Performance Data[1, 2, 3]**

**Bracket Material Strength**

| | |
|---|---|
| Young's Modulus | 10,100 ksi / 70 Gpa |
| Tensile Strength | 38 ksi / 260 Mpa |
| Shear Strength | 24 ksi / 165 Mpa |
| Tensile Yield | 35 ksi / 240 Mpa |

**Material Thermal Transmittance**

| | |
|---|---|
| Bracket Conductivity: | 1339 Btu-in/ft²-hr-°F (193 W/m-K) |
| Isolator Conductivity: | 0.81 Btu-in/ft²-hr-°F (0.117 W/m-K) |

[1] Inward Horizontal: SFS 1646 / R3
[2] Outward Horizontal: SFS 5900.21
[3] Vertical: SFS 5901.21

**Bracket Structural Values**

| Bracket Size | Vertcal Load | Inward Horizontal Load | Outward Horizontal Load |
|---|---|---|---|
| 40 | 542 lbf / 2.41 KN | 1344 lbf / 5.98 KN | 579 lbf / 2.58 KN |
| 60 | 436 lbf / 1.94 KN | 970 lbf / 4.31 KN | 781 lbf / 3.48 KN |
| 90 | 362 lbf / 1.61 KN | 727 lbf / 3.23 KN | 983 lbf / 4.37 KN |
| 120 | 197 lbf / 0.88 KN | 1080 lbf / 4.80 KN | 1174 lbf / 5.22 KN |
| 150 | 173 lbf / 0.77 KN | 661 lbf / 2.94 KN | |
| 180 | 149 lbf / 0.66 KN | 544 lbf / 2.42 KN | |
| 210 | 125 lbf / 0.56 KN | 317 lbf / 1.41 KN | |
| 240 | 101 lbf / 0.45 KN | 295 lbf / 1.31 KN | |
| 270 | 77 lbf / 0.34 KN | 286 lbf / 1.27 KN | |
| 300 | 53 lbf / 0.24 KN | 242 lbf / 1.07 KN | |

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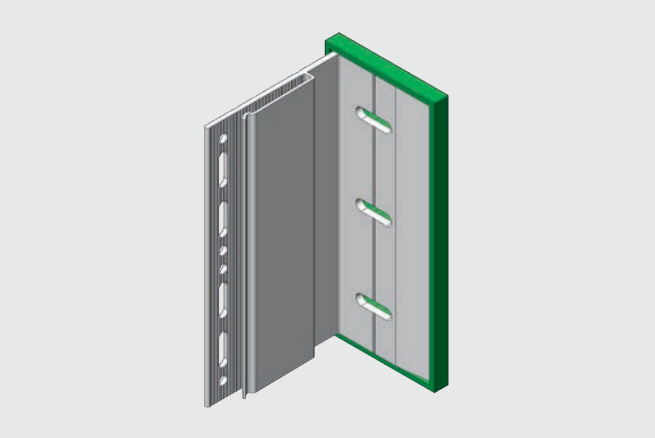
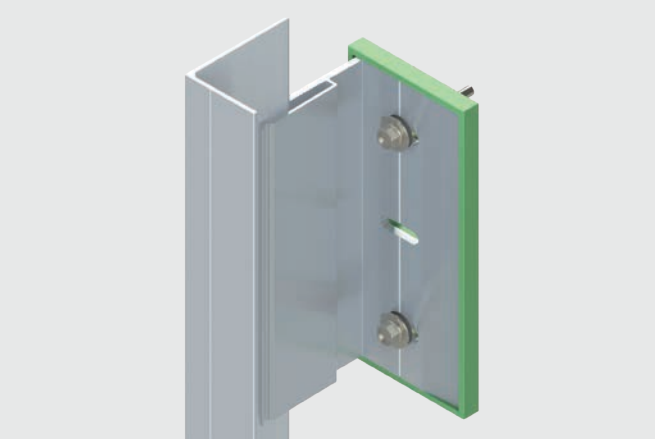
# NVELOPE™
# Double Bracket–6.5 mm slots





**Features and Benefits**
- Bracket design allows for rail retainment without additional tools
- Up to 1-½" adjustment range eliminates the need for shims
- Corrosion resistant and 100% recyclable
- Fastener guide marks and integrated thermal isolator to aid in constructabiltiy
- Up to a quarter inch of thermal movement
- Engineered to meet thermal code requirements

**Application**
- Creates a cavity between the architectural cladding and the building for the inclusion of exterior insulation
- Installs directly onto a variety of substrates including steel, wood, concrete and CMU
- Brackets are a component of the NV1 thermally broken subframe system which is used to attach architectural cladding materials utilizing vertically oriented extrusions

**Product Selection**

| Material No. | Bracket Depth (mm) | Cavity Range | | | | Product Code | Carton Wt. (lbs) | Carton Qty. |
|---|---|---|---|---|---|---|---|---|
| | | Minimum | | Maximum | | | | |
| | | (mm) | (in) | (mm) | (in) | | | |
| 1521239 | 40 | 47 | 1.85 | 67 | 2.64 | NV-VB40D-6.5 | 22 | 75 |
| 1521247 | 60 | 62 | 2.44 | 102 | 4.01 | NV-VB60D-6.5 | 33 | 75 |
| 1521255 | 90 | 92 | 3.62 | 132 | 5.19 | NV-VB90D-6.5 | 33 | 60 |
| 1521263 | 120 | 122 | 4.80 | 162 | 6.37 | NV-VB120D-6.5 | 34 | 40 |
| 1521273 | 150 | 152 | 5.96 | 192 | 7.56 | NV-VB150D-6.5 | 34 | 35 |
| 1521282 | 180 | 182 | 7.16 | 222 | 8.74 | NV-VB180D-6.5 | 33 | 30 |
| 1521291 | 210 | 212 | 8.35 | 252 | 9.92 | NV-VB210D-6.5 | 31 | 25 |
| 1521300 | 240 | 242 | 9.52 | 282 | 11.10 | NV-VB240D-6.5 | 35 | 25 |
| 1521309 | 270 | 272 | 10.70 | 302 | 12.28 | NV-VB270D-6.5 | 33 | 20 |
| 1521317 | 300 | 302 | 11.89 | 342 | 13.46 | NV-VB300D-6.5 | 35 | 20 |



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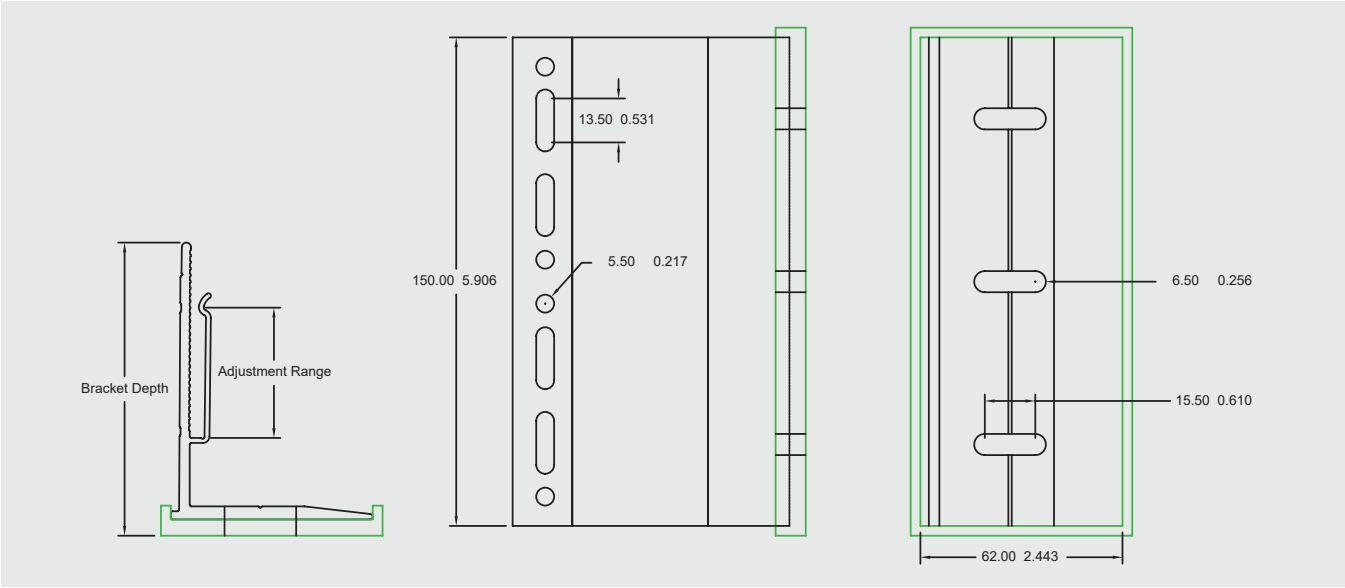
Imperial values are approximate conversions.

# NVELOPE™
# Double Bracket–6.5 mm slots




**Product Specifications**

Bracket Material: 6005A-T6 aluminum
Isolator Material: Polypropylene
Isolator Thickness: 5mm

**Performance Data[1, 2, 3]**

**Bracket Material Strength**

| | |
|---|---|
| Young's Modulus | 10,100 ksi / 70 Gpa |
| Tensile Strength | 38 ksi / 260 Mpa |
| Shear Strength | 24 ksi / 165 Mpa |
| Tensile Yield | 35 ksi / 240 Mpa |

**Material Thermal Transmittance**

| | |
|---|---|
| Bracket Conductivity: | 1339 Btu-in/ft²-hr-°F (193 W/m-K) |
| Isolator Conductivity: | 0.81 Btu-in/ft²-hr-°F (0.117 W/m-K) |

[1] Inward Horizontal: SFS 1646 / R3
[2] Outward Horizontal: SFS 5900.21
[3] Vertical: SFS 5901.21

**Bracket Structural Values**

| Bracket Size | Vertcal Load | Inward Horizontal Load | Outward Horizontal Load |
|---|---|---|---|
| 40 | 1280 lbf / 5.70 KN | 1984 lbf / 8.82 KN | 1219 lbf / 5.42 KN |
| 60 | 1150 lbf / 5.12 KN | 1455 lbf / 6.47 KN | 1338 lbf / 5.95 KN |
| 90 | 864 lbf / 3.84 KN | 1256 lbf / 5.58 KN | 1457 lbf / 6.48 KN |
| 120 | 460 lbf / 2.05 KN | 1719 lbf / 7.64 KN | 1576 lbf / 7.01 KN |
| 150 | 405 lbf / 1.80 KN | 1234 lbf / 5.49 KN | 1695 lbf / 7.54 KN |
| 180 | 350 lbf / 1.56 KN | 903 lbf / 4.02 KN | |
| 210 | 295 lbf / 1.31 KN | 749 lbf / 3.33 KN | |
| 240 | 240 lbf / 1.07 KN | 639 lbf / 2.84 KN | |
| 270 | 185 lbf / 0.82 KN | 573 lbf / 2.54 KN | |
| 300 | 130 lbf / 0.58 KN | 529 lbf / 2.35 KN | |

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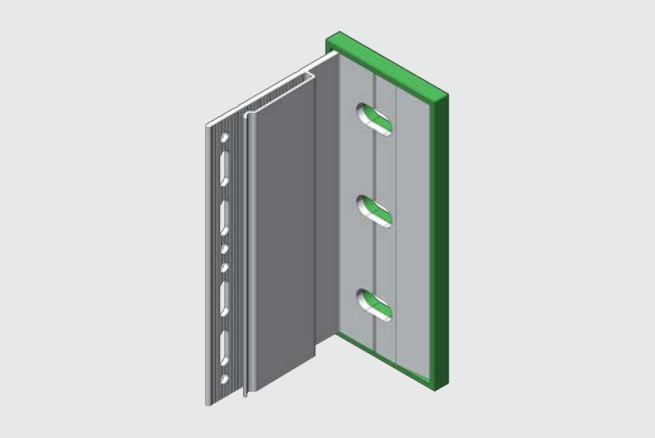
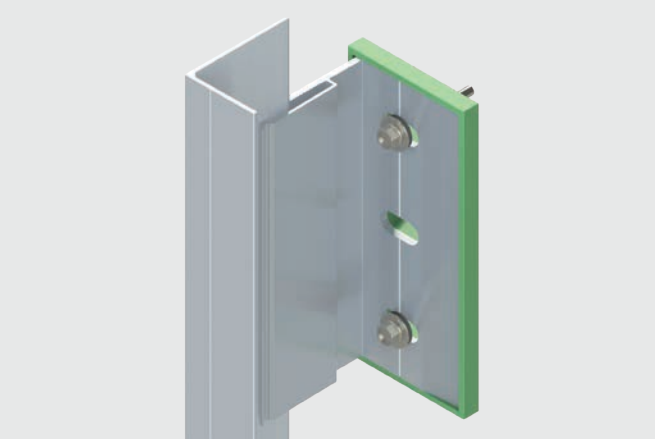
# NVELOPE™
# Double Bracket–11 mm slots





**Features and Benefits**
- Bracket design allows for rail retainment without additional tools
- Up to 1-½" adjustment range eliminates the need for shims
- Corrosion resistant and 100% recyclable
- Fastener guide marks and integrated thermal isolator to aid in constructabiltiy
- Up to a quarter inch of thermal movement
- Engineered to meet thermal code requirements

**Application**
- Creates a cavity between the architectural cladding and the building for the inclusion of exterior insulation
- Installs directly onto a variety of substrates including steel, wood, concrete and CMU
- Brackets are a component of the NV1 thermally broken subframe system which is used to attach architectural cladding materials utilizing vertically oriented extrusions

**Product Selection**

| Material No. | Bracket Depth (mm) | Cavity Range | | | | Product Code | Carton Wt. (lbs) | Carton Qty. |
|---|---|---|---|---|---|---|---|---|
| | | Minimum | | Maximum | | | | |
| | | (mm) | (in) | (mm) | (in) | | | |
| 1521238 | 40 | 47 | 1.85 | 67 | 2.64 | NV-VB40D-11 | 22 | 75 |
| 1521246 | 60 | 62 | 2.44 | 102 | 4.01 | NV-VB60D-11 | 33 | 75 |
| 1521254 | 90 | 92 | 3.62 | 132 | 5.19 | NV-VB90D-11 | 33 | 60 |
| 1521262 | 120 | 122 | 4.80 | 162 | 6.37 | NV-VB120D-11 | 34 | 40 |
| 1521272 | 150 | 152 | 5.96 | 192 | 7.56 | NV-VB150D-11 | 34 | 35 |
| 1521281 | 180 | 182 | 7.16 | 222 | 8.74 | NV-VB180D-11 | 34 | 30 |
| 1521290 | 210 | 212 | 8.35 | 252 | 9.92 | NV-VB210D-11 | 31 | 25 |
| 1521299 | 240 | 242 | 9.52 | 282 | 11.10 | NV-VB240D-11 | 35 | 25 |
| 1521308 | 270 | 272 | 10.70 | 302 | 12.28 | NV-VB270D-11 | 33 | 20 |
| 1521316 | 300 | 302 | 11.89 | 342 | 13.46 | NV-VB300D-11 | 35 | 20 |



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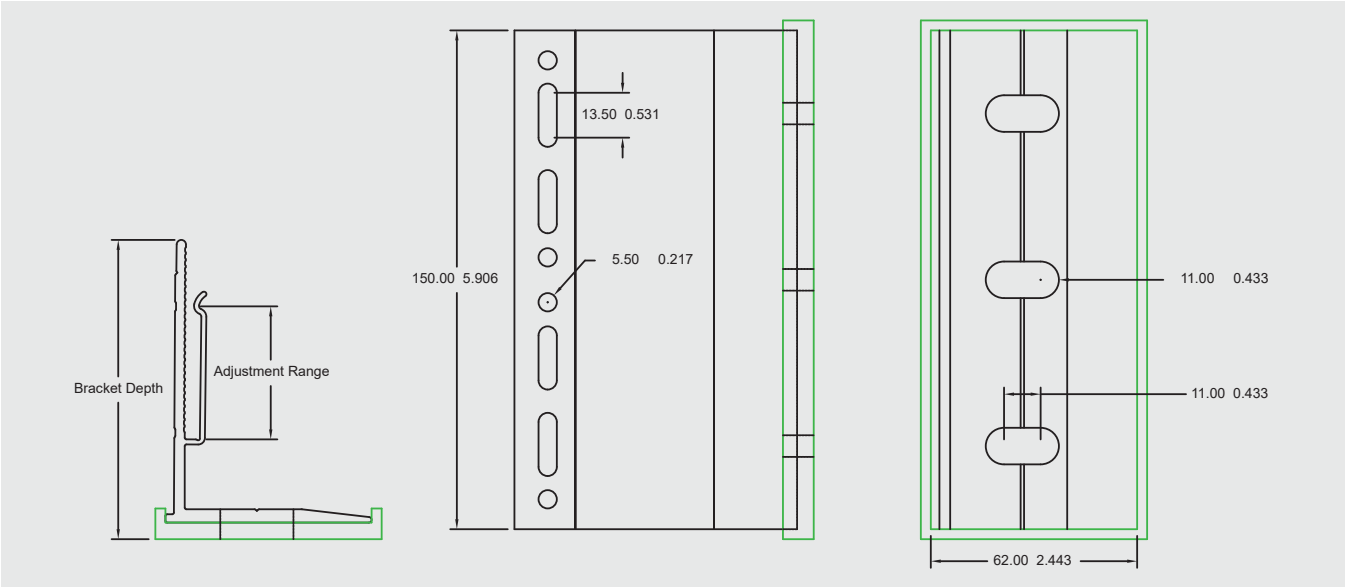
# NVELOPE™
# Double Bracket–11 mm slots




**Product Specifications**

Bracket Material: 6005A-T6 aluminum
Isolator Material: Polypropylene
Isolator Thickness: 5mm

**Performance Data[1, 2, 3]**

**Bracket Material Strength**

| | |
|---|---|
| Young's Modulus | 10,100 ksi / 70 Gpa |
| Tensile Strength | 38 ksi / 260 Mpa |
| Shear Strength | 24 ksi / 165 Mpa |
| Tensile Yield | 35 ksi / 240 Mpa |

**Material Thermal Transmittance**

| | |
|---|---|
| Bracket Conductivity: | 1339 Btu-in/ft²-hr-°F (193 W/m-K) |
| Isolator Conductivity: | 0.81 Btu-in/ft²-hr-°F (0.117 W/m-K) |

[1] Inward Horizontal: SFS 1646 / R3
[2] Outward Horizontal: SFS 5900.21
[3] Vertical: SFS 5901.21

**Bracket Structural Values**

| Bracket Size | Vertcal Load | Inward Horizontal Load | Outward Horizontal Load |
|---|---|---|---|
| 40 | 1280 lbf / 5.70 KN | 1984 lbf / 8.82 KN | 1219 lbf / 5.42 KN |
| 60 | 1150 lbf / 5.12 KN | 1455 lbf / 6.47 KN | 1338 lbf / 5.95 KN |
| 90 | 864 lbf / 3.84 KN | 1256 lbf / 5.58 KN | 1457 lbf / 6.48 KN |
| 120 | 460 lbf / 2.05 KN | 1719 lbf / 7.64 KN | 1576 lbf / 7.01 KN |
| 150 | 405 lbf / 1.80 KN | 1234 lbf / 5.49 KN | 1695 lbf / 7.54 KN |
| 180 | 350 lbf / 1.56 KN | 903 lbf / 4.02 KN | |
| 210 | 295 lbf / 1.31 KN | 749 lbf / 3.33 KN | |
| 240 | 240 lbf / 1.07 KN | 639 lbf / 2.84 KN | |
| 270 | 185 lbf / 0.82 KN | 573 lbf / 2.54 KN | |
| 300 | 130 lbf / 0.58 KN | 529 lbf / 2.35 KN | |

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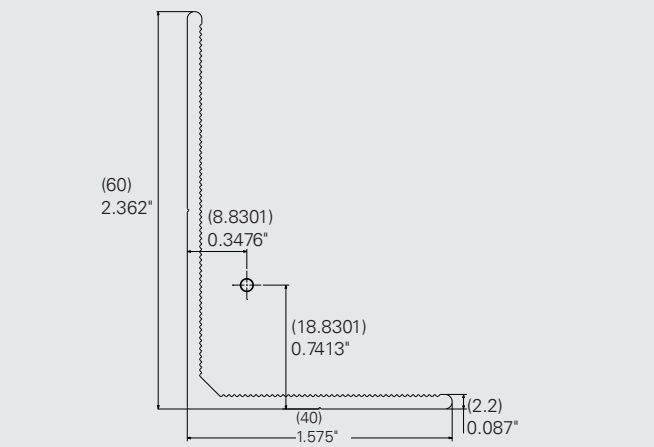
Imperial values are approximate conversions.

# NVELOPE™
# 2.2 mm L-rail




## Product Selection

| Material No. | Description | NAC Code | Material |
|---|---|---|---|
| 1521357 | L profile 60 × 40 x 2.2 × 3000 (118.11") | NV-L60-40-2.2-3000 | 6005A-T6 Aluminum |
| 1521375 | L profile 60 × 40 x 2.2 × 6000 (236.22") | NV-L60-40-2.2-6000 | 6005A-T6 Aluminum |

*Note: Other sizes are available, please contact SFS for additional information.

## Preformance Data

### Rail Material Properties

| | |
|---|---|
| Young's Modulus | 10,100 ksi (70 GPa) |
| Tensile Strength | 38 ksi (260 MPa) |
| Shear Strength | 24 ksi (165 MPa) |
| Tensile Yield | 35 ksi (240 MPa) |
| Thermal Conductivity | 1,310 Btu-in/ft$^2$-hr-°F (183 W/m-k) |

### Rail Section Properties

| | |
|---|---|
| Ix | 0.183 in$^4$ (76,269 mm$^4$) |
| Iy | 0.067 in$^4$ (27,910 mm$^4$) |
| Rx | 0.766 in (19.46 mm) |
| Ry | 0.464 in (11.77 mm) |
| A | 0.312 in$^2$ (201.31 mm$^2$) |
| Sx | 0.112 in$^3$ (1,834.7 mm$^3$) |
| Sy | 0.054 in$^3$ (889.44 mm$^3$) |



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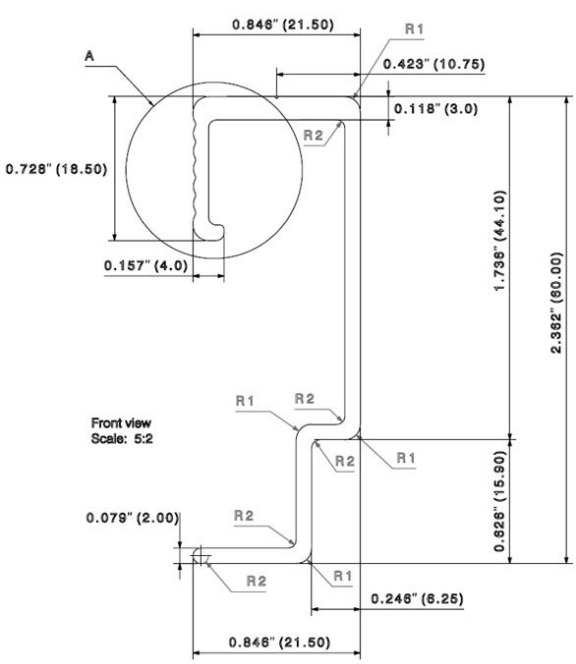



**6005A-T6 Aluminum**

Young's Modulus: 10,100 ksi (70 Gpa)

Tensile Strength: 38 ksi (260 Mpa)

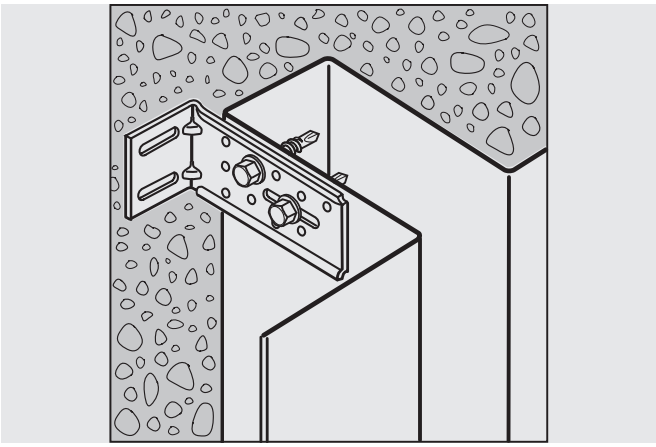
Shear Strength: 24 ksi (165 Mpa)

Tensile Yield: 35 ksi (240 Mpa)

Thermal Conductivity: 1310 Btu-in/ft$^2$-hr-$^o$F (183 W/m-K)

| Material # | Description | NAC Code |
|---|---|---|
| 1521331 | NV3 Profile 3000 (118.11") | NV-CP-NV3-3000 |
| 1521334 | NV3 Profile 6000 (236.22") | NV-CP-NV3-6000 |

# 1/4-14 SD2 Bi-Met 300® Subframe Attachment



### Features and Benefits

- Bi-metal fastener design allows for higher drilling capacity while maintaining the corrosion resistance properties of stainless steel
- Silver VistaCoat® provides a barrier to help prevent galvanic corrosion when used with aluminum
- High ductility reduces delayed embrittlement failures

### Application

- Light and medium gauge metal connections
- Curtain wall and building envelope attachments
- Dissimilar metal connections

### Approvals

- Listed on Intertek CCRR-0387 report

CODE COMPLIANCE
ETL US
Intertek
CCRR-0387

### Product Selection

| Material No. | Fastener Length | | Load Bearing Length | | Description | Carton Wt. (lbs.) | Carton Qty. |
|---|---|---|---|---|---|---|---|
| | (in) | (mm) | (in) | (mm) | | | |
| 1557694 | 1" | 25 | 0.47" | 12 | BMSD2-S3-#14x1-HW3/8 | 32 | 2,000 |
| 1557696 | 1-1/2" | 38 | 0.97" | 24 | BMSD2-S3-#14x1-1/2-HW3/8 | 30 | 1,500 |
| 1557698 | 2" | 51 | 1.44" | 37 | BMSD2-S3-#14x2-HW3/8 | 25 | 1,000 |

Product bagged 250 pieces, unless otherwise noted.



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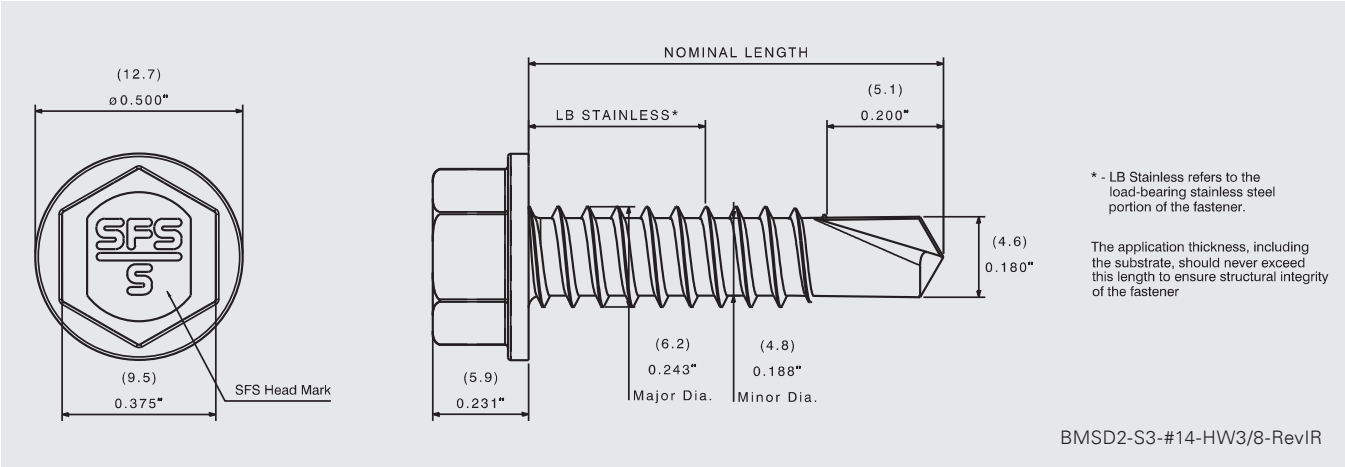
# 1/4-14 SD2 Bi-Met 300® Subframe Attachment




**Product Specifications**

| | |
|---|---|
| Diameter: | 1/4" (6.2 mm) |
| Threads Per Inch: | 14 |
| Head Style: | HWH 3/8" (9.5 mm) AF |
| Material: | 304SS |
| Drill Point: | SD2 |
| Drill Capacity: | 0.105" (2.7 mm) Max Steel<br>0.125" (3.2 mm) Aluminum |
| Thread Major Dia: | 0.243" (6.2 mm) |
| Thread Minor Dia: | 0.188" (4.8 mm) |

**Performance Data**[1,2,3]

| Material Strength | |
|---|---|
| Tensile | 3623 lbf / 16116 N |
| Shear | 2620 lbf / 11654 N |
| Torsional* | 140 lbf·in / 15.4 N·m |

* Torsional values for Stainless Steel section only.

[1] CCRR-0387
[2] See CCRR-0387 for allowable loads.
[3] PLK 22217

| Pull Out Strength Steel | |
|---|---|
| **20 Ga (0.9 mm)**[a] | 330 lbf / 1468 N |
| **18 Ga (1.2 mm)**[a] | 439 lbf / 1953 N |
| **16 Ga (1.5 mm)**[b] | 697 lbf / 3100 N |
| **14 Ga (1.9 mm)**[b] | 895 lbf / 3981 N |
| **12 Ga (2.7 mm)**[b] | 1221 lbf / 5431 N |

[a] 33 ksi
[b] 50 ksi

| Pull Out Strength Aluminum | |
|---|---|
| **1/8" (3.2 mm) 6063-T5** | 771 lbf / 3430 N |

**Installation and Application Considerations**

Install fasteners with 0–2000 RPM screw driver equipped with depth sensing nose piece.

**Use of impact guns or hammer drills is not recommended.**



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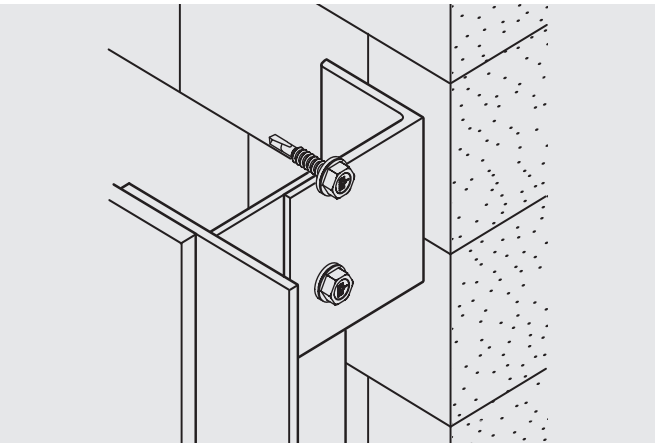
# SDA5 Full 316 SS Self-driller Sub-construction Fastener



**Features and Benefits**

- Reduced thread below the head prevents oversetting and rattling with wind loads
- Available in 316 stainless steel for increased lifetime with no fastener inspection
- Versatile 5/16" hexagonal external drive and SR2 internal drive
- Optimized drill point reduces installation times with a drilling capacity of up to 5mm in aluminum

**Application**

- Rainscreen cladding aluminum support systems
- Nvelope bracket to aluminum
- Aluminum rail attachments

**Product Selection**

| Material No. | Fastener Length | | Load Bearing Length | | | | Description | Carton Wt. (lbs.) | Carton Qty. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Minimum | | Maximum | | | | |
| | (in) | (mm) | (in) | (mm) | (in) | (mm) | | | |
| 1507572 | 7/8" | 22 | 0.14" | 3.5 | 0.31" | 8 | SDA5/3.5-8-H13-S4-5.5x22 | 5.5 | 500 |
| 1645134* | 1-3/4" | 45 | 1" | 25 | 1-1/16" | 28 | SDA5/25-28-H13-S4-5.5x45 | 10 | 500 |

*This length is specifically designed for the bracket-to-rail connection for the NVELOPE NH3 system.



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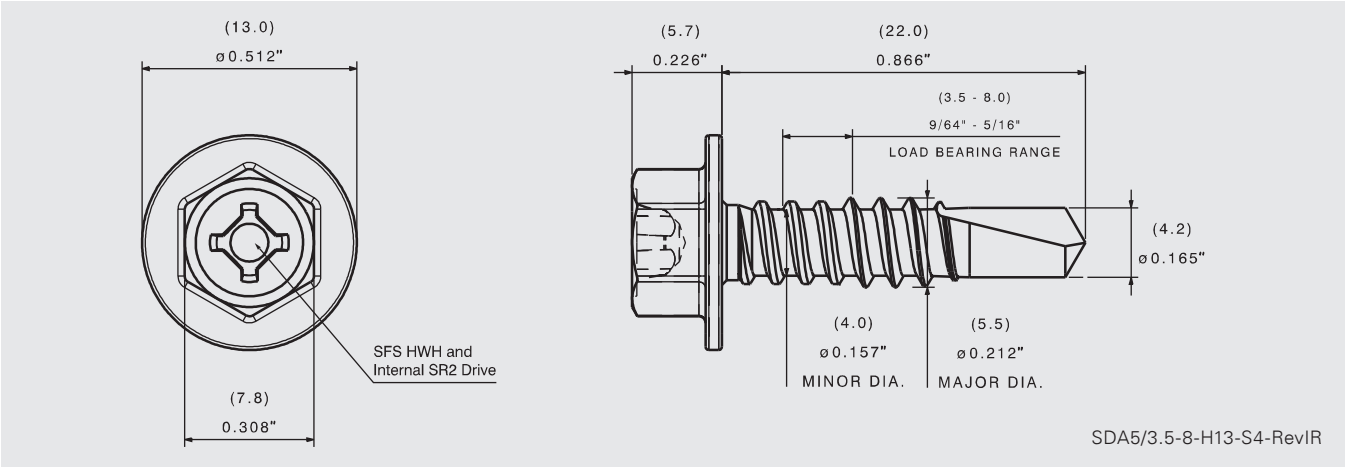
Metric values are approximate conversions.

# SDA5 Full 316 SS Self-driller Sub-construction Fastener




**Product Specifications**

| | |
|---|---|
| Diameter: | #12 (5.5 mm) |
| Threads Per Inch: | 14 |
| Head Style: | HWH 5/16" (7.8 mm) AF with SR2 internal drive |
| Material: | 316SS |
| Drill Point: | SD3 |
| Drill Capacity: | 0.197" (5 mm) Max |
| Thread Major Dia: | 0.212" (5.5 mm) |
| Thread Minor Dia: | 0.157" (4.0 mm) |

**Performance Data**[1]

| Material Strength | |
|---|---|
| Tensile | 2530 lbf / 11254 N |
| Shear | 1705 lbf / 7584 N |
| Torsional | 92 lbf·in / 10.39 N·m |

| Pull Out Strength Aluminum | |
|---|---|
| **2.2 mm L or T rail (0.087")*** | 756 lbf / 3363 N |
| **2.5 mm L or T rail (0.098")*** | 856 lbf / 3308 N |
| **1/8" 6063-T5 (3.2 mm)** | 951 lbf / 4230 N |

[1] SFS (5653.19).
*Values are only valid for aluminum rails supplied by SFS.

**Installation and Application Considerations**

Install fasteners with 0-2000 RPM screw driver equipped with depth sensing nose piece.



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**NVELOPE® Memo**

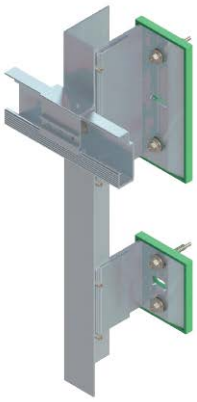
**RE: NV3 System Thermal Performance**

**To Whom It May Concern,**

**The NVELOPE® NV3 Thermally Broken Cladding Support System consists of a series of brackets attached to the substrate with vertically oriented rails. These brackets and rails are manufactured in the same sizes and materials as the NV1 system. Within the cavity created by these brackets and rails, insulation (typically mineral wool) is installed. The difference between the NV3 and NV1 systems is the addition of a series of horizontal carrier rails with NV3 which are installed outboard of the insulation/air cavity. This carrier rail allows for a horizontally oriented cladding system with a hidden fastening system to be installed. Since the added carrier rails are outboard of the insulation/air cavity, thermal performance data for the NV1 system can be applied to the NV3 system. Please reference the "NVELOPE® NV1 and NH2 Thermal Analysis" document prepared by Morrison Hershfield, Report Number: 190493100, dated May 5, 2020.**

**NV1 – Vertically running rail system**
Adjustable main support system for horizontally-attached rainscreen cladding applications. Mechanical face fastened panels.

**NV3 – Hidden mechanical fastened system**
Adjustable system for hidden fastened applications. Cladding panels mechanically attached.

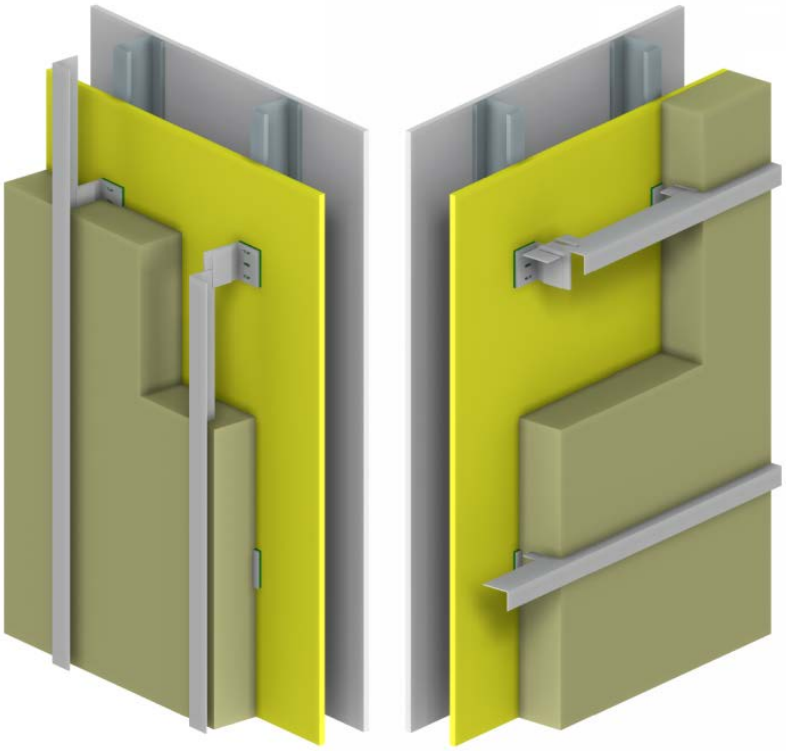


**Regards,**

**Brian Sharlow, P.E.**
**Engineering Manager- NVELOPE®**
**brian.sharlow@sfs.com**

MORRISON HERSHFIELD

# Nvelope NV1 and NH2 Thermal Analysis



Presented to:

**Mr. Robert Stricek**
Director, Standards & Scientific Affairs

**SFS Group USA**
1045 Spring Street
Wyomissing, PA 19610

Report Number: 190493100
May 5, 2020

# TABLE OF CONTENTS


| | | | Page |
|---|---|---|---|
| 1. | | INTRODUCTION | 1 |
| 2. | | MODELING PROCEDURES | 4 |
| 3. | | THERMAL RESULTS | 5 |
| | 3.1 | NV1 Clip System with Exterior Insulated Steel Stud Assembly | 5 |
| | 3.2 | NV1 Clip System with Split Insulated Steel Stud Assembly | 5 |
| | 3.3 | NV1 Clip System with CMU Wall Assembly | 8 |
| | 3.4 | NH2 Clip System with Exterior Insulated Steel Stud Assembly | 9 |
| | 3.5 | NH2 Clip System with Split Insulated Steel Stud Assembly | 9 |
| | 3.6 | NH2 Clip System with CMU Wall Assembly | 12 |

APPENDIX A: DETAIL DRAWINGS

APPENDIX B: MODELING PARAMETERS AND ASSUMPTIONS

APPENDIX C: MATERIAL PROPERTIES

APPENDIX D: EFFECTIVE ASSEMBLY R-VALUES

APPENDIX E: SIMULATED TEMPERATURE PROFILES

# 1. INTRODUCTION

Morrison Hershfield (MH) was retained by SFS Group USA (SFS) to evaluate the thermal performance of the Nvelope NV1 and NH2 clip systems for a variety of insulation thicknesses, clip spacings, and backup wall configurations. This report is a summary of the analysis.

The Nvelope NV1 clip provides an intermittent structural attachment for claddings along with vertical sub-girts. To provide horizontal sub-girt orientation, the NH2 adaptor is attached to the NV1 clip. The NV1 clip and NH2 adaptor are made from extruded aluminum alloy and the clip system includes a plastic isolator between the clip and the backup wall.

MH has previously evaluated the NV1 and NH2 systems for a variety of insulation thicknesses and backup wall configurations all spaced 16 inches o.c. horizontally[1]. For this report, the NV1 and NH2 clip systems were evaluated to determine the clear field U-values and effective R-values for additional bracket sizes, exterior insulation thicknesses, backup walls, and clip spacings.

Table 1.1 below summarizes the evaluated wall configurations, and Figure 1.1 and 1.2 illustrate representative configurations for all backup wall types for the NV1 system and the NH2 system, respectively. The geometry of the NV1 bracket and NH2 adaptor were based on drawings provided by SFS, and are given in Appendix A.

**Table 1.1:** Evaluated NV1 and NH2 Systems Assemblies

| Clip System | Backup Wall | Cavity Insulation Nominal R-value hr ft² °F / Btu | Exterior Insulation Nominal R-Value hr ft² °F / Btu | Horizontal Clip Spacing (in) | Vertical Clip Spacing (in) |
|---|---|---|---|---|---|
| NV1 | 3 5/8" Steel Stud, Uninsulated Cavity | -- | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 3 5/8" Steel Stud, Batt Insulation in Cavity | R11, R12, R13, R15 | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 6" Steel Stud, Batt Insulation in Cavity | R19 | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 8" CMU Wall with 1-5/8" Steel Stud Furring | -- | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16, 24, 32 | 16, 24, 36, 48 |
| NH2 | 3 5/8" Steel Stud, Uninsulated Cavity | -- | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 3 5/8" Steel Stud, Batt Insulation in Cavity | R11, R12, R13, R15 | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 6" Steel Stud, Batt Insulation in Cavity | R19 | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16 | 16, 24, 36, 48 |
| | 8" CMU Wall with 1-5/8" Steel Stud Furring | -- | R6.3, R8.4, R12.6, R16.8, R21, R25.2 | 16, 24, 32 | 16, 24, 36, 48 |

[1] Report number 5140108, issued April 30, 2015; Report number 5171233, issued October 10, 2017; Report number 190070700, issued December 21, 2018.

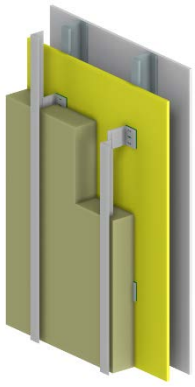
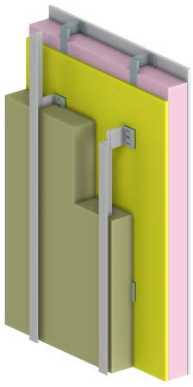
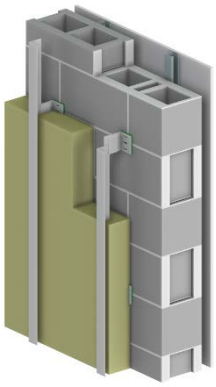
|  |  |  |
|---|---|---|
| **NV1 System with Exterior Insulated Steel Stud Assembly** | **NV1 System with Split Insulated Steel Stud Assembly** | **NV1 System with Concrete Block Wall Assembly** |
| • 1/2" gypsum<br>• 3 5/8" x 1 5/8" steel studs at 16" o.c. with uninsulated cavity<br>• 1/2" gypsum sheathing<br>• NV1 Clip System<br>• Exterior mineral wool insulation<br>• Vertical L-girt | • 1/2" gypsum<br>• 3 5/8" (or 6") x 1 5/8" steel studs at 16" o.c. with batt insulation in cavity<br>• 1/2" gypsum sheathing<br>• NV1 Clip System<br>• Exterior mineral wool insulation<br>• Vertical L-girt | • 1/2" gypsum<br>• 1 5/8" x 1 5/8" steel stud furrings at 16" o.c.<br>• 8" CMU<br>• NV1 Clip System<br>• Exterior mineral wool insulation<br>• Vertical L-girt |

**Figure 1.1:** Schematics of Evaluated NV1 Systems Assemblies

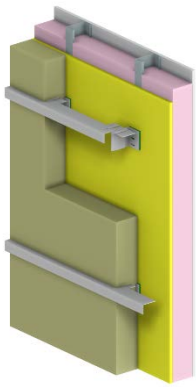
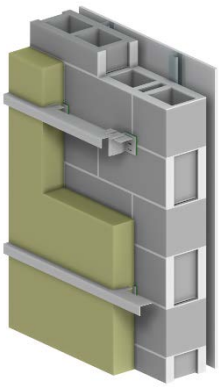
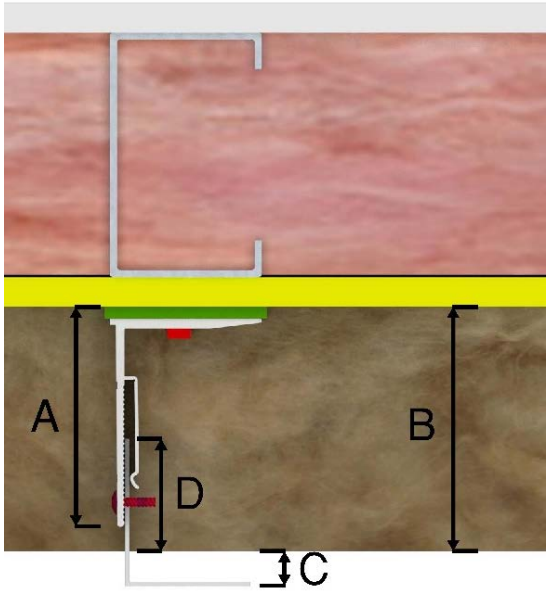
|  |  |  |
|---|---|---|
| **NH2 System with Exterior Insulated Steel Stud Assembly** | **NH2 System with Split Insulated Steel Stud Assembly** | **NH2 System with Concrete Block Wall Assembly** |
| • 1/2" gypsum<br>• 3 5/8" x 1 5/8" steel studs at 16" o.c. with uninsulated cavity<br>• 1/2" gypsum sheathing<br>• NH2 Clip System<br>• Exterior mineral wool insulation<br>• Horizontal L-girt | • 1/2" gypsum<br>• 3 5/8" (or 6") x 1 5/8" steel studs at 16" o.c. with batt insulation in cavity<br>• 1/2" gypsum sheathing<br>• NH2 Clip System<br>• Exterior mineral wool insulation<br>• Horizontal L-girt | • 1/2" gypsum<br>• 1 5/8" x 1 5/8" steel stud furrings at 16" o.c.<br>• 8" CMU<br>• NH2 Clip System<br>• Exterior mineral wool insulation<br>• Horizontal L-girt |

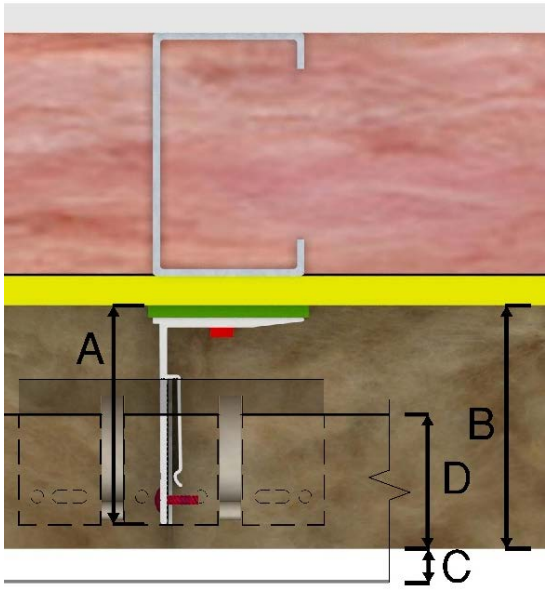
**Figure 1.2:** Schematics of Evaluated NH2 Systems Assemblies

For all configurations, the assemblies were evaluated with a 60 mm x 40 mm x 2.5 mm L-shaped sub-girt. For all scenarios for the NH2 system, the NH2 adaptor is considered installed tight to the back of the NV1 “helping hand”. For both the NV1 and NH2 systems, the various arrangements of NV1 bracket sizes, insulation thicknesses, rainscreen cavity sizes, and corresponding girt penetration depths are shown below in Figure 1.3 and Figure 1.4.




| - A - NV1 Bracket Size mm | - B - Insulation Thickness in (mm) | - C - Rainscreen Cavity in (mm) | - D - Girt Penetration Depth mm (in) |
|---|---|---|---|
| 40 | 1.5 (38) | 1 (25) | 14.6 (0.57) |
| 60 | 2 (51) | 1 (25) | 14.6 (0.57) |
| 60 | 3 (76) | 1 (25) | 34.6 (1.36) |
| 90 | 4 (102) | 1 (25) | 34.6 (1.36) |
| 120 | 5 (127) | 1 (25) | 34.6 (1.36) |
| 150 | 6 (152) | 1 (25) | 34.6 (1.36) |
| 180 | 6 (152) | 2 (51) | 9.2 (0.36) |
| 210 | 6 (152) | 3 (76) | 0 |

**Figure 1.3:** Girt Penetration for all Insulation Thicknesses for Evaluated NV1 System




| - A - NV1 Bracket Size mm | - B - Insulation Thickness in (mm) | - C - Rainscreen Cavity in (mm) | - D - Girt Penetration Depth mm (in) |
|---|---|---|---|
| 60 | 1.5 (38) | 1.5 (38) | 1.9 (0.07) |
| 60 | 2 (51) | 1 (25) | 14.6 (0.57) |
| 60 | 3 (76) | 1 (25) | 34.6 (1.36) |
| 90 | 4 (102) | 1 (25) | 34.6 (1.36) |
| 120 | 5 (127) | 1 (25) | 34.6 (1.36) |
| 150 | 6 (152) | 1 (25) | 34.6 (1.36) |
| 180 | 6 (152) | 2 (51) | 9.2 (0.36) |
| 210 | 6 (152) | 3 (76) | 0 |

**Figure 1.4:** Girt Penetration for all Insulation Thicknesses for Evaluated NH2 System

In addition to the above scenarios, the 90 mm NV1 bracket spaced 16 inches o.c. horizontally and 24 inches o.c. vertically was modelled with no exterior insulation with the CMU backup wall.

# 2. MODELING PROCEDURES

The thermal performance of the different assembly scenarios was evaluated by 3D thermal modeling using the Nx software package from Siemens, which is a general purpose computer aided design (CAD) and finite element analysis (FEA) package. The thermal solver and modeling procedures utilized for this study were extensively calibrated and validated to within +/- 5% of hotbox testing for *ASHRAE Research Project 1365-RP Thermal Performance of Building Envelope Details for Mid- and High-Rise Construction and for the Building Envelope Thermal Bridging Guide*[2]. The thermal analysis utilized steady-state conditions, published thermal properties of materials and information provided by SFS. Additional assumptions for the thermal analysis are listed in Appendix B. Further assembly information, including dimensions and materials are given in Appendix C.

[2] https://www.bchydro.com/thermalguide

# 3. THERMAL RESULTS

The clear field U-values for all NV1 and NH2 clip system assembly configurations are shown below in Table 3.1.1 through Table 3.6.1. The effective R-values for all assembly configurations can be found in Appendix D. Example temperature profiles for each configuration are provided in Appendix E.

## 3.1 NV1 Clip System with Exterior Insulated Steel Stud Assembly

**Table 3.1.1:** U-Value for NV1 Clip System with Exterior Insulated Steel Stud Assemblies with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[3] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.121 (0.684) | 0.116 (0.659) | 0.113 (0.641) | 0.111 (0.631) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.104 (0.592) | 0.099 (0.562) | 0.095 (0.540) | 0.093 (0.528) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.085 (0.484) | 0.079 (0.451) | 0.075 (0.427) | 0.073 (0.413) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.074 (0.419) | 0.067 (0.380) | 0.062 (0.353) | 0.059 (0.338) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.067 (0.378) | 0.059 (0.336) | 0.054 (0.306) | 0.051 (0.289) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.062 (0.349) | 0.054 (0.305) | 0.048 (0.273) | 0.045 (0.256) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.063 (0.355) | 0.054 (0.307) | 0.048 (0.273) | 0.045 (0.254) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.063 (0.357) | 0.054 (0.308) | 0.048 (0.273) | 0.045 (0.254) |

## 3.2 NV1 Clip System with Split Insulated Steel Stud Assembly

**Table 3.2.1:** U-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-11 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[4] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.073 (0.415) | 0.071 (0.403) | 0.069 (0.392) | 0.068 (0.386) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.067 (0.382) | 0.064 (0.365) | 0.062 (0.352) | 0.061 (0.345) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.059 (0.336) | 0.056 (0.317) | 0.053 (0.302) | 0.052 (0.293) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.054 (0.304) | 0.049 (0.281) | 0.046 (0.263) | 0.045 (0.253) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.050 (0.282) | 0.045 (0.256) | 0.042 (0.236) | 0.040 (0.224) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.266) | 0.042 (0.238) | 0.038 (0.216) | 0.036 (0.203) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.048 (0.270) | 0.042 (0.239) | 0.038 (0.215) | 0.036 (0.202) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.048 (0.271) | 0.042 (0.239) | 0.038 (0.215) | 0.036 (0.202) |

[3] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, and air films all contribute an additional R-3.2 towards the nominal R-value of the entire assembly.

[4] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-13.3 towards the nominal R-value of the entire assembly.

**Table 3.2.2:** U-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-12 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[5] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.071 (0.404) | 0.069 (0.392) | 0.067 (0.382) | 0.066 (0.375) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.066 (0.373) | 0.063 (0.356) | 0.061 (0.344) | 0.059 (0.336) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.058 (0.329) | 0.055 (0.310) | 0.052 (0.296) | 0.051 (0.287) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.053 (0.299) | 0.049 (0.276) | 0.046 (0.258) | 0.044 (0.248) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.049 (0.278) | 0.044 (0.252) | 0.041 (0.232) | 0.039 (0.221) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.262) | 0.041 (0.234) | 0.037 (0.213) | 0.035 (0.201) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.265) | 0.041 (0.235) | 0.037 (0.212) | 0.035 (0.199) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.267) | 0.041 (0.236) | 0.037 (0.212) | 0.035 (0.199) |

**Table 3.2.3:** U-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-13 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[6] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.069 (0.394) | 0.067 (0.382) | 0.066 (0.373) | 0.064 (0.366) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.064 (0.364) | 0.061 (0.348) | 0.059 (0.336) | 0.058 (0.329) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.057 (0.323) | 0.054 (0.304) | 0.051 (0.290) | 0.050 (0.282) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.052 (0.294) | 0.048 (0.271) | 0.045 (0.254) | 0.043 (0.244) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.048 (0.273) | 0.044 (0.248) | 0.040 (0.229) | 0.038 (0.218) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.259) | 0.041 (0.231) | 0.037 (0.210) | 0.035 (0.198) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.262) | 0.041 (0.232) | 0.037 (0.209) | 0.035 (0.197) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.263) | 0.041 (0.232) | 0.037 (0.210) | 0.035 (0.197) |

[5] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-14.3 towards the nominal R-value of the entire assembly.

[6] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-15.3 towards the nominal R-value of the entire assembly.

**Table 3.2.4:** U-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-15 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[7] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.066 (0.377) | 0.064 (0.365) | 0.063 (0.356) | 0.062 (0.349) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.062 (0.350) | 0.059 (0.335) | 0.057 (0.323) | 0.056 (0.315) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.055 (0.312) | 0.052 (0.294) | 0.049 (0.281) | 0.048 (0.272) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.050 (0.285) | 0.046 (0.263) | 0.043 (0.247) | 0.042 (0.237) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.047 (0.266) | 0.043 (0.241) | 0.039 (0.223) | 0.037 (0.212) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.044 (0.252) | 0.040 (0.225) | 0.036 (0.205) | 0.034 (0.193) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.045 (0.255) | 0.040 (0.226) | 0.036 (0.204) | 0.034 (0.192) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.045 (0.256) | 0.040 (0.227) | 0.036 (0.205) | 0.034 (0.192) |

**Table 3.2.5:** U-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-19 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[8] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | 0.061 (0.348) | 0.060 (0.339) | 0.058 (0.331) | 0.058 (0.327) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.057 (0.325) | 0.055 (0.312) | 0.053 (0.302) | 0.052 (0.297) |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.052 (0.292) | 0.049 (0.277) | 0.047 (0.265) | 0.046 (0.259) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.047 (0.269) | 0.044 (0.249) | 0.041 (0.234) | 0.040 (0.227) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.044 (0.252) | 0.040 (0.230) | 0.037 (0.213) | 0.036 (0.204) |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.042 (0.240) | 0.038 (0.215) | 0.035 (0.197) | 0.033 (0.187) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.043 (0.242) | 0.038 (0.216) | 0.035 (0.196) | 0.033 (0.186) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.043 (0.243) | 0.038 (0.217) | 0.035 (0.196) | 0.033 (0.186) |

[7] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-17.3 towards the nominal R-value of the entire assembly.

[8] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-21.3 towards the nominal R-value of the entire assembly.

## 3.3 NV1 Clip System with CMU Wall Assembly

**Table 3.3.1:** U-Value for NV1 Clip System with CMU Wall Assemblies with Clips Spaced 16", 24" and 32" Horizontally

| Horizontal Clip Spacing in | NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[9] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 16 | 40 | 1.5 | R-6.3 (1.11 RSI) | 0.114 (0.649) | 0.110 (0.623) | 0.106 (0.604) | 0.105 (0.594) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.102 (0.577)** | *0.096 (0.546)** | *0.092 (0.523)** | *0.090 (0.512)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.085 (0.480) | 0.078 (0.444) | 0.074 (0.417) | 0.071 (0.403) |
| | 90 | 0 | R-0 | *0.258 (1.46)** | 0.258 (1.46) | *0.258 (1.46)** | *0.258 (1.46)** |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.075 (0.425) | 0.067 (0.383) | 0.062 (0.352) | 0.059 (0.335) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.069 (0.389)** | *0.060 (0.343)** | *0.054 (0.308)** | *0.051 (0.291)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.064 (0.364) | 0.056 (0.316) | 0.049 (0.280) | 0.046 (0.260) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.065 (0.372) | 0.056 (0.319) | 0.049 (0.280) | 0.046 (0.260) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.066 (0.374) | 0.056 (0.320) | 0.049 (0.280) | 0.046 (0.260) |
| 24 | 40 | 1.5 | R-6.3 (1.11 RSI) | 0.109 (0.618) | 0.106 (0.600) | 0.103 (0.588) | 0.102 (0.581) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.095 (0.537)** | *0.091 (0.517)** | *0.088 (0.502)** | *0.087 (0.495)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.077 (0.436) | 0.072 (0.411) | 0.069 (0.393) | 0.068 (0.383) |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.066 (0.376) | 0.061 (0.347) | 0.057 (0.326) | 0.055 (0.315) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.059 (0.336)** | *0.054 (0.305)** | *0.050 (0.282)** | *0.048 (0.270)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.055 (0.309) | 0.049 (0.276) | 0.044 (0.252) | 0.042 (0.239) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.055 (0.315) | 0.049 (0.279) | 0.044 (0.252) | 0.042 (0.238) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.056 (0.317) | 0.049 (0.279) | 0.044 (0.252) | 0.042 (0.238) |
| 32 | 40 | 1.5 | R-6.3 (1.11 RSI) | 0.106 (0.603) | 0.104 (0.589) | 0.102 (0.580) | 0.101 (0.574) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.091 (0.518)** | *0.088 (0.502)** | *0.087 (0.493)** | *0.086 (0.486)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.073 (0.413) | 0.070 (0.395) | 0.067 (0.381) | 0.066 (0.374) |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.062 (0.351) | 0.058 (0.330) | 0.055 (0.313) | 0.054 (0.305) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.055 (0.310)** | *0.050 (0.287)** | *0.047 (0.269)** | *0.046 (0.260)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.050 (0.282) | 0.045 (0.257) | 0.042 (0.238) | 0.040 (0.228) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.050 (0.286) | 0.046 (0.258) | 0.042 (0.238) | 0.040 (0.228) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.051 (0.287) | 0.046 (0.259) | 0.042 (0.238) | 0.040 (0.228) |

[9] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, concrete blocks, and air films all contribute an additional R-3.9 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

## 3.4 NH2 Clip System with Exterior Insulated Steel Stud Assembly

**Table 3.4.1:** U-Value for NH2 Clip System with Exterior Insulated Steel Stud Assemblies with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[10] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.121 (0.684)** | 0.116 (0.659)** | 0.113 (0.641)** | 0.110 (0.624) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.104 (0.592)** | 0.099 (0.562)** | 0.095 (0.540)** | *0.093 (0.526)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.085 (0.484)** | 0.079 (0.451)** | 0.073 (0.417) | 0.070 (0.400) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.074 (0.419)** | 0.067 (0.380)** | 0.060 (0.343) | 0.057 (0.326) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.067 (0.378)** | 0.059 (0.336)** | *0.052 (0.295)** | *0.049 (0.279)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.062 (0.349)** | 0.054 (0.305)** | 0.046 (0.262) | 0.043 (0.246) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.062 (0.351) | 0.053 (0.302) | 0.047 (0.267) | 0.044 (0.250) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.063 (0.356) | 0.054 (0.305) | 0.047 (0.269) | 0.044 (0.251) |

## 3.5 NH2 Clip System with Split Insulated Steel Stud Assembly

**Table 3.5.1:** U-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-11 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[11] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.073 (0.415)** | 0.071 (0.403)** | 0.069 (0.392)** | 0.067 (0.382) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.067 (0.382)** | 0.064 (0.365)** | 0.062 (0.352)** | *0.060 (0.343)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.059 (0.336)** | 0.056 (0.317)** | 0.052 (0.295) | 0.050 (0.285) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.054 (0.304)** | 0.049 (0.281)** | 0.045 (0.256) | 0.043 (0.245) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.050 (0.282)** | 0.045 (0.256)** | *0.040 (0.229)** | *0.038 (0.218)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.266)** | 0.042 (0.238)** | 0.037 (0.209) | 0.035 (0.197) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.266) | 0.041 (0.234) | 0.037 (0.212) | 0.035 (0.199) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.268) | 0.042 (0.236) | 0.037 (0.213) | 0.035 (0.200) |

[10] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, and air films all contribute an additional R-3.2 towards the nominal R-value of the entire assembly.
[11] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-13.3 towards the nominal R-value of the entire assembly.
* Denotes interpolated results.
** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

**Table 3.5.2:** U-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-12 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[12] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.071 (0.404)** | 0.069 (0.392)** | 0.067 (0.382)** | 0.065 (0.372) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.066 (0.373)** | 0.063 (0.356)** | 0.061 (0.344)** | *0.059 (0.336)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.058 (0.329)** | 0.055 (0.310)** | 0.051 (0.289) | 0.049 (0.279) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.053 (0.299)** | 0.049 (0.276)** | 0.044 (0.251) | 0.042 (0.241) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.049 (0.278)** | 0.044 (0.252)** | *0.040 (0.225)** | *0.038 (0.215)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.262)** | 0.041 (0.234)** | 0.036 (0.206) | 0.034 (0.194) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.262) | 0.041 (0.231) | 0.037 (0.209) | 0.035 (0.197) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.047 (0.264) | 0.041 (0.233) | 0.037 (0.210) | 0.035 (0.197) |

**Table 3.5.3:** U-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-13 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[13] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.069 (0.394)** | 0.067 (0.382)** | 0.066 (0.373)** | 0.064 (0.363) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.064 (0.364)** | 0.061 (0.348)** | 0.059 (0.336)** | *0.058 (0.328)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.057 (0.323)** | 0.054 (0.304)** | 0.050 (0.284) | 0.048 (0.274) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.052 (0.294)** | 0.048 (0.271)** | 0.044 (0.247) | 0.042 (0.237) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.048 (0.273)** | 0.044 (0.248)** | *0.039 (0.222)** | *0.037 (0.211)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.259)** | 0.041 (0.231)** | 0.036 (0.203) | 0.034 (0.192) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.045 (0.258) | 0.040 (0.228) | 0.036 (0.206) | 0.034 (0.194) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.046 (0.260) | 0.040 (0.229) | 0.036 (0.207) | 0.034 (0.195) |

[12] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-14.3 towards the nominal R-value of the entire assembly.

[13] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-15.3 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

**Table 3.5.4:** U-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-15 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[14] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.066 (0.377)** | 0.064 (0.365)** | 0.063 (0.356)** | 0.061 (0.346) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.062 (0.350)** | 0.059 (0.335)** | 0.057 (0.323)** | *0.055 (0.314)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.055 (0.312)** | 0.052 (0.294)** | 0.048 (0.275) | 0.047 (0.264) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.050 (0.285)** | 0.046 (0.263)** | 0.042 (0.240) | 0.041 (0.230) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.047 (0.266)** | 0.043 (0.241)** | *0.038 (0.216)** | *0.036 (0.206)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.044 (0.252)** | 0.040 (0.225)** | 0.035 (0.198) | 0.033 (0.187) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.044 (0.251) | 0.039 (0.222) | 0.035 (0.201) | 0.033 (0.190) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.045 (0.254) | 0.039 (0.224) | 0.036 (0.202) | 0.034 (0.190) |

**Table 3.5.5:** U-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-19 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[15] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | 0.061 (0.348)** | 0.060 (0.339)** | 0.058 (0.331)** | 0.057 (0.324) |
| 60 | 2 | R-8.4 (1.48 RSI) | 0.057 (0.325)** | 0.055 (0.312)** | 0.053 (0.302)** | *0.052 (0.297)** |
| 60 | 3 | R-12.6 (2.22 RSI) | 0.052 (0.292)** | 0.049 (0.277)** | 0.045 (0.258) | 0.044 (0.251) |
| 90 | 4 | R-16.8 (2.96 RSI) | 0.047 (0.269)** | 0.044 (0.249)** | 0.040 (0.228) | 0.039 (0.221) |
| 120 | 5 | R-21.0 (3.70 RSI) | 0.044 (0.252)** | 0.040 (0.230)** | *0.036 (0.207)** | *0.035 (0.198)** |
| 150 | 6 | R-25.2 (4.44 RSI) | 0.042 (0.240)** | 0.038 (0.215)** | 0.034 (0.190) | 0.032 (0.181) |
| 180 | 6 | R-25.2 (4.44 RSI) | 0.042 (0.239) | 0.037 (0.212) | 0.034 (0.193) | 0.032 (0.183) |
| 210 | 6 | R-25.2 (4.44 RSI) | 0.042 (0.241) | 0.038 (0.214) | 0.034 (0.194) | 0.032 (0.184) |

[14] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-17.3 towards the nominal R-value of the entire assembly.

[15] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-21.3 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

## 3.6 NH2 Clip System with CMU Wall Assembly

**Table 3.6.1:** U-Value for NH2 Clip System with CMU Wall Assemblies with Clips Spaced 16", 24", and 32" Horizontally

| Horizontal Clip Spacing in | NV1 Bracket Size mm | Exterior Insulation Thickness in | Exterior Insulation Nominal R-Value[16] ft² hr °F/Btu (m² °K/W) | U-Value Btu/h ft² °F (W/m² °K) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 16 | 60 | 1.5 | R-6.3 (1.11 RSI) | 0.115 (0.654) | 0.109 (0.621) | 0.106 (0.599) | 0.104 (0.588) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.102 (0.579)** | *0.095 (0.541)** | *0.091 (0.515)** | *0.088 (0.502)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.084 (0.479) | 0.077 (0.435) | 0.071 (0.405) | 0.069 (0.390) |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.074 (0.418) | 0.065 (0.371) | 0.060 (0.339) | 0.057 (0.323) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.067 (0.379)** | *0.058 (0.329)** | *0.052 (0.296)** | *0.049 (0.280)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.062 (0.352) | 0.053 (0.303) | 0.047 (0.267) | 0.044 (0.249) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.064 (0.366) | 0.055 (0.312) | 0.048 (0.274) | 0.045 (0.255) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.066 (0.372) | 0.056 (0.316) | 0.049 (0.277) | 0.045 (0.257) |
| 24 | 60 | 1.5 | R-6.3 (1.11 RSI) | 0.110 (0.622) | 0.106 (0.600) | 0.103 (0.585) | 0.102 (0.577) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.096 (0.546)** | *0.091 (0.519)** | *0.088 (0.500)** | *0.086 (0.489)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.078 (0.442) | 0.072 (0.410) | 0.068 (0.388) | 0.066 (0.377) |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.066 (0.376) | 0.060 (0.343) | 0.056 (0.320) | 0.054 (0.309) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.059 (0.334)** | *0.053 (0.299)** | *0.049 (0.276)** | *0.047 (0.264)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.054 (0.306) | 0.048 (0.271) | 0.043 (0.246) | 0.041 (0.233) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.055 (0.313) | 0.048 (0.275) | 0.044 (0.249) | 0.041 (0.235) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.056 (0.316) | 0.049 (0.278) | 0.044 (0.250) | 0.042 (0.237) |
| 32 | 60 | 1.5 | R-6.3 (1.11 RSI) | 0.107 (0.606) | 0.104 (0.589) | 0.102 (0.578) | 0.101 (0.572) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *0.093 (0.530)** | *0.089 (0.508)** | *0.087 (0.493)** | *0.085 (0.484)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | 0.074 (0.423) | 0.070 (0.397) | 0.067 (0.379) | 0.065 (0.370) |
| | 90 | 4 | R-16.8 (2.96 RSI) | 0.063 (0.355) | 0.058 (0.329) | 0.055 (0.311) | 0.053 (0.301) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *0.055 (0.310)** | *0.050 (0.284)** | *0.047 (0.265)** | *0.045 (0.256)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | 0.050 (0.282) | 0.045 (0.254) | 0.041 (0.234) | 0.040 (0.225) |
| | 180 | 6 | R-25.2 (4.44 RSI) | 0.050 (0.285) | 0.045 (0.256) | 0.042 (0.236) | 0.040 (0.226) |
| | 210 | 6 | R-25.2 (4.44 RSI) | 0.051 (0.288) | 0.045 (0.258) | 0.042 (0.237) | 0.040 (0.227) |

The 90 mm NV1 bracket spaced 16 inches o.c. horizontally and 24 inches o.c. vertically was modelled with no exterior insulation with the CMU backup wall, with an effective R-value of R-3.9 (Appendix D, Table D3.1). This result may be extrapolated for all NV1 bracket sizes and spacings, as well all configurations of the NH2 system with no exterior insulation and a CMU backup wall.

[16] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, concrete blocks, and air films all contribute an additional R-3.9 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

We believe that this report meets your objectives for evaluating the thermal performance of the Nvelope NV1 and NH2 clip systems assemblies. If you have any questions or comments related to the above, please do not hesitate to contact the undersigned.

Morrison Hershfield Limited


Julien Schwartz, M.Eng.
*Building Energy Consultant*

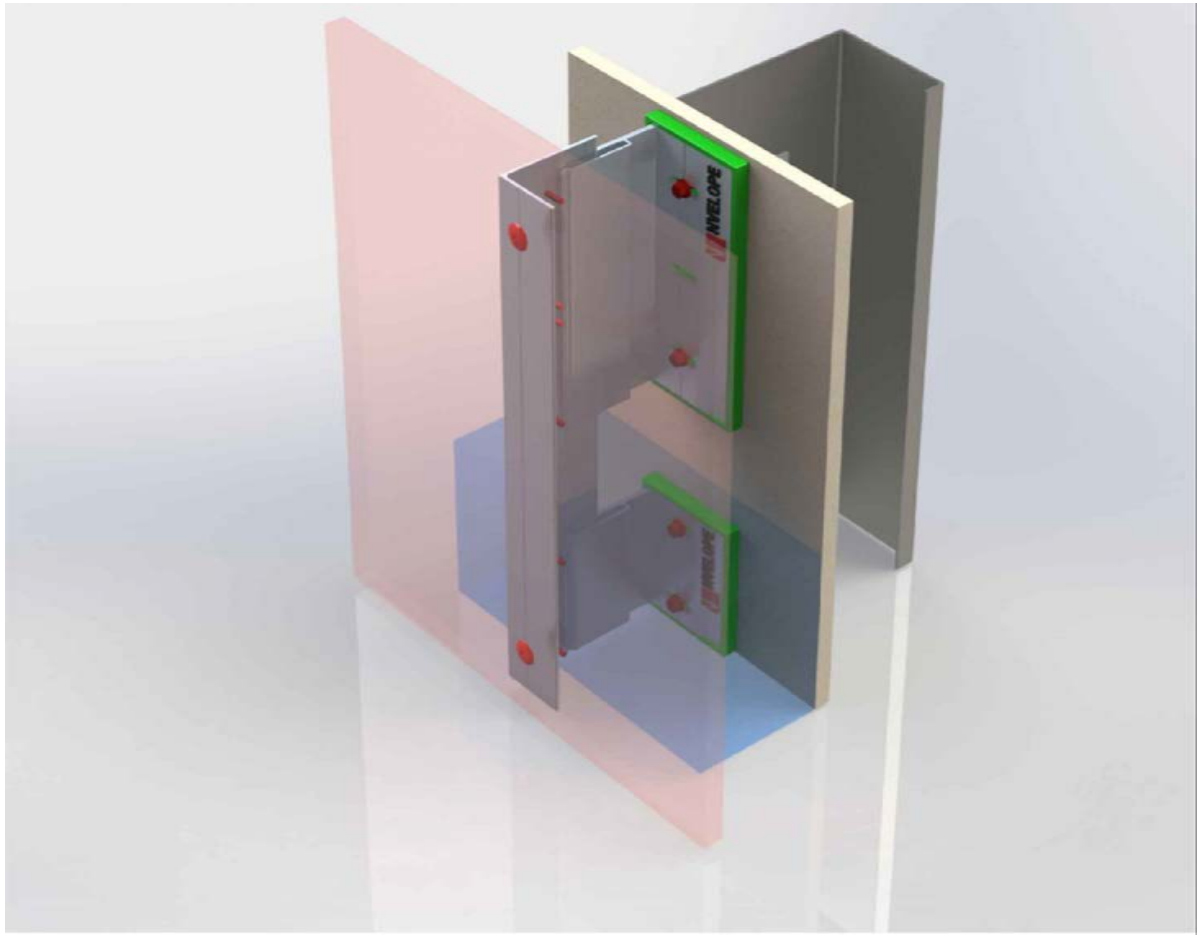
Katie Hay, P.Eng.
*Building Science Consultant*

# APPENDIX A:
# DETAIL DRAWINGS

# Thermally Broken Cladding Support System

## NV1 - EF: For Exposed Fastener Facade Attachment


| | |
|---|---|
| S-01 | NVELOPE BRACKET DETAILS |
| S-02 | NVELOPE RAIL & PROFILE DETAILS |
| S-03 | NVELOPE FASTENER DETAILS |
| D-01a | PLAN DETAIL - STEEL STUD FRAMED WALL |
| D-01b | PLAN DETAIL - CONCRETE WALL |
| D-01c | PLAN DETAIL - CMU/MASONRY WALL |
| D-02 | STOREFRONT JAMB DETAIL |
| D-03 | OUTSIDE CORNER DETAIL |
| D-04 | INSIDE CORNER DETAIL |
| D-05 | PARAPET DETAIL |
| D-06 | STOREFRONT HEAD DETAIL |
| D-07 | STOREFRONT SILL DETAIL |
| D-08 | BASE DETAIL |
| D-09 | HORIZONTAL PANEL JOINT |




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

SFS Group USA, Inc.
Construction Division
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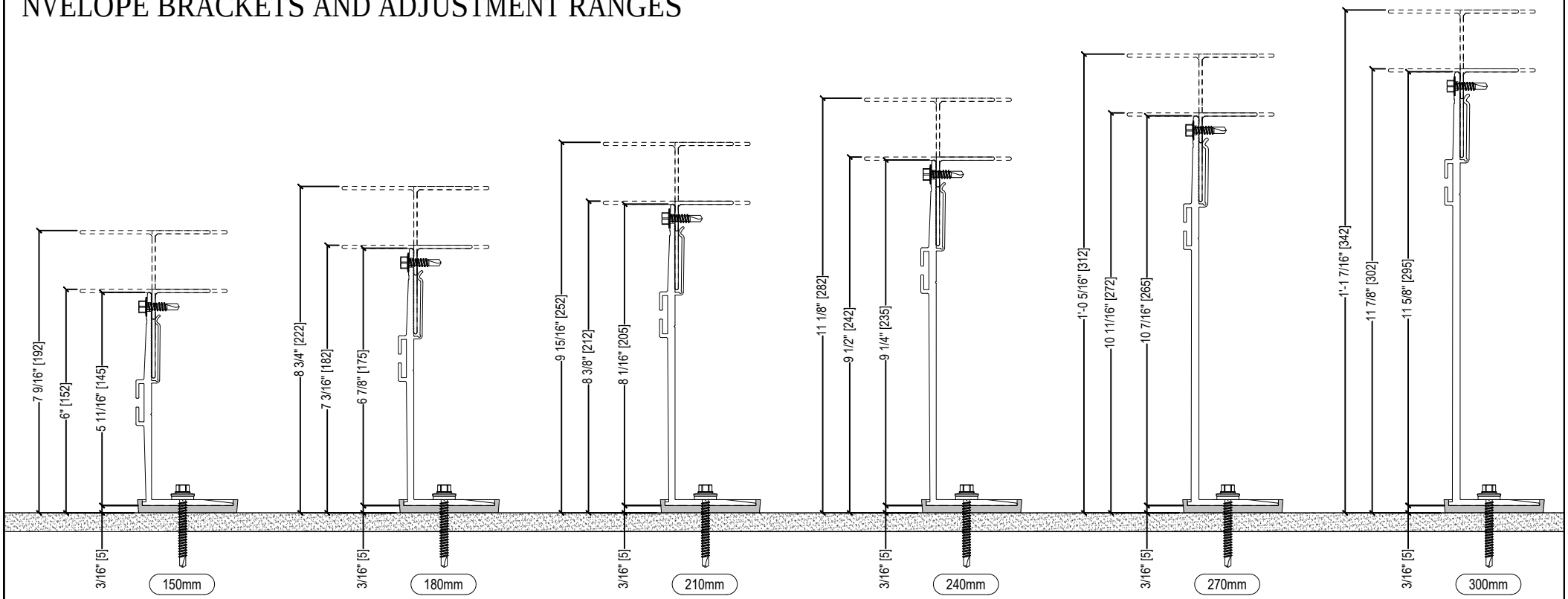
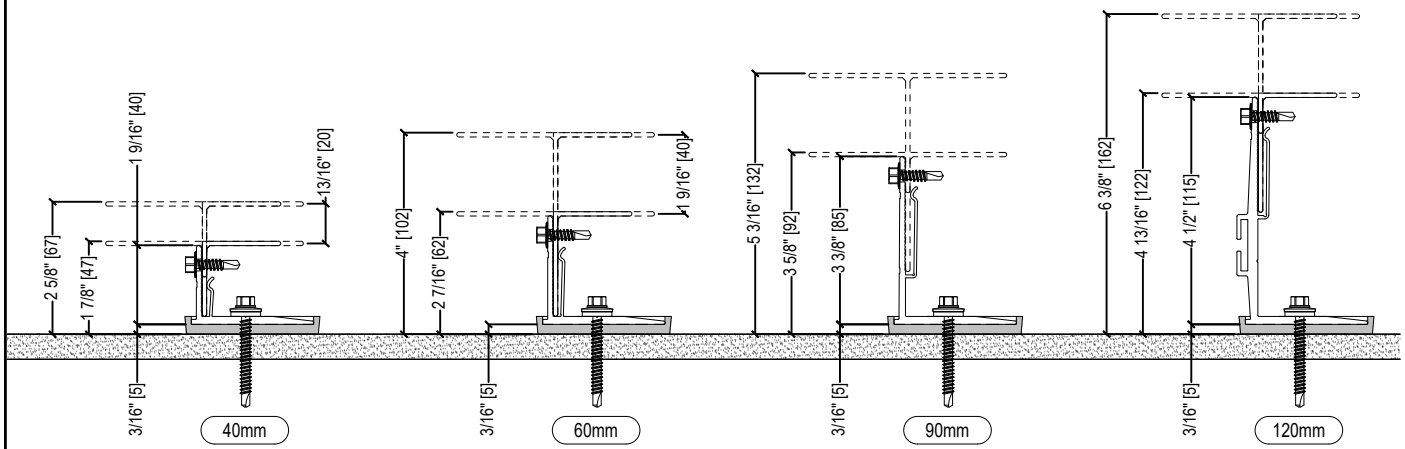
Wyomissing, PA 19610
T: +1 (800) 234-4533

Sheet Title: COVERSHEET & DRAWING INDEX
Issue Date: 1/5/2020
System ID: NV1-EF
Scale: N.T.S.
Sheet: COVER

# NVELOPE BRACKETS AND ADJUSTMENT RANGES




| NVELOPE BRACKET - ADJUSTMENT RANGE | | | |
|---|---|---|---|
| SIZE | DESCRIPTION | FROM | TO |
| 40mm | NV-VB040S | 1-7/8" (47mm) | 2-5/8" (67mm) |
| 60mm | NV-VB060S | 2-7/16" (62mm) | 4" (102mm) |
| 90mm | NV-VB090S | 3-5/8" (92mm) | 5-3/16" (132mm) |
| 120mm | NV-VB120S | 4-13/16" (122mm) | 6-3/8" (162mm) |
| 150mm | NV-VB150S | 6" (152mm) | 7-9/16" (192mm) |
| 180mm | NV-VB180S | 7-3/16" (182mm) | 8-3/4" (222mm) |
| 210mm | NV-VB210S | 8-3/8" (212mm) | 9-15/16 (252mm) |
| 240mm | NV-VB240S | 9-1/2" (242mm) | 11-1/8" (282mm) |
| 270mm | NV-VB270S | 10-11/16" (272mm) | 12-5/16" (312mm) |
| 300mm | NV-VB300S | 11-7/8" (302mm) | 13-7/8" (342mm) |
| BRACKET MATERIAL: 6005A-T6 ALUMINUM<br>THERMAL ISOLATOR MATERIAL: POLYPROPYLENE | | | |



System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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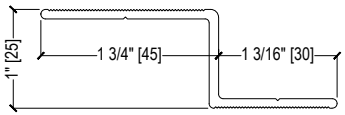
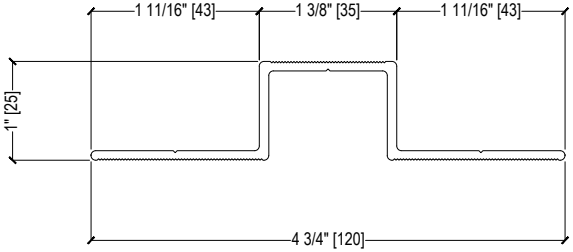
Sheet Title: NVELOPE BRACKET DETAILS
Issue Date: 1/5/2020
System ID: NV1-EF
Scale: 3" = 1'-0"
Sheet: S-01

# NVELOPE CLADDING RAILS AND MOUNTING PROFILES

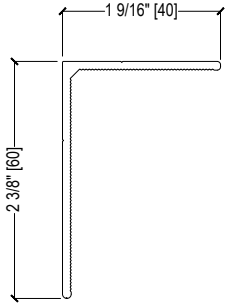
25-45-30
2.4MM



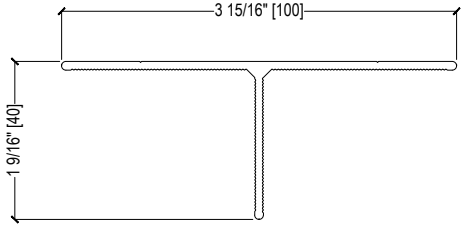

OM25-120
2.4MM



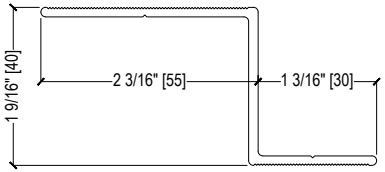

L60-40
2.2MM & 2.5MM



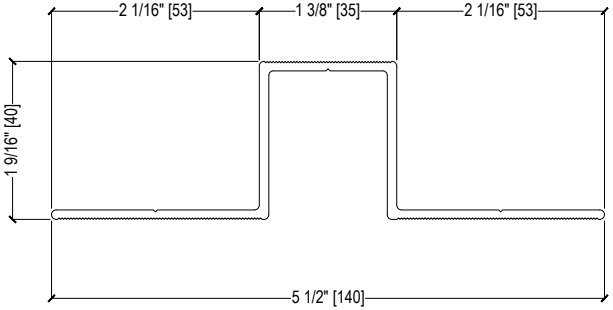

T40-100
2.2MM



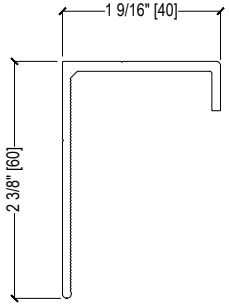

40-55-30
2.4MM



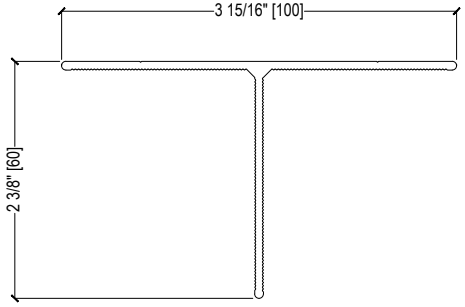

OM40-140
2.4MM



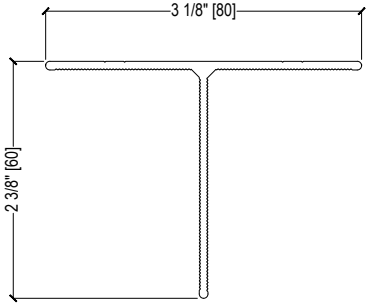

HBL60-40
2.5MM



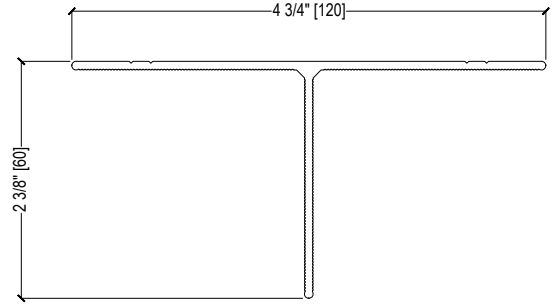

T60-100
2.2MM & 2.5MM



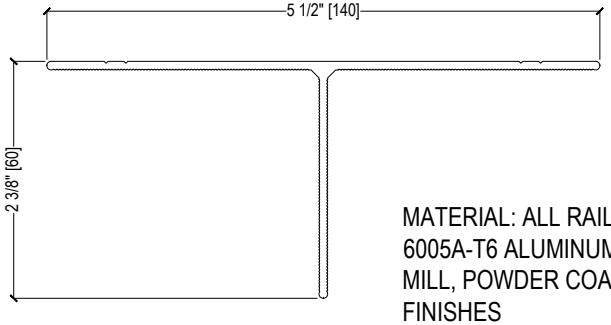

T60-80
2.2MM




T60-120
2.2MM




T60-140
2.2MM




MATERIAL: ALL RAILS ARE MADE FROM 6005A-T6 ALUMINUM AND AVAILABLE IN MILL, POWDER COATED, AND ANODIZED FINISHES



System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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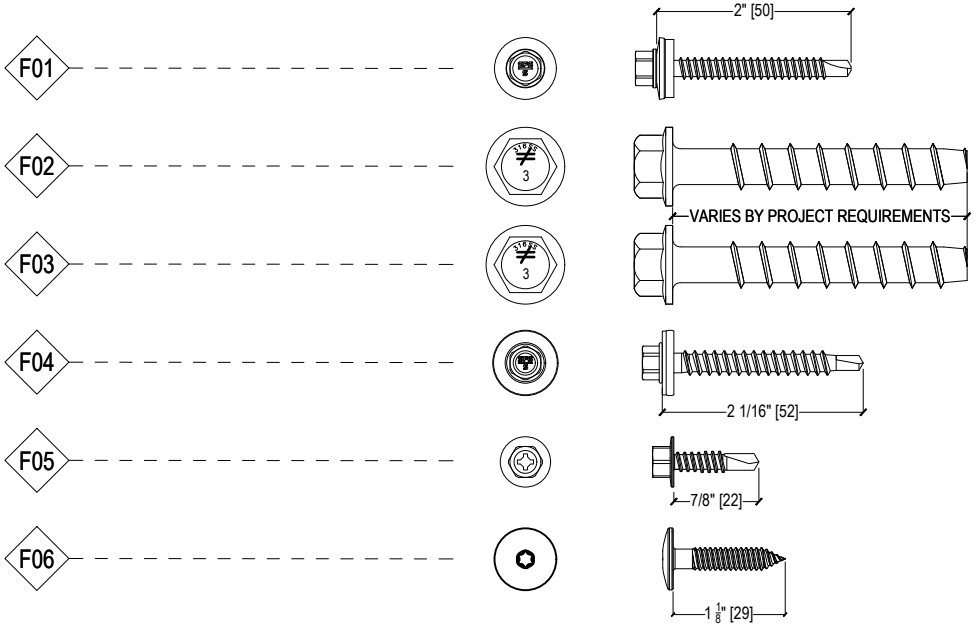
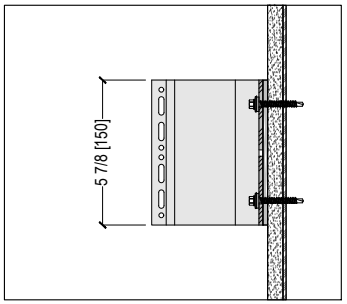
Sheet Title: NVELOPE RAIL & PROFILE DETAILS
Issue Date: 1/5/2020
System ID: NV1-EF
Scale: 6" = 1'-0"
Sheet: S-02

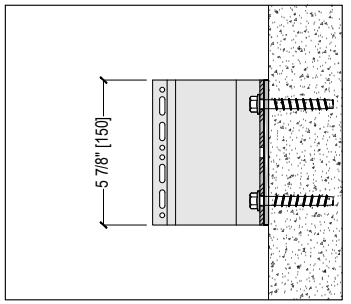
# STANDARD NVELOPE FASTENERS

| NO: | TYPICAL USE & APPLICATION | LENGTH | DIAMETER | HEAD/DRIVE | TIP | PART |
|---|---|---|---|---|---|---|
| F01 | Nvelope Bracket to Steel Stud Framing | 2" (50mm) | 1/4" (#14) | HWH | Self-Drill | 1544249 |
| F02 | Nvelope Bracket to CMU Substrate | Varies | 3/8" | HWH (9/16)" | Type B | Varies |
| F03 | Nvelope Bracket to Concrete Wall | Varies | 3/8" | HWH (9/16) | Type B | Varies |
| F04 | Nvelope Bracket to Wood Stud Framing | 2-1/16" (52mm) | 6.5mm | HWH | Self-Drill | 1544250 |
| F05 | Vertical Rail to Nvelope Wall Bracket | 7/8" (22mm) | 5.5mm (#12) | HWH/SR2 | Self-Drill | 1544263 |
| F06 | Facade Panel to Vertical Rail | 1 1/8" (29mm) | 5.8mm (#12) | 16mm Dome | Type A | 1572881 |

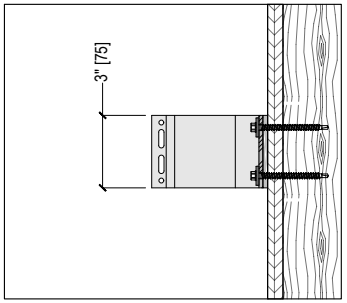


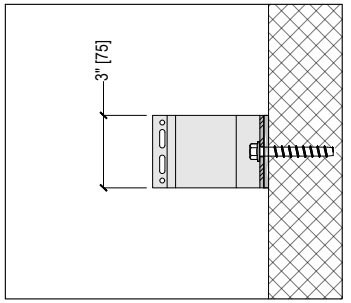
BRACKET AT STEEL STUD



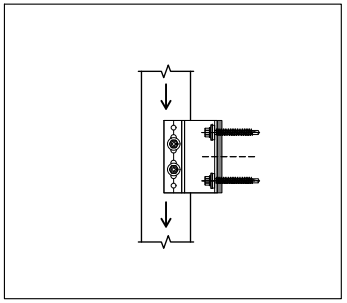
BRACKET AT CONCRETE

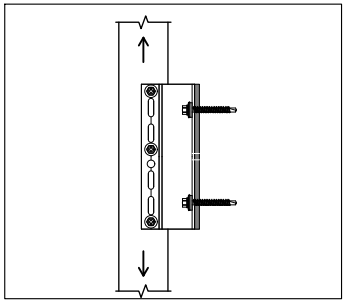


BRACKET AT WOOD STUD



BRACKET AT CMU BLOCK


SLIDING RAIL FASTENING


FIXED RAIL FASTENING

GENERAL FASTENER NOTES:

1. CONCRETE AND MASONRY ANCHOR TYPES VARY BASED ON PROJECT SPECIFIC REQUIREMENTS INCLUDING BUT NOT LIMITED TO WIND LOADs, DEAD LOADS, BUILDING HEIGHT, SEISMIC/SAFETY FACTOR, OR ANY REQUIREMENTS MANDATED BY THE ENGINEER OF RECORD (EOR) AND/OR AUTHORITIES HAVING JURISDICTION (AHJ). CONTACT SFS OR SEE COVER FOR ADDITIONAL INFORMATION AND CONSIDERATIONS.
2. EXPOSED CLADDING FASTENERS MAY VARY BY CLADDING TYPE, APPLICATION, SPACING, DESIGN INTENT AND DESIRED AESTHETIC AND/OR MANUFACTURER FASTENER REQUIREMENTS. CONTACT SFS FOR INFORMATION
3. FASTENERS USED TO ATTACH NVELOPE BRACKETS TO BUILDING SUBSTRATE MAY VARY FROM WHAT IS SHOWN BASED ON PROJECT SPECIFIC REQUIREMENTS. ALWAYS REFER TO ENGINEERING DRAWINGS AND CALCULATIONS FOR CORRECT FASTENERS.
4. ALL STANDARD FASTENERS WITHIN THE NVELOPE SYSTEM ARE 300 SERIES STAINLESS STEEL.



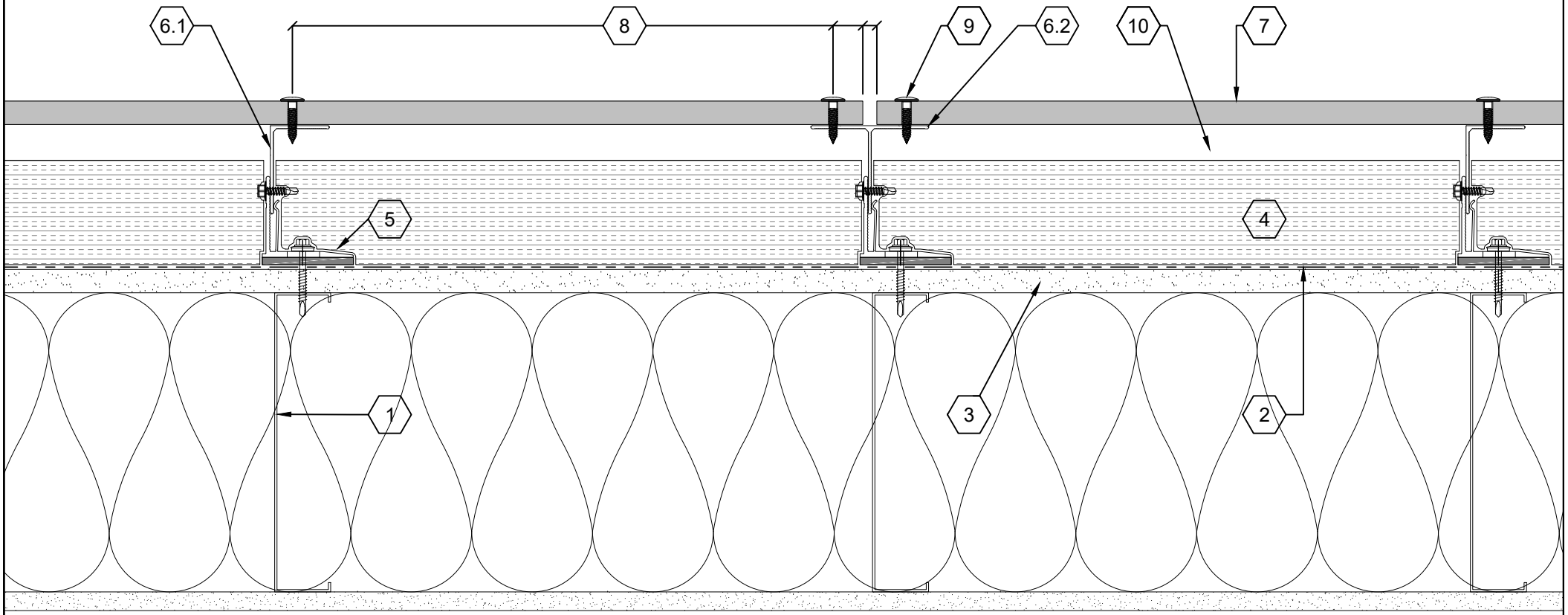
System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

SFS Group USA, Inc.
Construction Division
1045 Spring Street
Wyomissing, PA 19610
T: +1 (800) 234-4533

Sheet Title: NVELOPE FASTENERS DETAIL
Issue Date: 1/5/2020
System ID: NV1-EF
Scale: 6" = 1'-0"
Sheet: S-03

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE VERTICAL ALUMINUM PROFILE
   - 6.1. "L" PROFILE
   - 6.2. "T" PROFILE
7. PANEL PER ARCH, SUPPLIED BY OTHERS
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSIONS PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS)






System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Construction Division
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Sheet Title: PLAN DETAIL - STEEL STUD

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-01a

## DRAWING KEYNOTES

1. CONRETE WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. NOT USED
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE VERTICAL ALUMINUM PROFILE
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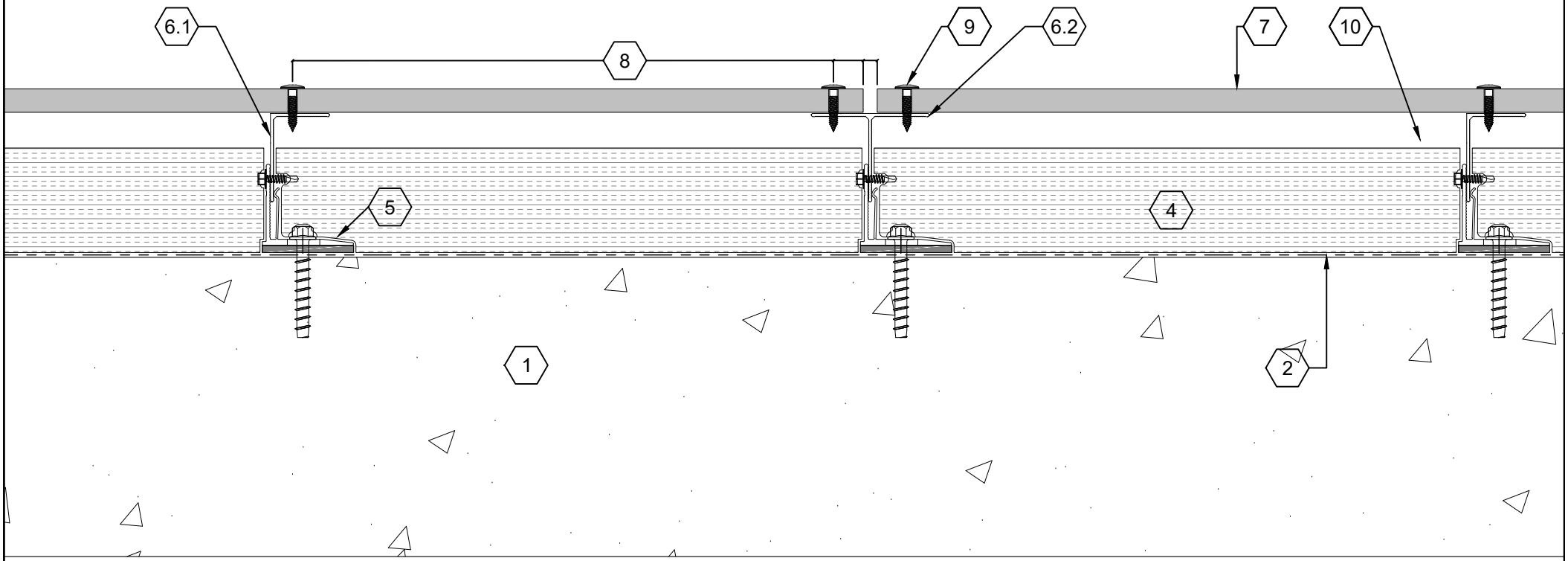
10. VENTILATION CAVITY (DEPTH PER OTHERS)






System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Construction Division
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Wyomissing, PA 19610
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Sheet Title: PLAN DETAIL - CONCRETE WALL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-01b

## DRAWING KEYNOTES

1. GROUT-FILLED CMU WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. NOT USED
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE VERTICAL ALUMINUM PROFILE
   - 6.1. "L" PROFILE
   - 6.2. "T" PROFILE
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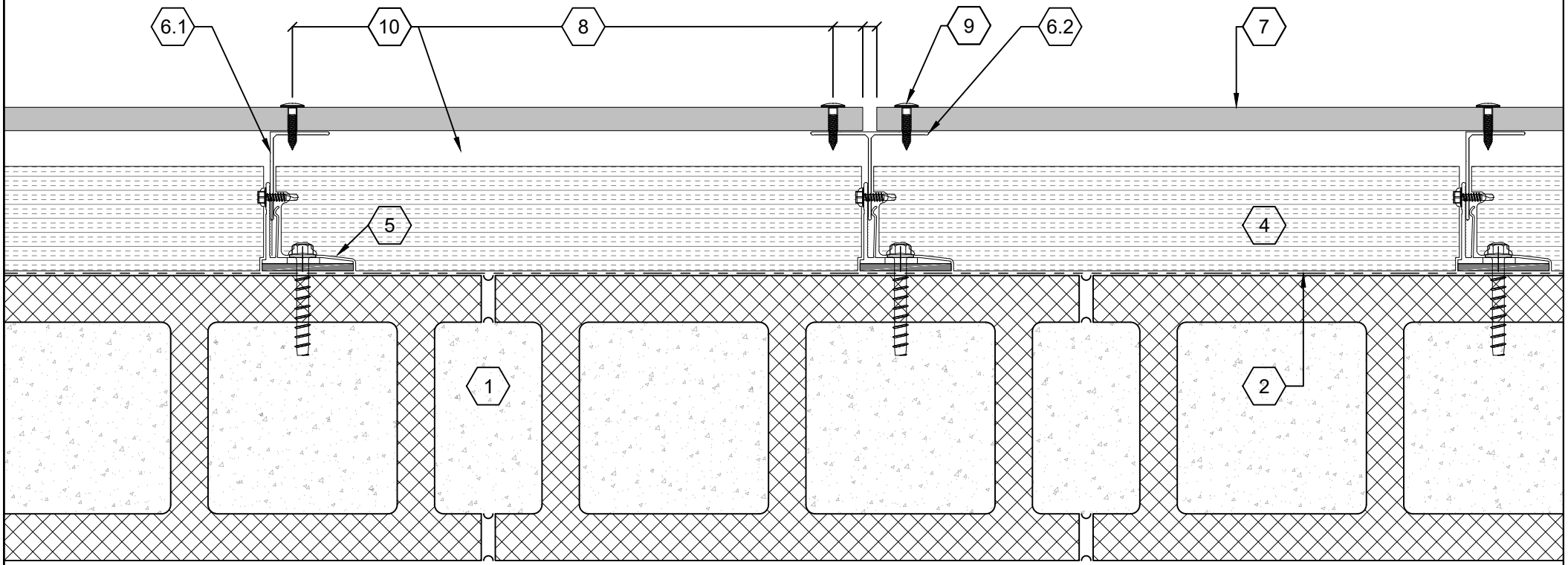
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS)






System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Construction Division
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Sheet Title: PLAN DETAIL - CMU/MASONRY
Issue Date: 1/5/2020
System ID: NV1-EF
Scale: 3" = 1'-0"
Sheet: D-01c

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
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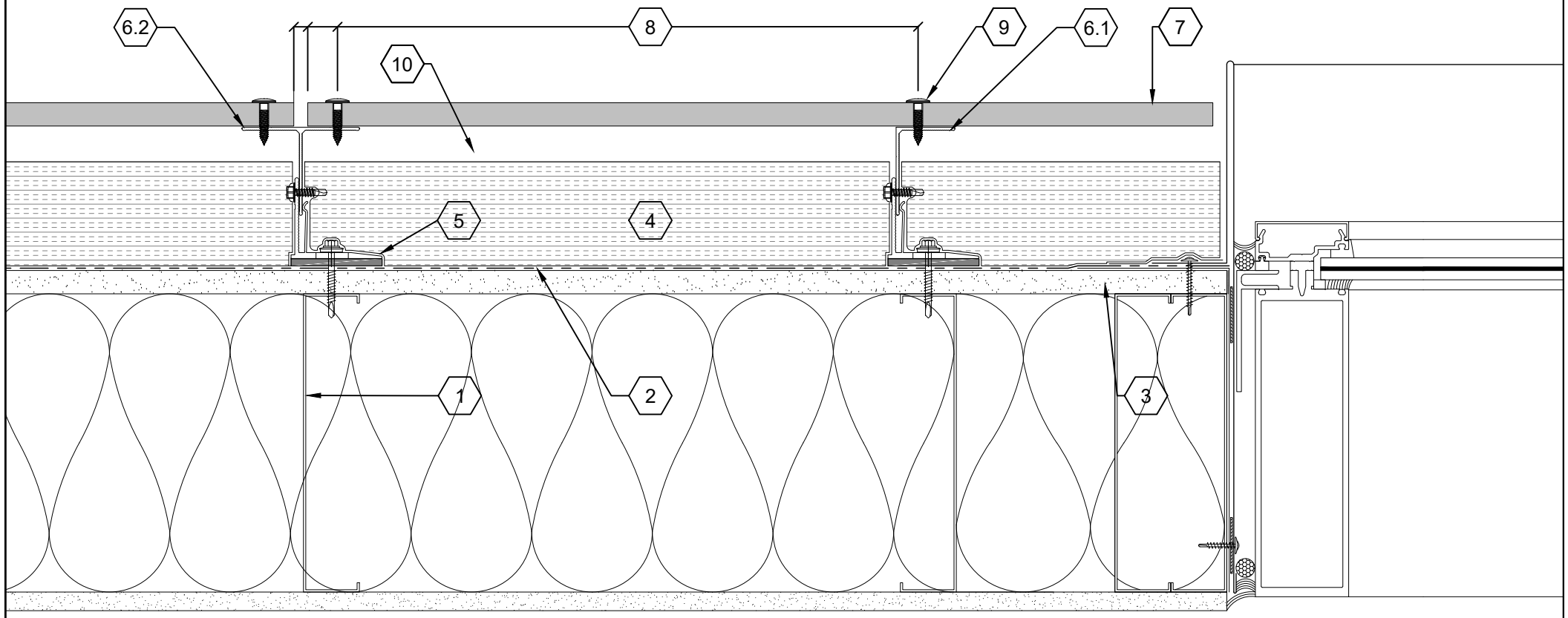




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: STOREFRONT JAMB DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-02

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
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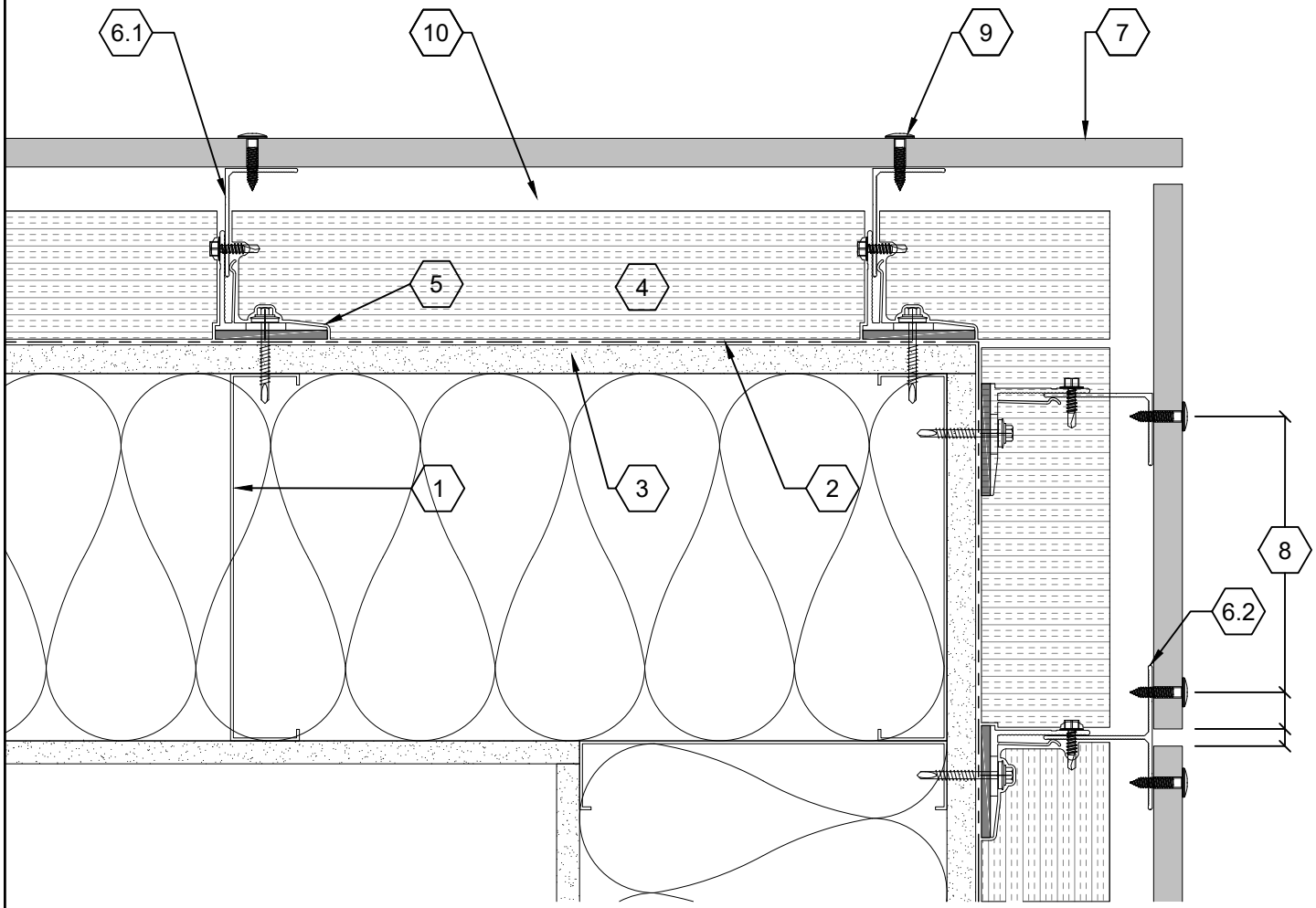


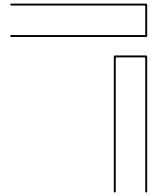

OPEN "STRAIGHT EDGE"
CORNER OPTION SHOWN



System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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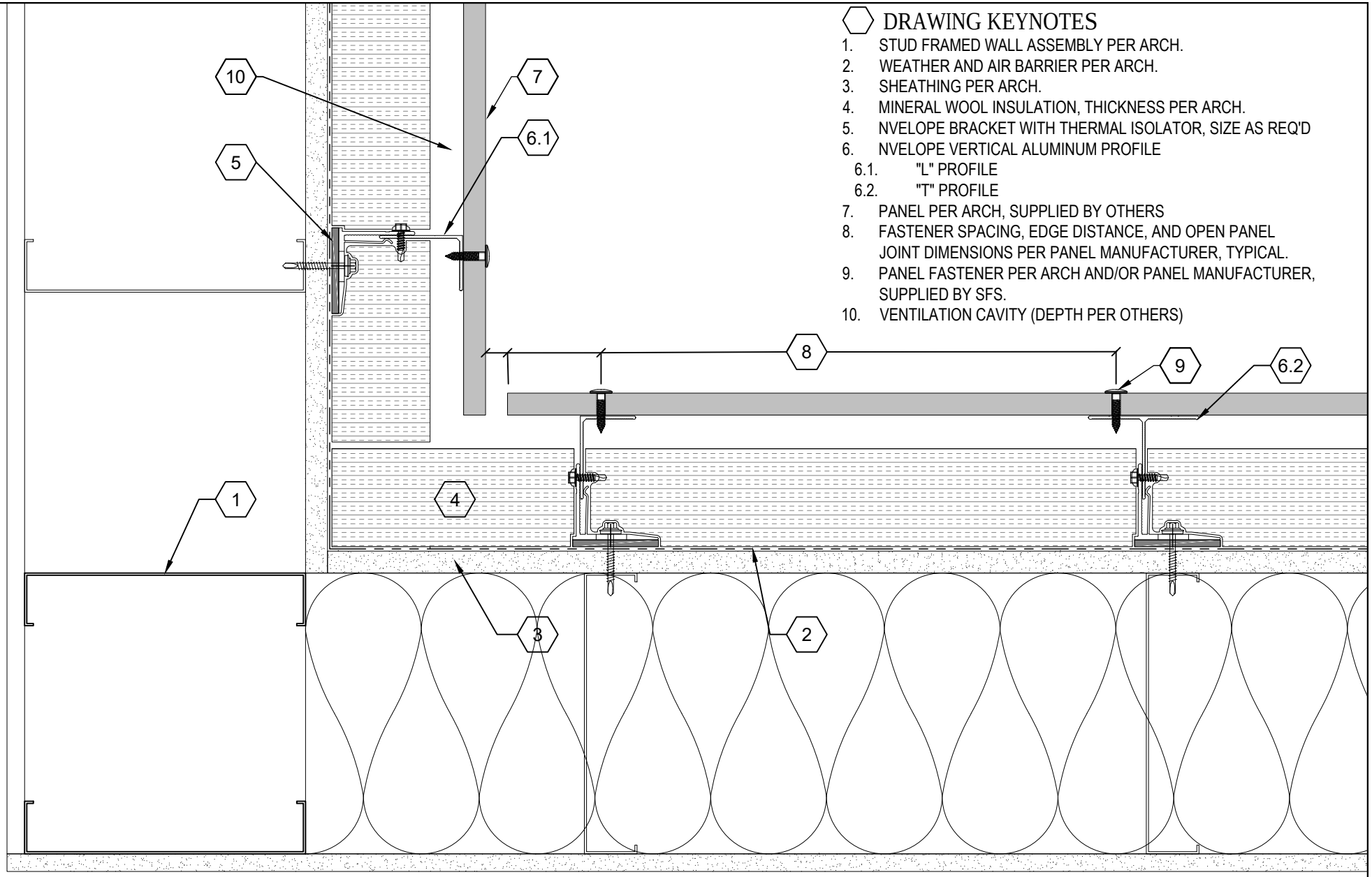
Sheet Title: OUTSIDE CORNER DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-03




## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
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System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: INSIDE CORNER DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-04

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
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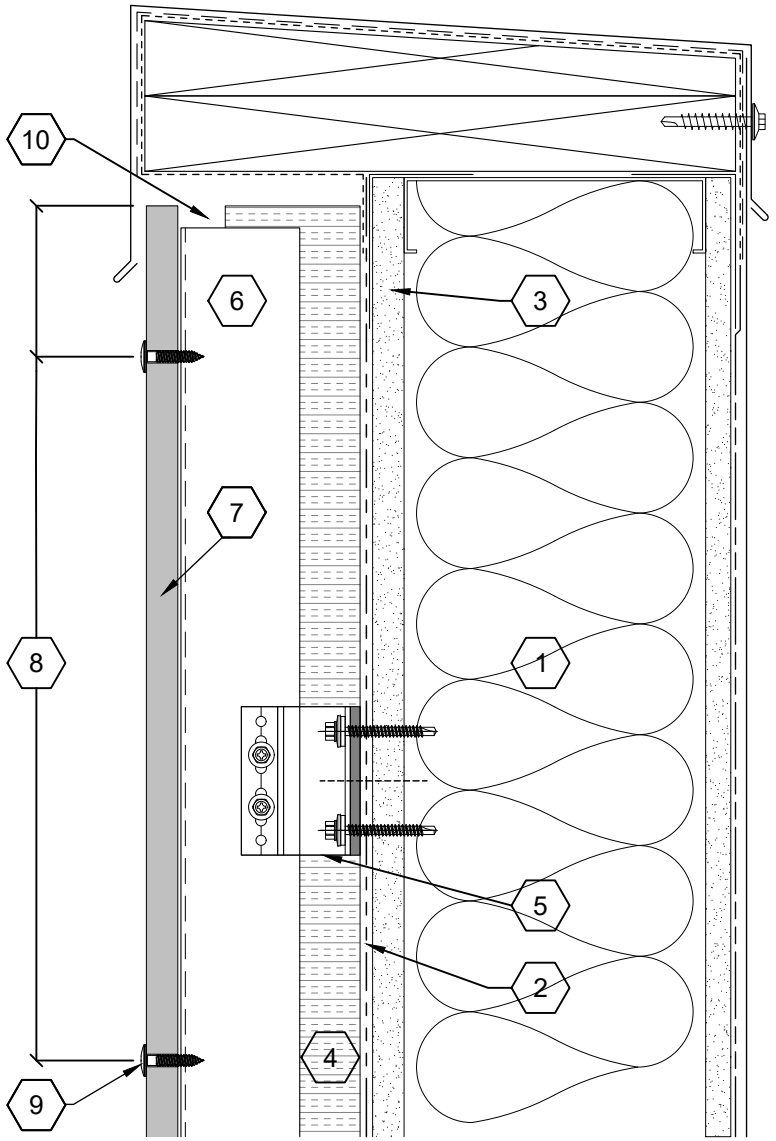




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Construction Division
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Sheet Title: PARAPET DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-05

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
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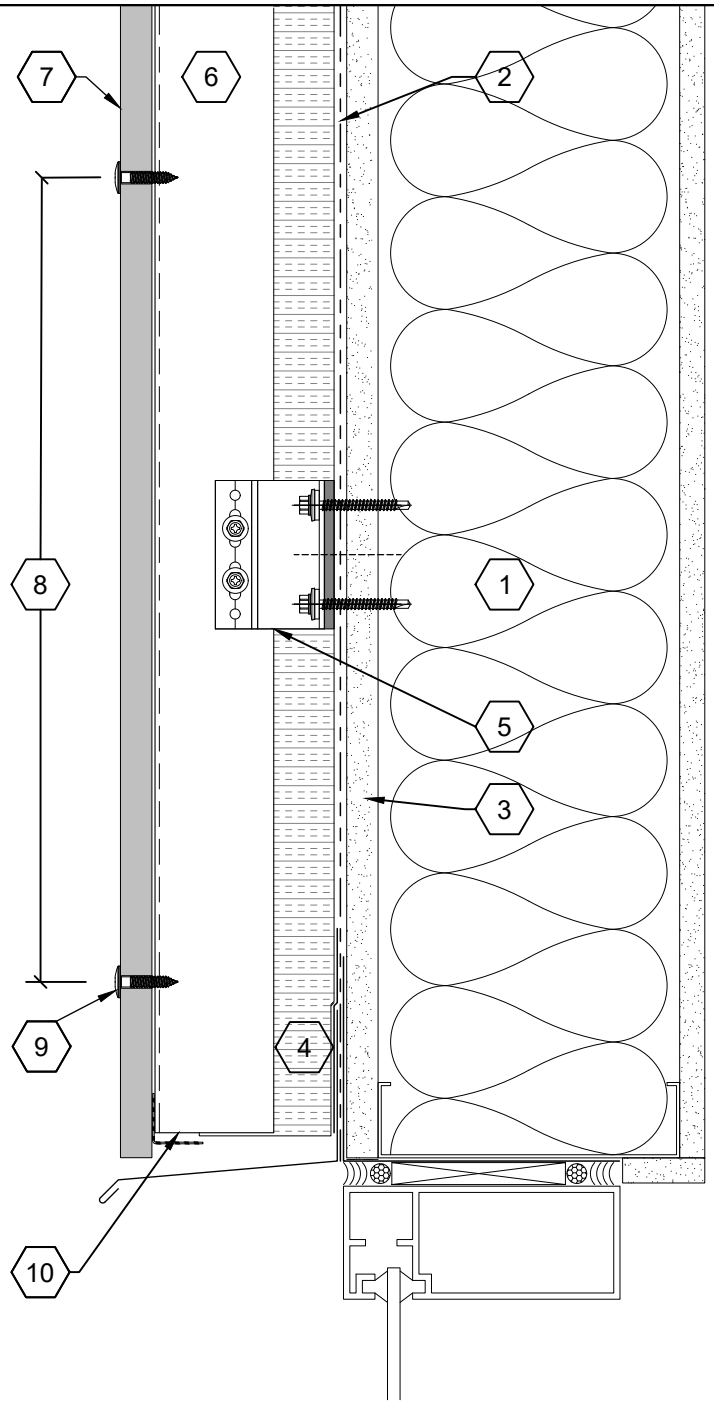




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Construction Division
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Sheet Title: STOREFRONT HEAD DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-06

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
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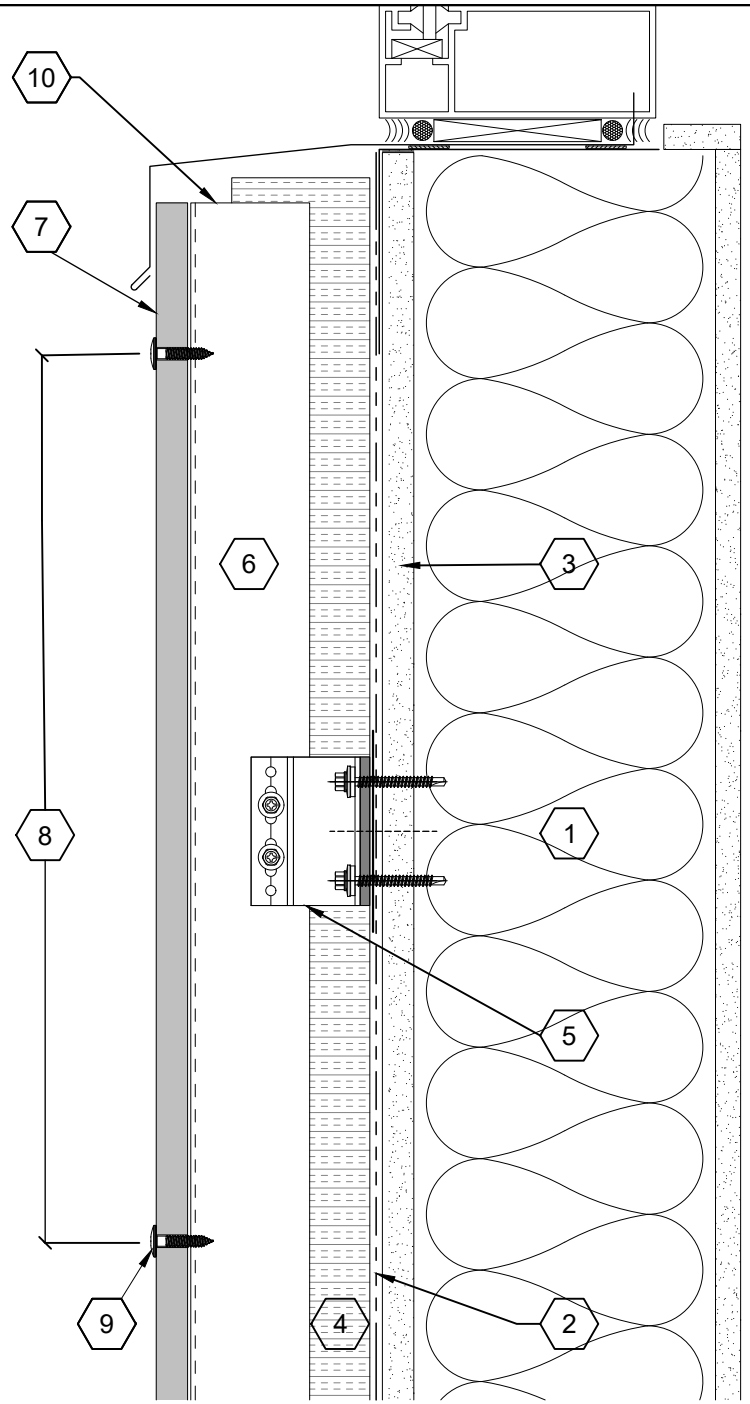
10. VENTILATION CAVITY (DEPTH PER OTHERS)






System:

SYSTEM: NV1-EF

CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: STOREFRONT SILL DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-07

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
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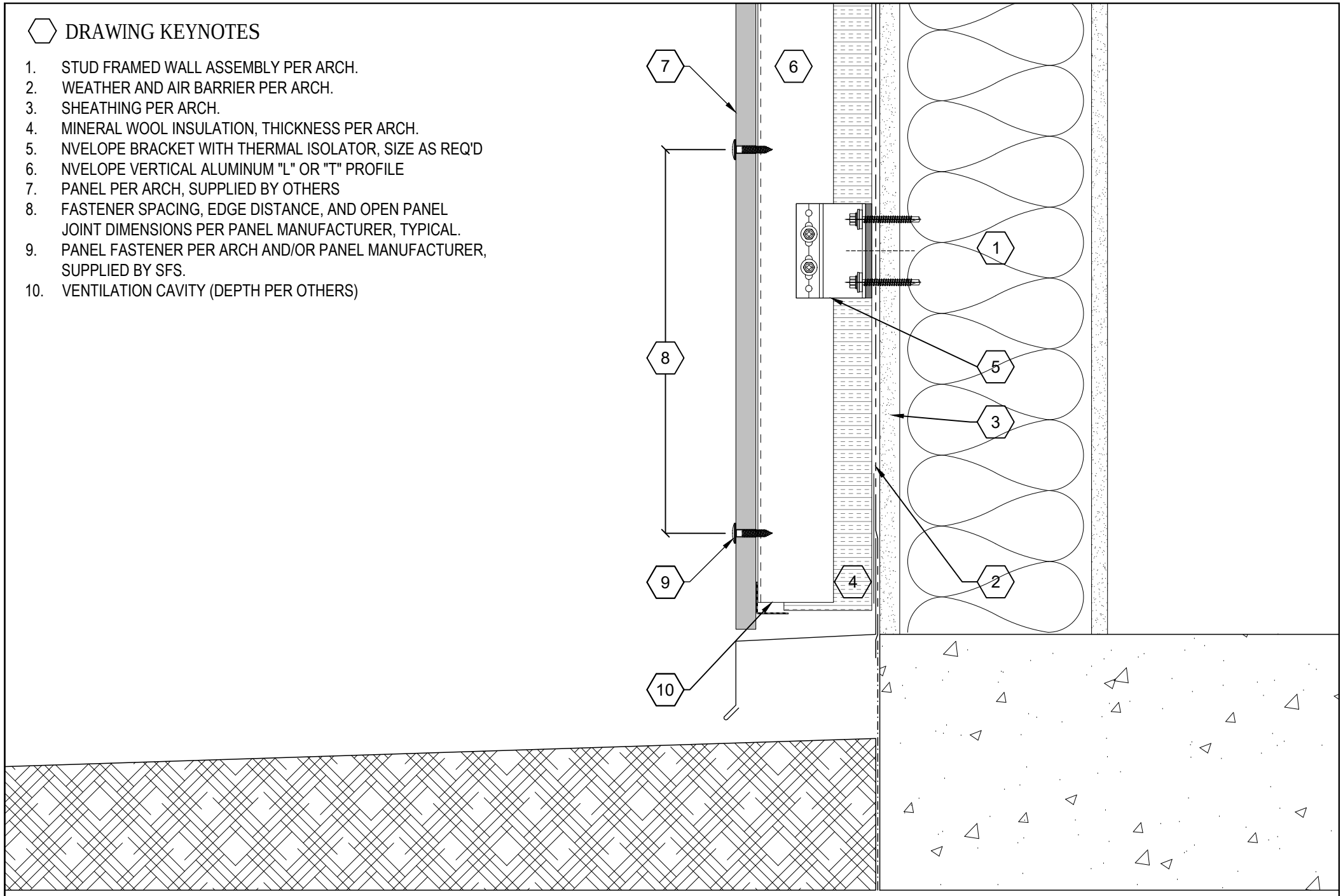




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: BASE DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

Scale: 3" = 1'-0"

Sheet: D-08

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
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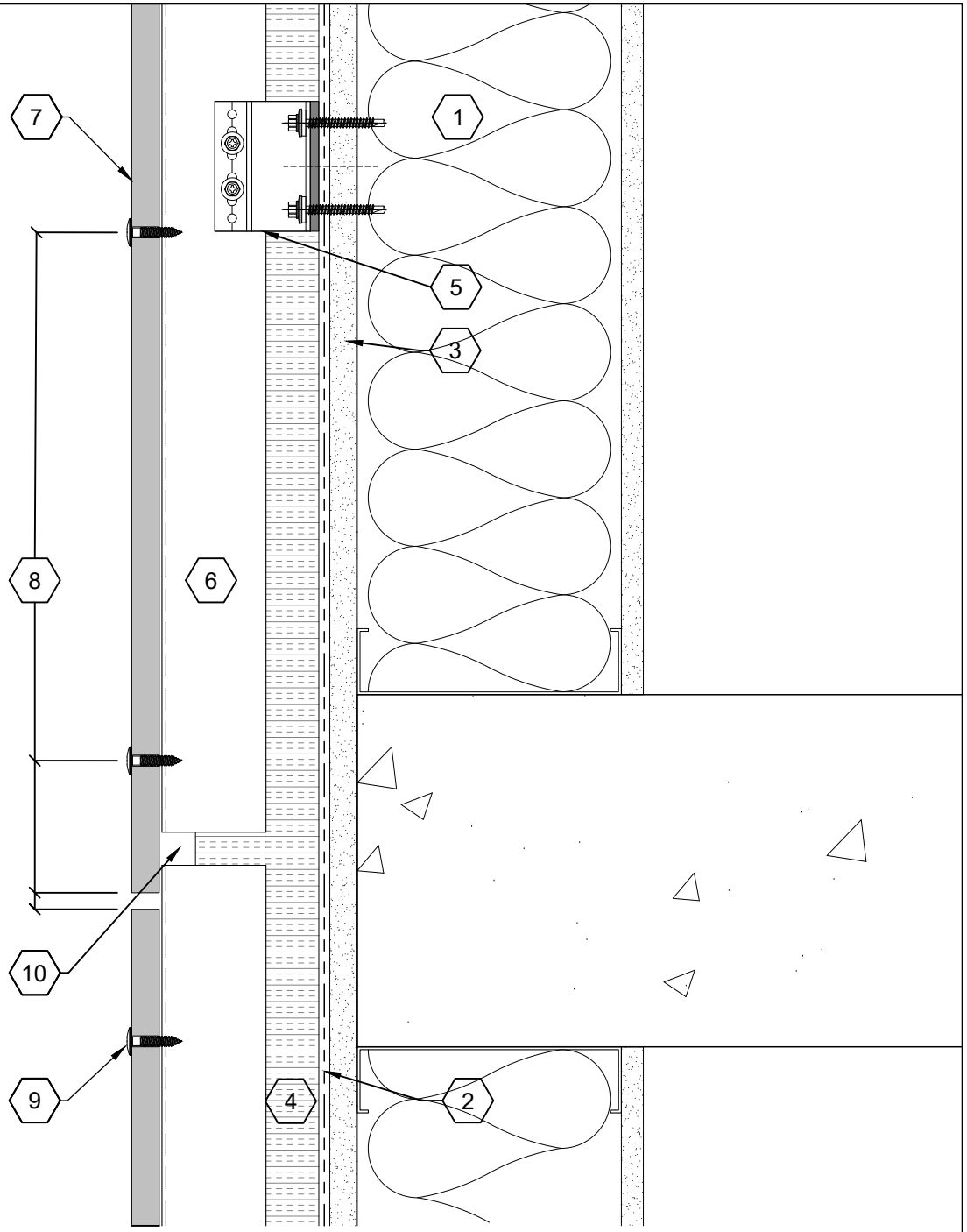




System:
SYSTEM: NV1-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: HORIZONTAL JOINT DETAIL

Issue Date: 1/5/2020

System ID: NV1-EF

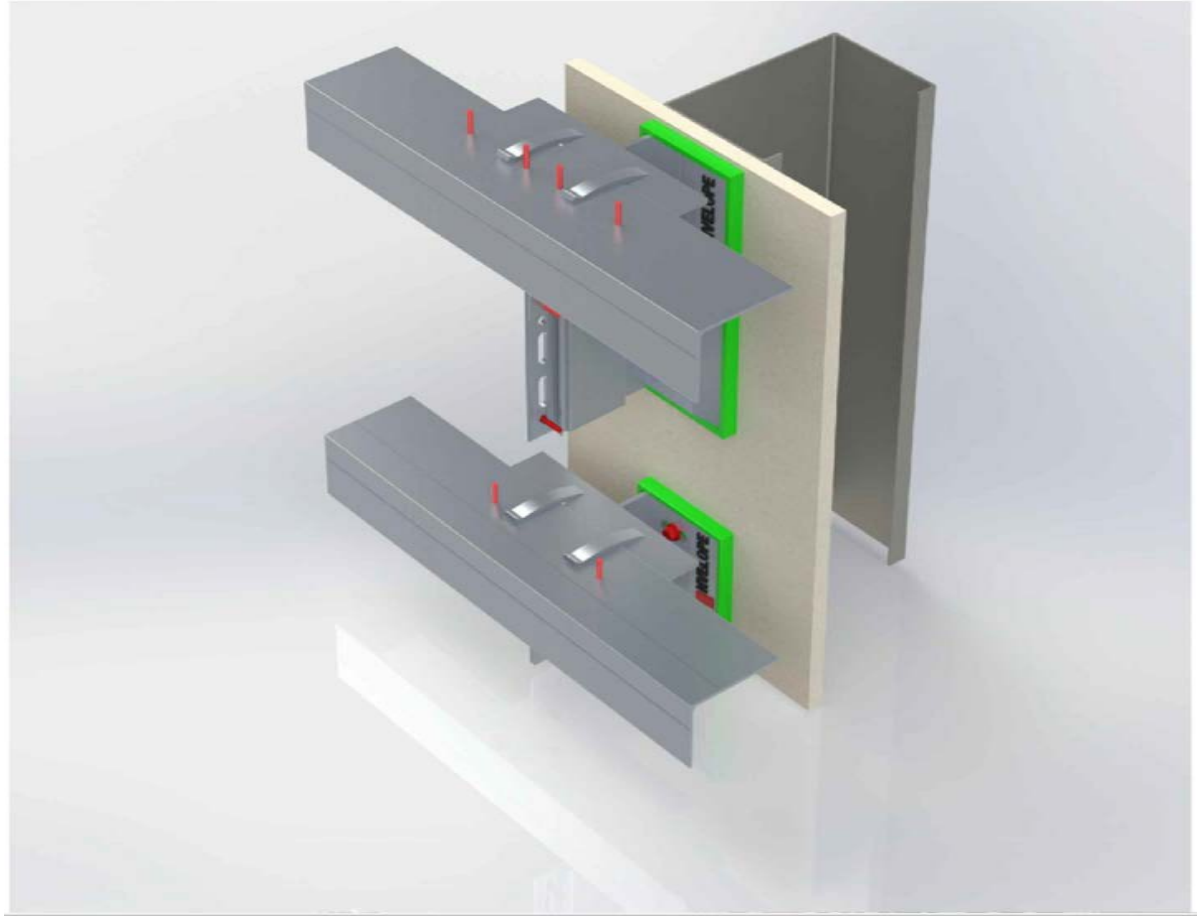
Scale: 3" = 1'-0"

Sheet: D-09

# Thermally Broken Cladding Support System

## NH2 - EF: For Exposed Fastener Facade Attachment to a Horizontally Oriented Sub-Frame


| | |
|---|---|
| S-01 | NVELOPE BRACKET DETAILS |
| S-02 | NVELOPE RAIL & PROFILE DETAILS |
| S-03 | NVELOPE FASTENER DETAILS |
| S-04 | ASSEMBLY DETAILS |
| D-01a | PLAN DETAIL - STEEL STUD FRAMED WALL |
| D-01b | PLAN DETAIL - CONCRETE WALL |
| D-01c | PLAN DETAIL - CMU/MASONRY WALL |
| D-02 | STOREFRONT JAMB DETAIL |
| D-03 | OUTSIDE CORNER DETAIL |
| D-04 | INSIDE CORNER DETAIL |
| D-05 | PARAPET DETAIL |
| D-06 | STOREFRONT HEAD DETAIL |
| D-07 | STOREFRONT SILL DETAIL |
| D-08 | BASE DETAIL |
| D-09 | HORIZONTAL PANEL JOINT |



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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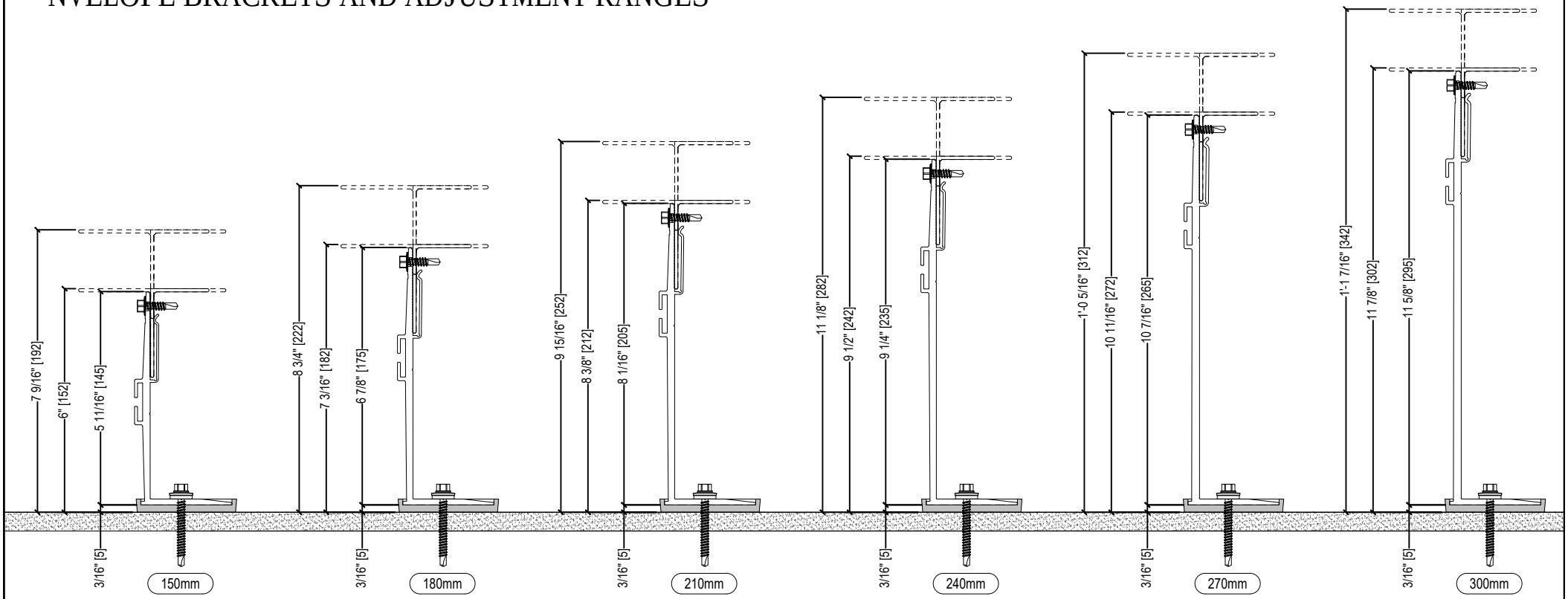
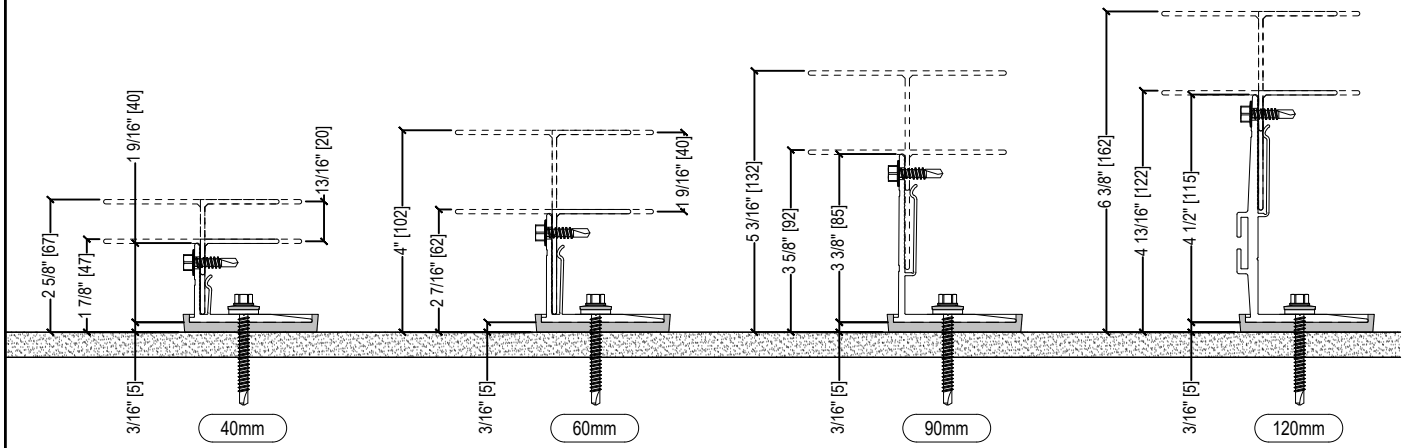
Sheet Title: COVERSHEET & DRAWING INDEX
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: N.T.S.
Sheet: COVER

# NVELOPE BRACKETS AND ADJUSTMENT RANGES




| NVELOPE BRACKET - ADJUSTMENT RANGE | | | |
|---|---|---|---|
| SIZE | DESCRIPTION | FROM | TO |
| 40mm | NV-VB040S | 1-7/8" (47mm) | 2-5/8" (67mm) |
| 60mm | NV-VB060S | 2-7/16" (62mm) | 4" (102mm) |
| 90mm | NV-VB090S | 3-5/8" (92mm) | 5-3/16" (132mm) |
| 120mm | NV-VB120S | 4-13/16" (122mm) | 6-3/8" (162mm) |
| 150mm | NV-VB150S | 6" (152mm) | 7-9/16" (192mm) |
| 180mm | NV-VB180S | 7-3/16" (182mm) | 8-3/4" (222mm) |
| 210mm | NV-VB210S | 8-3/8" (212mm) | 9-15/16 (252mm) |
| 240mm | NV-VB240S | 9-1/2" (242mm) | 11-1/8" (282mm) |
| 270mm | NV-VB270S | 10-11/16" (272mm) | 12-5/16" (312mm) |
| 300mm | NV-VB300S | 11-7/8" (302mm) | 13-7/8" (342mm) |
| BRACKET MATERIAL: 6005A-T6 ALUMINUM<br>THERMAL ISOLATOR MATERIAL: POLYPROPYLENE | | | |



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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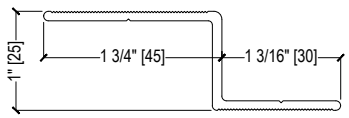
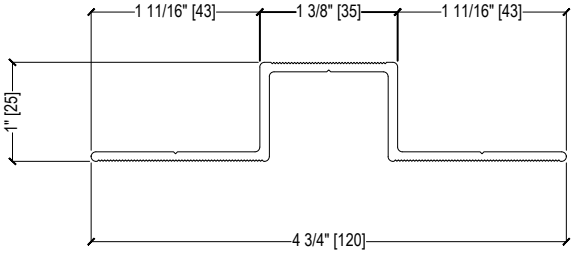
Sheet Title: NVELOPE BRACKET DETAILS
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 3" = 1'-0"
Sheet: S-01

# NVELOPE CLADDING RAILS AND MOUNTING PROFILES

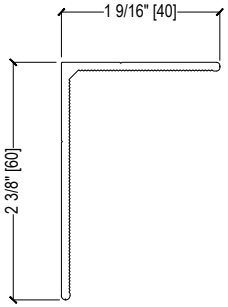
25-45-30
2.4MM



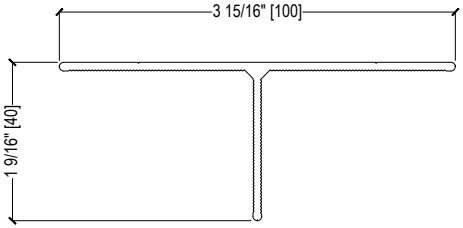

OM25-120
2.4MM



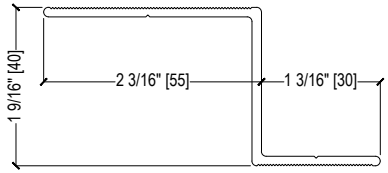

L60-40
2.2MM & 2.5MM



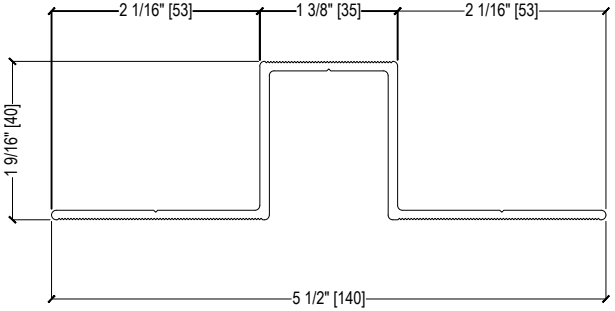

T40-100
2.2MM



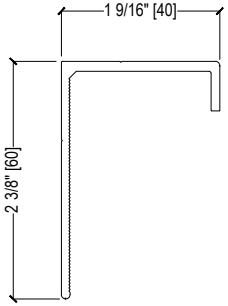

40-55-30
2.4MM



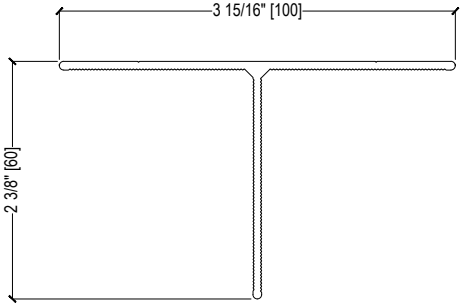

OM40-140
2.4MM



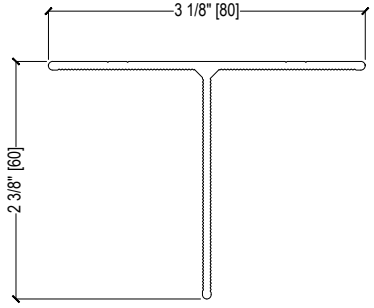

HBL60-40
2.5MM



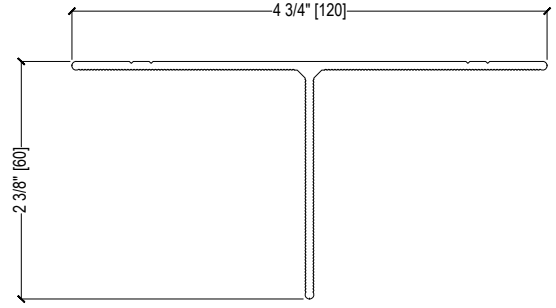

T60-100
2.2MM & 2.5MM



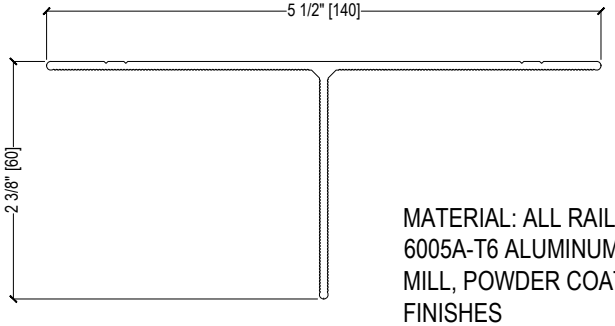

T60-80
2.2MM




T60-120
2.2MM




T60-140
2.2MM




MATERIAL: ALL RAILS ARE MADE FROM 6005A-T6 ALUMINUM AND AVAILABLE IN MILL, POWDER COATED, AND ANODIZED FINISHES



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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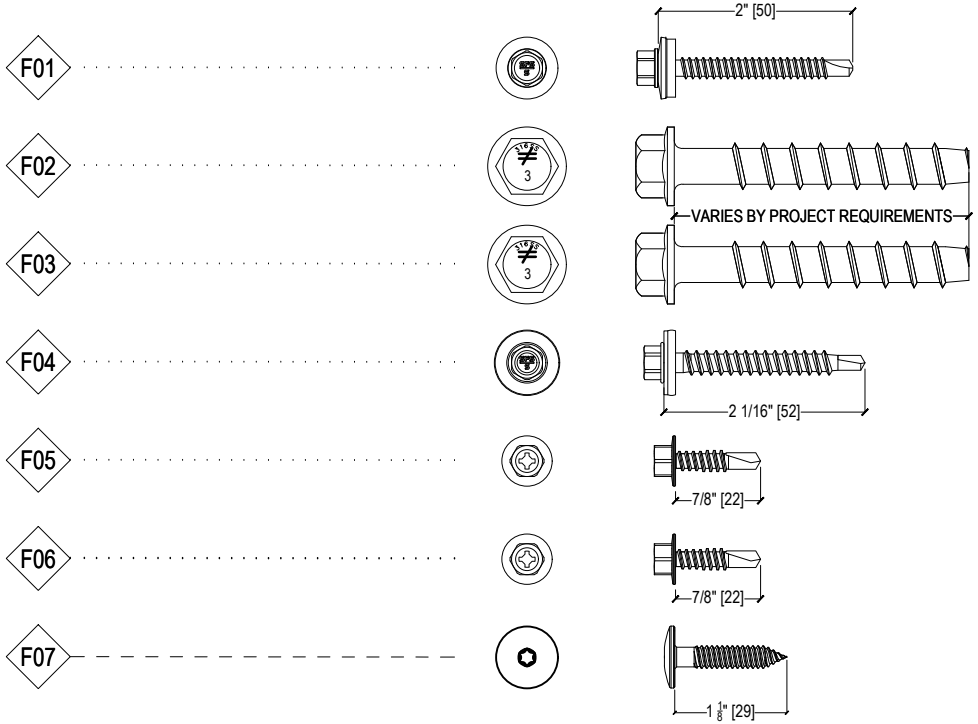
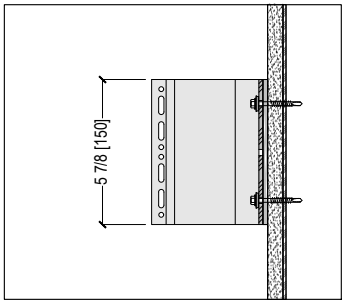
Sheet Title: NVELOPE RAIL & PROFILE DETAILS
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 6" = 1'-0"
Sheet: S-02

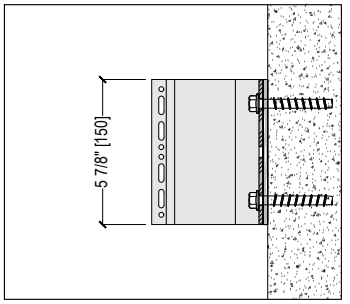
# NVELOPE CLADDING RAILS AND MOUNTING PROFILES

| NO: | TYPICAL USE & APPLICATION | LENGTH | DIAMETER | HEAD/DRIVE | TIP | PART |
|---|---|---|---|---|---|---|
| F01 | Nvelope Bracket to Steel Stud Framing | 2" (50mm) | 1/4" (#14) | HWH | Self-Drill | 1544249 |
| F02 | Nvelope Bracket to CMU Substrate | Varies | 3/8" | HWH (9/16") | Type B | Varies |
| F03 | Nvelope Bracket to Concrete Wall | Varies | 3/8" | HWH (9/16") | Type B | Varies |
| F04 | Nvelope Bracket to Wood Stud Framing | 2-1/16" (52mm) | 6.5mm | HWH | Self-Drill | 1544250 |
| F05 | NH-2 Adapter to Nvelope Wall Bracket | 7/8" (22mm) | 5.5mm (#12) | HWH/SR2 | Self-Drill | 1544263 |
| F06 | Horizontal Rail to Nvelope Wall Bracket | 7/8" (22mm) | 5.5mm (#12) | HWH/SR2 | Self-Drill | 1544263 |
| F07 | Facade Panel to Horizontal Rail | 1 1/8" (29mm) | 5.8mm (#12) | 16mm Dome | Type A | 1572881 |

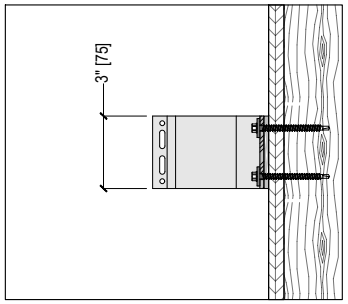


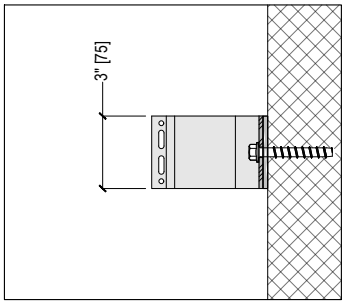
BRACKET AT STEEL STUD



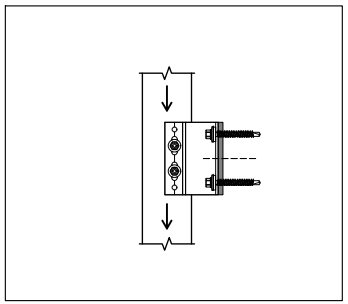
BRACKET AT CONCRETE

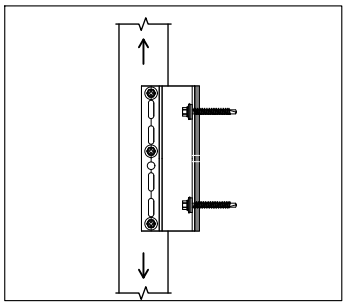


BRACKET AT WOOD STUD



BRACKET AT CMU BLOCK


SLIDING RAIL FASTENING


FIXED RAIL FASTENING

GENERAL FASTENER NOTES:

1. CONCRETE AND MASONRY ANCHOR TYPES VARY BASED ON PROJECT SPECIFIC REQUIREMENTS INCLUDING BUT NOT LIMITED TO WIND LOADs, DEAD LOADS, BUILDING HEIGHT, SEISMIC/SAFETY FACTOR, OR ANY REQUIREMENTS MANDATED BY THE ENGINEER OF RECORD (EOR) AND/OR AUTHORITIES HAVING JURISDICTION (AHJ). CONTACT SFS OR SEE COVER FOR ADDITIONAL INFORMATION AND CONSIDERATIONS.
2. EXPOSED CLADDING FASTENERS MAY VARY BY CLADDING TYPE, APPLICATION, SPACING, DESIGN INTENT AND DESIRED AESTHETIC AND/OR MANUFACTURER FASTENER REQUIREMENTS. CONTACT SFS FOR INFORMATION
3. FASTENERS USED TO ATTACH NVELOPE BRACKETS TO BUILDING SUBSTRATE MAY VARY FROM WHAT IS SHOWN BASED ON PROJECT SPECIFIC REQUIREMENTS. ALWAYS REFER TO ENGINEERING DRAWINGS AND CALCULATIONS FOR CORRECT FASTENERS.
4. ALL STANDARD FASTENERS WITHIN THE NVELOPE SYSTEM ARE 300 SERIES STAINLESS STEEL.



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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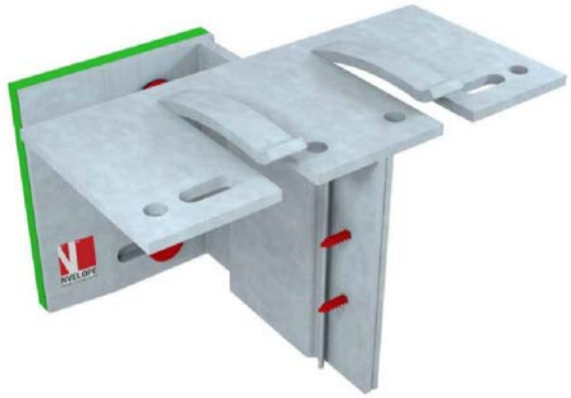
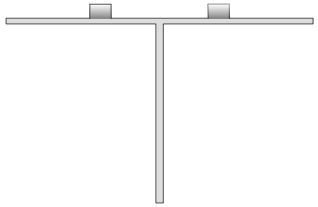
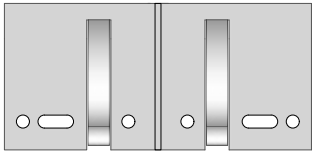
Sheet Title: NVELOPE FASTENER DETAILS
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 6" = 1'-0"
Sheet: S-03

# SYSTEM COMPONENTS - NH2 ADAPTER

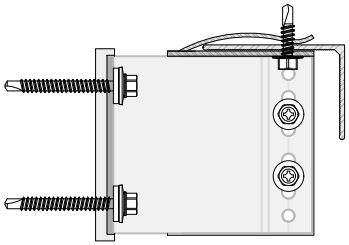




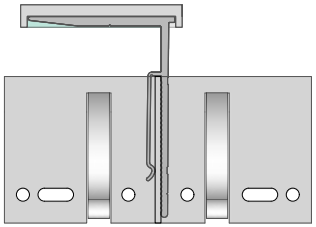
NH2 ADAPTER - FRONT VIEW



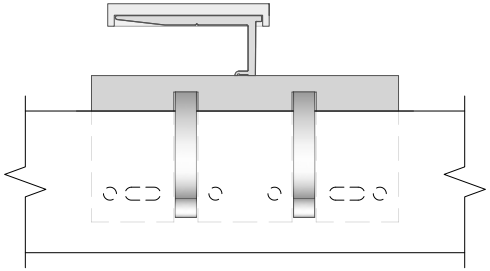
NH2 ADAPTER - TOP VIEW



NH2 ADAPTER - SIDE ASSEMBLY VIEW (WITH FASTENERS)



NH2 ADAPTER - TOP ASSEMBLY VIEW



NH2 ADAPTER - TOP ASSEMBLY VIEW WITH RAIL



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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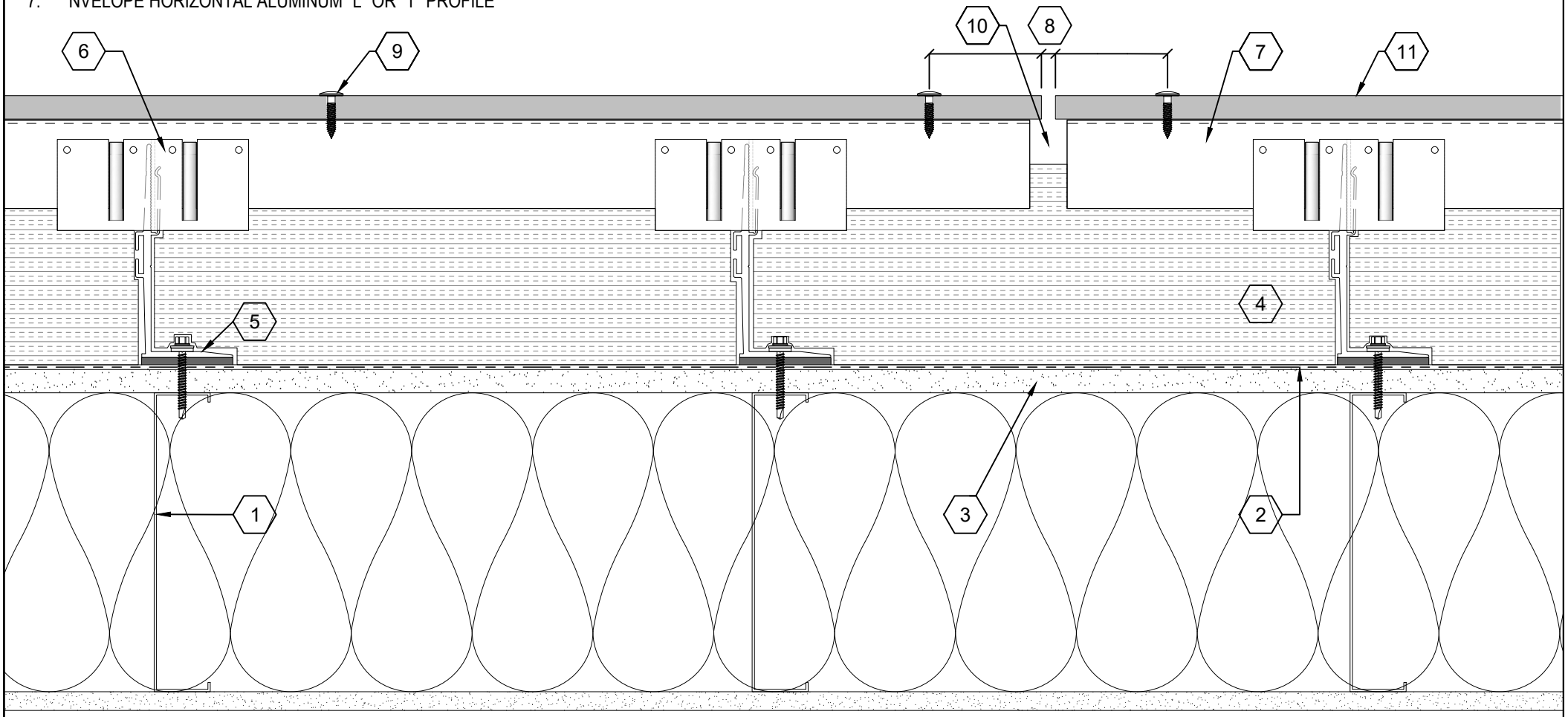
Sheet Title: SYSTEM COMPONENTS
Issue Date: 1/20/2020
System ID: NH2-EF
Scale:
Sheet: S-04

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSIONS PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: PLAN DETAIL - STEEL/WOOD STUD

Issue Date: 1/20/2020

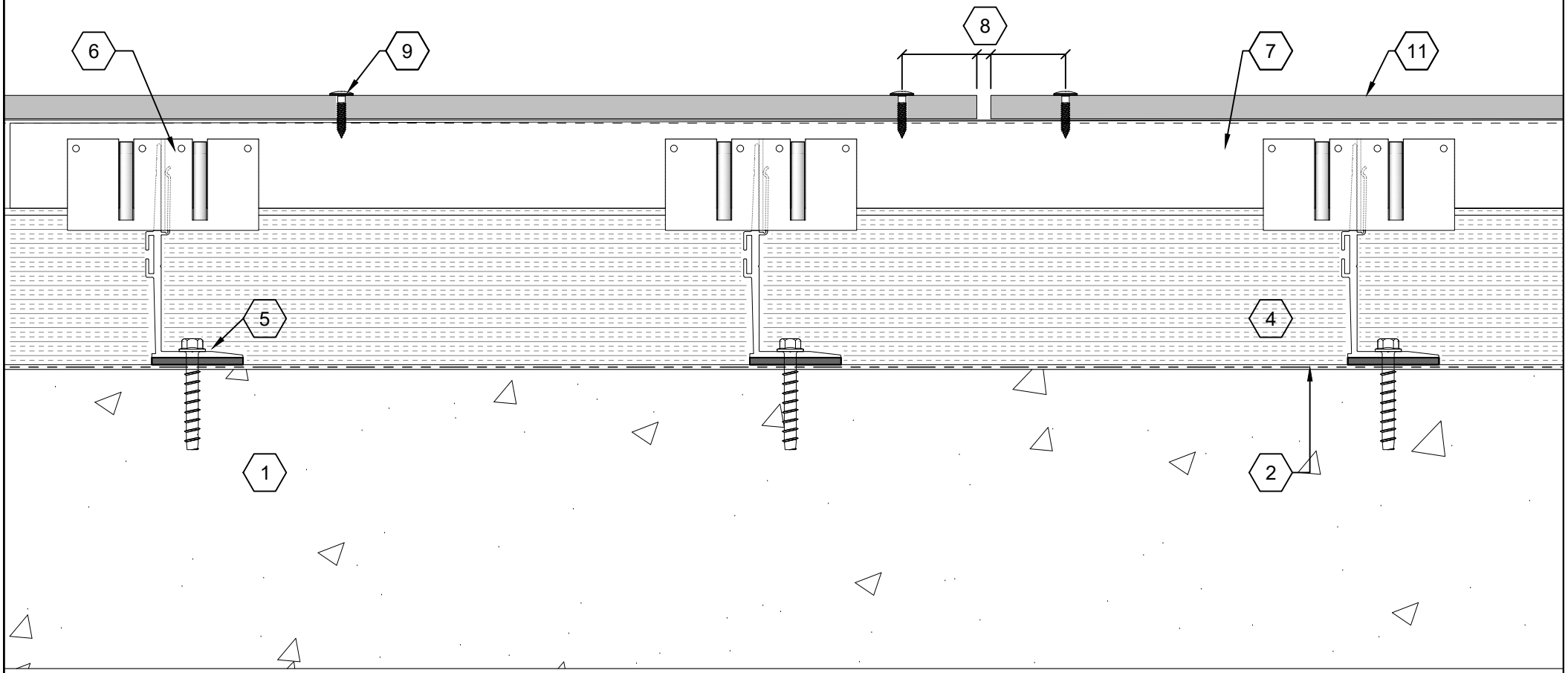
System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-01a

## DRAWING KEYNOTES

1. CONCRETE WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. NOT USED
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSIONS PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS, NOT SHOWN)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: PLAN DETAIL - CONCRETE WALL

Issue Date: 1/20/2020

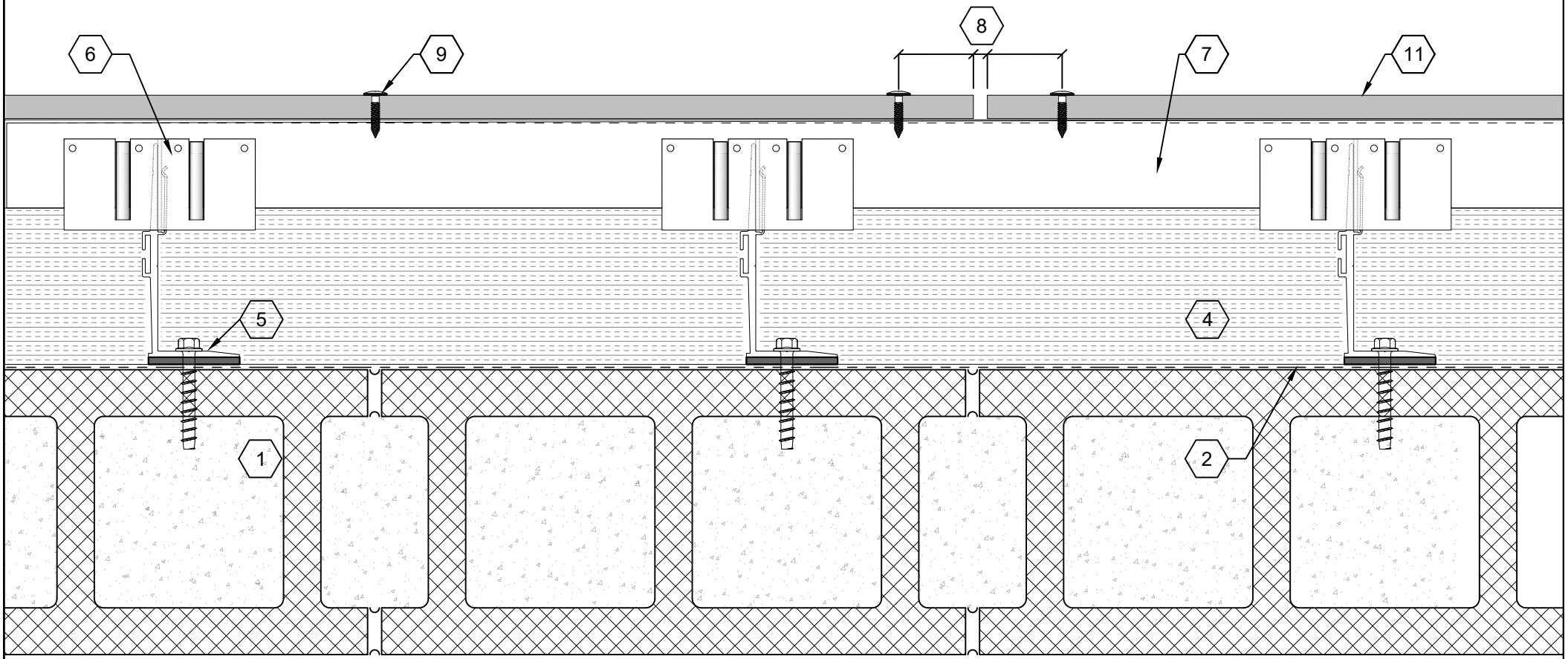
System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-01b

## DRAWING KEYNOTES

1. GROUT-FILLED CMU WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. NOT USED
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSIONS PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS, NOT SHOWN)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: PLAN DETAIL - CMU/MASONRY
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 3" = 1'-0"
Sheet: D-01c

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
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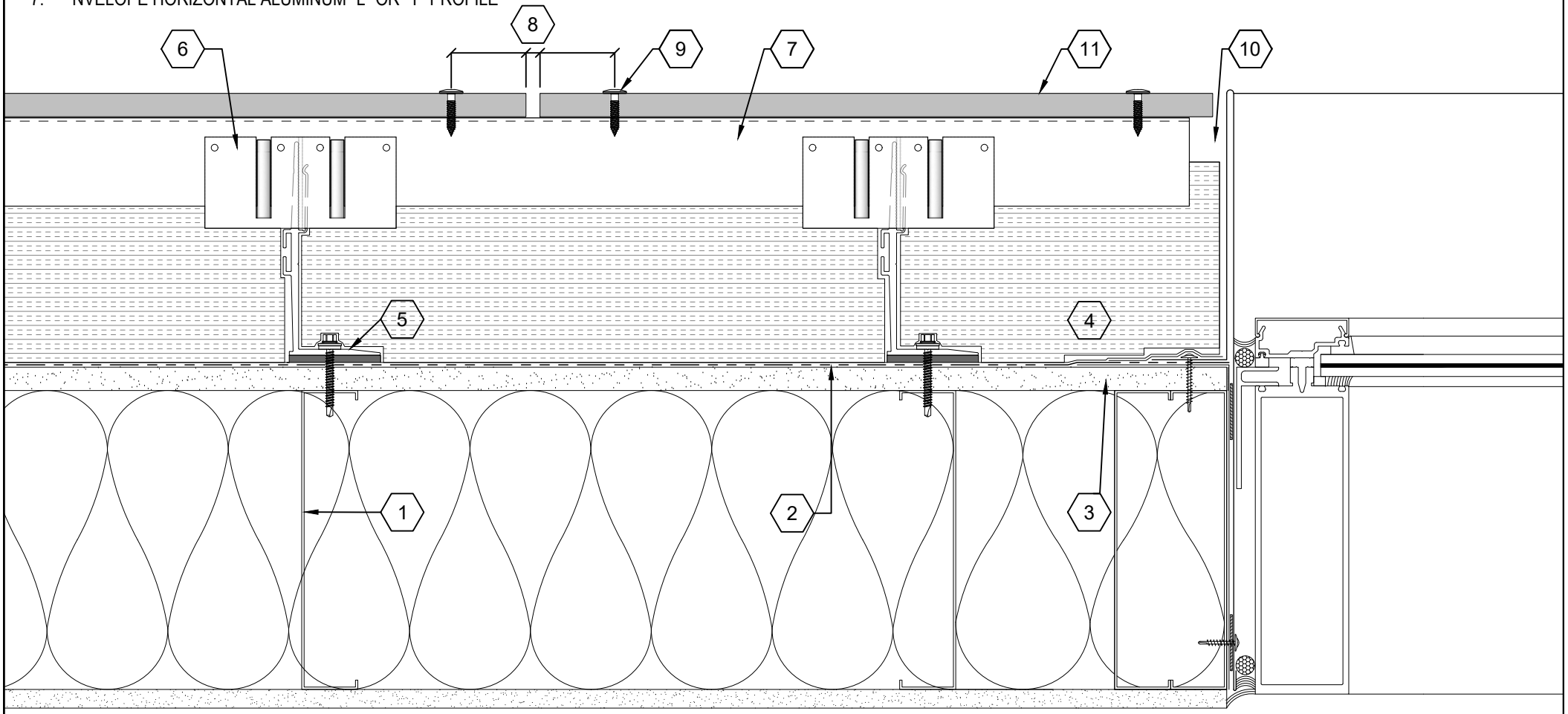
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: STOREFRONT JAMB DETAIL
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 3" = 1'-0"
Sheet: D-02

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
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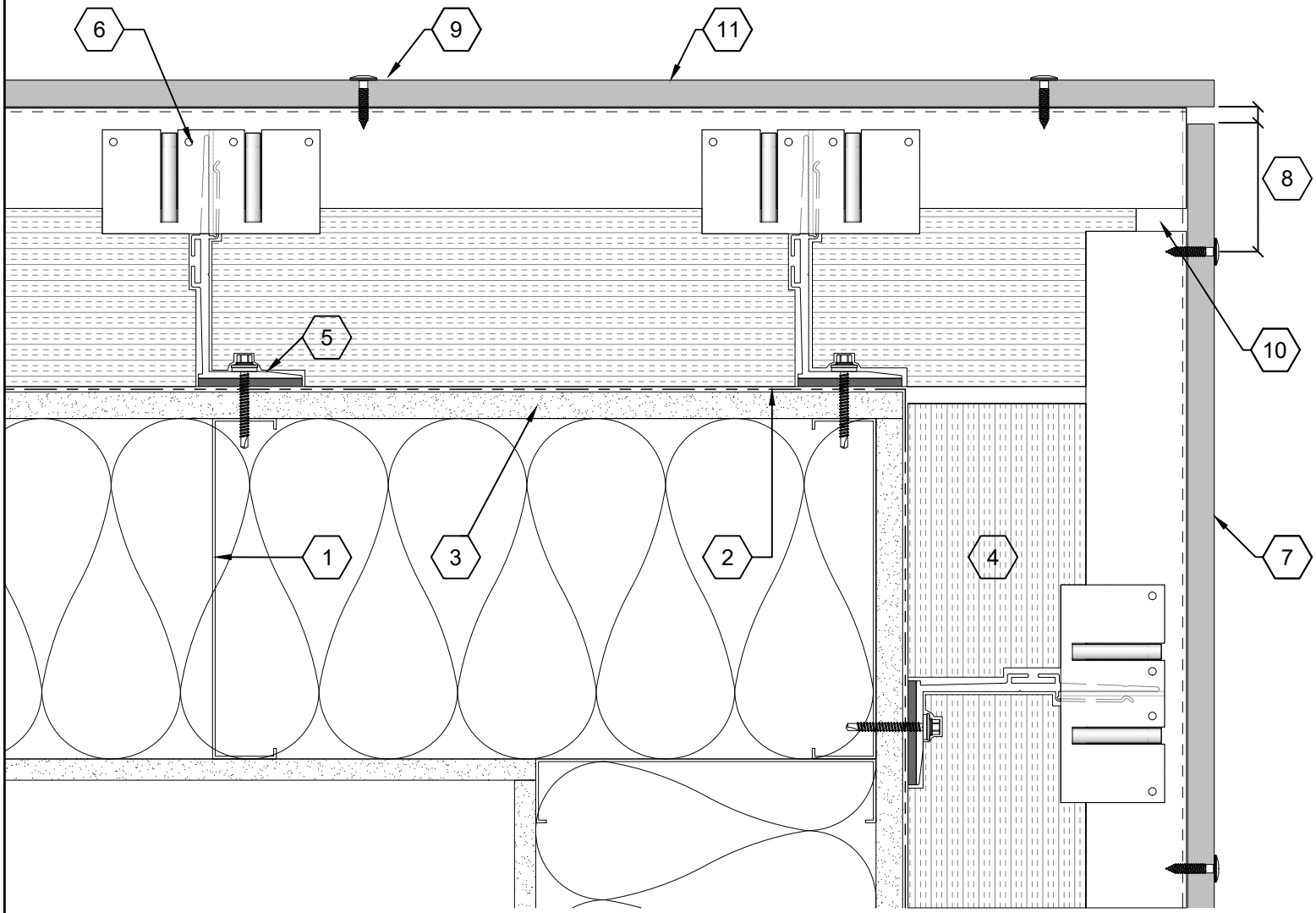
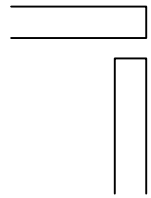
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS.
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS



OPEN "STRAIGHT EDGE"
CORNER OPTION SHOWN



System:
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CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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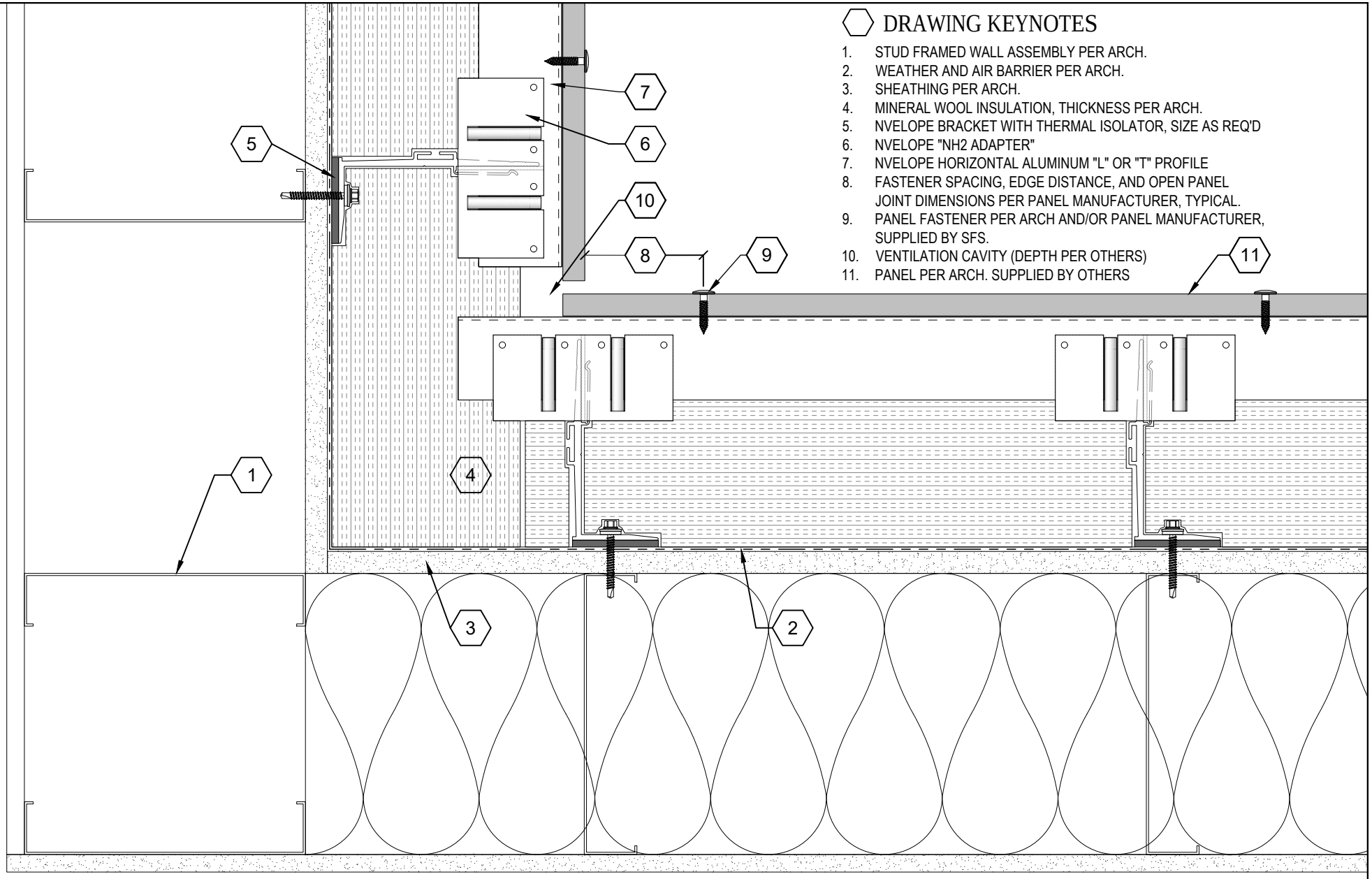
Sheet Title: OUTSIDE CORNER DETAIL

Issue Date: 1/20/2020

System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-03




## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQ'D
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
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10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH. SUPPLIED BY OTHERS



System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: INSIDE CORNER DETAIL

Issue Date: 1/20/2020

System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-04

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
   - 7.1 "L" PROFILE
   - 7.2 "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSION PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS
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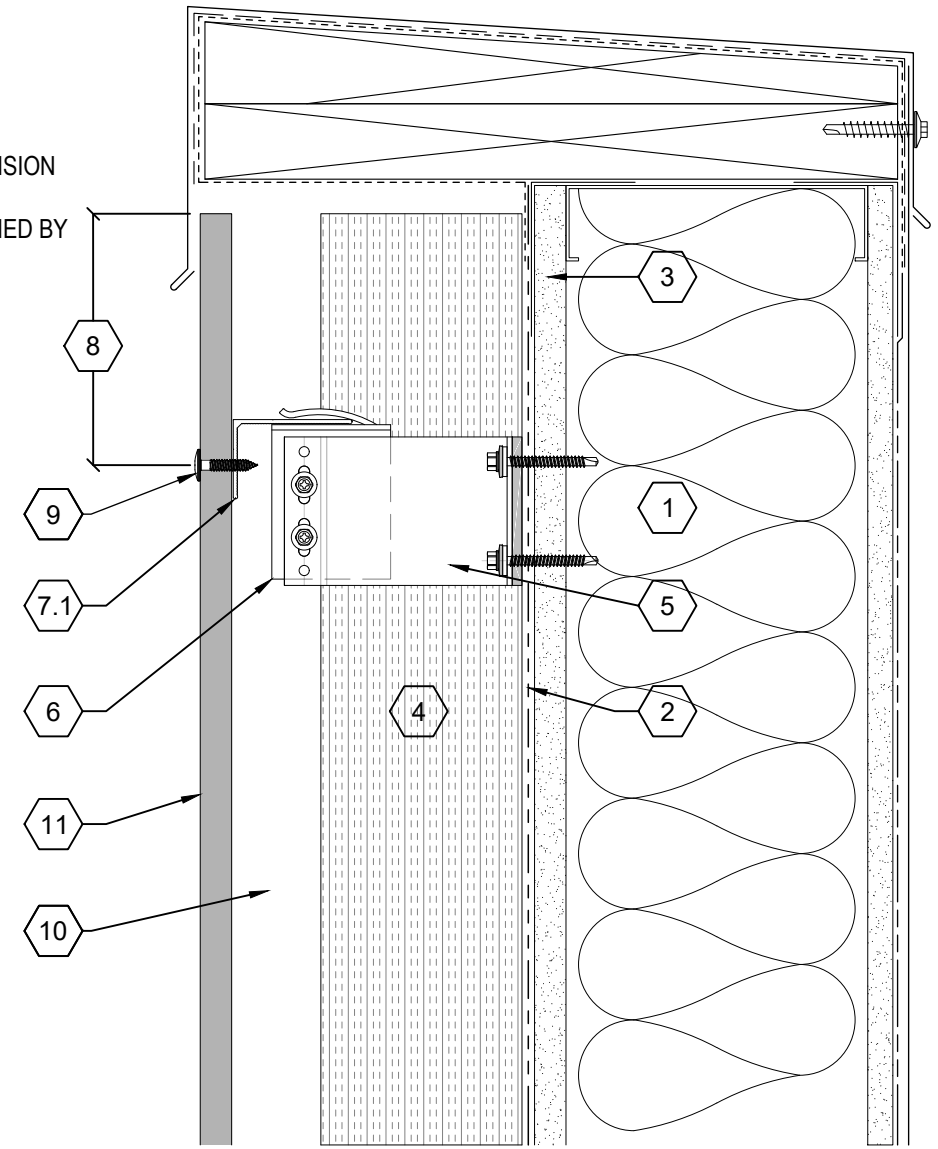
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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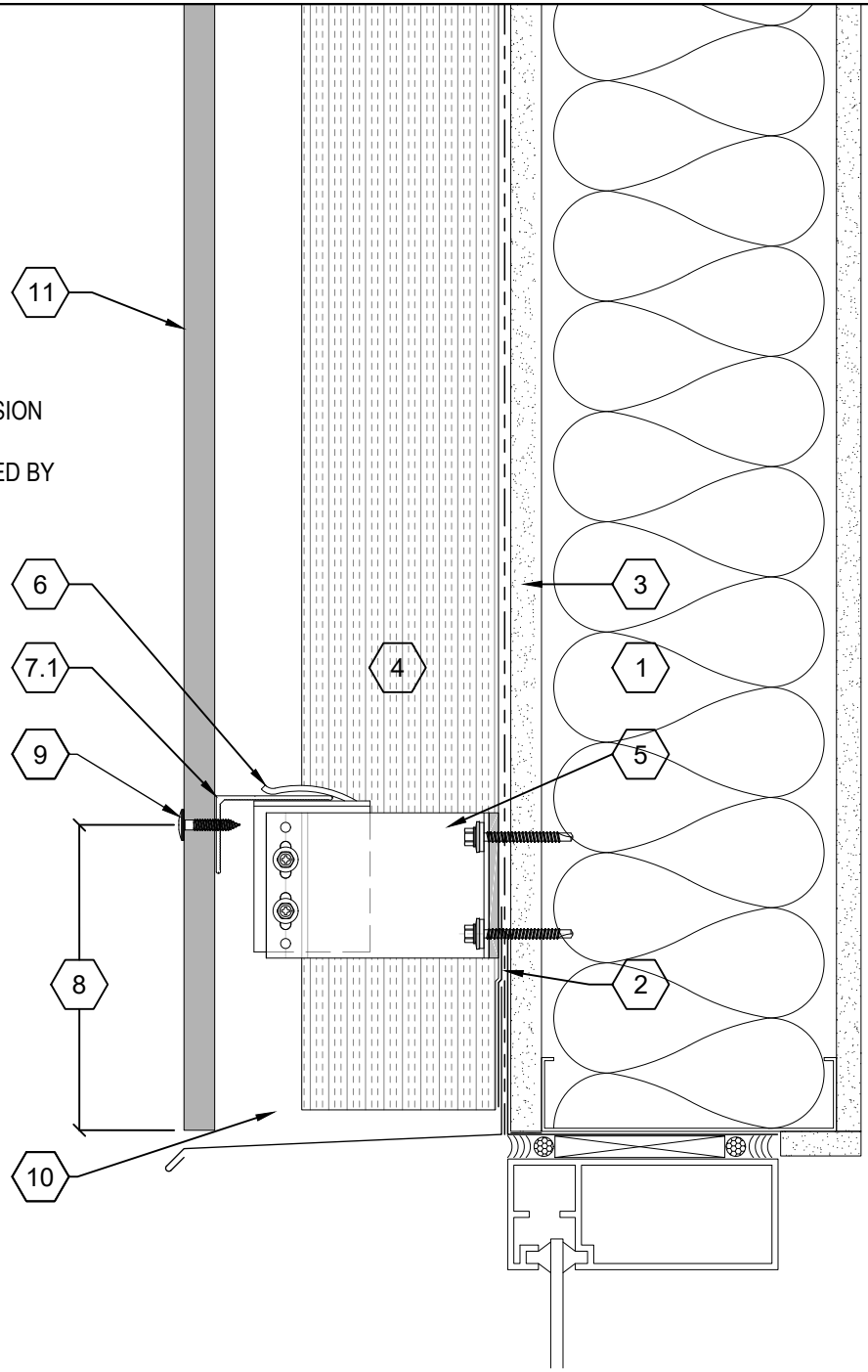
Sheet Title: PARAPET DETAIL
Issue Date: 1/20/2020
System ID: NH2-EF
Scale: 3" = 1'-0"
Sheet: D-05

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
   - 7.1 "L" PROFILE
   - 7.2 "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSION PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: STOREFRONT HEAD DETAIL

Issue Date: 1/20/2020

System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-06

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
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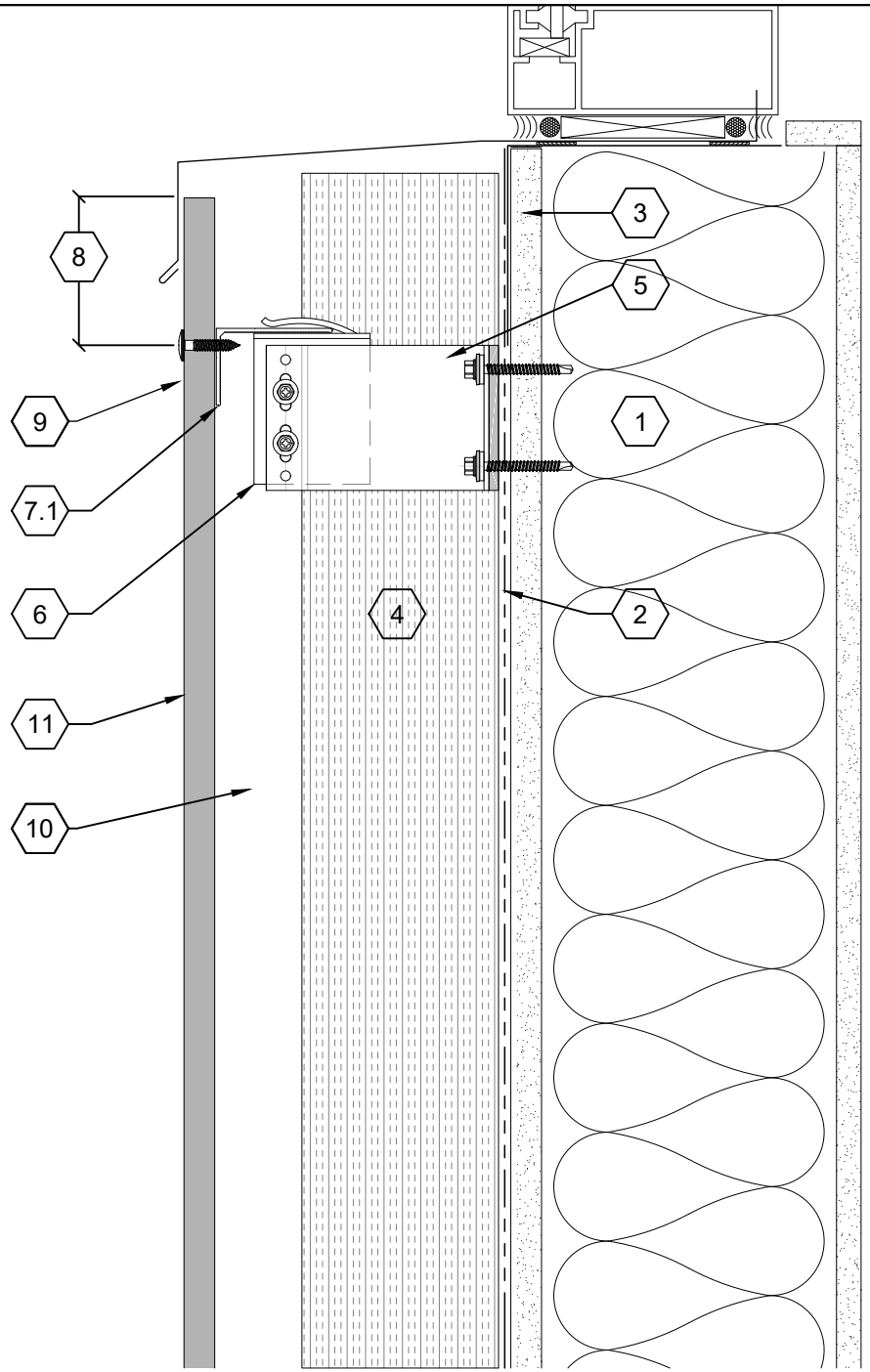
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
   - 7.1 "L" PROFILE
   - 7.2 "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSION PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

SFS Group USA, Inc.
Construction Division
1045 Spring Street
Wyomissing, PA 19610
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Sheet Title: STOREFRONT SILL DETAIL

Issue Date: 1/20/2020

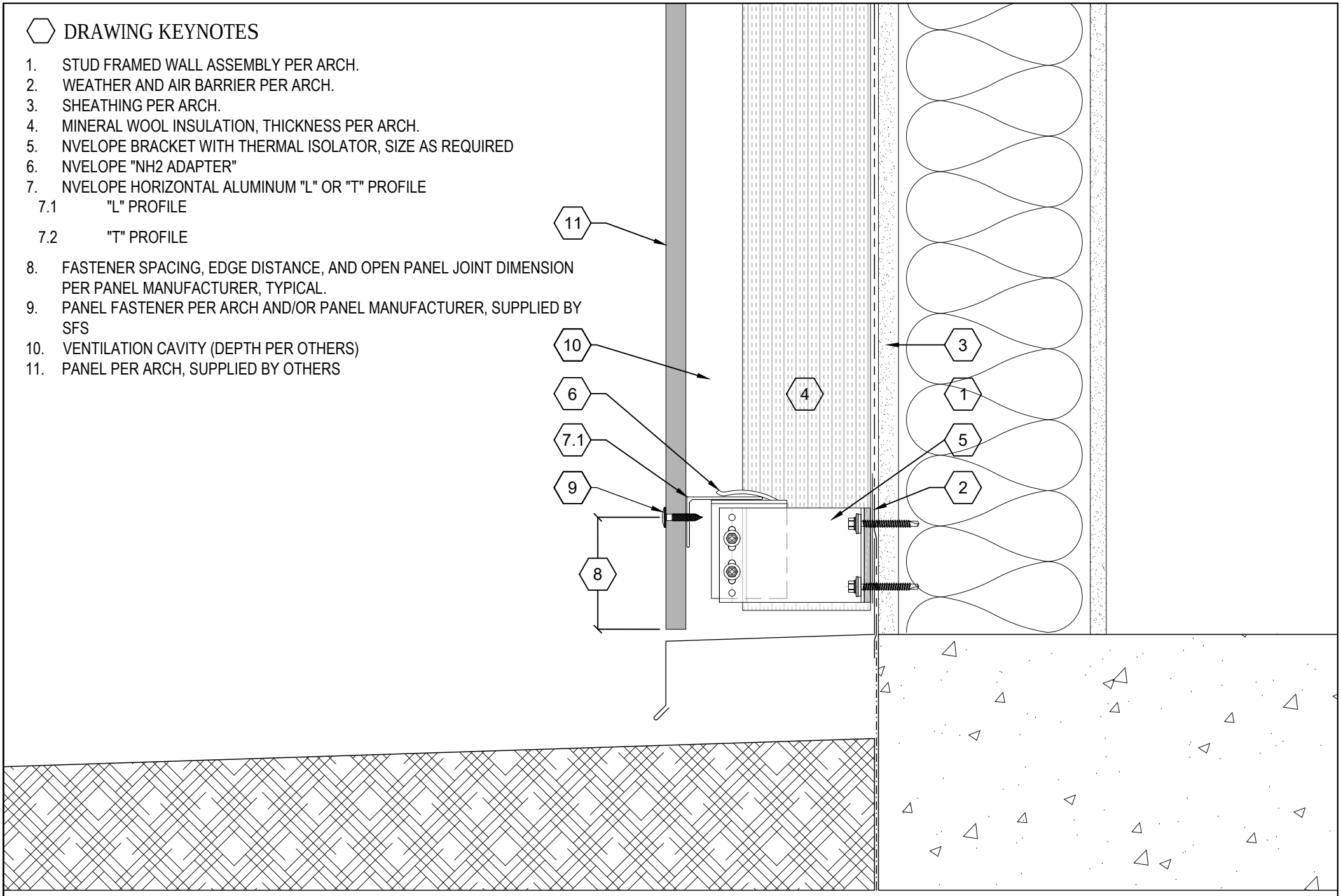
System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-07

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
   - 7.1 "L" PROFILE
   - 7.2 "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSION PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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Sheet Title: BASE DETAIL

Issue Date: 1/20/2020

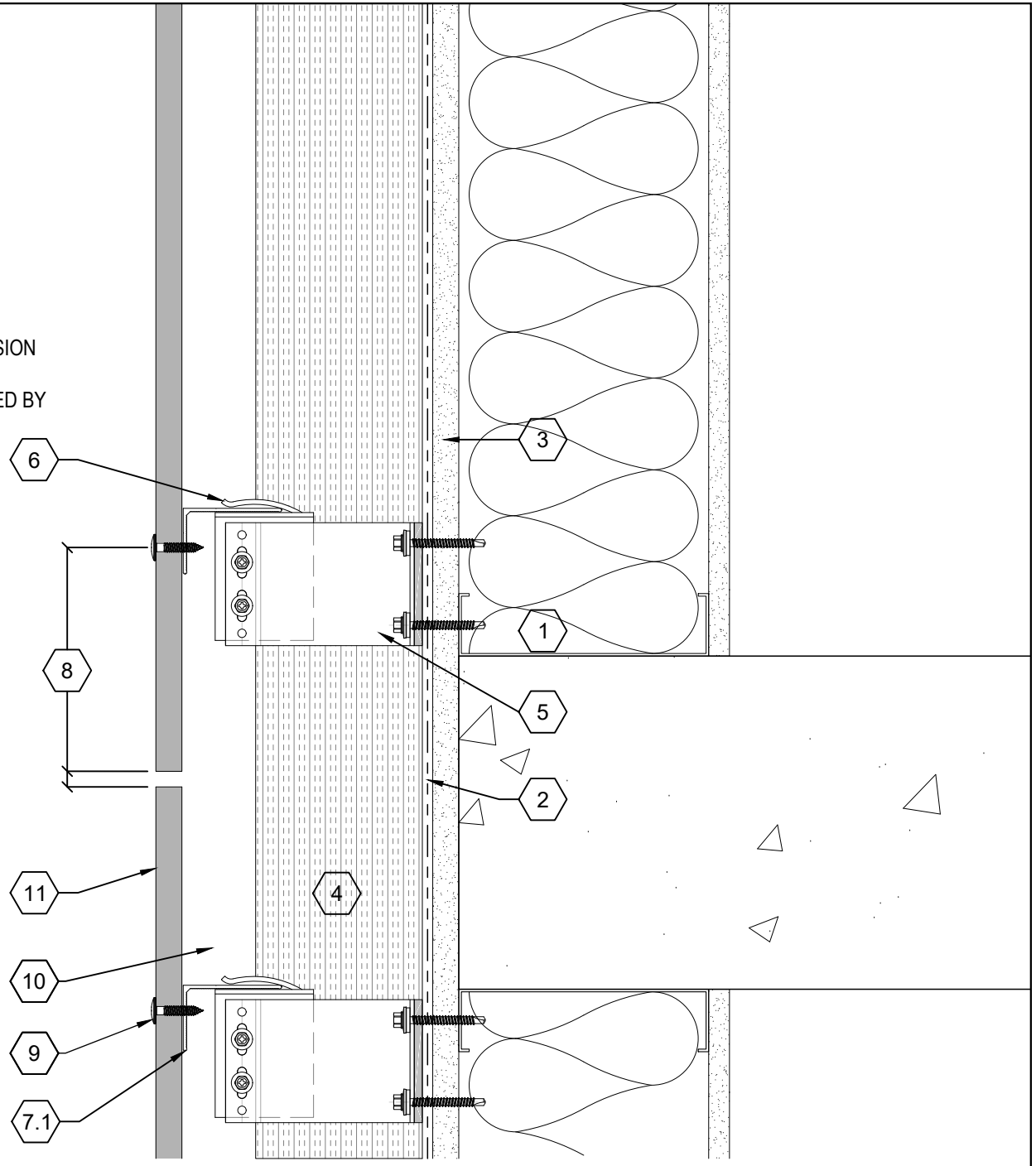
System ID: NH2-EF

Scale: 3" = 1'-0"

Sheet: D-08

## DRAWING KEYNOTES

1. STUD FRAMED WALL ASSEMBLY PER ARCH.
2. WEATHER AND AIR BARRIER PER ARCH.
3. SHEATHING PER ARCH.
4. MINERAL WOOL INSULATION, THICKNESS PER ARCH.
5. NVELOPE BRACKET WITH THERMAL ISOLATOR, SIZE AS REQUIRED
6. NVELOPE "NH2 ADAPTER"
7. NVELOPE HORIZONTAL ALUMINUM "L" OR "T" PROFILE
   - 7.1 "L" PROFILE
   - 7.2 "T" PROFILE
8. FASTENER SPACING, EDGE DISTANCE, AND OPEN PANEL JOINT DIMENSION PER PANEL MANUFACTURER, TYPICAL.
9. PANEL FASTENER PER ARCH AND/OR PANEL MANUFACTURER, SUPPLIED BY SFS
10. VENTILATION CAVITY (DEPTH PER OTHERS)
11. PANEL PER ARCH, SUPPLIED BY OTHERS






System:
SYSTEM: NH2-EF
CLADDING: FCB/HPL/GFRC (EXPOSED FASTENER)

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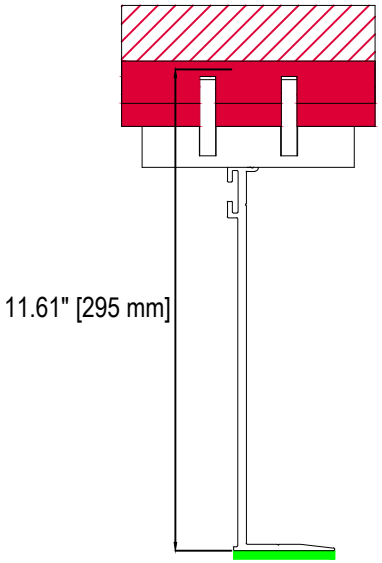
Sheet Title: HORIZONTAL JOINT DETAIL

Issue Date: 1/20/2020

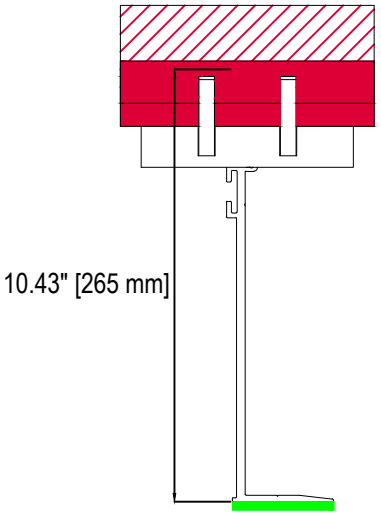
System ID: NH2-EF

Scale: 3" = 1'-0"

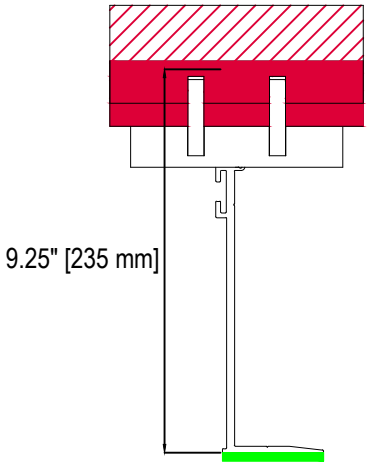
Sheet: D-09



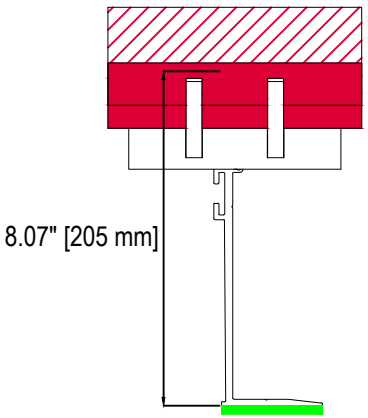

Adjustment
12.00 - 13.39
305 mm - 340 mm



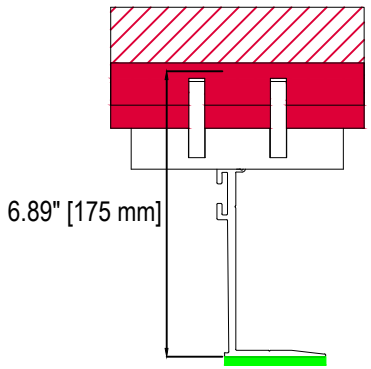

Adjustment
10.83 - 12.20
275 mm - 310 mm



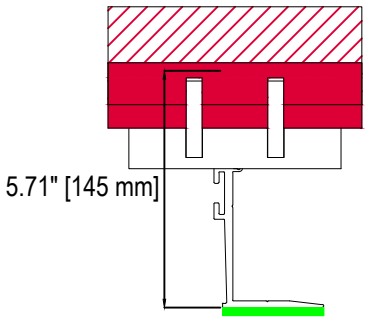

Adjustment
9.65 - 11.02
245 mm - 280 mm



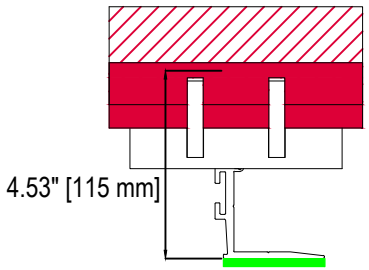

Adjustment
8.46 - 10.24
215 mm - 250 mm



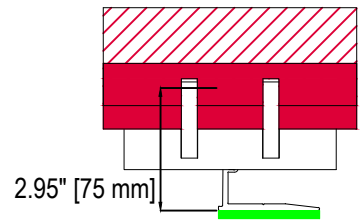

Adjustment
7.28 - 8.66
185 mm - 220 mm



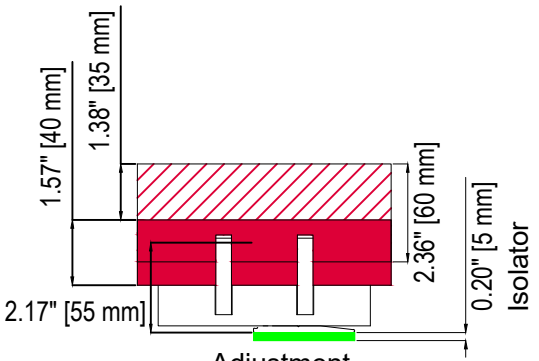

Adjustment
6.10 - 7.48
155 mm - 190 mm




Adjustment
4.92 - 6.30
125 mm - 160 mm




Adjustment
3.74 - 5.12
95 mm - 130 mm




Adjustment
2.95 - 4.33
75 mm - 110 mm

# APPENDIX B:
# MODELING PARAMETERS AND ASSUMPTIONS

# 1. GENERAL MODELING APPROACH

For this report, a steady-state conduction model was used. The following parameters were also assumed:

- Material properties were taken from information provided by SFS Group USA, and ASHRAE Handbook – Fundamentals for common materials.
- Enclosed air spaces were modeled with an equivalent thermal conductivity of the air that includes the impacts of convection and radiation within the enclosure. Calculations for this equivalent conductivity were based on ISO 10077.
- Interior/exterior air films were taken from Table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation. The exterior air films were based on an exterior wind speed of 15 mph.
- In ASHRAE 1365-RP, for rain screen cavity systems, most lightweight claddings have an insignificant impact on the thermal performance other than shielding the insulation from direct wind exposure. The cladding and secondary structure outboard of the clip system were not explicitly modeled but were incorporated into the exterior film coefficient.
- From the calibration in 1365-RP, contact resistances between materials were modeled and varied between R-0.01 and R-0.2 depending on the materials and interfaces.
- Insulation and other components were considered tight to adjacent interfaces.
- The clear field transmittances included in this analysis include uniform thermal bridges such as studs, clips, and girts.

# 2. TEMPERATURE INDEX

The temperature index is the ratio of the surface temperature relative to the interior and exterior temperatures. The temperature index has a value between 0 and 1, where 0 is the exterior temperature and 1 is the interior temperature. If $T_i$ is known, Equation 1 can be rearranged for $T_{surface}$. This arrangement allows the modeled surface temperatures to be applicable to any climate.

$$T_i = \frac{T_{surface} - T_{outside}}{T_{inside} - T_{outside}} \qquad \text{EQ 1}$$

Note, these indices shown in the temperature profiles for this analysis are for general information only and are not intended to predict in-service surface temperatures subject to transient conditions, variable heating systems, and/ or interior obstructions that restrict heating of the assembly. For full limitations of this modeling approach, see ASHRAE 1365-RP.

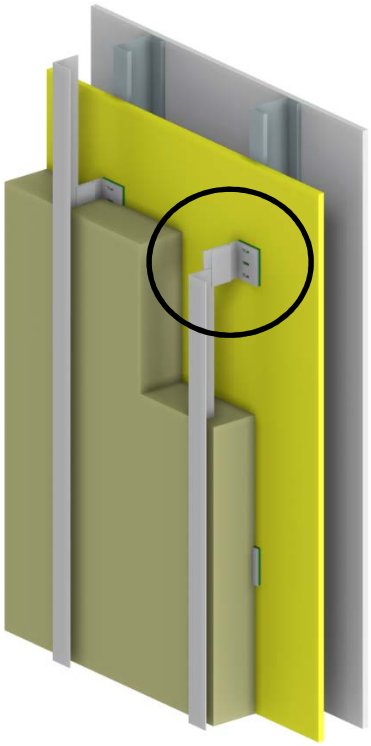
# 3. BOUNDARY CONDITIONS

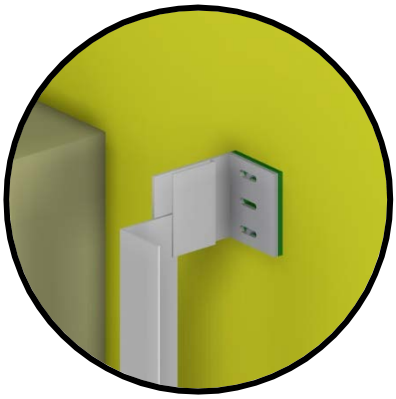
**Table B3.1:** Boundary Conditions

| Boundary Location | Combined Convective and Radiation Heat Transfer Coefficient BTU/hft$^2$°F (W/m$^2$K) |
|---|---|
| Exterior Wall Surfaces with Generic Cladding | 1.5 (8.3) |
| Interior Walls | 1.5 (8.3) |

# APPENDIX C:
# MATERIAL PROPERTIES

# 1. NV1 SYSTEM WITH EXTERIOR INSULATED STEEL STUD ASSEMBLY



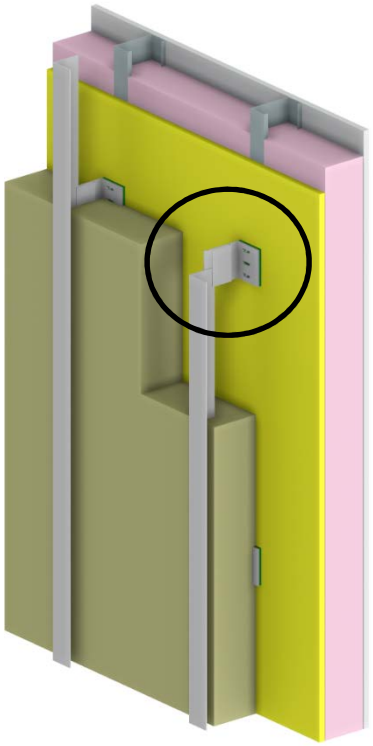


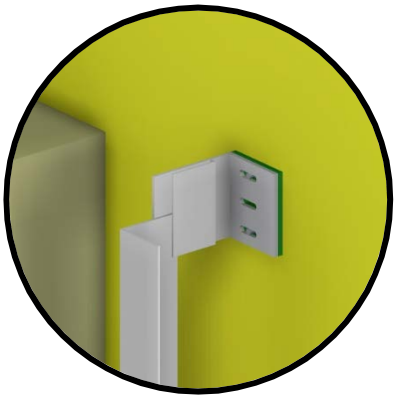
**NV1 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Air | 3 5/8 (92) | 4.0 (0.58) | R-0.9 (0.16 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Vertical Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-9.5 to R-28.4 (1.67 RSI to 5.00 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# 2. NV1 SYSTEM WITH SPLIT INSULATED STEEL STUD ASSEMBLY

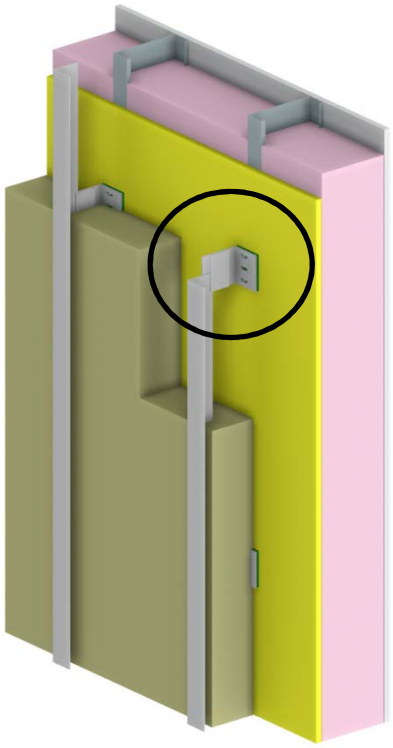


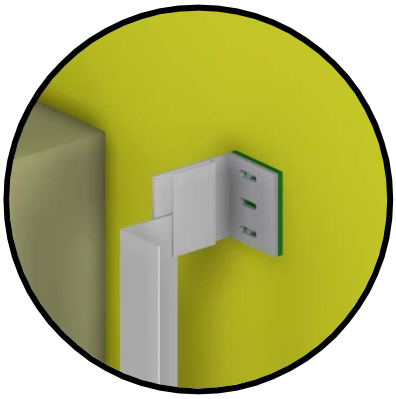


**NV1 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Fiberglass Batt Insulation | 3 5/8 (92) | Varies | R-11 to R-15 (1.94 RSI to 2.64 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Vertical Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-19.6 to R-42.5 (3.45 RSI to 7.49 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2



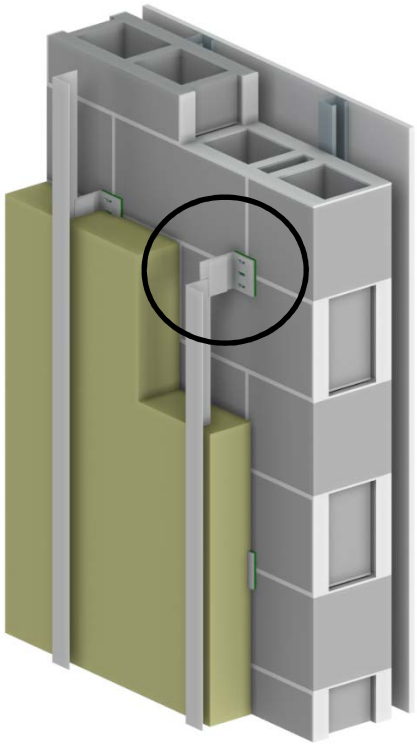


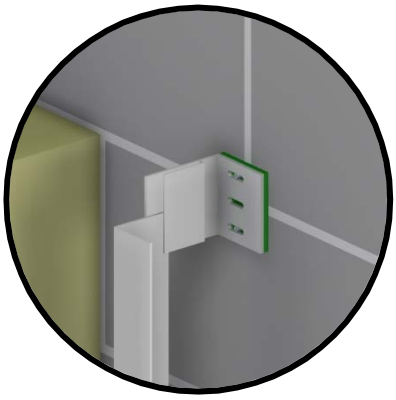
**NV1 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Fiberglass Batt Insulation | 6 (152) | 0.32 (0.046) | R-19 (3.35 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Vertical Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-27.6 to R-46.5 (4.86 RSI to 8.19 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# 3. NV1 SYSTEM WITH CONCRETE BLOCK WALL ASSEMBLY



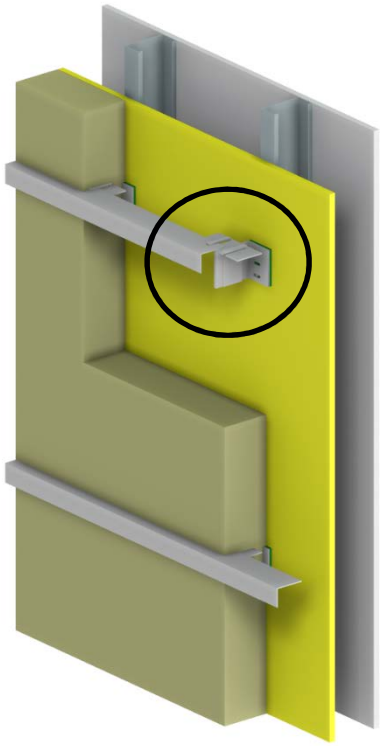


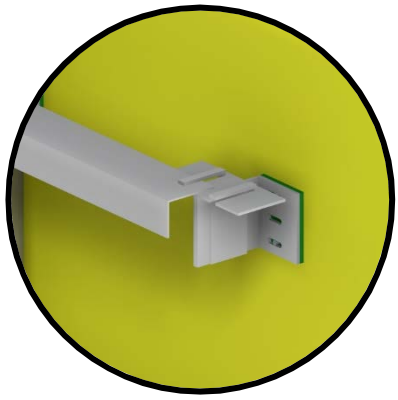
**NV1 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Air | 1 5/8 (92) | 1.8 (0.26) | R-0.9 (0.16 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Standard Concrete Blocks | Concrete | 8 (203) | 10.4 (1.50) | - |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Vertical Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-10.2 to R-29.1 (1.80 RSI to 5.13 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# 4. NH2 SYSTEM WITH EXTERIOR INSULATED STEEL STUD ASSEMBLY



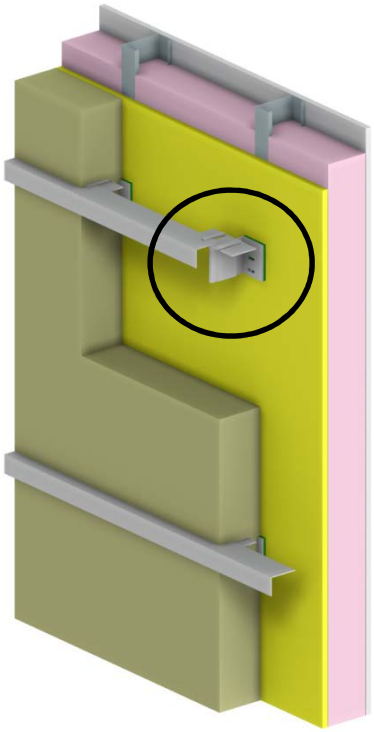


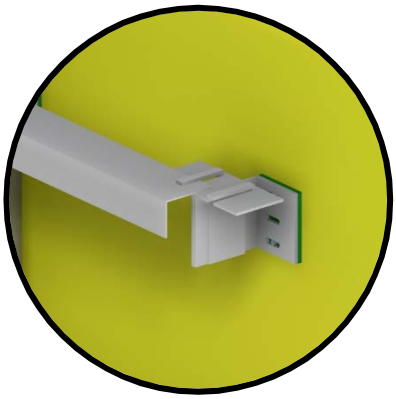
**NH2 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Air | 3 5/8 (92) | 4.0 (0.58) | R-0.9 (0.16 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| NH2 Adaptor | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Horizontal Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-9.5 to R-28.4 (1.67 RSI to 5.00 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# 5. NH2 SYSTEM WITH SPLIT INSULATED STEEL STUD ASSEMBLY

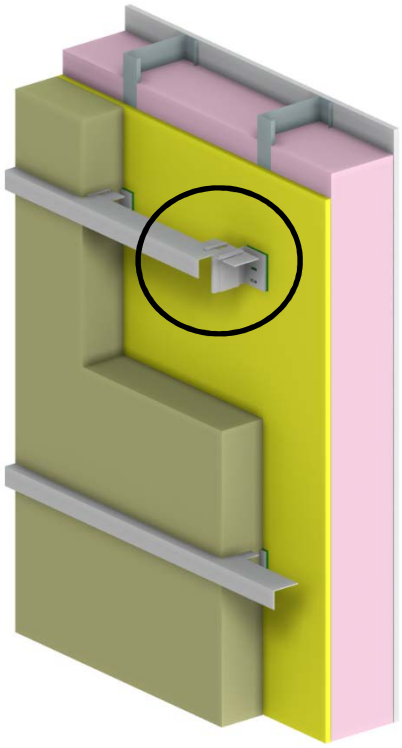


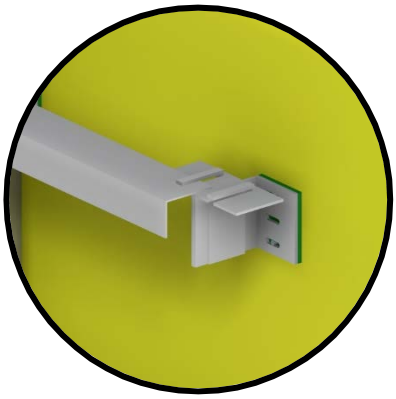


**NH2 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Fiberglass Batt Insulation | 3 5/8 (92) | Varies | R-11 to R-15 (1.94 RSI to 2.64 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| NH2 Adaptor | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Horizontal Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-19.6 to R-42.5 (3.45 RSI to 7.49 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2



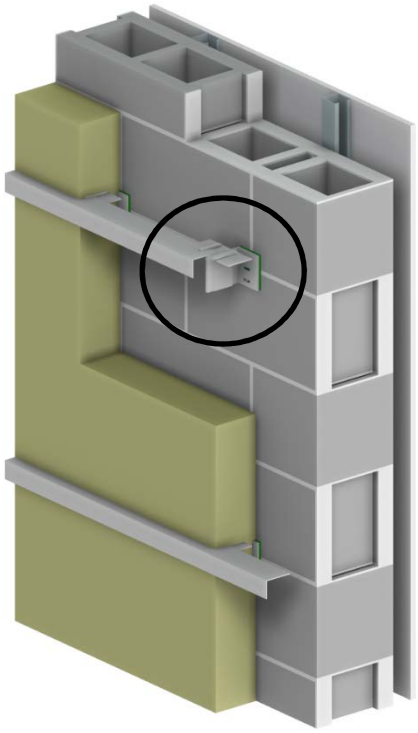


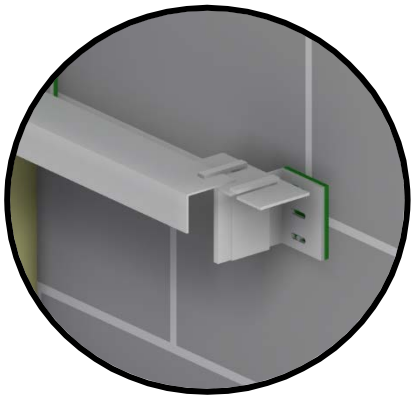
**NH2 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Fiberglass Batt Insulation | 6 (152) | 0.32 (0.046) | R-19 (3.35 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Sheathing | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| NH2 Adaptor | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Horizontal Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-27.6 to R-46.5 (4.86 RSI to 8.19 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# 6. NH2 SYSTEM WITH CONCRETE BLOCK WALL ASSEMBLY





**NH2 Clip System Detail**

| Component | Material | Thickness In (mm) | Thermal Conductivity Btu in / ft² hr °F (W/m K) | Nominal Resistance ft² hr °F / Btu (m² K/W) |
|---|---|---|---|---|
| Interior Film | - | - | - | R-0.7 (0.12 RSI) |
| Gypsum | Gypsum | 1/2 (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) |
| Stud Cavity | Air | 1 5/8 (92) | 1.8 (0.26) | R-0.9 (0.16 RSI) |
| Steel Stud | Galvanized Steel | 18 ga. | 430 (62) | - |
| Standard Concrete Blocks | Concrete | 8 (203) | 10.4 (1.50) | - |
| Exterior Insulation | Semi-rigid Mineral Wool Insulation (R4.2/in) | Varies | 0.24 (0.034) | R-6.3 to R-25.2 (1.11 to 4.44 RSI) |
| NV1 Clip | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| NH2 Adaptor | Aluminum 6005A-T6 | Varies | 1339 (193) | - |
| Isolator | NV1 Isolator | (5) | 0.81 (0.117) | - |
| Fasteners | Stainless Steel | 0.22" (5.5) θ | 118 (17) | - |
| Vertical Girt | Aluminum 6005A-T6 | 10 ga. | 1339 (193) | - |
| Air Spaces[1] | Air | Varies | Varies | - |
| Exterior Film | - | - | - | R-0.7 (0.12 RSI) |
| Overall Wall Assembly 1D | - | - | - | R-10.2 to R-29.1 (1.80 RSI to 5.13 RSI) |

[1] The thermal conductivities of the air spaces were determined according to ISO 10077-2

# APPENDIX D:
# EFFECTIVE ASSEMBLY R-VALUES

# 1. NV1 CLIP SYSTEM WITH EXTERIOR INSULATED STEEL STUD ASSEMBLY

**Table D.1.1:** Effective R-Value for NV1 Clip System with Exterior Insulated Steel Stud Assemblies with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[1] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-8.3 (1.46) | R-8.6 (1.52) | R-8.9 (1.56) | R-9.0 (1.59) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-9.6 (1.69) | R-10.1 (1.78) | R-10.5 (1.85) | R-10.8 (1.89) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-11.7 (2.07) | R-12.6 (2.22) | R-13.3 (2.34) | R-13.7 (2.42) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-13.6 (2.39) | R-14.9 (2.63) | R-16.1 (2.83) | R-16.8 (2.96) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-15.0 (2.65) | R-16.9 (2.98) | R-18.6 (3.27) | R-19.6 (3.45) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-16.3 (2.86) | R-18.6 (3.28) | R-20.8 (3.66) | R-22.2 (3.91) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-16.0 (2.82) | R-18.5 (3.26) | R-20.8 (3.67) | R-22.3 (3.93) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-15.9 (2.80) | R-18.4 (3.25) | R-20.8 (3.66) | R-22.3 (3.93) |

# 2. NV1 CLIP SYSTEM WITH SPLIT INSULATED STEEL STUD ASSEMBLY

**Table D.2.1:** Effective R-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-11 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[2] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-13.7 (2.41) | R-14.1 (2.48) | R-14.5 (2.55) | R-14.7 (2.59) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-14.9 (2.62) | R-15.6 (2.74) | R-16.1 (2.84) | R-16.5 (2.90) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-16.9 (2.98) | R-17.9 (3.16) | R-18.8 (3.31) | R-19.4 (3.41) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-18.7 (3.29) | R-20.2 (3.56) | R-21.6 (3.80) | R-22.5 (3.96) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.1 (3.54) | R-22.2 (3.91) | R-24.1 (4.24) | R-25.3 (4.46) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-21.3 (3.75) | R-23.9 (4.21) | R-26.3 (4.63) | R-27.9 (4.92) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-21.1 (3.71) | R-23.8 (4.19) | R-26.4 (4.65) | R-28.1 (4.95) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.0 (3.69) | R-23.8 (4.18) | R-26.4 (4.64) | R-28.1 (4.94) |

[1] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, and air films all contribute an additional R-3.2 towards the nominal R-value of the entire assembly.

[2] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-13.3 towards the nominal R-value of the entire assembly.

**Table D.2.2:** Effective R-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-12 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[3] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-14.0 (2.47) | R-14.5 (2.55) | R-14.9 (2.62) | R-15.1 (2.67) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-15.2 (2.68) | R-15.9 (2.81) | R-16.5 (2.91) | R-16.9 (2.97) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-17.3 (3.04) | R-18.3 (3.22) | R-19.2 (3.38) | R-19.8 (3.48) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-19.0 (3.35) | R-20.6 (3.63) | R-22.0 (3.87) | R-22.9 (4.03) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.4 (3.60) | R-22.6 (3.97) | R-24.4 (4.30) | R-25.7 (4.52) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-21.6 (3.81) | R-24.3 (4.27) | R-26.7 (4.70) | R-28.3 (4.99) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-21.4 (3.77) | R-24.1 (4.25) | R-26.8 (4.71) | R-28.5 (5.02) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.3 (3.75) | R-24.1 (4.25) | R-26.7 (4.71) | R-28.5 (5.02) |

**Table D.2.3:** Effective R-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-13 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[4] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-14.4 (2.54) | R-14.9 (2.62) | R-15.2 (2.68) | R-15.5 (2.73) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-15.6 (2.75) | R-16.3 (2.87) | R-16.9 (2.97) | R-17.3 (3.04) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-17.6 (3.10) | R-18.7 (3.29) | R-19.6 (3.44) | R-20.1 (3.55) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-19.3 (3.41) | R-20.9 (3.69) | R-22.3 (3.93) | R-23.2 (4.09) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.8 (3.66) | R-22.9 (4.03) | R-24.8 (4.37) | R-26.1 (4.59) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-22.0 (3.87) | R-24.6 (4.33) | R-27.0 (4.76) | R-28.7 (5.05) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-21.7 (3.82) | R-24.5 (4.31) | R-27.1 (4.77) | R-28.9 (5.08) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.6 (3.81) | R-24.4 (4.30) | R-27.1 (4.77) | R-28.8 (5.08) |

[3] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-14.3 towards the nominal R-value of the entire assembly.

[4] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-15.3 towards the nominal R-value of the entire assembly.

**Table D.2.4:** Effective R-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-15 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[5] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-15.1 (2.65) | R-15.5 (2.74) | R-15.9 (2.81) | R-16.3 (2.86) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-16.2 (2.86) | R-17.0 (2.99) | R-17.6 (3.10) | R-18.0 (3.17) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-18.2 (3.21) | R-19.3 (3.40) | R-20.2 (3.56) | R-20.9 (3.67) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-20.0 (3.51) | R-21.6 (3.80) | R-23.0 (4.05) | R-24.0 (4.22) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-21.4 (3.76) | R-23.5 (4.14) | R-25.5 (4.49) | R-26.8 (4.72) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-22.5 (3.97) | R-25.2 (4.44) | R-27.7 (4.88) | R-29.4 (5.17) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-22.3 (3.92) | R-25.1 (4.42) | R-27.8 (4.89) | R-29.6 (5.21) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-22.2 (3.91) | R-25.1 (4.41) | R-27.7 (4.89) | R-29.6 (5.20) |

**Table D.2.5:** Effective R-Value for NV1 Clip System with Split Insulated Steel Stud Assemblies with R-19 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[6] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 40 | 1.5 | R-6.3 (1.11 RSI) | R-16.3 (2.87) | R-16.8 (2.95) | R-17.2 (3.03) | R-17.3 (3.05) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-17.5 (3.08) | R-18.2 (3.20) | R-18.8 (3.31) | R-19.1 (3.36) |
| 60 | 3 | R-12.6 (2.22 RSI) | R-19.4 (3.42) | R-20.5 (3.61) | R-21.5 (3.78) | R-21.9 (3.86) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-21.1 (3.72) | R-22.8 (4.01) | R-24.2 (4.27) | R-25.0 (4.40) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-22.5 (3.97) | R-24.7 (4.35) | R-26.7 (4.70) | R-27.8 (4.90) |
| 150 | 6 | R-25.2 (4.44 RSI) | R-23.7 (4.17) | R-26.4 (4.64) | R-28.9 (5.09) | R-30.4 (5.35) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-23.4 (4.12) | R-26.3 (4.62) | R-29.0 (5.10) | R-30.6 (5.38) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-23.3 (4.11) | R-26.2 (4.62) | R-28.9 (5.09) | R-30.5 (5.38) |

[5] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-17.3 towards the nominal R-value of the entire assembly.

[6] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-21.3 towards the nominal R-value of the entire assembly.

# 3. NV1 CLIP SYSTEM WITH CMU WALL ASSEMBLY

**Table D.3.1:** Effective R-Value for NV1 Clip System with CMU Wall Assemblies with Clips Spaced 16", 24" and 32" Horizontally

| Horizontal Clip Spacing (in) | NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[7] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 16 | 40 | 1.5 | R-6.3 (1.11 RSI) | R-8.7 (1.54) | R-9.1 (1.60) | R-9.4 (1.66) | R-9.6 (1.68) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-9.8 (1.73)** | *R-10.4 (1.83)** | *R-10.8 (1.91)** | *R-11.1 (1.95)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-11.8 (2.08) | R-12.8 (2.25) | R-13.6 (2.40) | R-14.1 (2.48) |
| | 90 | 0 | R-0 | *R-3.9 (0.68)** | R-3.9 (0.68) | *R-3.9 (0.68)** | *R-3.9 (0.68)** |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-13.4 (2.36) | R-14.8 (2.61) | R-16.1 (2.84) | R-16.9 (2.98) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-14.6 (2.57)** | *R-16.6 (2.92)** | *R-18.4 (3.24)** | *R-19.5 (3.44)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-15.6 (2.75) | R-18.0 (3.17) | R-20.3 (3.58) | R-21.8 (3.84) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-15.3 (2.69) | R-17.8 (3.14) | R-20.3 (3.57) | R-21.9 (3.85) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-15.2 (2.67) | R-17.7 (3.13) | R-20.2 (3.57) | R-21.9 (3.85) |
| 24 | 40 | 1.5 | R-6.3 (1.11 RSI) | R-9.2 (1.62) | R-9.5 (1.67) | R-9.7 (1.70) | R-9.8 (1.72) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-10.6 (1.86)** | *R-11.0 (1.94)** | *R-11.3 (1.99)** | *R-11.5 (2.02)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-13.0 (2.30) | R-13.8 (2.43) | R-14.4 (2.54) | R-14.8 (2.61) |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-15.1 (2.66) | R-16.4 (2.88) | R-17.4 (3.07) | R-18.0 (3.17) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-16.9 (2.98)** | *R-18.6 (3.27)** | *R-20.1 (3.54)** | *R-21.0 (3.71)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-18.3 (3.23) | R-20.5 (3.62) | R-22.5 (3.97) | R-23.8 (4.19) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-18.0 (3.18) | R-20.4 (3.59) | R-22.5 (3.97) | R-23.8 (4.20) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-17.9 (3.16) | R-20.3 (3.58) | R-22.5 (3.96) | R-23.8 (4.20) |
| 32 | 40 | 1.5 | R-6.3 (1.11 RSI) | R-9.4 (1.66) | R-9.6 (1.70) | R-9.8 (1.73) | R-9.9 (1.74) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-11.0 (1.93)** | *R-11.3 (1.99)** | *R-11.5 (2.03)** | *R-11.7 (2.06)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-13.7 (2.42) | R-14.4 (2.53) | R-14.9 (2.62) | R-15.2 (2.68) |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-16.2 (2.85) | R-17.2 (3.03) | R-18.1 (3.19) | R-18.6 (3.28) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-18.3 (3.22)** | *R-19.8 (3.49)** | *R-21.1 (3.72)** | *R-21.9 (3.85)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-20.1 (3.55) | R-22.1 (3.89) | R-23.9 (4.20) | R-24.9 (4.38) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-19.8 (3.49) | R-22.0 (3.87) | R-23.8 (4.20) | R-24.9 (4.39) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-19.8 (3.48) | R-21.9 (3.86) | R-23.8 (4.19) | R-24.9 (4.39) |

[7] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, concrete blocks, and air films all contribute an additional R-3.9 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

# 4. NH2 CLIP SYSTEM WITH EXTERIOR INSULATED STEEL STUD ASSEMBLY

**Table D.4.1:** Effective R-Value for NH2 Clip System with Exterior Insulated Steel Stud Assemblies with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[8] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-8.3 (1.46)** | R-8.6 (1.52)** | R-8.9 (1.56)** | R-9.1 (1.60) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-9.6 (1.69)** | R-10.1 (1.78)** | R-10.5 (1.85)** | *R-10.8 (1.90)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-11.7 (2.07)** | R-12.6 (2.22)** | R-13.6 (2.40) | R-14.2 (2.50) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-13.6 (2.39)** | R-14.9 (2.63)** | R-16.6 (2.92) | R-17.4 (3.06) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-15.0 (2.65)** | R-16.9 (2.98)** | *R-19.2 (3.39)** | *R-20.3 (3.58)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-16.3 (2.86)** | R-18.6 (3.28)** | R-21.7 (3.81) | R-23.0 (4.06) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-16.2 (2.85) | R-18.8 (3.31) | R-21.3 (3.75) | R-22.7 (4.00) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-15.9 (2.81) | R-18.6 (3.28) | R-21.1 (3.72) | R-22.6 (3.98) |

# 5. NH2 CLIP SYSTEM WITH SPLIT INSULATED STEEL STUD ASSEMBLY

**Table D.5.1:** Effective R-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-11 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[9] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-13.7 (2.41)** | R-14.1 (2.48)** | R-14.5 (2.55)** | R-14.9 (2.62) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-14.9 (2.62)** | R-15.6 (2.74)** | R-16.1 (2.84)** | *R-16.5 (2.91)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-16.9 (2.98)** | R-17.9 (3.16)** | R-19.2 (3.39) | R-19.9 (3.51) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-18.7 (3.29)** | R-20.2 (3.56)** | R-22.2 (3.91) | R-23.1 (4.07) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.1 (3.54)** | R-22.2 (3.91)** | *R-24.8 (4.37)** | *R-26.0 (4.59)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-21.3 (3.75)** | R-23.9 (4.21)** | R-27.2 (4.79) | R-28.8 (5.07) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-21.4 (3.76) | R-24.3 (4.27) | R-26.8 (4.72) | R-28.5 (5.02) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.2 (3.73) | R-24.1 (4.24) | R-26.7 (4.70) | R-28.4 (4.99) |

[8] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, and air films all contribute an additional R-3.2 towards the nominal R-value of the entire assembly.

[9] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-13.3 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

**Table D.5.2:** Effective R-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-12 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[10] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-14.0 (2.47)** | R-14.5 (2.55)** | R-14.9 (2.62)** | R-15.3 (2.69) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-15.2 (2.68)** | R-15.9 (2.81)** | R-16.5 (2.91)** | *R-16.9 (2.98)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-17.3 (3.04)** | R-18.3 (3.22)** | R-19.6 (3.45) | R-20.4 (3.59) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-19.0 (3.35)** | R-20.6 (3.63)** | R-22.6 (3.98) | R-23.5 (4.15) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.4 (3.60)** | R-22.6 (3.97)** | *R-25.2 (4.44)** | *R-26.5 (4.66)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-21.6 (3.81)** | R-24.3 (4.27)** | R-27.6 (4.86) | R-29.2 (5.14) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-21.7 (3.82) | R-24.6 (4.33) | R-27.2 (4.79) | R-28.9 (5.09) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.5 (3.79) | R-24.4 (4.30) | R-27.0 (4.76) | R-28.8 (5.06) |

**Table D.5.3:** Effective R-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-13 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[11] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-14.4 (2.54)** | R-14.9 (2.62)** | R-15.2 (2.68)** | R-15.7 (2.76) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-15.6 (2.75)** | R-16.3 (2.87)** | R-16.9 (2.97)** | *R-17.3 (3.05)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-17.6 (3.10)** | R-18.7 (3.29)** | R-20.0 (3.52) | R-20.7 (3.65) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-19.3 (3.41)** | R-20.9 (3.69)** | R-23.0 (4.05) | R-23.9 (4.21) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-20.8 (3.66)** | R-22.9 (4.03)** | *R-25.6 (4.50)** | *R-26.9 (4.73)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-22.0 (3.87)** | R-24.6 (4.33)** | R-27.9 (4.92) | R-29.6 (5.21) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-22.0 (3.88) | R-24.9 (4.39) | R-27.6 (4.85) | R-29.3 (5.15) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-21.8 (3.84) | R-24.8 (4.36) | R-27.4 (4.83) | R-29.1 (5.13) |

[10] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-14.3 towards the nominal R-value of the entire assembly.

[11] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-15.3 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

**Table D.5.4:** Effective R-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-15 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[12] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-15.1 (2.65)** | R-15.5 (2.74)** | R-15.9 (2.81)** | R-16.4 (2.89) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-16.2 (2.86)** | R-17.0 (2.99)** | R-17.6 (3.10)** | *R-18.1 (3.19)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-18.2 (3.21)** | R-19.3 (3.40)** | R-20.7 (3.64) | R-21.5 (3.78) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-20.0 (3.51)** | R-21.6 (3.80)** | R-23.7 (4.17) | R-24.7 (4.34) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-21.4 (3.76)** | R-23.5 (4.14)** | *R-26.3 (4.63)** | *R-27.6 (4.86)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-22.5 (3.97)** | R-25.2 (4.44)** | R-28.6 (5.04) | R-30.3 (5.33) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-22.6 (3.98) | R-25.6 (4.50) | R-28.2 (4.97) | R-30.0 (5.28) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-22.4 (3.94) | R-25.4 (4.47) | R-28.1 (4.94) | R-29.8 (5.25) |

**Table D.5.5:** Effective R-Value for NH2 Clip System with Split Insulated Steel Stud Assemblies with R-19 Batt Insulation with Clips Spaced 16" Horizontally

| NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[13] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|
| | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 60 | 1.5 | R-6.3 (1.11 RSI) | R-16.3 (2.87)** | R-16.8 (2.95)** | R-17.2 (3.03)** | R-17.5 (3.08) |
| 60 | 2 | R-8.4 (1.48 RSI) | R-17.5 (3.08)** | R-18.2 (3.20)** | R-18.8 (3.31)** | *R-19.1 (3.37)** |
| 60 | 3 | R-12.6 (2.22 RSI) | R-19.4 (3.42)** | R-20.5 (3.61)** | R-22.0 (3.88) | R-22.6 (3.98) |
| 90 | 4 | R-16.8 (2.96 RSI) | R-21.1 (3.72)** | R-22.8 (4.01)** | R-24.9 (4.38) | R-25.7 (4.53) |
| 120 | 5 | R-21.0 (3.70 RSI) | R-22.5 (3.97)** | R-24.7 (4.35)** | *R-27.4 (4.83)** | *R-28.6 (5.04)** |
| 150 | 6 | R-25.2 (4.44 RSI) | R-23.7 (4.17)** | R-26.4 (4.64)** | R-29.8 (5.25) | R-31.3 (5.52) |
| 180 | 6 | R-25.2 (4.44 RSI) | R-23.8 (4.18) | R-26.7 (4.71) | R-29.4 (5.18) | R-31.0 (5.46) |
| 210 | 6 | R-25.2 (4.44 RSI) | R-23.5 (4.14) | R-26.5 (4.67) | R-29.2 (5.15) | R-30.9 (5.44) |

[12] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-17.3 towards the nominal R-value of the entire assembly.

[13] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, batt insulation, and air films all contribute an additional R-21.3 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

** Denotes NV1 system results. These scenarios were not evaluated with the NH2 system, see MH report number 190070700, issued December 21, 2018.

# 6. NH2 CLIP SYSTEM WITH CMU WALL ASSEMBLY

**Table D.6.1:** Effective R-Value for NH2 Clip System with CMU Wall Assemblies with Clips Spaced 16", 24" and 32" Horizontally

| Horizontal Clip Spacing (in) | NV1 Bracket Size (mm) | Exterior Insulation Thickness (in) | Exterior Insulation Nominal R-Value[14] ft² hr °F/Btu (m² °K/W) | Effective R-Value ft² hr °F/Btu (m² °K/W) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 16" Vertical Clip Spacing | 24" Vertical Clip Spacing | 36" Vertical Clip Spacing | 48" Vertical Clip Spacing |
| 16 | 60 | 1.5 | R-6.3 (1.11 RSI) | R-8.7 (1.53) | R-9.1 (1.61) | R-9.5 (1.67) | R-9.7 (1.70) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-9.8 (1.73)** | *R-10.5 (1.85)** | *R-11.0 (1.94)** | *R-11.3 (1.99)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-11.9 (2.09) | R-13.0 (2.30) | R-14.0 (2.47) | R-14.6 (2.56) |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-13.6 (2.39) | R-15.3 (2.70) | R-16.7 (2.95) | R-17.6 (3.09) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-15.0 (2.64)** | *R-17.2 (3.04)** | *R-19.2 (3.37)** | *R-20.3 (3.58)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-16.1 (2.84) | R-18.8 (3.31) | R-21.2 (3.74) | R-22.8 (4.01) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-15.5 (2.73) | R-18.2 (3.21) | R-20.7 (3.65) | R-22.3 (3.93) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-15.2 (2.69) | R-18.0 (3.16) | R-20.5 (3.61) | R-22.1 (3.89) |
| 24 | 60 | 1.5 | R-6.3 (1.11 RSI) | R-9.1 (1.61) | R-9.5 (1.67) | R-9.7 (1.71) | R-9.8 (1.73) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-10.4 (1.83)** | *R-10.9 (1.93)** | *R-11.4 (2.00)** | *R-11.6 (2.04)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-12.8 (2.26) | R-13.8 (2.44) | R-14.6 (2.58) | R-15.1 (2.65) |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-15.1 (2.66) | R-16.5 (2.91) | R-17.7 (3.12) | R-18.4 (3.24) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-17.0 (2.99)** | *R-19.0 (3.34)** | *R-20.6 (3.62)** | *R-21.5 (3.79)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-18.5 (3.26) | R-21.0 (3.70) | R-23.1 (4.07) | R-24.4 (4.29) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-18.1 (3.19) | R-20.6 (3.64) | R-22.8 (4.02) | R-24.1 (4.25) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-17.9 (3.16) | R-20.4 (3.60) | R-22.7 (3.99) | R-24.0 (4.22) |
| 32 | 60 | 1.5 | R-6.3 (1.11 RSI) | R-9.4 (1.65) | R-9.6 (1.70) | R-9.8 (1.73) | R-9.9 (1.75) |
| | 60 | 2 | R-8.4 (1.48 RSI) | *R-10.7 (1.89)** | *R-11.2 (1.97)** | *R-11.5 (2.03)** | *R-11.7 (2.07)** |
| | 60 | 3 | R-12.6 (2.22 RSI) | R-13.4 (2.36) | R-14.3 (2.52) | R-15.0 (2.64) | R-15.3 (2.70) |
| | 90 | 4 | R-16.8 (2.96 RSI) | R-16.0 (2.82) | R-17.3 (3.04) | R-18.3 (3.22) | R-18.8 (3.32) |
| | 120 | 5 | R-21.0 (3.70 RSI) | *R-18.3 (3.22)** | *R-20.0 (3.52)** | *R-21.4 (3.77)** | *R-22.2 (3.91)** |
| | 150 | 6 | R-25.2 (4.44 RSI) | R-20.1 (3.55) | R-22.4 (3.94) | R-24.2 (4.27) | R-25.3 (4.45) |
| | 180 | 6 | R-25.2 (4.44 RSI) | R-19.9 (3.50) | R-22.2 (3.90) | R-24.0 (4.24) | R-25.1 (4.43) |
| | 210 | 6 | R-25.2 (4.44 RSI) | R-19.7 (3.48) | R-22.0 (3.88) | R-23.9 (4.22) | R-25.1 (4.41) |

[14] This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, studs air cavity, concrete blocks, and air films all contribute an additional R-3.9 towards the nominal R-value of the entire assembly.

* Denotes interpolated results.

# APPENDIX E:
# SIMULATED TEMPERATURE PROFILES

# 1. NV1 CLIP SYSTEM

As an example of the thermal profiles of the NV1 clip system, the following figures illustrate a typical temperature distribution for the NV1 system with 4 inches of exterior insulation (R-16.8) with 16 inches o.c. horizontal and 36 inches o.c. vertical bracket spacings for each backup wall. The profiles are presented as a temperature index (between 0 and 1). See Appendix B.2 for more information.

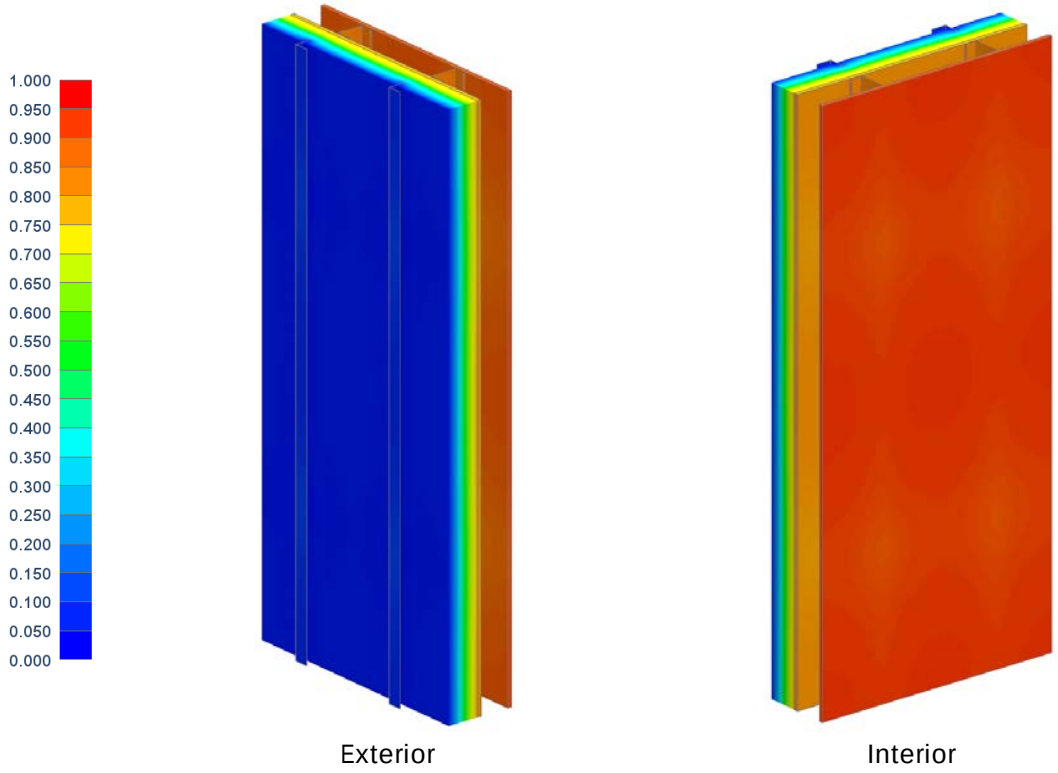



Figure E.1.1: Temperature Profile of NV1 Clip System with Exterior Insulated Steel Stud Assembly

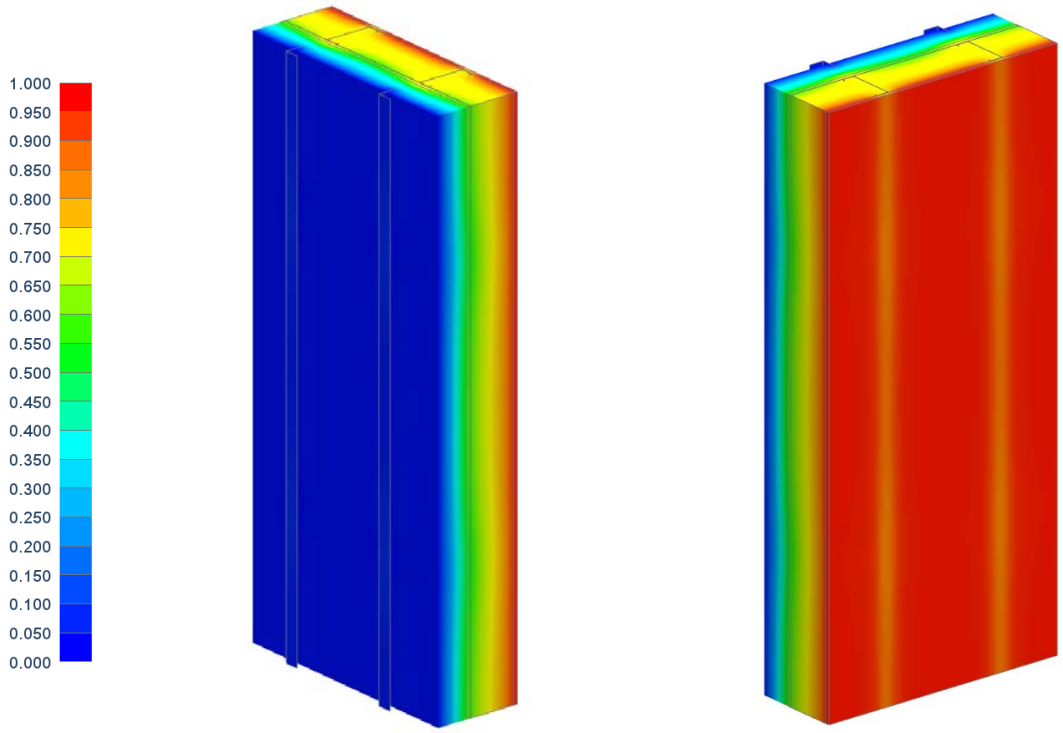



Figure E.1.2: Temperature Profile of NV1 Clip System with Split Insulated Steel Stud Assembly with R-19 Batt Insulation

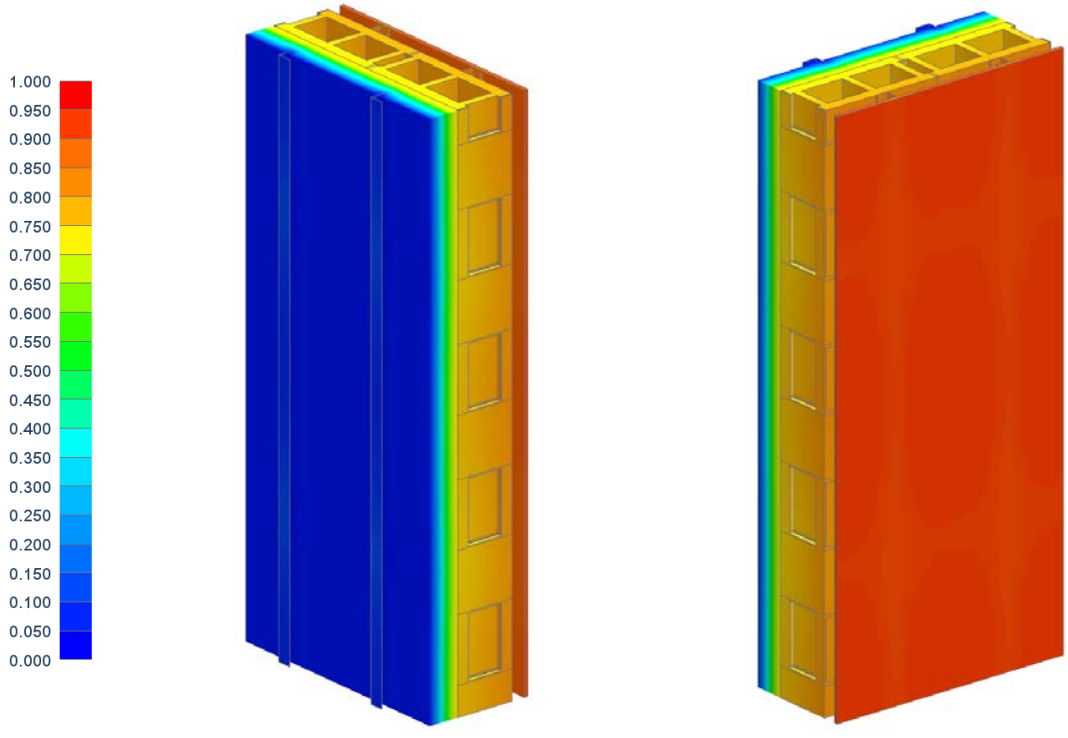



Figure E.1.3: Temperature Profile of NV1 Clip System with CMU Wall Assembly

# 2. NH2 CLIP SYSTEM

As an example of the thermal profiles of the NH2 clip system, the following figures illustrate a typical temperature distribution for the NH2 system with 4 inches of exterior insulation (R-16.8) with 16 inches o.c. horizontal and 36 inches o.c. vertical bracket spacings for each backup wall. The profiles are presented as a temperature index (between 0 and 1). See Appendix B.2 for more information.

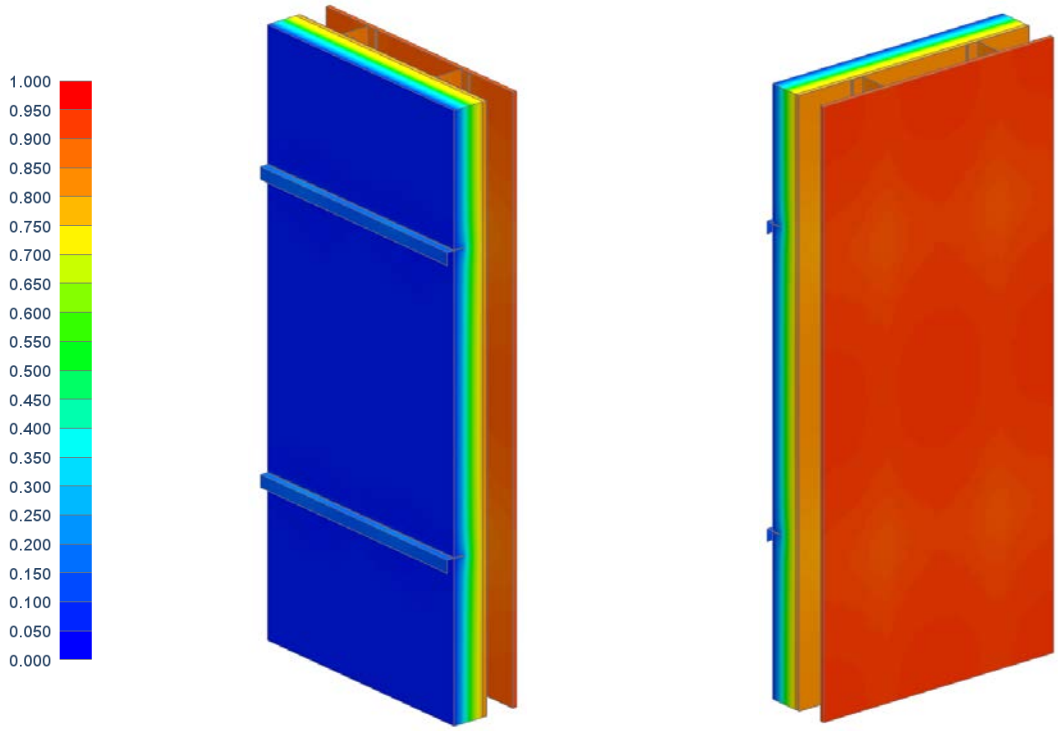



Figure E.2.1: Temperature Profile of NH2 Clip System with Exterior Insulated Steel Stud Assembly

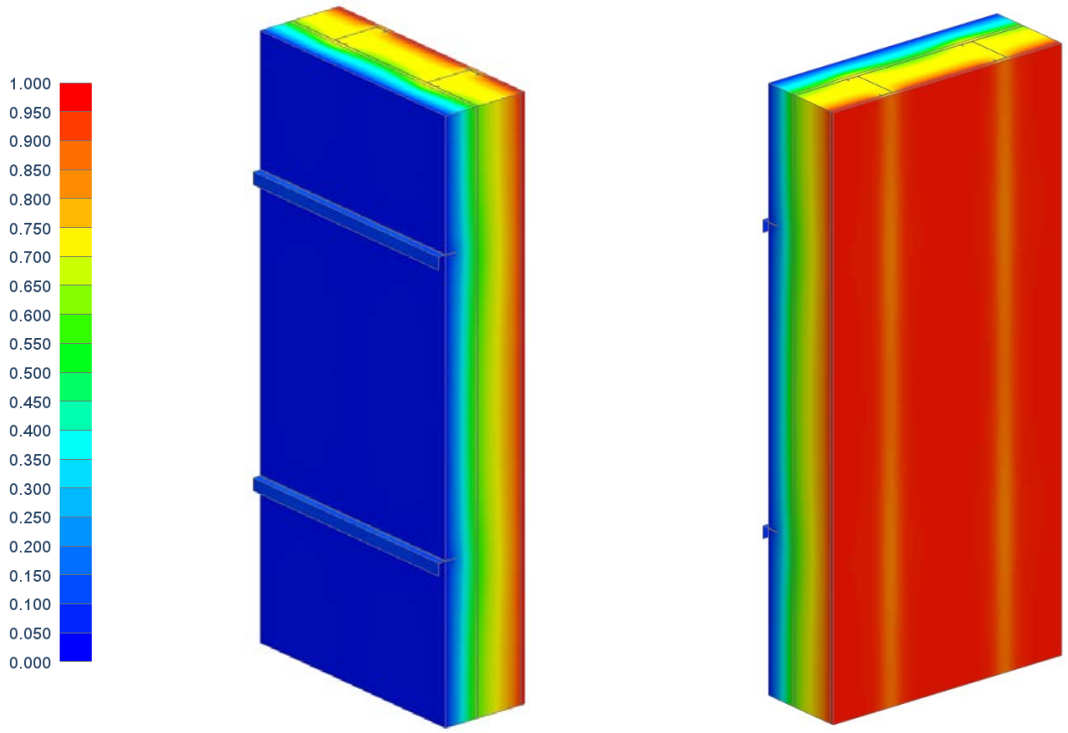



Figure E.2.2: Temperature Profile of NH2 Clip System with Split Insulated Steel Stud Assembly with R-19 Batt Insulation

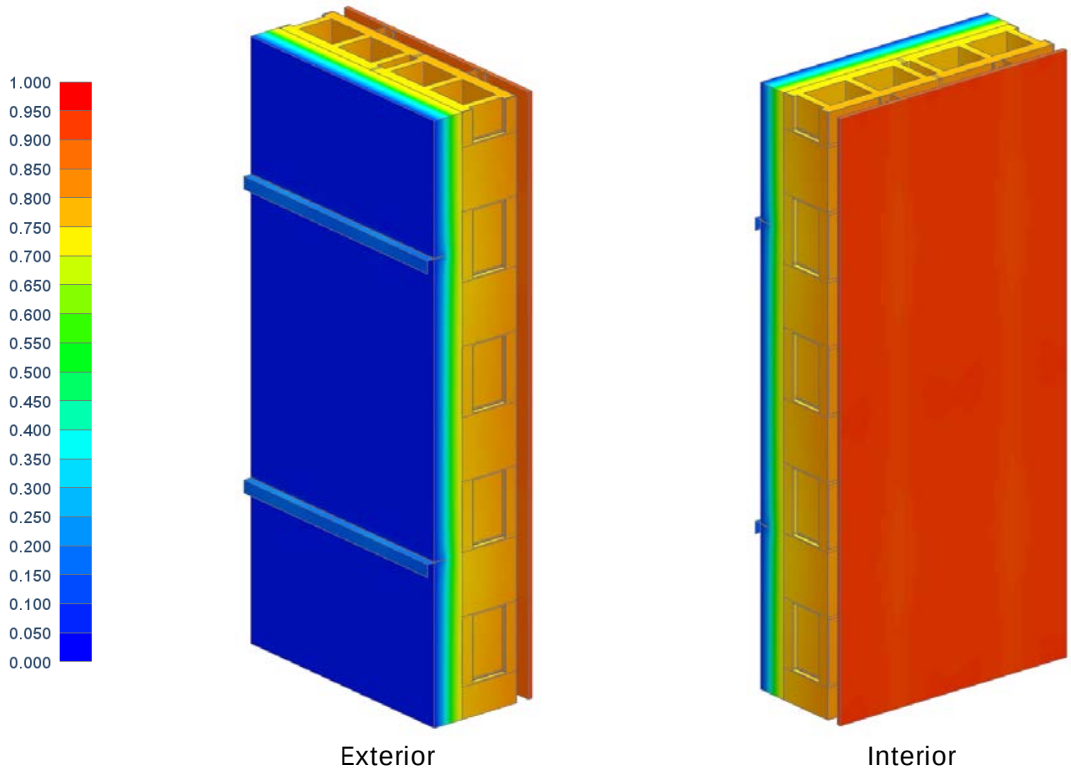



Figure E.2.3: Temperature Profile of NH2 Clip System with CMU Wall Assembly

**PRIEST & ASSOCIATES CONSULTING, LLC**

# ENGINEERING EVALUATION

Engineering Evaluation of SFS NVELOPE Cladding Attachment Systems for Compliance to NFPA 285

Project No. 104446A

Prepared for:

SFS Intec
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March 1, 2017

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*Abstract*

*SFS Intec manufactures various types of cladding attachment systems for exterior walls. These incorporate designs which minimize thermal transmission through exterior walls and for some designs separate dead load from wind load using separate attachment clips. The systems reviewed are the NVELOPE NV1, NV2, NV3, NV4, NV5, NV6, NV7, NV8, NVF2F, NH1 and the EKO systems. Normally, attachment systems are not considered as the main component being evaluated in an NFPA 285 test. However, after analyzing the various systems, it is evident that these attachment systems will not detract from approved NFPA 285 wall designs with specific limitations.*

The conclusions reached by this evaluation are true and correct, within the bounds of sound engineering practice. All reasoning for our decisions is contained within this document.

Submitted by,

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March 1, 2017

Reviewed and Approved,

Deg Priest
President

March 1, 2017

## INTRODUCTION

Normally, attachment systems are not considered as the main component being evaluated in an NFPA 285 test. Typically, combustible cladding systems, insulation or weather barriers are evaluated. Since the test is not a component test, manufacturers typically test worst case wall assemblies so that alternate wall components can replace the tested components in use on real construction projects. The reason for this is because there are dozens of choices for each wall component (interior sheathing, studs, cavity insulation, exterior sheathing, WRB, exterior insulation, air gap, cladding and attachment systems) and it is impractical to test every combination. Based on this, most approvals for alternate constructions (DRJ Evaluation Reports, ICC-ES ER Reports, Intertek Listings and CCRR reports, UL Listings and ER reports, IAPMO evaluation reports, etc.) are based on worst case system testing. In most cases, typical generic attachment systems are used. For this evaluation, we will consider if the NVELOPE attachment systems will or will not affect test results.

Most approvals for insulation or weather barriers are based on tests with brick, or ACM claddings. These two claddings are the accepted baseline claddings from which most other claddings can be approved. All other claddings are evaluated as being improvements to the tested design (or equivalent or deemed to not affect results). For combustible cladding approvals (ACM, HPL, etc.), these are typically tested with mineral fiber insulation, but may in some cases (for ACM only) be tested with combustible insulation and WRB materials. HPL claddings are typically only allowed to be used with mineral fiber insulation covering a combustible WRB material.

## REFERENCE DOCUMENTS

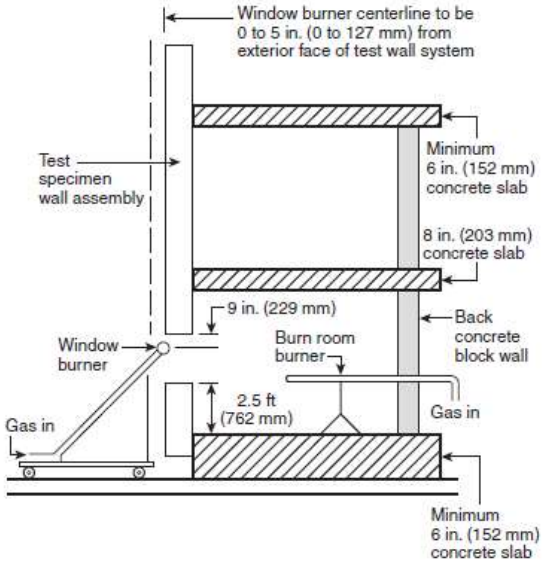
1) *NVELOPE Brochure*
2) *NVELOPE Thermal Isolator Product Data Sheet*
3) *Hughes Associates Letter 1JJB00024.002 StoneLite Panel NFPA 285 Test with NVELOPE Rain-screen Thermal Isolation System*
4) *NFPA 285-12 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-loadbearing Wall Assemblies Containing Combustible Components*
5) *SWRI Report 01.19577.01.610(1) NFPA 285 Test on StoneLite Panel System with NVELOPE Attachment System*
6) *Dow Thermax ESR 1659*
7) *EKO Product Brochure*

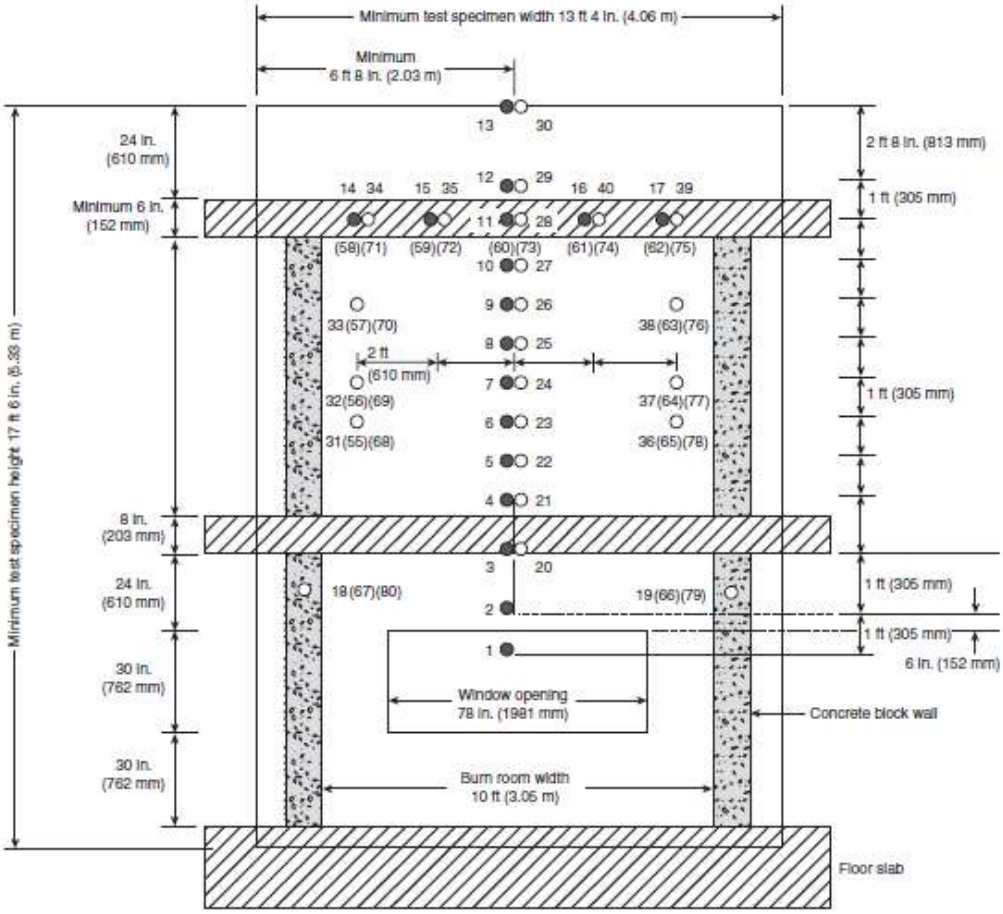
## EVALUATION METHOD

### NFPA 285 Criteria

The NFPA 285 fire test (Ref. 4) is designed to test the flame spread properties of exterior walls containing combustible components. Two noncombustible rooms are stacked to simulate two stories of a multi-story building. The wall assembly is then attached to the exterior face of the rooms. A typical test wall measures 14 ft x 18 ft with a 30 in. x 78 in. window opening placed on the bottom floor.

Two burners are ignited to produce a specific time-temperature profile in the room and on the exterior face of the wall. Thermocouples are placed at strategic locations to monitor temperature as an indicator of flame spread. In the depiction below, thermocouples 1-10, and 20-27 are not used for compliance purposes. The remainders are used to monitor flame spread.

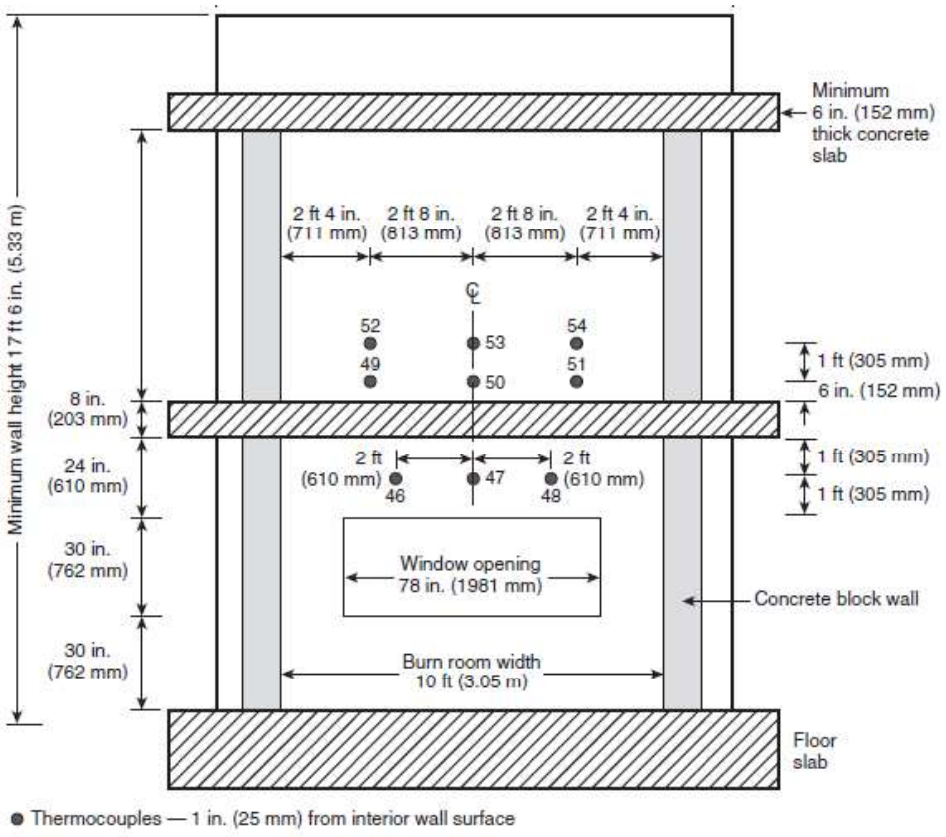



● Thermocouples — 1 in. (25 mm) from exterior wall surface

○ Thermocouples — in the wall cavity air space or the insulation, or both, as shown in Figure 6.1(b) Details A through I.

( ) Thermocouples — Additional thermocouples in the insulation or the stud cavity, or both, where required for the test specimen construction being tested, as shown in Figure 6.1(b) Details C through I.




During a test, a calibrated fire starts in the bottom room. After 5 minutes, the exterior burner is ignited to produce a specific heat flux/temperature pattern on the exterior of the wall. Both burners remain ignited during the remainder of the 30 minute test. Personnel monitor flame spread visually during the course of the test. A computer data acquisition system monitors and records the thermocouple temperatures. The criteria for passing (Ref. 4) are as follows (reworded in simpler terms for this analysis):

1) Flames shall not spread vertically 10 ft above the window opening as determined visually or by thermocouples located at the 10 ft level. Failure occurs when thermocouples 11 or 14-17 exceed 1000°F.
2) Flames shall not spread (visually) horizontally 5 ft on either side of the centerline of the window opening.
3) Flames shall not spread inside the wall cavity as determined by thermocouples placed within the wall cavity insulation and air gaps if present. Failure occurs when thermocouples 28, 31-40 or 55-65 and 68-79 exceed 750°F above ambient.
4) Flames shall not spread horizontally within the wall cavity past the interior room dimension as determined by wall cavity thermocouples. Failure occurs when thermocouples 18-19, 66-67 or 79-80 exceed 750°F above ambient.
5) Flames shall not spread to the second story room as determined by interior wall surface thermocouples. Failure occurs when thermocouples 49-54 exceed 500°F above ambient.
6) Flames shall not occur in the second story (visually).
7) Flames shall not escape (visually) from the interior to the exterior at the wall/wall intersection of the bottom story room.

**Analysis of Typical Wall Test Components**

When analyzing flammability comparisons of NFPA 285 wall systems, the elements which could potentially cause increased flame spread should be considered. Justifications are established for interchanging/removing/adding brands/types/models of components for each element.

1) **Interior Gypsum Wallboard –** Most approvals list ⅝ inch type X gypsum wallboard as the only option. Our experience has shown that using ½ inch regular gypsum wallboard causes failures of thermocouples 18 and 19 (Foam Core Thermocouples). Therefore, use of ½ inch regular gypsum board is not permitted as the interior sheathing.
2) **Steel Studs –** Most NFPA 285 tests use 3⅝ inch deep 20 GA. steel studs spaced 24 inch OC with lateral horizontal bracing every 4 ft as the worst case. Field applications typically use 16 or 24 inch spacing. Wider spacing is worst case since the wall is potentially more flexible and prone to warping. Therefore thicker studs, deeper stud depth and 16 inch spacing is allowed based on testing worst case. Testing with steel stud base walls allows use of concrete or CMU masonry base walls as replacements.
3) **Cavity Insulation –** Some tests incorporate stud cavity insulation. Various types are used such as SPF foam, fiberglass matt, or mineral fiber. Typically, testing with none allows use of faced or unfaced fiberglass or mineral wool matt or sheets. Testing with SPF will allow less flammable SPF brands or models based on cone calorimeter flammability data analysis or previous NFPA 285 base wall tests insulated with SPF insulation.
4) **Exterior Sheathing –** Tests usually incorporate ½ and ⅝ inch thick gypsum sheathing or glass matt sheathing such as Densglass Gold. The exterior sheathing may be replaced with any other tested, listed or approved exterior sheathings of the same thickness or greater. Some approvals allow none based on tests with no sheathing. However, allowing no exterior sheathing may allow the exterior insulation to burn from both sides, or may ignite combustible cavity insulations. For the case of allowing no exterior sheathing, specific approvals (such as Ref. 6, ESR 1659) should be followed carefully.
   *Note: It is our opinion that the base wall reacts independently of the products exterior to the base wall when the wall is sheathed with gypsum board on both sides. The gypsum layer prevents direct ignition of the cavity insulation and prevents flames from spreading vertically when floor line fire stopping is used.*

5) **WRB Over Exterior Sheathing** - Some tests incorporate a WRB product over the exterior sheathing. Testing with a WRB will allow less flammable WRB brands or models based on cone calorimeter flammability data analysis.
6) **Exterior Insulation –** Some tests incorporate exterior insulation. Various types are used such as mineral fiber, SPF, Polyisocyanurate, EPS and XPS. Typically, interchanging insulation types is not allowed. But reducing the thickness of a combustible insulation is allowed since the wall has less fuel load than the tested system. However, removing the insulation totally may expose the WRB product to direct flame exposure (for light, low melting point claddings). Some WRB products are more flammable than the overlying foam insulation. Because of this, we do not allow "none" to be an option for insulation in wall designs incorporating WRB's unless that WRB has been proven to not cause failures with tests on ACM cladded walls. However, some WRB's are less flammable than the overlying foam insulation or do not combust under NFPA 285 heating conditions. These cases must be addressed on a case by case basis using cone calorimeter analysis of the foam and/or WRB.
7) **Exterior WRB** - Some tests incorporate a WRB product over the exterior insulation. Testing with a WRB will allow less flammable WRB brands or models based on cone calorimeter flammability data analysis.
8) **Air Gap –**Testing with ACM or brick both incorporate an air gap. For brick, the tested air gap is typically 2 inches. For ACM, the air gap is typically between ½ inch and 2¼ inches. It is important that the air gap not be greater than what was tested.
9) **Exterior Cladding –** As previously stated, most approvals for insulation or weather barriers are based on tests with brick, or ACM claddings. These two claddings are the accepted baseline claddings from which most other claddings can be approved. All other claddings are evaluated as

being improvements to the tested design (or equivalent or deemed to not affect results). For combustible cladding approvals (ACM, HPL, etc.), these are typically tested with mineral fiber insulation.

10) **Attachment System**

As previously stated, most tests incorporate generic cladding attachment systems. For brick tests, common brick ties are used. Testing with brick allows use of other heavy masonry systems. Since these products are durable under fire conditions, the attachment system never gets exposed to direct flames from the test. However, if the window header fails, melts, falls apart, or allows heat to ignite wall core combustibles, a test failure can occur if the foam insulation burns severely enough to trigger thermocouple failures (Usually TC #28). It has been our experience that wall core temperature failures occur before exposing the attachment system to enough heat to cause cladding collapse. In fact, we have never witnessed a cladding collapse in the many hundreds of tests we've personally witnessed (or reports we've read).

For ACM, there is no common attachment system. Most ACM manufacturers do not manufacture attachment systems. But they sell their product to ACM fabricators who cut, bend and create attachment systems. Most approvals do not list attachment systems only because it is not practical to include every possible cladding attachment which would qualify. There are simply too many to list. But engineering evaluations (such as this report) are written to qualify these details on a case-by-case basis.

Testing with ACM is considered worst case due to the fact that ACM can melt and ignite and typically utilize semi-open joint designs. During a fire test, as the ACM melts, this creates a simulated open joint design in the worst possible location – the fire source. The melt pattern for NFPA 285 fire tests on ACM is usually large (approx 3 ft wide x 3 ft tall in a triangular pattern). Because of this extreme opening size, we allow any cladding that has superior fire properties than ACM as an allowed alternate using any commonly approved attachment system.

An NVELOPE system was tested in an NFPA 285 assembly with a heavy combustible cladding (Ref. 5). In that test, the attachment system performed well with rainsceen joints (considered worst case) exposing the attachment points to significant heat from the NFPA 285 fire test. See post test photos and temperature data below.

**Figure C-15. Close-up of Window Opening immediately after Exposure.**

**Figure C-16. Post Test Assembly Dissection – Exterior Surface of Mineral Wool Layer after Exposure.**

**Figure C-17. Post Test Assembly Dissection – Interior Surface of *StoneLite® Panels (SP-1-10-3)* Panels following Exposure.**


**Figure C-18. Post Test Assembly Dissection – Mineral Wool Removed. Condition of Henry Blueskin following Exposure.**

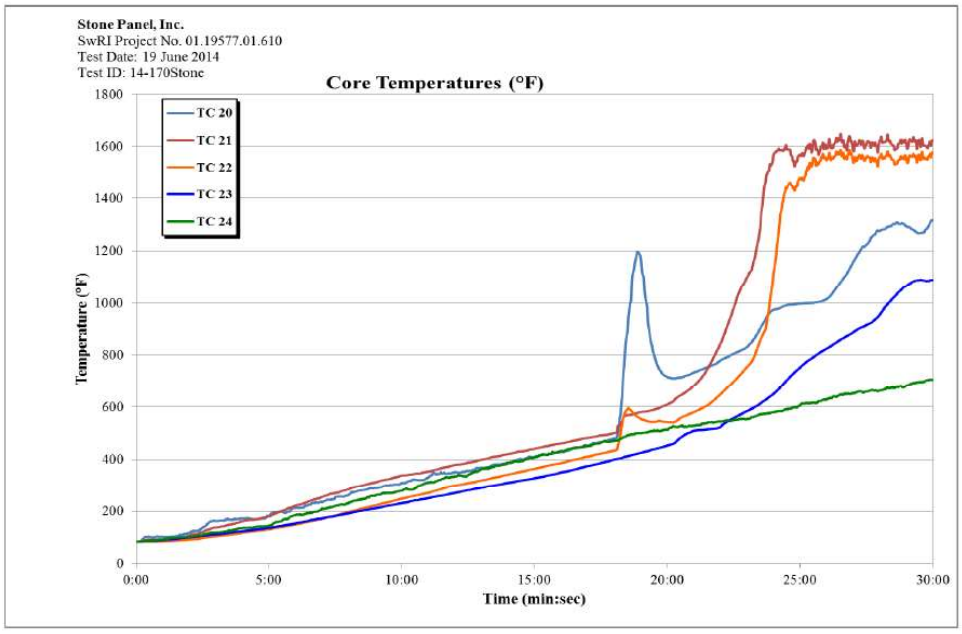



**Figure D-5. *StoneLite® Panels (SP-1-10-3)* Wall Panel Assembly Core Temperatures (TCs 20–24).**

The results of the fire test (Ref. 5) indicate that the attachment system remained intact, held the heavy cladding panels in place and did not contribute to flame spread.

**Analysis of SFS Intec Attachment Systems**

SFS Intec submitted designs of their NVELOPE attachment systems for evaluation in this report (see Appendix A and Refs. 1, 2 & 7). These are the NVELOPE NV1, NV2, NV3, NV4, NV5, NV6, NV7, NV8, NVF2F, NH1 and the EKO systems. It should be noted that an NVELOPE System has been previously tested (Ref. 5) and evaluated for use (Ref. 3) in various NFPA 285 assemblies incorporating StoneLite panel systems.

The various systems are listed below (Ref. 1, 2, 7)

| | |
|---|---|
| **NV1** | NV1 is the NVELOPE back frame – vertical cladding applications. |
| **NV2** | NV2 is suitable for concealed fix cladding applications – structural bond (Sika sikatack panel system). |
| **NV3** | NV3 is the NVELOPE system for concealed fix / mechanically fixed applications. |
| **NV4** | NV4 (ts200) is the NVELOPE system for concealed fix / mechanically fixed applications – vertical cladding applications. |
| **NV5** | NV5 (ts300) is the NVELOPE system for concealed fix applications – vertical cladding applications (trespa meteon HPL only). |
| **NV6** | NV6 is the NVELOPE system for supporting a timber batten – vertical cladding applications (to support vertical and / or horizontal cladding elements). |
| **NV7** | NV7 is the NVELOPE system for secret fix cassette (ACM / zinc / aluminium) – vertical cladding applications. |
| **NV8** | NV8 is the NVELOPE system for concealed fix / mechanically fixed and structurally bonded applications. |
| **NVF2F** | NVF2F is the NVELOPE back frame – vertical floor to floor cladding applications. |
| **NH1** | NH1 is the NVELOPE system used to support vertical elements. |

| Generic - Cladding types | NV1 | NV2 | NV3 | NV4 (ts200) | NV5 (ts300) | NV6 | NV7 | NV8 | NVF2F | NH1 |
|---|---|---|---|---|---|---|---|---|---|---|
| ACM | Ok | Ok | | | | | Ok | Ok | Ok | Ok |
| Aluminium | Ok | Ok | | | | | Ok | Ok | Ok | Ok |
| Brick slip | Ok | | | | | | | | Ok | Ok |
| Ceramic | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| Copper | Ok | Ok | | | | Ok | Ok | Ok | Ok | Ok |
| Fibre cement | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| Fibre concrete | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| GRC | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| GRP | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| Glass (non-vision) | Ok | Ok | | | | | | Ok | Ok | Ok |
| HPL - high pressure laminate | Ok | Ok | Ok | Trespa | Trespa | | | Ok | Ok | Ok |
| Photovoltaic | Ok | | | | | | Ok | Ok | Ok | Ok |
| Render | Ok | | | | | Ok | | Ok | Ok | Ok |
| Stainless steel | Ok | Ok | | | | Ok | Ok | Ok | Ok | Ok |
| Terracotta | Ok | | | | | | | | Ok | Ok |
| Timber | Ok | | | | | Ok | | | Ok | Ok |
| Timber laminate | Ok | Ok | | | | | | Ok | Ok | Ok |
| Thin stone | Ok | Ok | Ok | | | | | Ok | Ok | Ok |
| Weatherboarding | Ok | | | | | Ok | | | Ok | Ok |
| Zinc | Ok | | | | | Ok | Ok | | Ok | Ok |


Note: The EKO system is always used as a hybrid system in which aluminum brackets hold the dead load, while the EKO clips hold the wind load. This is called the NVELOPE Hybrid system.

All of the N-series systems use metallic construction with a thin plastic thermal isolator cover (on interior side) to reduce thermal transmission of the attachment system. These systems do not incorporate any combustible components (see Appendix A) except for the thermal isolator. From a fire performance point of view, they are manufactured from mostly metal components in sufficient thickness and mass as to be similar to most of the attachment systems we've seen tested. It is assumed that these attachment systems have undergone wind load testing for structural performance. However, structural integrity is outside the scope of this evaluation. The small amount of material used for thermal isolation is not considered to cause NFPA 285 test failures for the following reasons (includes EKO brackets):

1) The thermal isolator (closest to interior side) is behind the exterior insulation. It is expected that the flame spread of the insulation will occur before the fire exposes the cap. If enough insulation burns to expose the cap, a test failure due to foam flame spread will occur before the cap has time to melt or ignite.

2) The thermal isolators and EKO brackets are discontinuous over the wall surface area. If an isolator (or EKO bracket) ignition occurs, the burning is localized and cannot spread flame on its own. It is common to allow flammable joint tapes for foam board joints. These are allowed due to the discontinuous nature of installation and use of staggered joints. These products cannot spread flame uncontrollably due to the small amount of material used and the discontinuous application. If these products, are allowed, it is our judgment that the thermal isolators or EKO brackets have even less potential for flame spread due to the small size.

**Joint Location**
All known NFPA 285 approvals do not limit the position of joints. This report will be consistent with that philosophy. If an approval lists specific joint limitations, those limitations will apply.

**CONCLUSIONS**
Based on the information above, we have determined that previously approved NFPA 285 wall systems may use the NVELOPE NV1, NV2, NV3, NV4, NV5, NV6, NV7, NV8, NVF2F, NH1 and the EKO (Hybrid) systems and can meet the criteria of NFPA 285 with specific limitations as per the table below.

**Allowed NFPA 285 Assemblies**
Walls not requiring NFPA 285 compliance (per the International Building Code) may use NVELOPE NV1, NV2, NV3, NV4, NV5, NV6, NV7, NV8, NVF2F, NH1 and the EKO (Hybrid) systems, since these components will not contribute to flame spread of noncombustible constructions.

NFPA 285 Compliance Requirements: Items listed below must be a part of the wall assembly in order for the assembly with the NVELOPE NV1, NV2, NV3, NV4, NV5, NV6, NV7, NV8, NVF2F, NH1 and the EKO (Hybrid) systems to be NFPA 285 compliant. Refer to foam or WRB manufacturer NFPA 285 approval tables for actual allowances other than those shown below. *Approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO are considered valid for this report.*

**NFPA 285 Table of Allowed Components on next page…..**

| Wall Component | Specific Component |
|---|---|
| **Base Wall**<br>Use 1, 2 or 3 | 1) Concrete<br>2) CMU<br>3) 1 layer of ⅝ inch thick type X gypsum wallboard installed on the interior side of minimum 3⅝ inch deep (min.), minimum 20 gauge galvanized steel studs spaced a maximum of 24 inch on center, minimum of 1 layer of ½" thick exterior gypsum sheathing installed on the exterior side. Lateral bracing installed minimum every 4 ft vertically or as required. |
| **Fire Stopping in Stud Cavity at floor lines** | 4 inch, 4 pcf mineral wool (e.g., Thermafiber) in each stud cavity at each floor line. The insulation is friction fit between studs or installed with Z clips. |
| **Cavity Insulation**<br>Use 1, 2, 3, 4 or 5<br>*Note 1. Approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO are considered valid for this report.*<br>*Note 2: See special requirement below if exterior sheathing is not used.* | 1) None (see note 2)<br>2) Fiberglass (faced or unfaced)<br>3) Mineral wool insulation (faced or unfaced)<br>4) Any other noncombustible insulation material (faced or unfaced)<br>5) Any approved SPF spray foam insulation approved for use in stud cavities in NFPA 285 compliant assemblies.<br><br>*See Note 1 for approval agencies.* |
| **Exterior Sheathing**<br>*Note. Specific approvals require specific minimum exterior sheathings and brands/types.* | 1) Minimum ½ or ⅝ inch thick listed or certified exterior-type gypsum sheathing (see Note).<br>2) NONE - only for those approvals that allow no exterior sheathing and specific cavity insulations (including no cavity insulation).<br><br>*For those cases where no exterior sheathing is allowed, use the specific cavity insulation in the approval.* |
| **WRB over Base Wall**<br>Use 1, 2 or 3<br><br>*Note. Approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO are considered valid for this report.* | 1) None<br>2) Any WRB/AVB barrier that has been approved to be used in an NFPA 285 compliant assembly paired with mineral wool, Polyisocyanurate, EPS or XPS insulation. See Note for approval agencies.<br>3) Any WRB that meets the 2015 IBC Exceptions for WRB's (Only for walls in which the WRB is the only combustible). |
| **Exterior Insulation –**<br>Use either 1, 2, 3 or 4<br><br>*Note. Approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO are considered valid for this report.* | 1) None – For constructions requiring a WRB, the construction must incorporate a WRB or AVB that meets the 2015 IBC exceptions for WRB's. These WRB's can only be used with noncombustible claddings and insulations per the 2015 code exceptions.<br>2) 2 inch thick (min.) 4 pcf mineral fiber insulation allowed for use with WRB item 2 or 3 above (note - WRB Item 3 must use Cladding 1a below)<br>3) Any Polyisocyanurate, EPS or XPS insulation that has been approved (see note) to be used in an NFPA 285 compliant assembly paired with the WRB's in item 2 above)<br>4) Any closed cell SPF insulation that has been approved (see note) to be used in an NFPA 285 compliant assembly that has also qualified to be an effective WRB. |

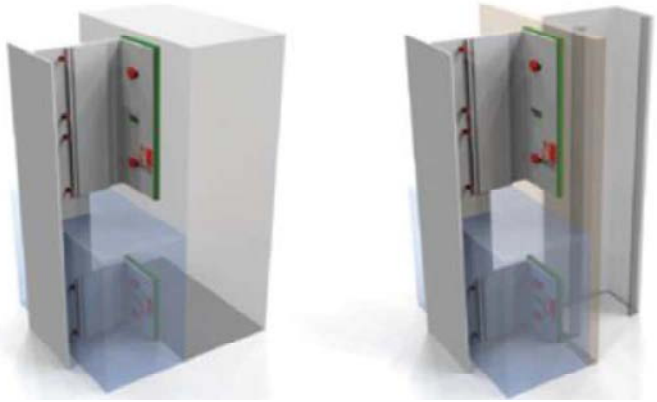
| | |
|---|---|
| **Exterior Cladding** - Use 1 or 2 with cladding installation technique shown for NVELOPE or EKO (Hybrid) Wall Systems<br><br>*Note. Approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO are considered valid for this report.* | 1) Claddings below may only be used with noncombustible exterior insulation Item 2 above (mineral fiber).<br>a. Any noncombustible cladding. Any standard installation technique can be used. (Such as stone, terra cotta, fiber cement, concrete, solid metal, etc.)<br>b. Combustible cladding. Use any cladding that has been successfully tested by the panel manufacturer (or fabricator) via the NFPA 285 test method. Any standard installation technique can be used.<br>c. Adhered Masonry (minimum ¾ inch thick clay brick or stone; ⅜ inch thick tile) bonded with cementitious mortar (standard or polymer modified) to a minimum ½ inch thick cement board or gypsum sheathing.<br>2) Claddings below may be used with any approved (see note) combustible exterior insulation.<br>Any cladding (combustible or noncombustible) that has been approved to be used in an NFPA 285 compliant assembly paired with approved Polyisocyanurate, EPS, XPS or SPF insulation. Each insulation must be specifically approved for the exact cladding types listed in the approval.<br><br>Cladding Installation Technique<br>All claddings listed above (or in the approvals in the note) may use NVELOPE NV1, NV2, NV3, NV6, NV7, NV8, NVF2F, NH1 or the EKO (Hybrid) systems.<br><br>NVELOPE NV4, NV5 may only be used for Trespa HPL NFPA 285 approved systems.<br><br>EKO (Hybrid) must use metallic dead load brackets and EKO wind load brackets.<br><br>**IMPORTANT**: See next item (Window/Door Header/Jamb details) for specific insulation types which require special detailing. |
| **Window/Door Headers/Jambs**<br><br>. | Must use approved design for specific system being considered (see note)<br>*Note. EPS and XPS require specific door/window header and jamb details to be compliant to NFPA 285. Polyiso and SPF may or may not require specific header/jamb details. See approvals from DRJ Engineering, ICC-ES, Intertek, UL and IAPMO for the specific header/jamb detail required for each insulation type* |

# APPENDIX A

SFS NVELOPE Attachment Systems

## NV1 is the NVELOPE back frame – vertical cladding applications.

Suitable as a back frame system – NV1 is suitable for face fixing / rivet fixing cladding elements to e.g. fibre cement, high-pressure laminate (HPL), ACM and metal rainscreen panels.



## NV2 is the NVELOPE system for concealed fix / structural bonding applications.

NV2 is suitable for concealed fix cladding applications – structural bond (Sika sikatack panel system).

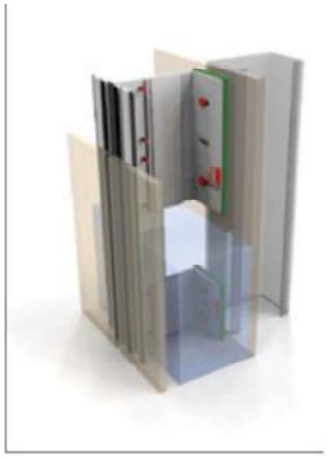
NV2 is the NVELOPE system for secret fix / structural bonding applications – vertical cladding applications.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE support brackets, fixed through a series of fixed and flexible points.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

NVELOPE fixed point brackets absorb both vertical dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the facade cladding and local wind loads.



## More about NV2

**Material:**

**NV3 is the NVELOPE system for concealed fix / mechanically fixed applications.**

NV3 elements – fibre cement, high-pressure laminate (HPL), ceramic, thin stone etc. Horizontal NVELOPE channel profiles are fixed to the vertical profiles. Rainscreen panels are hung from and secured with hangers.

## Features

NV3 is the NVELOPE system for secret fix / mechanically fixed applications – vertical cladding applications.

Secured using hangers and undercut stud anchors or screws to provide a concealed fixing.

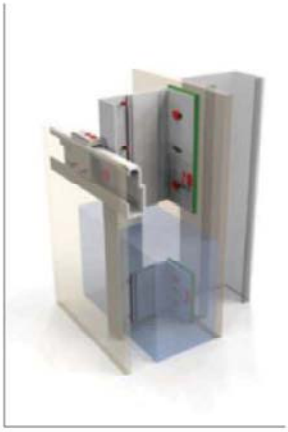
Horizontal NVELOPE channel profiles are fixed to the vertical profiles. Rainscreen panels are hung from and secured to the horizontal profiles with hangers and adjustable hangers.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE support brackets, fixed through a series of fixed and flexible points.

NVELOPE fixed point brackets absorb both vertical dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the façade cladding, local wind loads.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.



## More about NV3

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV3-vertical-cladding.html* ■

**NV4 is the NVELOPE suitable system for concealed fix / mechanically fixed applications.**

NV4 elements –Trespa Meteon HPL. Horizontal NVELOPE channel profiles are fixed to the vertical profiles. Rainscreen panels are hung from and secured with hangers.

## Features

NV4 (ts200) is the NVELOPE system for concealed fix / mechanically fixed applications – vertical cladding applications – Trespa.

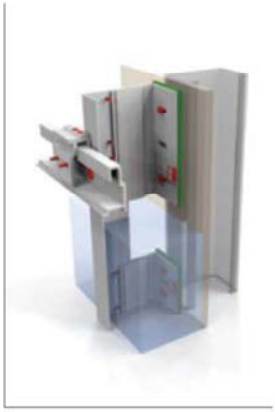
Horizontal NVELOPE channel profiles are fixed to the vertical profiles. Rainscreen panels are hung from and secured to the horizontal profiles with hangers and adjustable hangers.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE helping hand support brackets, fixed through a series of fixed and flexible points.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

NVELOPE fixed point brackets absorb both vertical dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the façade cladding, local wind loads.



## More about NV4 (ts200)

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV4-vertical-cladding.html* ■

**NV5 is the NVELOPE system for concealed fix applications.**

NV5 elements – Trespa Meteon HPL only. Panels are supported at the bottom by the horizontal NV5 channel profile which provides restraint to panel tops. Vertical joints can be open, baffled or formed by half laps with appropriately designed panel edges providing a concealed fixing.

## Features

NV5 (ts300) is the NVELOPE system for concealed fix applications – vertical cladding applications (Trespa meteon HPL only).

The panels are supported at the bottom by the horizontal NVELOPE NV5 (ts300) channel profile which provides restraint to panel edges.

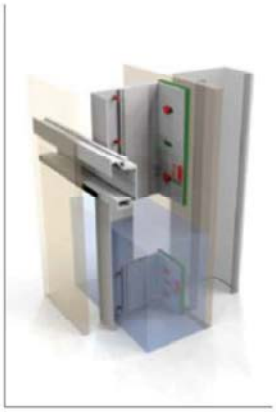
Vertical joints can be open, baffled or formed by half laps with appropriately designed panel edges providing a concealed fixing.

Individual panels can be removed for maintenance or replacement.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE support brackets, fixed through a series of fixed and flexible points.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction. NVELOPE fixed point brackets absorb both vertical and dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the façade cladding, local wind loads.



## More about NV5 (ts300)

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV5-vertical-cladding.html* ■

**NV6 is the NVELOPE system for supporting a timber batten.**

Suitable for supporting vertical or horizontal timber or cement weatherboarding. Panels may then be attached to support other materials, e.g. copper, zinc, etc.

Supporting timber cladding / weatherboarding and ply.

## Features

NV6 is the NVELOPE system for supporting a timber batten – vertical cladding applications (to support vertical and / or horizontal cladding elements).

Timber batten can be used to support timber cladding / weatherboarding and ply (used as a substrate for other materials e.g metal).

Concealed fix system, utilising NVELOPE brackets plus NVELOPE carrier.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

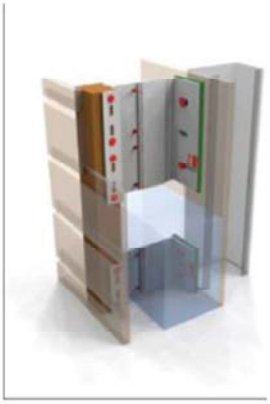
NVELOPE fixed point brackets absorb both vertical dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the facade cladding, local wind loads.

## Support

Vertical timber cladding: vertical timber bearers are supported with NVELOPE carriers brackets fixed back to NVELOPE support brackets.

Horizontal timber cladding: vertical timber bearers are supported with NVELOPE carriers fixed back to NVELOPE support brackets, then counter battened.



## More about NV6

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV6-vertical-cladding.html* ■

**NV7 is the NVELOPE system for supporting cassettes.**

Suitable for supporting ACM / ZCM / Aluminium cassettes.

Speak to our technical team.

## Features

NV7 is the NVELOPE system for concealed fix cassette (ACM / zinc / aluminium) – vertical cladding applications.

Secured using cassette hangers to provide a concealed fixing.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE support brackets, fixed through a series of fixed and flexible points.

NVELOPE fixed point brackets absorb both vertical and dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the facade cladding, local wind loads, cladding zone and substrate.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

## More about NV7

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678 (Brackets)

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV7-vertical-cladding.html* ■

**NV8 is the NVELOPE system for concealed fix / mechanically fixed and structurally bonded applications.**

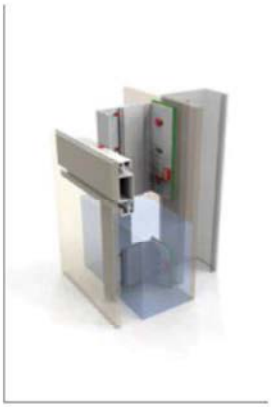
## Features

NV8 is an alternative NVELOPE system for secret fix / mechanically fixed / structurally bonded applications. On site or off site secured using hangers and undercut stud anchors, screws or structural adhesive (Sika) to provide a concealed fixing.

Horizontal NVELOPE channel profiles are fixed to the vertical profiles. Rainscreen panels are hung from and secured to the horizontal profiles with hangers and adjustable hangers.

NVELOPE 'T' and 'L' profiles are fixed using NVELOPE support brackets, fixed through a series of fixed and flexible points. NVELOPE fixed point brackets absorb both vertical dead loads.

NVELOPE bracket spacing is determined by cladding options such as the dimensions and weight of the façade cladding, local wind loads. NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

## More about NV8

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678 (Brackets).

**Options:**
NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system).

*For more visit: www.nvelope.com/cladding-systems-NV8-vertical-cladding.html* ■

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**NVF2F is the NVELOPE back frame – vertical floor to floor cladding applications.**

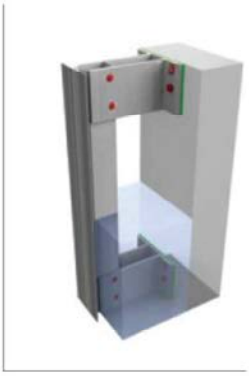
Suitable as a back frame system – NVF2F is suitable for face fixing / rivet fixing cladding – elements to e.g. fibre cement, high-pressure laminate (HPL), ACM and metal rainscreen panels. NVF2F can support NV3 / 4 / 5 / 6 / 7 and 8.

## Features

NVF2F is the NVELOPE back frame – vertical floor to floor cladding applications.

NVELOPE floor to floor (mullion) box 'T' profiles are fixed using NVELOPE support brackets. NVELOPE brackets absorb wind loading and allow for expansion and contraction and both vertical dead loads.

NVELOPE Bracket spacing is determined by cladding options such as the dimensions and weight of the façade cladding, local wind loads and cladding zone.



## More about NVF2F

**Material:**

Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Options:**

NVELOPE brackets (V): allows adjustment between the face of the primary support to outer face of vertical profile. Thermal isolators: hard PVC isolator assembled as standard (located between the NVELOPE bracket and the primary structural support system) are available.

*For more visit: www.nvelope.com/cladding-systems-NVF2F-vertical-cladding.html* ■

**NH1 is the NVELOPE system used to support vertical elements.**

Allowing for varied façade design options.

## Features

NH brackets are orientated horizontally.

An NVELOPE NH brace bar can be inserted into the bracket pocket in the underside of the bracket to create a horizontal NH bracket.

NH1 is the NVELOPE back frame – horizontally orientated system.

NVELOPE horizontal 'L' is fixed into the support brackets, fixed through a series of fixed and flexible points.

NVELOPE flexible point brackets absorb wind loading and allow for expansion and contraction.

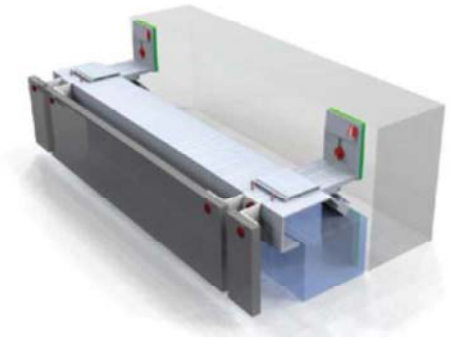
NVELOPE fixed point brackets absorb dead loads.

## More about NH1

**Material:**
Manufactured from extruded aluminium alloys conforming to EN 573-3 (material) and EN 755 production standards.

**Approvals:**
British Board of Agrément (BBA) - 09 / 4678

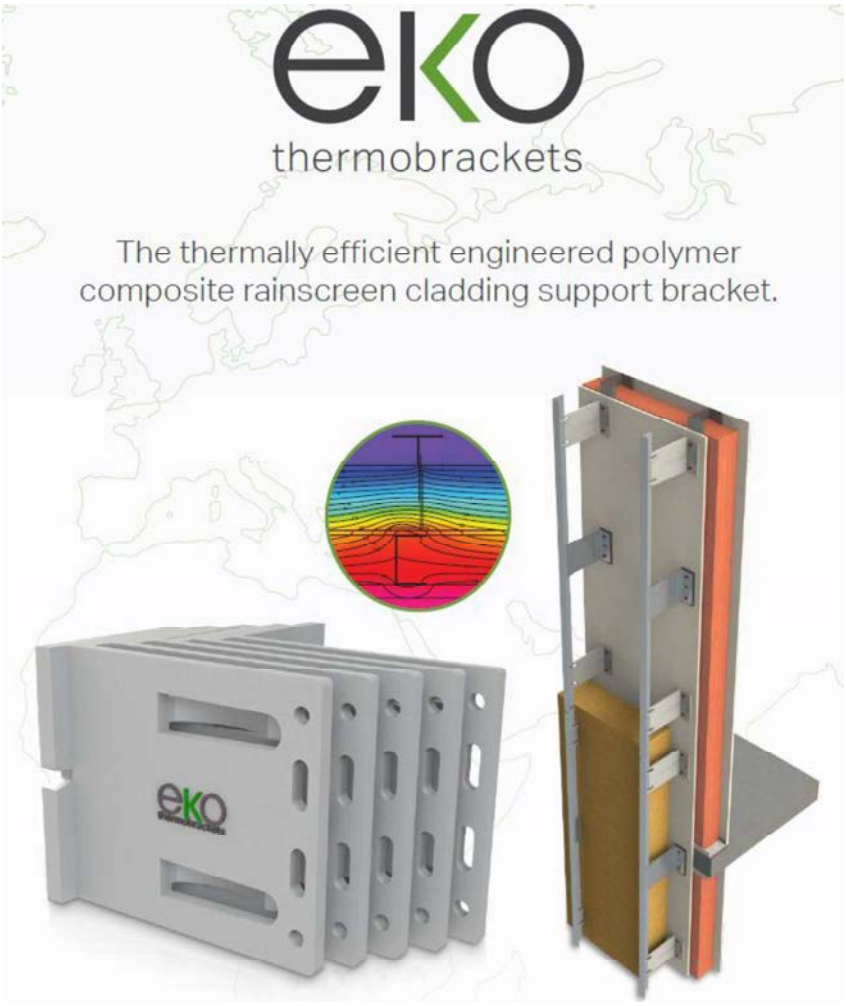
*For more visit: www.nvelope.com/cladding-systems-NH1-horizontal-cladding.html* ■



NVELOPE
MAKING CLADDING HAPPEN

THERMAL ISOLATOR PRODUCT DATA

| Property | Test Standard | Unit | Value |
|---|---|---|---|
| density | ISO 1183 | g/cm3 | 0.91 |
| tensile strength | ISO 527-1 | N/mm2 | 36 |
| breaking elongation | ISO 527-1 | % | 6 |
| tensile modulus | ISO 527-1 | N/mm2 | |
| impact resistance | ISO 179/1eU | kJ/m2 | 90 |
| notch impact resistance | ISO 179/1eA | kJ/m2 | 3.5 |
| heat conductivity | DIN 52612 | W/mK | 0.117 |
| flame-resistant | DIN 4102 | - | B1 |
| physiological harmlessness to BGA | - | - | Yes |
| heat or chemically weldable | | | Yes |
| bonding | | | Yes |
| painting | | | Yes |




The comparison of EKO rainscreen brackets with Aluminium brackets has been determined using three dimensional thermal modelling with predetermined basic construction(s).

The software used, models with supplied manufacturer thermal conductivities (Wmk) set out over a typical façade layout. 3D U-value modelling was carried out in accordance with BS EN 10211 and BS EN 6946 requirements. To understand the effect of EKO brackets, Single and Double Aluminium brackets were compared using incremental insulation thicknesses with each bracket depth).

It is important to note that the external wind loading and chosen façade material will alter these dimensions and it is advised a Project Builder should be completed.

~~~ End of Report ~~~
~~~

# Sustainability
# Our Green Credentials

- ✓ Bracket - Made from Aluminum 6005A-T6
- ✓ Thermal Isolator Pad – Made from Polypropylene Copolymer
- ✓ Both materials come with a declaration
  - 100% recyclable
  - 100% traceable
  - LBC Red List Free (Visit ILFI for full compliance details)

- Resin based solutions can only use 3% recycled material
- Steel based solutions need coatings breaking down
- Steel based solutions can rust if the coating fails


SFS GROUP, USA

# NVELOPE® THERMALLY BROKEN CLADDING SUPPORT SYSTEM

Nvelope, a brand of SFS Group, is a thermally broken cladding support system used to support cladding and facade panels made of various materials to external building walls. The system is composed of extruded aluminum profiles of 6005 T6 grade aluminum, commonly used in the extrusion process. The system has three main components, L-shaped aluminum brackets of a nominal wall thickness of .188", aluminum rails of profiles in shapes of L, T, Omega, Z or C with nominal wall thickness of 2.2 mm or .087".

All fasteners and connections are engineered and supplied with the system.

They include:

- ¼-14 or #14-10 304 series stainless steel bi-metal self-drilling screws for connections to SSF or wood.
- #12-14 all 316 stainless steel with a Nickel-Zinc plate for connections of the bracket to rail.
- Nominal 3/8" 304 or 316 series stainless steel bi-metal concrete screw-anchors for connections to concrete or CMU. Diameter is .460" and the pilot hole is drilled with a 3/8" masonry drill.

Cladding (facade) panels, provided by other manufacturers are attached to the rails with rivets, through-hole fasteners or blind fasteners, all of which are not part of the Nvelope system, however, SFS manufactures many rivets and 300 series stainless steel fasteners that can be used to connect the cladding to the Nvelope rails. .

The thermally broken feature of Nvelope is achieved by the system's final component, an injection molded polypropylene plastic isolator, having a nominal cross-sectional thickness of .100". The isolator (green in color) is positioned between the L-shaped bracket base and the building's exterior wall in order to provide a thermal break. Depending upon the thickness of the building's exterior wall system cavity, Nvelope bracket heights are available in 40mm, 60mm, 90mm, 120mm, 150mm, 180mm, 210mm, 240mm, 270mm and 300mm, inclusive of the polypropylene isolator. For brackets of height 60-300mm, the polypropylene is snapped onto the base of the bracket, thus becoming an integral part of the bracket. In the case of the 40mm bracket, because of its geometry, the polypropylene isolator cannot be snapped-on, and thus is installed as a loose piece.

https://us.sfs.com/nvelope

DECLARE IDSFS-0001

LICENSE EXPIRATION01 JAN 2023

LIVING BUILDING CHALLENGE COMPLIANCE: COMPLIANT

- I-13 RED LIST (DECLARATION STATUS): LBC RED LIST FREE
- I-14 RESPONSIBLE SOURCING: NOT APPLICABLE
- I-10 HEALTHY INTERIOR PERFORMANCE: NOT APPLICABLE

LIVING PRODUCT CHALLENGE (LPC) CERTIFIEDNO

FINAL ASSEMBLY LOCATION

- WYOMISSING, PENNSYLVANIA, USA

Revised 12-29-2023 (BG)

LIFE EXPECTANCYLIFE OF STRUCTURE YEAR(S)
END OF LIFE OPTIONS100% RECYCLABLE
ENTERPRISE GREEN COMMUNITY CRITERIA

## INGREDIENT LIST

| COMPONENT | INGREDIENT NAME | CAS# | % |
|---|---|---|---|
| Nvelope Brackets and Rails | Aluminum, Grade 6005 T6 | N/A | 90% |
| Nvelope Fasteners | 300 Series Stainless Steel | N/A | 6% |
| Nvelope bracket thermal Isolator | Polypropylene | 9003-07-0 | 4% |

## COMPANY INFORMATION

**SFS Group, USA**
1045 Spring Street
Wyomissing PA 19518
**Technical Support:**
Will Arndt
william.arndt@sfs.com (Wyomissing, PA) || 610.401.6377

**For Sales Support:**
SFS's Nvelope Eastern Business Development Manager
Tarro Jefferies (Nashville, TN)
tarro.jefferies.freer@sfs.com || 615.925.9668

SFS's Nvelope Western Business Development Manager
John Scott (Denver, CO)
John.scott@sfs.com || 720.916.1384

Revised 12-29-2023 (BG)

To whom it may concern,

The following letter is to provide clarification on the content of our aluminum products and their production origin. SFS Group USA rail profiles are extruded by local suppliers in the state of Pennsylvania. Their use of recycled content is as follows: 10% post consumer, approximately 70% post industrial, and the remaining content is virgin material. The percentage of post-industrial to virgin varies depending on how much virgin material is needed to meet AA specifications. The suppliers have stated that, on any given month, at least 62% of the material they source is secondary.

The thermally broken cladding support clips are extruded, cut, and punched in the United Kingdom. Aluminum sourced in the UK is 100% recycled from the post-industrial process of extruding and smelting said aluminum.

All said materials needed for the job are gathered and packaged in our Wyomissing, Pennsylvania facility.

Please let us know if you have any questions or require further information.

Thank you,

James Cole

James Cole
Regional Product Manager - Commerical Construction
04/2023

# Statement of Verification

BREG EN EPD No.: 000473 Issue 01

This is to verify that the

**Environmental Product Declaration**

provided by:

**SFS Group Fastening Technology Ltd**

BRE Global Verified EPD

is in accordance with the requirements of:

**EN 15804:2012+A1:2013**

and

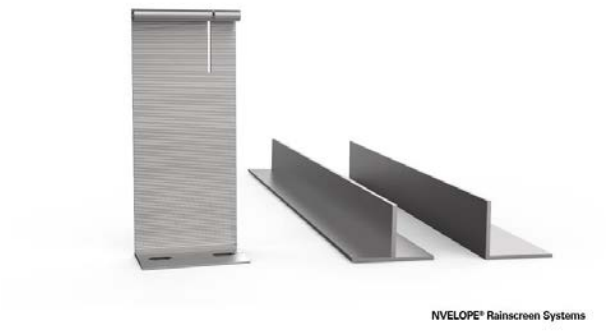
**BRE Global Scheme Document SD207**

This declaration is for:

**1 kg of aluminium profiles or brackets as installed as a subframe system**

## Company Address

SFS Group Fastening Technology Ltd
Division Construction
153 Kirkstall Road
Leeds
LS4 2AT




| | | |
|---|---|---|
| Signed for BRE Global Ltd | Emma Baker<br>Operator | 30 January 2023<br>Date of this Issue |
| 30 January 2023<br>Date of First Issue | | 29 January 2028<br>Expiry Date |



# Environmental Product Declaration

## EPD Number: 000473

## General Information

| EPD Programme Operator | Applicable Product Category Rules |
|---|---|
| BRE Global<br>Watford, Herts<br>WD25 9XX<br>United Kingdom | BRE Environmental Profiles 2013 Product Category Rules for Type III environmental product declaration of construction products to EN 15804:2012+A1:2013 |
| **Commissioner of LCA study** | **LCA consultant/Tool** |
| SFS Group Fastening Technology Ltd<br>Division Construction<br>153 Kirkstall Road<br>Leeds<br>LS4 2AT | BRE LINA 2.0<br>Andrew Stolworthy – SFS Group Fastening Technology Ltd |
| **Declared/Functional Unit** | **Applicability/Coverage** |
| 1 kg of aluminium profiles or brackets as installed as a subframe system | Product Average. |
| **EPD Type** | **Background database** |
| Cradle to Gate | ecoinvent 3.2 |

| Demonstration of Verification |
|---|
| CEN standard EN 15804 serves as the core PCR [a] |
| Independent verification of the declaration and data according to EN ISO 14025:2010<br>☐Internal ☒ External |
| (Where appropriate [b])Third party verifier:<br>Nigel Jones |
| a: Product category rules<br>b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4) |

| Comparability |
|---|
| Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A1:2013. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A1:2013 for further guidance |

## Information modules covered

| Product | | | Construction | | Use stage | | | | | | | End-of-life | | | | | Benefits and loads beyond the system boundary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Related to the building fabric | | | | | Related to the building | | | | | | | |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | | D |
| Raw materials supply | Transport | Manufacturing | Transport to site | Construction – Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction demolition | Transport | Waste processing | Disposal | | Reuse, Recovery and/or Recycling potential |
| ☑ | ☑ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | | ☐ |

Note: Ticks indicate the Information Modules declared.

## Manufacturing site(s)

SFS Factory 36
Mammoth Drive
Wolverhampton
WV10 9TF
UK

# Construction Product

## Product Description

The NVELOPE Sub Frame System from SFS is a family of products designed to support a rainscreen cladding system for the building envelope. The system consists of aluminium helping hand brackets which are attached to the external wall structure of the building using appropriate fasteners, attached to these are a range of aluminium profiles that form a grid for the aesthetic & weather resistant external fa ade system to be attached using appropriate fasteners. The gap created by the system is typically 47mm to 402mm and allows for installation of insulation which improves the thermal performance of the external wall system. The NVELOPE Sub Frame system is a configurable kit of parts to suit the project requirements which includes NV, NH and F2F products which are fitted with a range of profiles to create the final system.

These NVELOPE family of systems have *British Board of Agr ment (BBA) certification and are CE and UKCA marked to EN 1090-1:2009+A1:2011.

This EPD is based on the grouping of the below products produced in the period of one year:

NVELOPE Brackets - NV, NH3, NVF2F

NVELOPE Profiles - L, T, Lipped L, Corner, NV3, Nv4, NV5, NV8, NV10, F2F Box & T Box

The system described above is complimented by thermal Pads & Isolators and a range of fixings for each connection, the aluminium profiles are generally supplied in a mill finish however can be powder coated or anodised if required.

* http://bba-data-platform-aux.azurewebsites.net/api/artefact/26924a55-837a-429a-96e9-313eb78c3af5

## Technical Information

| Property | Value, Unit |
|---|---|
| Aluminium Alloy | 6005A T6 |
| Product Standard | EN755-9:2016 |
| Proof Stress | 200 min, MPa |
| Tensile Strength | 250 min, MPa |
| Elongation A50mm | 6 min, % |
| Hardness Brinell | 85, HB |
| **Products Included** | **Size (mm)** |
| NVELOPE NV Bracket Range | 40,60,90,120,150,180,210,240,270,300 |
| NVELOPE NH3 Bracket Range | 75,90,120,150,180,210,240,270,300 |
| NVELOPE NVF2F Bracket Range | 72,122,172,222 |
| NVELOPE® Profiles | L,T,Lipped L,Corner,NV3,NV4,NV5,NV8,NV10,F2F |

NVELOPE® Rainscreen Systems

## Main Product Contents

| Material/Chemical Input | % |
|---|---|
| Aluminium Alloy 6005A T6 | 100% |
| Click here to enter text. | Click here to enter text. |

## Manufacturing Process

The manufacturing site included in this life cycle analysis is SFS Factory 36 in Wolverhampton, UK.

The process of manufacturing begins with extruded aluminium profiles arriving at the factory from the UK mills, due to the inherent nature of the aluminium no surface treatment or coating takes place.

There are 2 different streams of product that define the processes required:

**Profiles/ Rails**

Majority of these arrive from the mills cut to the required length, so can be transferred directly into storage ready for despatch, on occasions they are required to be cut to a specific length to match a customer requirement. This is carried out on a manual or automated saw; these are cut singularly or in multiple lengths depending on the job required. Loading / unloading is dependent on the length of cut profiles, they are then wrapped with plastic and loaded into timber framed stillage and transferred into storage.

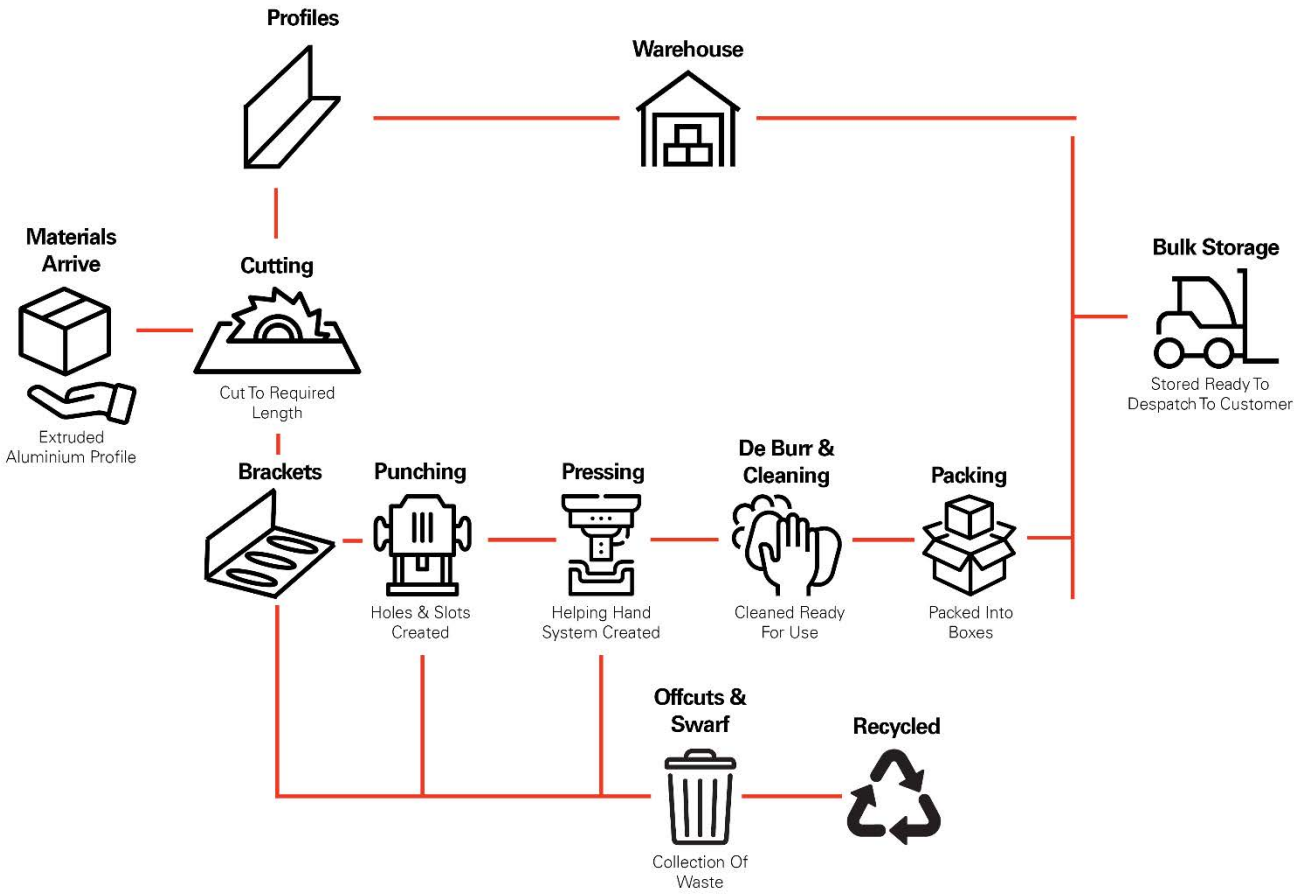
**Brackets/ Hangers**

These require a number of fabrication steps to turn the starting extrusion into a finished component:

- Long length extrusions are cut to the required length using a saw (manual or automated), cut in single or multiple lengths dependent on the profile, packed into cages for transfer to next operation/process.
- Holes and slots are pressed on the vertical leg of the bracket & hanger using a power press, stored in cages for transfer to next operation/process.
- The brackets are loaded onto a power press which creates the helping hand system and slots are then pressed in the foot of the bracket, brackets are then stored in cages for transfer to next operation/process.
- The brackets and hangers are deburred to remove any sharp edges and cleaned at each point in the process by hand.
- Hangers are packed into cardboard boxes and brackets are fitted with the required isolator (not included in this LCA) before being packed into cardboard boxes.
- The finished boxes are labelled, stacked on pallets and transferred into storage.

The water mix metal working fluid waste is emptied in intermediate bulk containers and collected by a registered hazardous waste carrier, it is processed and recycled where possible or disposed of legally.

## Process flow diagram




# Life Cycle Assessment Calculation Rules

## Declared / Functional unit description

1 kilogram of aluminium profiles or brackets as installed as a subframe system.

## System boundary

This is a cradle-to-gate LCA study that follows the modular design defined in EN15804:2012+A1:2013 for lifecycle stages A1-A3.

## Data sources, quality and allocation

Datasets are derived from Ecoinvent v3.2 (2015) and the LCA tool used was BRE LINA v2.0. The LCA models and reports the production stage modules, A1 to A3. No inputs or outputs have been excluded, all the ancillary materials, energy, and water use are included. The only exceptions are packaging (which is not used in the process), and direct emissions to air,cwater and soil, which are not measured.

SFS manufacture other products in addition to Aluminium brackets & profiles, therefore an allocation of fuel consumption, water consumption & discharge, and waste emissions was required. So, the allocation has made accordingly to that:

- 100% of the profile material received is allocated
- 25% of the total energy used is allocated
- 100% of the propane used is allocated
- 15% of the aluminium scrap waste is allocated
- 20% of the water mix metal working fluids are allocated

All data has been collected from supplier s invoices and allocation % from production data. The quality of data from supplier s invoices is accurate, allocations are based on averages over the year period covering (01/01/2021 – 31/12/2021). The original data collection form has been used while doing an LCA analysis, there was a no uplift in the given data. Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e., raw material production) from the Ecoinvent 3.2 database. All Ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN15804.

Specific European and UK datasets have been selected from the Ecoinvent LCI for this LCA. The quality level of geographical and technical representativeness is therefore Very Good. The quality level of time representativeness is fair as the background LCI datasets are based on Ecoinvent v3.2 which was compiled in 2015. Therefore, there is approximately 5-6 years between the Ecoinvent LCI reference year and the time period for which the LCA was undertaken

## Cut-off criteria

No inputs or outputs have been excluded, all the ancillary materials, energy, and water use are included. The only exceptions are packaging (which is not used in the process), and direct emissions to air, water and soil, which are not measured.

## LCA Results

(MND module not declared; MNR module not relevant; INA indicator not assessed; AGG aggregated)

### Parameters describing environmental impacts

| | | | GWP | ODP | AP | EP | POCP | ADPE | ADPF |
|---|---|---|---|---|---|---|---|---|---|
| | | | kg $CO_2$ equiv. | kg CFC 11 equiv. | kg $SO_2$ equiv. | kg $(PO_4)^{3-}$ equiv. | kg $C_2H_4$ equiv. | kg Sb equiv. | MJ, net calorific value. |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (of product stage) | A1-3 | 9.59E+00 | 1.71E-06 | 6.35E-02 | 2.07E-02 | 1.07E-02 | 5.21E-04 | 1.67E+02 |

GWP Global Warming Potential;
ODP Ozone Depletion Potential;
AP Acidification Potential for Soil and Water;
EP Eutrophication Potential;
POCP Formation potential of tropospheric Ozone;
ADPE Abiotic Depletion Potential – Elements;
ADPF Abiotic Depletion Potential – Fossil Fuels;

### Parameters describing resource use, primary energy

| | | | PERE | PERM | PERT | PENRE | PENRM | PENRT |
|---|---|---|---|---|---|---|---|---|
| | | | MJ | MJ | MJ | MJ | MJ | MJ |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (of product stage) | A1-3 | 1.85E+01 | 3.68E-04 | 1.85E+01 | 1.83E+02 | 0.00E+00 | 1.83E+02 |

PERE Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM Use of renewable primary energy resources used as raw materials;
PERT Total use of renewable primary energy resources;
PENRE Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM Use of non-renewable primary energy resources used as raw materials;
PENRT Total use of non-renewable primary energy resource

### Parameters describing resource use, secondary materials and fuels, use of water

| | | | SM | RSF | NRSF | FW |
|---|---|---|---|---|---|---|
| | | | kg | MJ net calorific value | MJ net calorific value | $m^3$ |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG |
| | Total (of product stage) | A1-3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.20E-01 |

SM Use of secondary material;
RSF Use of renewable secondary fuels;
NRSF Use of non-renewable secondary fuels;
FW Net use of fresh water

## LCA Results (continued)

| Other environmental information describing waste categories | | | | | |
|---|---|---|---|---|---|
| | | | HWD | NHWD | RWD |
| | | | kg | kg | kg |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG |
| | Total (of product stage) | A1-3 | 5.28E-01 | 4.38E-01 | 3.22E-04 |

HWD Hazardous waste disposed;
NHWD Non-hazardous waste disposed;
RWD Radioactive waste disposed

| Other environmental information describing output flows – at end of life | | | | | | |
|---|---|---|---|---|---|---|
| | | | CRU | MFR | MER | EE |
| | | | kg | kg | kg | MJ per energy carrier |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG |
| | Total (of product stage) | A1-3 | 0.00E+00 | 6.19E-02 | 0.00E+00 | 0.00E+00 |

CRU Components for reuse;
MFR Materials for recycling
MER Materials for energy recovery;
EE Exported Energy

## Interpretation of results:

As the product is 100% “Aluminium alloy”, most of the environmental impacts are attributed to the manufacturing phase, covered by information modules A1-A3 of EN15804:2012+A1:2013.

## References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A1:2013. London, BSI, 2013.

BSI. Environmental labels and declarations – Type III Environmental declarations – Principles and procedures. BS EN ISO 14025:2010 (exactly identical to ISO 14025:2006). London, BSI, 2010.

BSI. Environmental management – Life cycle assessment – Principles and framework. BS EN ISO 14040:2006. London, BSI, 2006.

BSI. Environmental management – Life cycle assessment – requirements and guidelines. BS EN ISO 14044:2006. London, BSI, 2006.

BS EN 755-9:2016 - Aluminium and aluminium alloys. Extruded rod/ bar, tube and profiles. Profiles, tolerances on dimensions and form.

BS EN 1090-1:2009+A1:2011 - Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components.

# 15 Year Limited Warranty - NVELOPE

**Warranty #**

**System:**

## Limited Warranty Declaration

SFS Group USA, Inc. (SFS) warrants to the original building owner (Owner), subject to the terms hereof, that the NVELOPE System (Product) sold on the original building owner s building (Project) will be free from defects in material and workmanship and will be supplied to meet SFS proprietary performance and design standards using materials specified by SFS for a period of fifteen (15) years from date of substantial completion.

This warranty does not apply to failure of product exposed to corrosive or aggressive atmospheric conditions inside or outside the building including, but not limited to, areas subject to tide or salt water, fallout or exposure to corrosive chemicals, ash, fumes, nuclear radiation, acid rain, dissimilar materials or where corrosive fumes or condensates are generated or released within the exposed area of the products.

The warranty does not apply to any failure of product caused by any of the following improper application of the product, non-compliance with installation instructions, non-compliance of the drawings, non-compliance with contract documents, in-transit damage, improper storage, job site damage, vandalism, failure of surrounding or adjacent materials, misuse, neglect, improper handling, external forces, explosions, fires, acts of God, , natural disasters, or design deficiencies of the building.

SFS shall make the exclusive determination as to whether a breach of warranty has occurred, and if so, SFS will provide replacement products in quantities sufficient to permit Owner to fully replace failed products or refund to the Owner the original purchase price of the products paid to SFS for the failed products. SFS Sole responsibility for breach of this warranty shall be limited exclusively to replacement of the failed products, or at the sole option of SFS to refund the original purchase price of the products from SFS to the owner for the failed products.

Notification of a claim under this warranty be submitted in writing within thirty days after discovery of a warranted failure, to SFS Group USA, Inc., 1045 Spring Street, Wyomissing, PA 19610. SFS will examine, or cause to be examined, the products in question. The Owner will allow access to affected areas of the building for examination and furnish adequate identification of the products involved in the claim including but not limited to project name, address, completion date, names and addresses of contractors, architects and engineers associated with the project.

**This warranty applies only to the original building owner at the time of substantial completion and is not transferable or assignable. This warranty shall not become effective until all invoices for the application, supplies and services have been paid in full to SFS and to the contractors, material suppliers and service providers of the products.**

**THE WARRANTY AND REMEDIES STATED HERIN ARE EXCLUSIVE OF AND IN LIEU OF ALL OTHER WARRANTIES. EXPRESS OR IMPLIED, INCLUDING AND IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PURPOSE. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, EXCEPT THOSE STATED HEREIN.**

**UNDER NO CIRCUMSTANCES SHALL SFS LIABILITY UNDER THIS WARRATY EXCEED THE AMOUNTS STIPULATED ABOVE, NOR SHALL SUCH LIABILITY BE CONSTRUED AS EXTENDING TO ANYTHING OTHER THAN THE COST OF REPLACING FAULTY PRODUCT. IN NO EVENT SHALL SFS BE LIABLE TO ANY CLAIMANT, WITH RESPECT TO ANY CLAIMED BREACH OF WARRANTY OR OTHERWISE FOR ANY LOST PROFITS, OR CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES ARISING FROM THE USE OF THE PRODUCTS, OR ANY BREACH OF THIS WARRANTY.**

Name of Project: _____

Address of Building: _____

Date of Issue: _____ Date of Expiration: _____

# 20 Year Limited Warranty - NVELOPE

**Warranty #**

**System:**

## Limited Warranty Declaration

SFS Group USA, Inc. (SFS) warrants to the original building owner (Owner), subject to the terms hereof, that the NVELOPE System (Product) sold on the original building owner s building (Project) will be free from defects in material and workmanship and will be supplied to meet SFS proprietary performance and design standards using materials specified by SFS for a period of twenty (20) years from date of substantial completion.

This warranty does not apply to failure of product exposed to corrosive or aggressive atmospheric conditions inside or outside the building including, but not limited to, areas subject to tide or salt water, fallout or exposure to corrosive chemicals, ash, fumes, nuclear radiation, acid rain, dissimilar materials or where corrosive fumes or condensates are generated or released within the exposed area of the products.

The warranty does not apply to any failure of product caused by any of the following improper application of the product, non-compliance with installation instructions, non-compliance of the drawings, non-compliance with contract documents, in-transit damage, improper storage, job site damage, vandalism, failure of surrounding or adjacent materials, misuse, neglect, improper handling, external forces, explosions, fires, acts of God, , natural disasters, or design deficiencies of the building.

SFS shall make the exclusive determination as to whether a breach of warranty has occurred, and if so, SFS will provide replacement products in quantities sufficient to permit Owner to fully replace failed products or refund to the Owner the original purchase price of the products paid to SFS for the failed products. SFS Sole responsibility for breach of this warranty shall be limited exclusively to replacement of the failed products, or at the sole option of SFS to refund the original purchase price of the products from SFS to the owner for the failed products.

Notification of a claim under this warranty be submitted in writing within thirty days after discovery of a warranted failure, to SFS Group USA, Inc., 1045 Spring Street, Wyomissing, PA 19610. SFS will examine, or cause to be examined, the products in question. The Owner will allow access to affected areas of the building for examination and furnish adequate identification of the products involved in the claim including but not limited to project name, address, completion date, names and addresses of contractors, architects and engineers associated with the project.

**This warranty applies only to the original building owner at the time of substantial completion and is not transferable or assignable. This warranty shall not become effective until all invoices for the application, supplies and services have been paid in full to SFS and to the contractors, material suppliers and service providers of the products.**

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Name of Project: _____

Address of Building: _____

Date of Issue: _____ Date of Expiration: _____