MITEK INC.
16023 Swingley Ridge Road
Chesterfield, MO 63017
(805) 477-0793
www.hardyframe.com

HARDY FRAME® COLD-FORMED STEEL (CFS) MOMENT FRAMES: PORTAL AND PICTURE FRAMES

CSI Sections:

05 40 00 Cold-Formed Metal Framing
05 40 19 Cold-Formed Shear Wall Panels
06 12 19 Shear Wall Panels

1.0 RECOGNITION

MiTek's Hardy Frame® Cold-Formed Steel (CFS) Moment Frames have been evaluated for use as lateral force-resisting system elements in Light-Framed Buildings of wood or CFS construction to resist earthquake or wind forces. The structural properties of the Hardy Frame® CFS Moment Frames have been evaluated for equivalency to light-framed shear walls sheathed with wood structural panels and comply with the intent of the provisions of the following codes and regulations:

- 2018 and 2015 International Building Code® (IBC)
- 2018 and 2015 International Residential Code® (IRC)
- 2019 California Building Code® (CBC) - Attached Supplement
- 2019 California Residential Code® (CRC) – Attached Supplement
- 2020 City of Los Angeles Building Code® (LABC) - Attached Supplement
- 2020 City of Los Angeles Residential Code® (LARC) - Attached Supplement

2.0 LIMITATIONS

Use of the Hardy Frame® CFS Moment Frame lateral force resisting system (Portal Frame or Picture Frame) recognized in this report is subject to the following limitations:

2.1 The frames are designed and manufactured in accordance with this report by MiTek Inc. Installation of the frames shall be in accordance with this report, the manufacturer's instructions, and the building plans approved by the building official.

2.2 All frame elements, connections within the frames, and details of the frames shall be designed by a registered design professional working on behalf of MiTek. The frame design and supporting documentation shall be submitted to the project engineer of record for acceptance and approval by the building official as part of the project design documents.

2.3 This report does not cover the design of the concrete or masonry foundation system or supporting members for raised and upper floor installation. These systems/members shall be designed to account for forces imposed by the Hardy Frame® products described in this report.

2.4 Elements outside and/or attached to the frames shall be designed and detailed in accordance with 2018, 2015 IBC Chapter 22 for CFS construction, or Chapter 23 for wood construction, of the IBC, or Chapter 6 of the IRC.

2.5 The Allowable Strength Design (V_{ASD}) shear values with gravity loads for a select number of Predesigned Portal frames and Picture frames are listed in Tables 2A, 2B, and 2C of this report.

2.6 Hardy Frame® widths and heights are limited to this report. Stacked installations in multi-story buildings of wood or CFS are limited to five stories.

2.7 Design loads and drifts shall be limited to the allowable loads and drifts listed in this report or as designed by MiTek.

2.8 Compliance of the CFS Moment Frame with the code and this evaluation report shall be confirmed by submitting building design calculations and details to the building official for approval, except for braced and alternate braced wall substitutions noted in Section 3.2.17 of this report. When required by the statutes of the jurisdiction, where the project is located, the calculations and details shall be provided by a registered design professional.

2.9 When used in a stacked configuration in multi-story installations where overturning tension forces exceed the design capacity of Moment Frame elements under combined stresses; overturning tension forces shall be resisted by a continuous rod tie-down (CRTD) system. The CRTD system shall accommodate expected wood shrinkage and settlement. The calculations and details of the CRTD shall be prepared by a registered design professional and shall be submitted to the project engineer of record for acceptance and to the building official as part of the project design documents.

2.10 The Moment Frames used in exterior walls shall be covered with an approved exterior wall covering in accordance with Chapter 14 of the IBC or Chapter 7 of the IRC.

2.11 The frame components are produced at MiTek facilities in Tolleson, Arizona.

3.0 PRODUCT USE

3.1 General: Hardy Frame® CFS Moment Frames consist of prefabricated CFS beam and column elements that are connected together in the shop or in the field to form vertical and lateral force–resisting wall-frames. The frames may be used individually or stacked vertically in low-rise or multi-story wood and cold-formed steel light-frame construction. When designed and constructed as described in this report, the frames comply with Section 11.1.4 of ASCE 7-10 and ASCE 7-16 and are equivalent to, and may be used as an alternative to light-frame (wood or CFS) shear walls sheathed with wood structural panels in seismic force-resisting systems shown in items A.15, A.16, B.22, and B.23 of Table 12.2-1 of ASCE 7-10 or ASCE 7-16; or used in wind resisting systems.

Together the beam and column elements are assembled into one of two configurations; the Portal Frame consists of a header beam element between two columns (Figure 1 of this report), and the Picture Frame consists of both a header beam (top) and sill beam (bottom) between two columns (Figure 2 of this report). Both product types are designed to resist in-plane and out-of-plane lateral wind or earthquake loading while supporting vertical gravity and/or overturning loads. The beam or column element is a one-piece cold-formed steel, C-shaped panel assembly that is enclosed at the top and bottom with CFS channels as described in the quality documentation.

When used as part of a Seismic Force-Resisting System, the primary *energy dissipation mechanism* (EDM) of the Hardy Frame® CFS Portal and Picture Frames to protect the structure is the post-yield hinge behavior within the panel zone (joint) formed at the intersection of the beam and the column of the Frame, or within the base connection of a Portal Frame. The panel zone may be fabricated *integrally* to the ends of the beam (Figure 6 of this report) or may be fabricated in an individual *stand-alone* configuration that is independently attached to the beam and to the column to join the two elements (Figure 7 of this report).

The Hardy Frame® CFS Moment Frames may be installed over concrete or masonry foundations, elevated concrete slabs, wood sill plates, raised wood floors, wood or steel beams, directly on lower CFS Portal or Picture frames, and may be stacked two to five stories in multi-story construction (Figure 8 of this report) when proper consideration is given to overturning forces, settlement and shrinkage (wood), and contribution of vertical floor deformation to lateral story drifts.

3.2 Design:

3.2.1 General: Hardy Frame® CFS Moment Frames may be used as vertical lateral force-resisting elements within the seismic force-resisting system for structures as shown in items A.15, A.16, B.22, and B.23 of Table 12.2-1 of ASCE 7-10 or ASCE 7-16; or used in wind resisting systems, when designed and installed in accordance with this report. The system seismic parameters, performance coefficients, and factors for the IBC are permitted to be:

Seismic Coefficient or Factor	ASCE 7	
Seismic Design Category (SDC)	A, B, C, D, E, & F	
	Bearing Wall	Building Frame
R maximum	6 ½	7
Ω_0 minimum	3*	2 ½*
C_d minimum	4	4 ½

* Minus ½ for structures with flexible diaphragms in accordance with footnote g of ASCE 7 Table 12.2-1

The building height shall not exceed the lesser of the limits specified in Table 503 of the IBC and 65 feet (19.8 m) for structures located in Seismic Design Categories D, E, or F. Combinations of different systems to resist seismic forces in the same direction shall comply with the requirements of Section 12.2.3 of ASCE 7.

Seismic loads shall be determined in accordance with IBC Section 1613 and ASCE 7. Wind loads shall be determined in accordance with IBC Section 1613 and ASCE 7. When used under combined loading; seismic or wind with vertical gravity loads, load combinations shall be per IBC Section 1605.2 (LRFD) or 1605.3 (ASD). Second-order (P-delta) effects on frame forces and drifts shall be considered when required by ASCE 7 Section 12.8.7.

Design drift for frames subjected to seismic forces shall not exceed the allowable story drift listed in ASCE 7 Table 12.12-1. Wind drift shall not exceed h/160 at the strength (LRFD) level or h/267 at the Allowable Strength Design (ASD) level.

Two or more CFS Frames may be installed in an edge-to-edge or back-to-back configuration. When these Frames have the same lateral stiffness, the allowable design value of the system is equal to the sum of the corresponding allowable design values for each frame. The building design professional shall justify the development of a continuous load path, including collectors and foundation design. The anchorage shall also be designed considering the edge-to-edge or back-to-back configuration.

For those frames listed in Tables 2A, 2B, and 2C of this report, the stiffness of CFS Frames is calculated by dividing the tabulated in-plane shear capacity by the tabulated drift at that capacity value. The stiffness of other frames not listed in the tables shall be determined by MiTek and included in the design calculations for use by the building design professional and submitted to the building official for approval.

Where Hardy Frame® CFS Frames with various geometries or different beam/column elements occur in a wall line or are combined with other types of lateral-force-resisting systems, the applied shear loads in that line shall be distributed to each resisting system based on their relative lateral stiffness. Calculations distributing design lateral loads, based on the known stiffness, shall be prepared by a building design professional and submitted to the building official for approval.

Figure 9, Figure 10, Figure 11, and Figure 12 of this report provide sample framing details as guidance for wood-framed construction. Details to accommodate a specific job need, complying with the applicable code and the requirements of this report, shall be prepared by the building design professional and submitted to the building official for approval.

3.2.2 Frame Capacity: The design capacities for the Hardy Frame® CFS Frames values shall be calculated per IBC Chapter 22, and the appropriate sections of AISI S100, S240, S400, and AISC 360.

Pre-designed portal frames and picture frames satisfying the requirements in Sections 3.2.3 to 3.2.7 of this report are presented in Tables 2A, 2B, and 2C of this report for the specific conditions listed, including in-plane shear capacity, in-plane drifts at capacity, allowable axial compression capacities, supplemental gravity load capacity, support material, base fixity, and anchorage requirements, for both wind and seismic loads. Frames not listed in these tables require design by MiTek in accordance with Chapters 19, 22, and 23 of the IBC, using the procedures and limitations described in this report. The designs shall be submitted to the responsible building design professional for review and to the building official for approval.

The calculated strength capacity of a portal or picture frame shall be the lesser of the capacity limits based upon; a) governing capacity of frame members (columns, beam(s), and panel zones) under combined stress, b) calculated peak load limit of the frame due to the action of the panel zones and base connection, or c) load capacity at maximum drift limit set forth in ACSE 7 Table 12.12-1.

For multi-story applications, structural capacities and drift values determined by calculation or as shown in the tables within this report shall include evaluation of bearing stresses on the supporting base materials (wood, concrete, or steel) for the conditions described in Section 2.9 of this report.

3.2.3 Plastic Hinge Location: The primary *energy dissipation mechanism* (EDM) of the Hardy Frame® CFS Portal and Picture Frame to protect the structure is the plastic hinge formation within the panel zone joints, and for the portal frame, additional plastic flexural hinge formed at the base of the column.

3.2.4 Column and Beam Design Capacities: Beam and column design capacities shall comply with Chapter 22 of the 2018 and 2015 IBC and the specific requirements of AISI S100 and AISI S240 for the appropriate combination of loading (Bending, Bending and Shear, and Bending and Compression), including the effects of buckling.

Beam and column design capacities shall be greater than the combined load demand as determined from a rational analysis, based upon validated engineering principles, of the frame with combined lateral and vertical loads determined in accordance with Chapter 16 of IBC and ASCE 7.

3.2.5 Panel Zone: Panel Zone design capacities are calculated by MiTek engineers and shall comply with Chapter 22 of the 2018 and 2015 IBC, and AISC 360 Section G2-2 modified as follows:

The total nominal capacity of the panel zone (V_{PZn}) is a combination of the shear strength of the CFS web of the panel zone with tension field action (V_{Web}), and shear strength due to the flexural frame action of the panel zone's horizontal and vertical boundary elements (V_{BE}):

$$V_{PZn} = V_{Web} + V_{BE} \qquad \text{(Eq -1)}$$

The safety factor, Ω, and resistance factor, Φ, shall comply with AISC 360 Section G1.

Panel zone design capacities shall be greater than shear load demand as determined from a rational analysis, based upon validated engineering principles, of the frame with combined lateral and vertical loads determined in accordance with Chapter 16 of IBC and ASCE 7.

3.2.6 Frame Drift Design: Lateral deflection under seismic loads shall be calculated by MiTek at the strength level (LRFD) from a rational analysis, based upon validated engineering principles, of the frame with combined lateral and vertical loads determined in accordance with Chapter 16 of IBC and ASCE 7. Lateral deflection shall not exceed story drift limits specified in Table 12.2-1 of ASCE/SEI 7.

The structural model used for determining frame lateral deflection shall consider the flexural, shear, and axial stiffness of the frame components, and shall include the effect of the joint stiffness; and the attachment of the joint bolts (*tensioned* versus *snug-tight*) at the panel zone. For portal frames, the base condition (*fix-base* versus *semi-rigid*) is also considered. The modeling parameters used are supported by calculation and/or test data.

For frames used in multistory construction, the additional lateral drift contribution from wood compression/bearing, and the vertical deflection of CRTD (including deflection of shrinkage compensating device) shall be included in the drift calculations.

When Hardy Frame® CFS Frame is installed on wood beams or steel beams the tabulated design values in Tables 2B and 2C of this report or the calculated values are used. The building design professional shall consider the additional drift due to beam deflection within the width of the frame.

3.2.7 Frame Maximum Allowable Design Load: Maximum Allowable Lateral Design Load (V_{ASD}) shall not exceed the calculated Peak Lateral Strength of the Frame (V_{Peak}) divided by a factor of 2.5:

$$V_{ASD} = V_{Peak}/2.5; \; V_{LRFD} = V_{ASD}/0.7 \qquad \text{(Eq -2)}$$

The peak lateral strength of the frame shall be calculated using the expected shear strength (V_{PZe}) of the panel zones based on Section 3.2.5 of this report. The peak lateral strength may be estimated as the calculated lateral load when both the top and bottom panel zones in a picture frame, and the top panel zones and the base connections in a portal frame, have fully yielded. The peak lateral strength may be calculated as:

Portal Frame:

$$V_{Peak} = 2 \times \frac{M_{PZ}+MBase}{H} \qquad \text{(Eq -3)}$$

Picture Frame:

$$V_{Peak} = 2 \times \frac{MPZ+MPZ-B}{H} \qquad \text{(Eq -4)}$$

Where:

M_{PZ} = Moment strength of top panel zone (Portal or Picture Frame);

M_{PZ} = $V_{PZe} \times d_b$(Eq -5)

M_{PZ-B} = Moment strength of bottom panel zone (Picture Frame);

M_{PZ-B} = $V_{PZe} \times d_c$ (Eq -6)

M_{Base-F} = Fix-Base Moment strength of the base connection (Portal Frame) of Hardy Frame® HFX Panels;

M_{Base-P} = Pin-Base Moment strength of the base connection (Portal Frame);

$$M_{Base-P} = M_{Base-F} \times \left(\frac{d_{bolt-pin}}{d_{bolt-pin}}\right)^2 \qquad \text{(Eq -7)}$$

d_b = Depth of beam

d_b = Depth of column

d_{bolt} = Distance from center of bolt to edge column

H = Height of frame from center-to-center of panel zones, or from base to center of upper panel zone.

3.2.8 Frame Limitations: Frames and members forming the frames shall satisfy the following limitations:

1) Beam, Column, and Panel Zone elements shall be CFS built-up members fabricated by MiTek as described in the quality documentation.
2) Beam and Column assembly depths shall be limited to a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm).
3) The ratio of beam clear-span to beam depth shall be 4.5 or greater, but not to exceed 20. Beam clear-span is the distance from the inside face of the column to the inside face of the adjacent column.
4) The ratio of column clear-height to column depth shall be less than or equal to:
   a. 14 for a fix-base portal frame and picture frame, or
   b. 11 for a pin-base portal frame.

   Column clear-height is the distance from the base to the underside of the panel zone for the portal frame, or the distance from the top of the lower panel zone to the underside of the top panel zone for a picture frame.
5) Total single frame height shall not exceed 16 feet (4877 mm) without additional analysis and calculations submitted and approved by the building official.
6) The ratio of width (horizontal)-to-height (vertical), *w/h*, of the panel zone (*integral* or *stand-alone*) shall be equal to or greater than 1.0, but not exceed 1.75.

3.2.9 Lateral Bracing: Lateral bracing of the frame shall be provided as follows:

1) Lateral bracing is required for the top flange of the beam within the clear span of the beam (between the columns) and at the panel zone (*integral* or *stand-alone*).
2) Within the clear-span of the beam distance between points of lateral bracing shall not exceed 48 inches (1219 mm).
3) Required strength (P_{rb}) of beam lateral bracing shall be calculated using AISC 360 Appendix 6 as follows:

   $$P_{rb} = 0.02M_r \text{ x } (C_d/h_0) \qquad \text{(Eq -8)}$$

   Where:

   C_d = 1.0

   h_0 = distance between flange centroids

   Mr = Moment strength (MPZ) of top panel zone (Eq -5).

4) Lateral bracing shall be provided at the top of the top panel zone at each of the column flanges.

5) The required strength (P_{rpz}) of panel zone lateral bracing shall be half of that required at the beam ($P_{rpz} = 0.5P_{rb}$).

Lateral bracing may be provided indirectly by the floor framing through the attachment of the beam top flange to the wall top plate (double or single) or track, or through direct attachment of the beam top flange to the floor framing (joist, beam, rim joist, or blocking).

3.2.10 Multi-Story Applications - Overturning: When the Hardy Frame® CFS Frames are used in stacked conditions for multistory construction, the effects of overturning forces on design strength and lateral deflection shall be considered.

Overturning tension forces shall be resisted by a CRTD system that shall include accommodation for vertical settlement and shrinkage of the wood construction. The system shall be designed by MiTek engineers or the responsible building design engineer.

Overturning compression forces on the CFS frame members shall be combined with lateral forces. When combined demand loads exceed the combined capacity of the standard C-shaped panel assembly column, axial reinforcing placed at the neutral axis of the column shall be provided as detailed in the quality documentation. The capacity of the column shall be reevaluated in accordance with Section 3.2.4 of this report. The capacity shall exceed the demand from the combined loading including axial compression.

Overturning compression forces inducted by the frame on wood supports are resisted by the bearing strength of the wood sill plate and floor framing members. The capacity of the wood members within the load path shall be in accordance with ANSI/AF&PA NDS. Stresses on the wood elements shall be calculated over an effective length equal to the depth of the column plus the depth of the Picture frame beam measured from the outside edge of the frame (Figure 13 of this report)

3.2.11 Anchorage to Concrete: Anchorage to concrete for Hardy Frame® CFS Frames shall be designed and installed to resist tension and/or shear loads, as applicable, in accordance with Chapter 17 of ACI 318-14 per 2018 and 2015 IBC.

The Hardy Frame® anchorage details shown in Figures 14 and 15 of this report have been designed to comply with the IBC and ACI 318 for anchorage requirements. Alternate anchorage details may be used when specifically designed and detailed by the registered design professional, including overstrength when required, subject to approval by the building official. Design of the foundation, concrete beam, or slab shall be by the registered design professional to accommodate the specific condition and critical load demand in accordance with the provisions of the applicable code.

3.2.12 Anchorage to Masonry: Design calculations and details for the cast-in-place anchorage of Hardy Frame® CFS Frames, to masonry foundations or walls, shall be prepared by the building design professional in accordance with Chapter 21 of the IBC.

3.2.13 Anchorage to Steel Beam: Design calculations and details for the connection of Hardy Frame® CFS Frames, to steel beams, shall be prepared by the building design professional in accordance with Chapter 21 of the IBC. For beams supporting discontinuous frames, the building design professional shall consider the effect of seismic forces including overstrength per Section 12.3.3.3 of ASCE 7 for the design of the supporting member.

3.2.14 Anchorage to Wood Beam: Connections to wood beams for Hardy Frame® CFS Frames described in this report shall be designed and detailed by a building design professional in accordance with Chapter 23 of the IBC. For beams supporting discontinuous frames, the building design professional shall consider the effect of seismic forces including overstrength as set forth in Section 12.3.3.3 of ASCE 7 for the design of the supporting member.

3.2.15 MiTek® Pro-Series WS Screws: Tabulated wood screw quantities in Table 1A of this report for resisting the allowable in-plane wind and seismic loads utilize a load duration factor, C_D, of 1.6 for wood-framed construction in accordance with the ANSI/AF&PA NDS. Screw connections in Hardy Frame® CFS Frame may be used to resist ASD tension (uplift) forces resulting from the wind. In wood-framed construction, the ASD withdrawal, W, may be computed using the published values for the USP WS Series, or the building design professional may compute withdrawal values in accordance with the ANSI/AF&PA NDS for other screw types.

3.2.16 Screw Fasteners in CFS: In CFS-framed construction, the screw connection for resisting the allowable in-plane wind and seismic loads shall be designed and detailed by a building design professional in accordance with AISI S100 under the IBC or IRC. The nominal screw diameter shall be 1/4 inch (6.4 mm). The screw head diameter shall be a minimum of 5/16 inch (7.94 mm), unless a washer measuring 5/16 inch (7.94 mm) in diameter by 0.05 inch (1.27 mm) thick is placed under the head. The screw shall comply with the requirements of Section 4.2.8 of this report. All of the screws shall be uniformly spaced along the length of the channel, using the pre-drilled holes.

3.2.17 Braced Wall Panels: A Hardy Frame® CFS Portal (Semi-Rigid or Fix-Base) or Picture Frame with minimum 12 inch (304 mm) beam(s) and 12 inch (304 mm) columns may replace up to 6 feet (1829 mm) of braced panel length or each alternate bracing panel specified in Section 2308.6 of the

2015 or 2018 IBC, or Section R602.10 of the 2015 or 2018 IRC.

3.3 Installation:

3.3.1 General: Hardy Frame® CFS Frames are developed for installation in single-story or multi-story light-framed wood or CFS structures as described in Sections 3.1 and 3.2. The frames shall be installed in accordance with the plans and specifications approved by the building official. Supports for Hardy Frame® CFS Frames include but are not limited to concrete or masonry foundations, on washers over heavy hex or SAE Grade 8 nuts, on solid-sawn wood, engineered wood, open web wood floor trusses, or hot-rolled steel floor systems. Installation details shown in Figures 9, 10, 11, and 12 of this report are intended as a guide for certain typical surrounding framing conditions. Details and calculations to accommodate situations and critical load combinations specific to a particular structure shall be prepared by the building design professional in accordance with the applicable code and the requirements of this report and shall be submitted to the building official for approval. The nuts at the bolted base connections [fix-base (rigid) or pin-base (semi-rigid)] of the Frame installed on concrete, masonry, or steel, shall be installed "snug-tight". Snug-tightened condition is "the tightness that is attained with a few impacts of an impact wrench or the full effort of an installer using an ordinary spud wrench to bring the plies into firm contact." (RCSC). More than one cycle through the bolt pattern may be required to achieve the snug-tightened connection. Firm contact is the condition "that exists on a faying surface when the plies are solidly seated against each other, but not necessarily in continuous contact." (RCSC).

3.3.2 Attachment of Column and/or Beam to Panel Zone: Hardy Frame® CFS Portal and Picture Frames are assembled from the beam, column, and panel zone members. When fabricated with an *integral* panel zone, the beam is attached directly to the column. When the frame is installed with the *stand-alone* panel zone, the panel zone is attached to both the beam and the column. In either configuration, the attachment at each connection interface consists of two 1 1/8-inch diameter bolts.

Unless the frame is specified to require *tensioned* joints, bolts need only be installed snug-tight. When *tensioned* joints are specified, bolts shall be brought snug-tight, then torqued to 1,000 ft-lbs. Proper bolt torque shall be determined using calibrated torque wrench, "turn-of-nut" method, or by use of Direct Tension Indicator (DTI) washers that comply with Section 4.2.5 of this report and installed per manufacturer's instructions.

When *tensioned* joints are specified and Frames are field assembled, inspections by the governing building jurisdiction of the Panel Zone connection(s) are limited to (1) confirmation the flat surface of DTI washers is in contact with the column or beam, (2) there is a hardened round washer between the bump surface and the nut, (3) that nuts have been tightened sufficiently for orange silicone to be visible from the total number of DTI bumps minus one (minimum).

When *tensioned* joints are specified and Frames are pre-assembled by the MiTek, inspections by the governing building jurisdiction of the Panel Zone connection(s) are limited to (1) confirmation the flat surface of DTI washers are in contact with the column or beam, (2) there is a hardened round washer between the bump surface and the nut, (3) that nuts have been tightened sufficiently for orange silicone to be visible from the total number of DTI bumps minus one (minimum).

Alternately, when bolt torque for *tensioned* joints is determined using calibrated torque wrench or "turn-of-nut" method instead of DTI washers, installation, and inspection shall be per Section 8.2 of Research Council on Structural Connection's (RCSC) *Specification for Structural Joints Using High Strength Bolts.*

3.3.3 Installation in Wood-Framed Construction: Hardy Frame® CFS portal frames are intended to be installed on rigid support surfaces (concrete or steel) while picture frames may be installed on support surfaces of wood, concrete, or steel. When installed in light-framed wood construction, the primary shear transfer at the top of the portal or picture frames is accomplished by connecting the top flange of the header beam to a lateral load collector with ¼-inch-diameter (6.6 mm) by 3-inch-long minimum wood or lag screws through predrilled holes in the beam within the center section. Other connection methods are possible including threaded fasteners, when substantiated by design and details, which are subject to the approval of the building official. Where required, solid filler pieces may be used above the Frame to make up the height difference between the Frame and the collector. In this case, the building design professional shall design and detail the shear transfer, increased reactions, additional in-plane drifts, and out-of-plane stability due to in-plane and out-of-plane loading. Alternatively, a Frame with a custom height may be specified.

To accommodate the attachment of wood wall studs or window framing when occurs, a minimum of four nominally ¼-inch-diameter (6.4 mm) holes are provided at column and beam edges.

3.3.4 Installation on Raised and Upper Floor Systems (Picture Frame): Where the Hardy Frame® CFS Picture Frames are installed on solid sawn lumber or engineered wood platform floor systems, a continuous load path with adequate strength and stiffness shall be provided to transfer all forces and reactions to a Portal Frame, another steel frame, or the foundation. Attachments of the Picture Frame shall account for the transfer of lateral shear and overturning forces.

Lateral shear transfer at the top of the frame is as described in Section 3.3.3 of this report. The shear transfer at the base of the frame shall be achieved by attaching the bottom flange of the sill beam to wood members below with 1/4-inch-diameter (6.6 mm) minimum 3-inch-long wood or lag screws through predrilled holes in the beam within the center section. To provide full bearing below the frame and to comply with the minimum screw edge distances for shear transfer, a nominally 4-by (minimum) lumber member shall be installed in the floor system. Where multiple-ply, nominally 2-by lumber members are used, additional connectors may be required to offset the effect of lesser screw edge distances.

For the Hardy Frame® CFS Picture Frame overturning tension forces are resisted by steel all-threaded rod (ATR) installed in provided holes at the center of the panel zone. The size of the rod shall be determined by the building design professional and designed to resist calculated overturning forces from the analysis. The steel rod may be part of a continuous rod tie-down system such as the MiTek Z4 system, where the ATR is continuous from the uppermost stacked frame down to the foundation or supporting structural steel beam. When a continuous rod tie-down system is used, shrinkage-compensating devices shall be used at each level of the stack to attach the frame to the ATR. Alternately, where justified by analysis, the tension rods may be installed from the bottom of the upper frame, through the floor framing, to the top of the lower frame. A nut is required at each end of the rod to attach the rod to the upper and lower frames. The building design professional shall determine if shrinkage compensation is required for frame-to-frame connections. When the alternate overturning tension connection is used, the Frame elements shall be designed to resist combined loading including the accumulative tension forces.

3.3.5 Installation in Cold-formed Steel Construction: When Hardy Frame® CFS Frames are installed in buildings of CFS construction, design values for the frames shall be the same as those for installation on concrete or rigid supports (steel). To transfer the lateral shear load to the Frame, the top flange of the header beam shall be connected to a lateral load collector, consisting of minimum 43-mil-thick (1.1 mm) (No. 18 gage) CFS. The connection shall be accomplished using ¼-inch-diameter (6.4 mm) self-drilling tapping screws that comply with Section 4.8 of this report and are approved by the building official. Where required, filler pieces may be used above the Frame to make up the height difference between the Hardy Frame® CFS Frame and the collector. In this case, the building design professional shall design and detail the shear transfer, increased reactions, additional in-plane drifts, and out-of-plane stability due to in-plane and out-of-plane loading.

A minimum of four nominally 1/4-inch-diameter (6.4 mm) holes are provided at column and beam edges to facilitate the attachment of CFS studs or window framing, when required.

3.3.6 Installation on Concrete or Masonry Foundations: The Hardy Frame® CFS Frame shall be secured to the embedded anchors with nuts over washers when supported by concrete or masonry foundations. The building design professional may either specify cast-in anchors placed in the foundation before pouring concrete or grout; or approved post-installed mechanical or adhesive anchors (only for concrete foundations). Templates that hold the embedded portion of anchors, such as the Hardy Frame® Bolt Brace, may be used to assist with the proper positioning of cast-in anchors. Figures 14 and 15 of this report provide guidance for the installation of the Frame directly on concrete or masonry, or a nut and washer.

3.3.7 Miscellaneous Holes: As detailed in the production drawings, Hardy Frame® CFS Frames are fabricated with holes to allow electrical and mechanical component access at predetermined locations. Frame beams, columns, and panel zones also contain nominal 1/4-inch-diameter (6.4 mm) screw holes in the flanges for attachment to surrounding framing. Additional holes in beams or columns webs may be field-installed when determined by calculation using AISI S100 and approved by the building official. No additional holes, other than those provided in manufacturing by MiTek, are permitted within the Panel Zone.

3.4 Special Inspections:

3.4.1 General: If required, Periodic special inspection shall consist of:

When installed on concrete or masonry; verifying hold-down anchor type, placement (including edge distance, length into concrete, and spacing), and size.

Attachment to other elements of the wood structure or CFS structure per construction details.

For field assembly of frame; verify bolt grade, size, and installation of the bolt, nut, and washer type; verify that for *tensioned* joints the bolts are torqued correctly (by use of DTI washers or other methods described in Section 3.3.2), or that bolts are installed "snug tight" for joints not requiring *tensioned* joints.

3.4.2 2018 and 2015 IBC: For structures that qualify under Section 1704.1, 1704.4, or 1705.3, special inspections are not required. For other structures, periodic special inspections shall be performed in accordance with Sections 1705.1.1, 1705.11.1, and 1705.11.2 or Sections, 1705.12.2 and 1705.12.3, as applicable.

3.4.3 2018 and 2015 IRC: Special inspections are not required in structures regulated under the IRC unless an engineered design is submitted in accordance with Section 301.1.3 of the IRC, for which the special inspections shall be conducted complying with Section 3.4.2 of this report.

4.0 PRODUCT DESCRIPTION

4.1 General: The Hardy Frame® CFS Moment Frames consist of prefabricated CFS beam and column elements that are connected in the shop or in the field to form vertical and lateral force–resisting wall-frames. The frames comply with Section 11.1.4 of ASCE 7-10 and ASCE 7-16 and are equivalent to, and may be used as alternatives to, light-frame (wood or CFS) shear walls sheathed with wood structural panels in seismic force-resisting systems shown in items A.15, A.16, B.22, and B.23 of Table 12.2-1 of ASCE 7-10 or ASCE 7-16; or used in wind resisting systems.

4.2 Materials:

4.2.1 Hardy Frame® CFS Moment Frame Elements: C-shaped portion of the beam, column, and panel zone assemblies; and all c-shaped and z-shaped flange and web strengthening elements are formed from 97-mil-thick (2.5 mm) (No. 12 gage) carbon steel complying with either ASTM A 653, Designation SS, Grade 50, Designation HSLAS, Grade 50, or ASTM A1003, Designation SS, Grade 50, steel with a minimum G60 galvanized coating designation.

4.2.2 Steel Reinforcing Plates: All flat steel plates used for the base and cap of the column, beam end plates, and the vertical and horizontal boundary elements of the panel zone are 3/4-inch-thick (19 mm) carbon steel complying with ASTM A36.

4.2.3 Panel Stiffeners: All outside edge flange stiffeners used on Hardy Frame® beams, columns, and panel zones are minimum 0.2242-inch-thick (5.7 mm) [No. 4 gage] carbon steel complying with ASTM A36.

4.2.4 Panel Zone Bolts and Nuts: Bolts joining the column to the beam-integrated panel zone or joining column and beam to stand-alone panel zone shall be 1⅛-inch diameter and shall comply with ASTM F3125 Grade A325, SAE J429 Grade 8, or ASTM A193 Grade B7. Nuts shall comply with A563 Grade DH heavy hex, or SAE J995 Grade 8.

4.2.5 Panel Zone Washers: When panel zone joints are designated as requiring *tensioned* bolts; direct tension indicating (DTI) washers shall be used. DTI washers shall comply with the requirements of ASTM F959 and be those designated for use with 1⅛ inch-diameter ASTM F3125 Grade A325 bolts. Other washers used when the panel zone joint is designated as requiring *tensioned* bolts shall be hardened flat washers that comply with ASTM F436.
Washers used when the panel zone joint is not designated as requiring *tensioned* bolts shall be hardened flat washers that comply with ASTM F436.

4.2.6 Base Anchors at Concrete Foundation or Slab: Hold-down Anchors and Rods: High Strength (HS) anchors shall be used for attachment to concrete. High Strength hold-down anchors shall comply with ASTM F 1554, Grade 105; ASTM A 193, Grade B7; or ASTM A 354, Grade BD. Nuts for HS anchors shall comply with Section 4.2.4 of this report. Plate washers that are used for the end of embed rods shall comply with ASTM A36 or ASTM A572-50.

4.2.7 Wood Screws: Wood screws are for steel-to-wood connections. Uses with the Hardy Frame® CFS Frame, are as indicated in this report. Screws shall be MiTek® Pro-Series WS Series or approved equivalent. Screw dimensions, design, and installation requirements shall be as indicated in Table 1A of this report.

4.2.8 Self-drilling Tapping Screws: The screws fastening the Hardy Frame® CFS frames to other elements of the CFS structure (collector, drag, straps, etc.) shall conform to the requirements of SAE J78, ASTM C954, or C1513. In addition, when evaluated in accordance with AISI S904, the nominal tensile and nominal shear strength of the screws (P_{nts} and P_{nvs} per AISI S100-16; or P_{ts} and P_{ss} per AISI S100-12) shall be no less than 4,000 pounds (17792 N) and 2,000 pounds (8896 N), respectively.

5.0 IDENTIFICATION

MiTek's Hardy Frame® Cold-Formed Steel (CFS) Moment Frames are identified by labels bearing the following information: manufacturer's name (MiTek Inc.) and address, product name, model number, evaluation report number (IAPMO ER-491), and the name of the inspection agency (RADCO, Inc). The spacer identification may also include the IAPMO Uniform Evaluation Service Mark of Conformity. Either Mark of Conformity may be used as shown below:

or

IAPMO UES ER-491

6.0 SUBSTANTIATING DATA

6.1 Report on *Light Gage Cold-Formed Steel Moment Frame, Experimental and Numerical Analysis, Design Procedure*.

6.2 Test reports are from laboratories in compliance with ISO/IEC 17025.

6.3 Structural calculations in accordance with Chapters 19, 22, and 23 of 2018 and 2015 IBC.

6.4 Quality documentation.

6.5 Production Drawings

6.6 Product and installation details.

6.7 Manufacturer's descriptive literature and installation instructions.

6.8 Report of physical and mechanical property testing in accordance with ASTM A370.

6.9 Test report on *Cyclic Lateral Load Testing of Lightgage Steel Moment Frame* (*Phase I, Phase II, Phase III, and Phase IV*) in accordance with ASTM E2126.

6.10 CFS Connection Testing Report on *Cyclic Lateral Load Testing of Joints* in accordance with ASTM E2126 and AISC 341.

6.11 Data in accordance with ASTM D7989, *Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels.*

6.12 Data in accordance with ICC-ES AC322 Approved August 2018, *Acceptance Criteria for Prefabricated, Cold-formed, Steel Lateral-Force-Resisting Vertical Assemblies.*

7.0 STATEMENT OF RECOGNITION

This evaluation report describes the results of research completed by IAPMO Uniform Evaluation Service on Hardy Frame® Cold-Formed Steel (CFS) Moment Frames. –The UES Technical Committee finds that, in their opinion, the design, detailing, and installation of CFS Moment Frames as described in this report conform with or are suitable alternates to that specified in the codes referenced in Section 1.0 of this report. Products are manufactured at the location noted in Section 2.11 of this report under a quality control program with periodic inspections under the supervision of IAPMO UES.

TABLE 1A: HF CFS Frame Member Size and Attachment

HFXMF & HFXPIC Model Numbers	Col Depth in	Beam Depth in	Min WS3 Screw Qty for Shear Transfer in Wood	Min # of Anchor & Bolts Diameter for Shear Transfer in Concrete
HFXPIC1212	12	12	18	4 EA - 5/8" Dia
HFXMF1212				N/A
HFXPIC1512	15		22	4 EA - 5/8" Dia
HFXMF1512				N/A
HFXPIC1812	18		26	4 EA - 5/8" Dia
HFXMF1812				N/A
HFXPIC2112	21		30	4 EA - 5/8" Dia
HFXMF2112				N/A
HFXPIC1515	15	15	28	4 EA - 5/8" Dia
HFXMF1515				N/A
HFXPIC1815	18		32	4 EA - 5/8" Dia
HFXMF1815				N/A
HFXPIC2115	21		36	4 EA - 5/8" Dia
HFXMF2115				N/A
HFXPIC2415	24		42	6 EA - 5/8" Dia
HFXMF2415				N/A
HFXPIC1818	18	18	42	4 EA - 5/8" Dia
HFXMF1818				N/A
HFXPIC2118	21		48	6 EA - 5/8" Dia
HFXMF2118				N/A
HFXPIC2418	24		54	6 EA - 5/8" Dia
HFXMF2418				N/A

TABLE 2A: Lateral Load Capacity for PORTAL Frame on Concrete [1,2,5,8]

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3] lbs.	Story Drift Δ_{ASD}[4] in.	Unfactored Gravity Load w_g[6] lbs/ft	Axial Load on Column (w/o col post) P_c[7] lbs.	Axial Load on Column (w/ col post) P_c[7] lbs.
HFXMF1212 8x8	8'-0"	8'-0"	11,400	0.399	2,230	20,300	20,300
HFXMF1512 8x8	8'-0"	8'-0"	13,000	0.368	3,140	25,100	31,000
HFXMF1515 8x8	8'-0"	8'-0"	14,300	0.361	3,930	23,100	29,600
HFXMF1812 8x8	8'-0"	8'-0"	17,000	0.359	2,950	21,100	26,400
HFXMF1815 8x8	8'-0"	8'-0"	18,800	0.351	3,430	19,100	24,900
HFXMF2112 8x8	8'-0"	8'-0"	18,800	0.313	3,110	23,200	28,800
HFXMF2115 8x8	8'-0"	8'-0"	20,900	0.306	4,300	20,600	26,800
HFXMF1212 9x8	9'-0"	8'-0"	11,300	0.399	1,780	21,000	21,000
HFXMF1512 9x8	9'-0"	8'-0"	13,000	0.372	2,410	25,400	31,300
HFXMF1515 9x8	9'-0"	8'-0"	14,300	0.365	2,950	23,700	30,200
HFXMF1812 9x8	9'-0"	8'-0"	17,000	0.365	2,330	21,500	26,700
HFXMF1815 9x8	9'-0"	8'-0"	18,800	0.356	2,620	19,700	25,400
HFXMF2112 9x8	9'-0"	8'-0"	18,800	0.318	2,820	23,400	29,000
HFXMF2115 9x8	9'-0"	8'-0"	20,900	0.311	3,700	21,100	27,200
HFXMF1212 10x8	10'-0"	8'-0"	11,200	0.399	1,450	21,400	21,400
HFXMF1512 10x8	10'-0"	8'-0"	13,000	0.377	1,920	25,600	31,400
HFXMF1515 10x8	10'-0"	8'-0"	14,300	0.368	2,300	24,000	30,500
HFXMF1812 10x8	10'-0"	8'-0"	17,000	0.369	1,890	21,700	26,800
HFXMF1815 10x8	10'-0"	8'-0"	18,800	0.358	2,090	20,100	25,800
HFXMF2112 10x8	10'-0"	8'-0"	18,800	0.322	2,550	23,500	28,900
HFXMF2115 10x8	10'-0"	8'-0"	20,900	0.314	2,950	21,600	27,600
HFXMF1212 11x8	11'-0"	8'-0"	11,000	0.399	1,230	21,900	21,900
HFXMF1512 11x8	11'-0"	8'-0"	13,000	0.382	1,570	25,600	31,400
HFXMF1515 11x8	11'-0"	8'-0"	14,300	0.370	1,840	24,300	30,700
HFXMF1812 11x8	11'-0"	8'-0"	17,000	0.375	1,580	21,800	26,800
HFXMF1815 11x8	11'-0"	8'-0"	18,800	0.362	1,710	20,400	26,000
HFXMF2112 11x8	11'-0"	8'-0"	18,800	0.327	2,190	23,500	28,900
HFXMF2115 11x8	11'-0"	8'-0"	20,900	0.316	2,410	21,900	27,800
HFXMF1212 12x8	12'-0"	8'-0"	10,900	0.399	1,050	22,300	22,300
HFXMF1512 12x8	12'-0"	8'-0"	13,000	0.387	1,310	25,600	31,300
HFXMF1515 12x8	12'-0"	8'-0"	14,300	0.374	1,510	24,400	30,800
HFXMF1812 12x8	12'-0"	8'-0"	17,000	0.381	1,350	21,800	26,700
HFXMF1815 12x8	12'-0"	8'-0"	18,800	0.367	1,430	20,600	26,100
HFXMF2112 12x8	12'-0"	8'-0"	18,800	0.331	1,860	23,500	28,800
HFXMF2115 12x8	12'-0"	8'-0"	20,900	0.321	2,020	22,100	28,000
HFXMF1212 13x8	13'-0"	8'-0"	10,800	0.399	910	22,600	22,600
HFXMF1512 13x8	13'-0"	8'-0"	13,000	0.391	1,120	25,600	31,200
HFXMF1515 13x8	13'-0"	8'-0"	14,300	0.377	1,260	24,500	30,800
HFXMF1812 13x8	13'-0"	8'-0"	17,000	0.385	1,160	21,700	26,600
HFXMF1815 13x8	13'-0"	8'-0"	18,800	0.369	1,220	20,700	26,200
HFXMF2112 13x8	13'-0"	8'-0"	18,800	0.336	1,620	23,500	28,700
HFXMF2115 13x8	13'-0"	8'-0"	20,900	0.324	1,720	22,200	28,000
HFXMF1212 14x8	14'-0"	8'-0"	10,700	0.399	800	22,800	22,800
HFXMF1512 14x8	14'-0"	8'-0"	13,000	0.396	960	25,500	31,100
HFXMF1515 14x8	14'-0"	8'-0"	14,300	0.380	1,070	24,500	30,800
HFXMF1812 14x8	14'-0"	8'-0"	17,000	0.391	1,020	21,600	26,400
HFXMF1815 14x8	14'-0"	8'-0"	18,800	0.374	1,050	20,700	26,100
HFXMF2112 14x8	14'-0"	8'-0"	18,800	0.340	1,410	23,400	28,600
HFXMF2115 14x8	14'-0"	8'-0"	20,900	0.328	1,490	22,300	28,100
HFXMF1212 16x8	16'-0"	8'-0"	10,400	0.399	640	23,300	23,300
HFXMF1512 16x8	16'-0"	8'-0"	12,800	0.399	760	25,700	31,300
HFXMF1515 16x8	16'-0"	8'-0"	14,300	0.388	810	24,500	30,700
HFXMF1812 16x8	16'-0"	8'-0"	16,900	0.399	810	21,400	26,100
HFXMF1815 16x8	16'-0"	8'-0"	18,800	0.382	820	20,600	25,900
HFXMF2112 16x8	16'-0"	8'-0"	18,800	0.345	1,120	23,600	28,700
HFXMF2115 16x8	16'-0"	8'-0"	20,900	0.330	1,190	22,900	28,600
HFXMF1212 18x8	18'-0"	8'-0"	10,200	0.399	520	23,600	23,600
HFXMF1512 18x8	18'-0"	8'-0"	12,500	0.399	630	26,100	31,700
HFXMF1515 18x8	18'-0"	8'-0"	14,300	0.396	640	24,300	30,400
HFXMF1812 18x8	18'-0"	8'-0"	16,500	0.399	680	21,900	26,600
HFXMF1815 18x8	18'-0"	8'-0"	18,800	0.389	660	20,400	25,600
HFXMF2112 18x8	18'-0"	8'-0"	18,800	0.347	930	24,000	29,000

TABLE 2A: Lateral Load Capacity for PORTAL Frame on Concrete [1,2,5,8]

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXMF2115 18x8	18'-0"	8'-0"	20,900	0.332	970	23,300	29,000
HFXMF1212 20x8	20'-0"	8'-0"	10,000	0.399	440	24,000	24,000
HFXMF1512 20x8	20'-0"	8'-0"	12,200	0.399	530	26,500	32,100
HFXMF1515 20x8	20'-0"	8'-0"	14,200	0.399	520	24,400	30,500
HFXMF1812 20x8	20'-0"	8'-0"	16,200	0.399	590	22,300	27,000
HFXMF1815 20x8	20'-0"	8'-0"	18,800	0.396	540	20,100	25,200
HFXMF2112 20x8	20'-0"	8'-0"	18,800	0.332	780	24,200	29,300
HFXMF2115 20x8	20'-0"	8'-0"	20,900	0.334	820	23,600	29,300
HFXMF1212 8x9	8'-0"	9'-0"	9,600	0.449	2,640	19,600	19,600
HFXMF1512 8x9	8'-0"	9'-0"	11,400	0.425	3,220	22,600	28,100
HFXMF1515 8x9	8'-0"	9'-0"	12,500	0.417	4,200	20,900	27,000
HFXMF1812 8x9	8'-0"	9'-0"	14,800	0.413	2,990	19,100	24,000
HFXMF1815 8x9	8'-0"	9'-0"	16,300	0.403	3,620	17,300	22,700
HFXMF2112 8x9	8'-0"	9'-0"	16,400	0.357	3,090	20,900	26,200
HFXMF2115 8x9	8'-0"	9'-0"	18,200	0.351	4,300	18,600	24,500
HFXMF1212 9x9	9'-0"	9'-0"	9,500	0.449	2,060	20,200	20,200
HFXMF1512 9x9	9'-0"	9'-0"	11,400	0.430	2,470	23,000	28,400
HFXMF1515 9x9	9'-0"	9'-0"	12,500	0.420	3,140	21,500	27,500
HFXMF1812 9x9	9'-0"	9'-0"	14,800	0.419	2,350	19,500	24,300
HFXMF1815 9x9	9'-0"	9'-0"	16,300	0.407	2,760	17,900	23,300
HFXMF2112 9x9	9'-0"	9'-0"	16,400	0.363	2,800	21,200	26,400
HFXMF2115 9x9	9'-0"	9'-0"	18,200	0.353	3,810	19,100	24,900
HFXMF1212 10x9	10'-0"	9'-0"	9,400	0.449	1,670	20,700	20,700
HFXMF1512 10x9	10'-0"	9'-0"	11,400	0.435	1,960	23,200	28,600
HFXMF1515 10x9	10'-0"	9'-0"	12,500	0.423	2,430	21,800	27,900
HFXMF1812 10x9	10'-0"	9'-0"	14,800	0.424	1,910	19,800	24,500
HFXMF1815 10x9	10'-0"	9'-0"	16,300	0.411	2,190	18,400	23,800
HFXMF2112 10x9	10'-0"	9'-0"	16,400	0.369	2,540	21,300	26,400
HFXMF2115 10x9	10'-0"	9'-0"	18,200	0.357	3,030	19,600	25,400
HFXMF1212 11x9	11'-0"	9'-0"	9,300	0.449	1,390	21,100	21,100
HFXMF1512 11x9	11'-0"	9'-0"	11,400	0.441	1,600	23,300	28,600
HFXMF1515 11x9	11'-0"	9'-0"	12,500	0.428	1,950	22,100	28,100
HFXMF1812 11x9	11'-0"	9'-0"	14,800	0.429	1,590	19,900	24,600
HFXMF1815 11x9	11'-0"	9'-0"	16,300	0.415	1,780	18,700	24,000
HFXMF2112 11x9	11'-0"	9'-0"	16,400	0.375	2,190	21,400	26,400
HFXMF2115 11x9	11'-0"	9'-0"	18,200	0.362	2,470	20,000	25,600
HFXMF1212 12x9	12'-0"	9'-0"	9,200	0.449	1,170	21,400	21,400
HFXMF1512 12x9	12'-0"	9'-0"	11,400	0.446	1,330	23,400	28,600
HFXMF1515 12x9	12'-0"	9'-0"	12,500	0.431	1,590	22,300	28,200
HFXMF1812 12x9	12'-0"	9'-0"	14,800	0.437	1,350	20,000	24,600
HFXMF1815 12x9	12'-0"	9'-0"	16,300	0.418	1,480	18,900	24,200
HFXMF2112 12x9	12'-0"	9'-0"	16,400	0.379	1,860	21,500	26,400
HFXMF2115 12x9	12'-0"	9'-0"	18,200	0.366	2,060	20,200	25,800
HFXMF1212 13x9	13'-0"	9'-0"	9,100	0.449	1,020	21,700	21,700
HFXMF1512 13x9	13'-0"	9'-0"	11,300	0.449	1,140	23,500	28,800
HFXMF1515 13x9	13'-0"	9'-0"	12,500	0.435	1,330	22,400	28,300
HFXMF1812 13x9	13'-0"	9'-0"	14,800	0.442	1,160	19,900	24,500
HFXMF1815 13x9	13'-0"	9'-0"	16,300	0.423	1,250	19,000	24,300
HFXMF2112 13x9	13'-0"	9'-0"	16,400	0.384	1,610	21,500	26,300
HFXMF2115 13x9	13'-0"	9'-0"	18,200	0.370	1,760	20,300	25,900
HFXMF1212 14x9	14'-0"	9'-0"	9,000	0.449	880	21,900	21,900
HFXMF1512 14x9	14'-0"	9'-0"	11,200	0.449	1,010	23,800	29,100
HFXMF1515 14x9	14'-0"	9'-0"	12,500	0.438	1,120	22,400	28,300
HFXMF1812 14x9	14'-0"	9'-0"	14,800	0.447	1,020	19,900	24,300
HFXMF1815 14x9	14'-0"	9'-0"	16,300	0.428	1,080	19,100	24,300
HFXMF2112 14x9	14'-0"	9'-0"	16,400	0.390	1,400	21,400	26,200
HFXMF2115 14x9	14'-0"	9'-0"	18,200	0.375	1,510	20,400	25,900
HFXMF1212 16x9	16'-0"	9'-0"	8,800	0.449	690	22,400	22,400
HFXMF1512 16x9	16'-0"	9'-0"	10,900	0.449	800	24,300	29,600
HFXMF1515 16x9	16'-0"	9'-0"	12,500	0.447	850	22,500	28,300
HFXMF1812 16x9	16'-0"	9'-0"	14,500	0.449	840	20,500	25,000
HFXMF1815 16x9	16'-0"	9'-0"	16,300	0.437	860	19,500	24,600

TABLE 2A: Lateral Load Capacity for PORTAL Frame on Concrete [1,2,5,8] (continued)

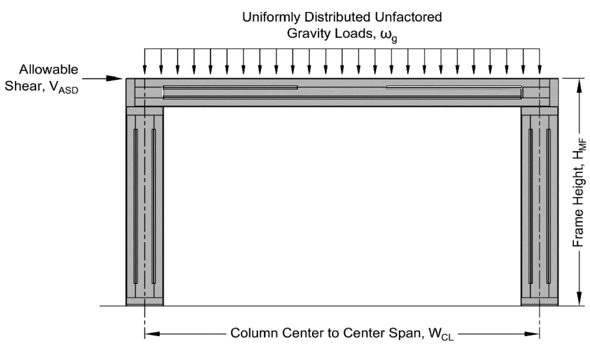
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXMF2112 16x9	16'-0"	9'-0"	16,400	0.400	1,100	21,200	25,900
HFXMF2115 16x9	16'-0"	9'-0"	18,200	0.384	1,170	20,400	25,800
HFXMF1212 18x9	18'-0"	9'-0"	8,600	0.449	560	22,700	22,700
HFXMF1512 18x9	18'-0"	9'-0"	10,700	0.449	660	24,700	29,900
HFXMF1515 18x9	18'-0"	9'-0"	12,300	0.449	670	22,800	28,600
HFXMF1812 18x9	18'-0"	9'-0"	14,200	0.449	700	20,900	25,400
HFXMF1815 18x9	18'-0"	9'-0"	16,300	0.445	670	19,000	23,900
HFXMF2112 18x9	18'-0"	9'-0"	16,400	0.405	900	21,400	26,000
HFXMF2115 18x9	18'-0"	9'-0"	18,200	0.385	950	20,800	26,100
HFXMF1212 20x9	20'-0"	9'-0"	8,500	0.449	470	23,000	23,000
HFXMF1512 20x9	20'-0"	9'-0"	10,500	0.449	550	25,000	30,300
HFXMF1515 20x9	20'-0"	9'-0"	12,100	0.449	560	23,100	28,900
HFXMF1812 20x9	20'-0"	9'-0"	13,900	0.449	600	21,300	25,800
HFXMF1815 20x9	20'-0"	9'-0"	16,100	0.449	560	19,100	24,000
HFXMF2112 20x9	20'-0"	9'-0"	16,400	0.406	760	21,600	26,300
HFXMF2115 20x9	20'-0"	9'-0"	18,200	0.388	800	21,000	26,400
HFXMF1212 8x10	8'-0"	10'-0"	8,200	0.499	3,020	18,300	18,300
HFXMF1512 8x10	8'-0"	10'-0"	10,100	0.485	3,300	20,100	25,000
HFXMF1515 8x10	8'-0"	10'-0"	11,000	0.477	4,420	18,500	24,100
HFXMF1812 8x10	8'-0"	10'-0"	13,200	0.469	3,000	16,900	21,400
HFXMF1815 8x10	8'-0"	10'-0"	14,400	0.458	3,720	15,200	20,300
HFXMF2112 8x10	8'-0"	10'-0"	14,600	0.405	3,060	18,500	23,400
HFXMF2115 8x10	8'-0"	10'-0"	16,100	0.397	4,040	16,500	22,100
HFXMF1212 9x10	9'-0"	10'-0"	8,200	0.499	2,340	18,900	18,900
HFXMF1512 9x10	9'-0"	10'-0"	10,100	0.490	2,520	20,400	31,900
HFXMF1515 9x10	9'-0"	10'-0"	11,000	0.480	3,290	19,000	31,000
HFXMF1812 9x10	9'-0"	10'-0"	13,200	0.476	2,360	17,400	21,800
HFXMF1815 9x10	9'-0"	10'-0"	14,400	0.462	2,860	15,900	21,000
HFXMF2112 9x10	9'-0"	10'-0"	14,600	0.410	2,780	18,900	29,800
HFXMF2115 9x10	9'-0"	10'-0"	16,100	0.401	3,710	17,000	22,400
HFXMF1212 10x10	10'-0"	10'-0"	8,100	0.499	1,870	19,300	19,300
HFXMF1512 10x10	10'-0"	10'-0"	10,100	0.496	2,000	20,700	25,600
HFXMF1515 10x10	10'-0"	10'-0"	11,000	0.483	2,550	19,400	25,000
HFXMF1812 10x10	10'-0"	10'-0"	13,200	0.482	1,910	17,700	22,000
HFXMF1815 10x10	10'-0"	10'-0"	14,400	0.465	2,260	16,400	21,400
HFXMF2112 10x10	10'-0"	10'-0"	14,600	0.417	2,520	19,000	23,700
HFXMF2115 10x10	10'-0"	10'-0"	16,100	0.405	3,090	17,400	22,800
HFXMF1212 11x10	11'-0"	10'-0"	8,000	0.499	1,540	19,700	19,700
HFXMF1512 11x10	11'-0"	10'-0"	10,000	0.499	1,640	21,000	32,300
HFXMF1515 11x10	11'-0"	10'-0"	11,000	0.487	2,020	19,700	31,500
HFXMF1812 11x10	11'-0"	10'-0"	13,200	0.488	1,590	17,800	22,100
HFXMF1815 11x10	11'-0"	10'-0"	14,400	0.470	1,830	16,800	21,700
HFXMF2112 11x10	11'-0"	10'-0"	14,600	0.422	2,190	19,100	29,600
HFXMF2115 11x10	11'-0"	10'-0"	16,100	0.408	2,520	17,800	23,100
HFXMF1212 12x10	12'-0"	10'-0"	7,900	0.499	1,290	20,100	20,100
HFXMF1512 12x10	12'-0"	10'-0"	9,900	0.499	1,400	21,400	26,300
HFXMF1515 12x10	12'-0"	10'-0"	11,000	0.490	1,650	19,900	25,400
HFXMF1812 12x10	12'-0"	10'-0"	13,200	0.495	1,340	17,900	22,200
HFXMF1815 12x10	12'-0"	10'-0"	14,400	0.475	1,520	17,000	21,900
HFXMF2112 12x10	12'-0"	10'-0"	14,600	0.429	1,850	19,200	23,800
HFXMF2115 12x10	12'-0"	10'-0"	16,100	0.412	2,100	18,100	23,300
HFXMF1212 13x10	13'-0"	10'-0"	7,800	0.499	1,100	20,300	20,300
HFXMF1512 13x10	13'-0"	10'-0"	9,800	0.499	1,220	21,800	33,100
HFXMF1515 13x10	13'-0"	10'-0"	11,000	0.496	1,380	20,100	31,700
HFXMF1812 13x10	13'-0"	10'-0"	13,100	0.499	1,180	18,200	22,400
HFXMF1815 13x10	13'-0"	10'-0"	14,400	0.479	1,290	17,200	22,000
HFXMF2112 13x10	13'-0"	10'-0"	14,600	0.435	1,600	19,300	29,500
HFXMF2115 13x10	13'-0"	10'-0"	16,100	0.418	1,780	18,200	23,500
HFXMF1212 14x10	14'-0"	10'-0"	7,700	0.499	960	20,600	20,600
HFXMF1512 14x10	14'-0"	10'-0"	9,700	0.499	1,060	22,000	26,900
HFXMF1515 14x10	14'-0"	10'-0"	11,000	0.499	1,170	20,200	25,700
HFXMF1812 14x10	14'-0"	10'-0"	12,900	0.499	1,050	18,500	22,800

TABLE 2A: Lateral Load Capacity for PORTAL Frame on Concrete [1,2,5,8] (continued)

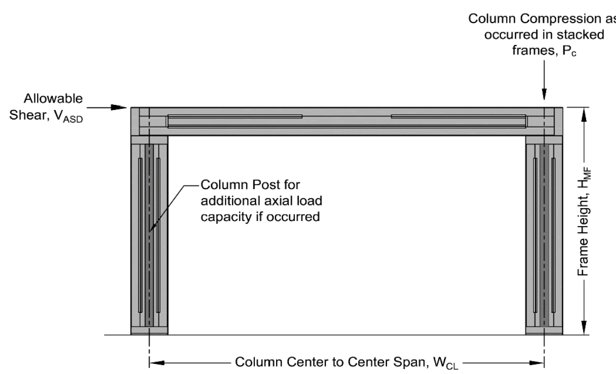
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs	lbs
HFXMF1815 14x10	14'-0"	10'-0"	14,400	0.484	1,110	17,300	22,100
HFXMF2112 14x10	14'-0"	10'-0"	14,600	0.442	1,390	19,300	23,700
HFXMF2115 14x10	14'-0"	10'-0"	16,100	0.422	1,530	18,400	23,500
HFXMF1212 16x10	16'-0"	10'-0"	7,600	0.499	740	21,000	21,000
HFXMF1512 16x10	16'-0"	10'-0"	9,500	0.499	840	22,500	33,900
HFXMF1515 16x10	16'-0"	10'-0"	10,800	0.499	900	20,700	32,300
HFXMF1812 16x10	16'-0"	10'-0"	12,600	0.499	860	19,100	23,300
HFXMF1815 16x10	16'-0"	10'-0"	14,400	0.495	860	17,300	22,000
HFXMF2112 16x10	16'-0"	10'-0"	14,600	0.452	1,090	19,200	29,000
HFXMF2115 16x10	16'-0"	10'-0"	16,100	0.432	1,180	18,400	23,500
HFXMF1212 18x10	18'-0"	10'-0"	7,400	0.499	600	21,300	21,300
HFXMF1512 18x10	18'-0"	10'-0"	9,300	0.499	680	22,900	27,700
HFXMF1515 18x10	18'-0"	10'-0"	10,600	0.499	730	21,200	26,600
HFXMF1812 18x10	18'-0"	10'-0"	12,400	0.499	710	19,600	23,800
HFXMF1815 18x10	18'-0"	10'-0"	14,300	0.499	690	17,600	22,300
HFXMF2112 18x10	18'-0"	10'-0"	14,600	0.463	880	19,000	23,200
HFXMF2115 18x10	18'-0"	10'-0"	16,100	0.441	940	18,400	23,300
HFXMF1212 20x10	20'-0"	10'-0"	7,300	0.499	490	21,500	21,500
HFXMF1512 20x10	20'-0"	10'-0"	9,100	0.499	570	23,200	34,500
HFXMF1515 20x10	20'-0"	10'-0"	10,500	0.499	600	21,500	33,100
HFXMF1812 20x10	20'-0"	10'-0"	12,100	0.499	610	19,900	24,200
HFXMF1815 20x10	20'-0"	10'-0"	14,000	0.499	590	18,000	22,700
HFXMF2112 20x10	20'-0"	10'-0"	14,600	0.467	740	19,100	28,600
HFXMF2115 20x10	20'-0"	10'-0"	16,100	0.446	780	18,600	23,400

Table Notes:

1. These table values reflect Allowable Strength Design (ASD) with *Tensioned* bolt connections at the Panel Zones and installation on 2,500 psi minimum compressive strength concrete or nuts and washers elevated up to 1½ inches above concrete with 5,000 psi minimum compressive strength non-shrink grout.
2. Hardy Frame CFS Moment Frames are designed to conform to strength and deflection limitations in accordance with applicable code requirements (AISI-S100, AISI-S240, AISI- S400, AISC-360, and IBC) using Load and Resistance Factored Design (LRFD).
3. V_{ASD} in this table are seismic capacities for R = 6.5 and C_d = 4.0. For wind design, allowable shear loads may be determined by multiplying values in the table with a factor of 0.85.
   $V_{ASD\text{-}wind} = 0.85 V_{ASD}$
4. Δ_{ASD} represents inter-story drift at allowable shear load (V_{ASD}) that does not exceed the code required limitation for the seismic load (Δ_s = 0.025h) and is limited to h/267 for ASD wind load.
5. Tabulated allowable axial load on the column excludes the overstrength (Ω_0) factor.
6. w_g is the maximum unfactored uniform gravity loads applied on the beam in combination with V_{ASD} as shown in Case A illustration below.
7. P_c is the maximum axial load that can be applied on the column in combination with V_{ASD} as shown in Case B illustration below. When uniform gravity loads on the beam, w, are combined with both V_{ASD} and P_c, reduce P_c by $\omega \times W_{CL}/2$ as follows: $P_c - \omega \times W_{CL}/2$.
8. Anchor bolts to concrete shall comply with ASTM A193 Grade B7 or equivalent.



CASE A ILLUSTRATION



CASE B ILLUSTRATION

TABLE 2B: Lateral Load Capacity for PICTURE Frame on Concrete [1,2,5,8]

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3] lbs.	Story Drift Δ_{ASD}[4] in.	Unfactored Gravity Load w_g[6] lbs/ft	Axial Load on Column (w/o col post) P_c[7] lbs.	Axial Load on Column (w/ col post) P_c[7] lbs.
HFXPIC1212 8x8	8'-0"	8'-0"	12,000	0.388	1,800	31,000	N/A
HFXPIC1512 8x8	8'-0"	8'-0"	14,300	0.399	1,890	34,400	42,000
HFXPIC1515 8x8	8'-0"	8'-0"	18,200	0.381	1,440	30,000	37,100
HFXPIC1812 8x8	8'-0"	8'-0"	16,700	0.384	2,000	35,500	43,200
HFXPIC1815 8x8	8'-0"	8'-0"	21,100	0.357	1,800	31,600	38,900
HFXPIC2112 8x8	8'-0"	8'-0"	18,800	0.378	2,280	35,900	43,900
HFXPIC2115 8x8	8'-0"	8'-0"	24,000	0.347	2,220	32,800	40,600
HFXPIC1212 9x8	9'-0"	8'-0"	12,000	0.398	1,320	31,600	N/A
HFXPIC1512 9x8	9'-0"	8'-0"	13,900	0.399	1,630	35,200	42,800
HFXPIC1515 9x8	9'-0"	8'-0"	18,200	0.389	1,050	30,900	38,100
HFXPIC1812 9x8	9'-0"	8'-0"	16,700	0.399	1,500	36,300	44,000
HFXPIC1815 9x8	9'-0"	8'-0"	21,100	0.367	1,310	32,600	40,000
HFXPIC2112 9x8	9'-0"	8'-0"	18,800	0.395	1,710	36,800	44,800
HFXPIC2115 9x8	9'-0"	8'-0"	24,000	0.358	1,640	34,000	41,800
HFXPIC1212 10x8	10'-0"	8'-0"	11,700	0.399	1,150	32,100	N/A
HFXPIC1512 10x8	10'-0"	8'-0"	13,400	0.399	1,410	35,800	43,300
HFXPIC1515 10x8	10'-0"	8'-0"	18,200	0.398	780	31,700	38,800
HFXPIC1812 10x8	10'-0"	8'-0"	16,000	0.399	1,380	37,000	44,700
HFXPIC1815 10x8	10'-0"	8'-0"	21,100	0.378	990	33,500	40,900
HFXPIC2112 10x8	10'-0"	8'-0"	18,100	0.399	1,530	37,600	45,700
HFXPIC2115 10x8	10'-0"	8'-0"	24,000	0.369	1,250	35,000	42,800
HFXPIC1212 11x8	11'-0"	8'-0"	11,400	0.399	1,020	32,500	N/A
HFXPIC1512 11x8	11'-0"	8'-0"	13,000	0.399	1,240	36,300	43,800
HFXPIC1515 11x8	11'-0"	8'-0"	17,800	0.399	730	33,000	40,300
HFXPIC1812 11x8	11'-0"	8'-0"	15,400	0.399	1,170	38,100	45,900
HFXPIC1815 11x8	11'-0"	8'-0"	21,100	0.388	770	34,200	41,600
HFXPIC2112 11x8	11'-0"	8'-0"	17,400	0.399	1,420	38,300	46,400
HFXPIC2115 11x8	11'-0"	8'-0"	24,000	0.381	980	35,800	43,600
HFXPIC1212 12x8	12'-0"	8'-0"	11,100	0.399	890	32,800	N/A
HFXPIC1512 12x8	12'-0"	8'-0"	12,600	0.399	1,110	36,700	44,200
HFXPIC1515 12x8	12'-0"	8'-0"	17,400	0.399	700	34,500	41,900
HFXPIC1812 12x8	12'-0"	8'-0"	14,800	0.399	1,150	38,100	45,800
HFXPIC1815 12x8	12'-0"	8'-0"	21,100	0.399	620	34,900	42,300
HFXPIC2112 12x8	12'-0"	8'-0"	16,600	0.399	1,300	38,900	46,900
HFXPIC2115 12x8	12'-0"	8'-0"	24,000	0.395	790	36,400	44,300
HFXPIC1212 13x8	13'-0"	8'-0"	10,700	0.399	810	33,100	N/A
HFXPIC1512 13x8	13'-0"	8'-0"	12,200	0.399	1,000	37,000	44,500
HFXPIC1515 13x8	13'-0"	8'-0"	17,000	0.399	670	35,700	43,200
HFXPIC1812 13x8	13'-0"	8'-0"	14,200	0.399	1,050	38,500	46,200
HFXPIC1815 13x8	13'-0"	8'-0"	20,500	0.399	620	36,400	44,000
HFXPIC2112 13x8	13'-0"	8'-0"	15,900	0.399	1,200	39,400	47,400
HFXPIC2115 13x8	13'-0"	8'-0"	23,500	0.399	730	37,500	45,500
HFXPIC1212 14x8	14'-0"	8'-0"	10,500	0.399	730	33,300	N/A
HFXPIC1512 14x8	14'-0"	8'-0"	11,800	0.399	890	37,300	44,700
HFXPIC1515 14x8	14'-0"	8'-0"	16,600	0.399	630	36,500	44,100
HFXPIC1812 14x8	14'-0"	8'-0"	13,700	0.399	960	38,900	46,500
HFXPIC1815 14x8	14'-0"	8'-0"	19,900	0.399	620	37,600	45,300
HFXPIC2112 14x8	14'-0"	8'-0"	15,300	0.399	1,100	39,800	47,800
HFXPIC2115 14x8	14'-0"	8'-0"	22,700	0.399	730	38,000	46,000
HFXPIC1212 16x8	16'-0"	8'-0"	9,900	0.399	600	33,600	N/A
HFXPIC1512 16x8	16'-0"	8'-0"	11,100	0.399	740	37,700	45,100
HFXPIC1515 16x8	16'-0"	8'-0"	15,800	0.399	550	37,000	44,500
HFXPIC1812 16x8	16'-0"	8'-0"	12,800	0.399	820	39,300	47,000
HFXPIC1815 16x8	16'-0"	8'-0"	18,800	0.399	580	38,200	45,800
HFXPIC2112 16x8	16'-0"	8'-0"	14,100	0.399	940	40,400	48,300
HFXPIC2115 16x8	16'-0"	8'-0"	21,300	0.399	680	38,800	46,700
HFXPIC1212 18x8	18'-0"	8'-0"	9,400	0.399	510	33,800	N/A
HFXPIC1512 18x8	18'-0"	8'-0"	10,400	0.399	630	37,900	45,400
HFXPIC1515 18x8	18'-0"	8'-0"	15,100	0.399	490	37,300	44,800
HFXPIC1812 18x8	18'-0"	8'-0"	11,900	0.399	690	39,700	47,300
HFXPIC1815 18x8	18'-0"	8'-0"	17,800	0.399	530	38,600	46,300
HFXPIC2112 18x8	18'-0"	8'-0"	13,100	0.399	810	40,800	48,700

TABLE 2B: Lateral Load Capacity for PICTURE Frame on Concrete [1,2,5,8] (continued)

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXPIC2115 18x8	18'-0"	8'-0"	20,000	0.399	640	39,300	47,200
HFXPIC1212 20x8	20'-0"	8'-0"	8,900	0.399	440	34,000	N/A
HFXPIC1512 20x8	20'-0"	8'-0"	9,900	0.399	530	38,100	45,600
HFXPIC1515 20x8	20'-0"	8'-0"	14,500	0.399	440	37,600	45,100
HFXPIC1812 20x8	20'-0"	8'-0"	11,200	0.399	600	40,000	47,500
HFXPIC1815 20x8	20'-0"	8'-0"	16,900	0.399	480	39,000	46,500
HFXPIC2112 20x8	20'-0"	8'-0"	12,200	0.399	700	41,100	49,000
HFXPIC2115 20x8	20'-0"	8'-0"	18,900	0.399	580	39,700	47,600
HFXPIC1212 8x9	8'-0"	9'-0"	10,300	0.449	2,070	27,500	N/A
HFXPIC1512 8x9	8'-0"	9'-0"	12,000	0.449	2,350	30,900	37,800
HFXPIC1515 8x9	8'-0"	9'-0"	15,400	0.443	1,860	27,500	34,100
HFXPIC1812 8x9	8'-0"	9'-0"	14,300	0.440	2,210	31,900	38,900
HFXPIC1815 8x9	8'-0"	9'-0"	17,900	0.412	2,200	29,000	35,800
HFXPIC2112 8x9	8'-0"	9'-0"	16,100	0.430	2,490	32,200	39,600
HFXPIC2115 8x9	8'-0"	9'-0"	20,300	0.396	2,280	30,100	37,400
HFXPIC1212 9x9	9'-0"	9'-0"	10,000	0.449	1,700	28,200	N/A
HFXPIC1512 9x9	9'-0"	9'-0"	11,600	0.449	1,940	31,600	38,500
HFXPIC1515 9x9	9'-0"	9'-0"	15,300	0.449	1,410	28,600	35,300
HFXPIC1812 9x9	9'-0"	9'-0"	14,000	0.449	1,780	32,700	39,700
HFXPIC1815 9x9	9'-0"	9'-0"	17,900	0.422	1,610	30,000	36,900
HFXPIC2112 9x9	9'-0"	9'-0"	16,100	0.449	1,870	33,000	40,500
HFXPIC2115 9x9	9'-0"	9'-0"	20,300	0.407	1,950	31,100	38,500
HFXPIC1212 10x9	10'-0"	9'-0"	9,700	0.449	1,430	28,600	N/A
HFXPIC1512 10x9	10'-0"	9'-0"	11,200	0.449	1,650	32,200	39,100
HFXPIC1515 10x9	10'-0"	9'-0"	15,000	0.449	1,240	30,100	36,900
HFXPIC1812 10x9	10'-0"	9'-0"	13,500	0.449	1,570	33,400	40,500
HFXPIC1815 10x9	10'-0"	9'-0"	17,900	0.433	1,220	30,900	37,700
HFXPIC2112 10x9	10'-0"	9'-0"	15,400	0.449	1,690	33,900	41,300
HFXPIC2115 10x9	10'-0"	9'-0"	20,300	0.420	1,490	32,000	39,300
HFXPIC1212 11x9	11'-0"	9'-0"	9,400	0.449	1,230	29,000	N/A
HFXPIC1512 11x9	11'-0"	9'-0"	10,900	0.449	1,430	31,500	38,300
HFXPIC1515 11x9	11'-0"	9'-0"	14,700	0.449	1,090	31,400	38,300
HFXPIC1812 11x9	11'-0"	9'-0"	13,000	0.449	1,400	34,000	41,100
HFXPIC1815 11x9	11'-0"	9'-0"	17,900	0.445	950	31,600	38,500
HFXPIC2112 11x9	11'-0"	9'-0"	14,800	0.449	1,540	34,600	42,000
HFXPIC2115 11x9	11'-0"	9'-0"	20,300	0.434	1,170	32,600	40,000
HFXPIC1212 12x9	12'-0"	9'-0"	9,200	0.449	1,060	29,400	N/A
HFXPIC1512 12x9	12'-0"	9'-0"	10,600	0.449	880	35,700	43,000
HFXPIC1515 12x9	12'-0"	9'-0"	14,300	0.449	990	32,000	38,900
HFXPIC1812 12x9	12'-0"	9'-0"	12,500	0.449	1,260	34,500	41,500
HFXPIC1815 12x9	12'-0"	9'-0"	17,500	0.449	860	32,800	39,800
HFXPIC2112 12x9	12'-0"	9'-0"	14,100	0.449	1,400	35,200	42,600
HFXPIC2115 12x9	12'-0"	9'-0"	20,300	0.448	940	33,200	40,500
HFXPIC1212 13x9	13'-0"	9'-0"	8,900	0.449	940	29,600	N/A
HFXPIC1512 13x9	13'-0"	9'-0"	10,200	0.449	1,100	33,400	40,200
HFXPIC1515 13x9	13'-0"	9'-0"	14,000	0.449	880	32,400	39,300
HFXPIC1812 13x9	13'-0"	9'-0"	12,100	0.449	1,140	34,900	41,900
HFXPIC1815 13x9	13'-0"	9'-0"	17,100	0.449	810	33,400	40,400
HFXPIC2112 13x9	13'-0"	9'-0"	13,600	0.449	1,270	35,700	43,100
HFXPIC2115 13x9	13'-0"	9'-0"	19,700	0.449	890	33,800	41,100
HFXPIC1212 14x9	14'-0"	9'-0"	8,700	0.449	840	29,800	N/A
HFXPIC1512 14x9	14'-0"	9'-0"	9,900	0.449	990	33,600	40,500
HFXPIC1515 14x9	14'-0"	9'-0"	13,700	0.449	810	32,700	39,600
HFXPIC1812 14x9	14'-0"	9'-0"	11,600	0.449	1,040	35,200	42,200
HFXPIC1815 14x9	14'-0"	9'-0"	16,600	0.449	770	33,800	40,800
HFXPIC2112 14x9	14'-0"	9'-0"	13,000	0.449	1,170	36,100	43,400
HFXPIC2115 14x9	14'-0"	9'-0"	19,100	0.449	860	34,300	41,600
HFXPIC1212 16x9	16'-0"	9'-0"	8,300	0.449	670	30,100	N/A
HFXPIC1512 16x9	16'-0"	9'-0"	9,300	0.449	800	34,100	40,900
HFXPIC1515 16x9	16'-0"	9'-0"	13,100	0.449	670	33,200	40,100
HFXPIC1812 16x9	16'-0"	9'-0"	10,900	0.449	860	35,700	42,700
HFXPIC1815 16x9	16'-0"	9'-0"	15,700	0.449	670	34,500	41,400

TABLE 2B: Lateral Load Capacity for PICTURE Frame on Concrete [1,2,5,8] (continued)

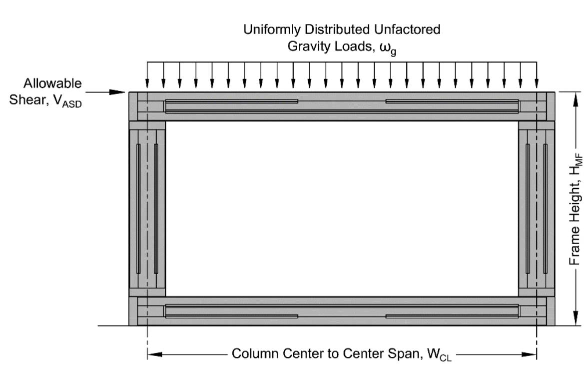
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXPIC2112 16x9	16'-0"	9'-0"	12,000	0.449	990	36,700	44,000
HFXPIC2115 16x9	16'-0"	9'-0"	17,900	0.449	780	35,000	42,300
HFXPIC1212 18x9	18'-0"	9'-0"	7,800	0.449	560	30,400	N/A
HFXPIC1512 18x9	18'-0"	9'-0"	8,800	0.449	670	34,300	41,100
HFXPIC1515 18x9	18'-0"	9'-0"	12,500	0.449	580	33,600	40,400
HFXPIC1812 18x9	18'-0"	9'-0"	10,200	0.449	730	36,100	43,100
HFXPIC1815 18x9	18'-0"	9'-0"	14,900	0.449	600	34,900	41,900
HFXPIC2112 18x9	18'-0"	9'-0"	11,200	0.449	840	37,100	44,500
HFXPIC2115 18x9	18'-0"	9'-0"	16,900	0.449	690	35,600	42,800
HFXPIC1212 20x9	20'-0"	9'-0"	7,500	0.449	480	30,600	N/A
HFXPIC1512 20x9	20'-0"	9'-0"	8,400	0.449	560	34,600	41,300
HFXPIC1515 20x9	20'-0"	9'-0"	12,000	0.449	490	33,800	40,700
HFXPIC1812 20x9	20'-0"	9'-0"	9,500	0.449	630	36,400	43,300
HFXPIC1815 20x9	20'-0"	9'-0"	14,200	0.449	530	35,200	42,200
HFXPIC2112 20x9	20'-0"	9'-0"	10,500	0.449	720	37,400	44,800
HFXPIC2115 20x9	20'-0"	9'-0"	15,900	0.449	620	36,000	43,200
HFXPIC1212 8x10	8'-0"	10'-0"	8,700	0.499	2,570	24,300	N/A
HFXPIC1512 8x10	8'-0"	10'-0"	10,200	0.499	2,740	27,400	33,600
HFXPIC1515 8x10	8'-0"	10'-0"	13,100	0.499	2,460	25,400	31,500
HFXPIC1812 8x10	8'-0"	10'-0"	12,500	0.498	2,380	28,200	34,600
HFXPIC1815 8x10	8'-0"	10'-0"	15,500	0.468	2,510	26,100	32,400
HFXPIC2112 8x10	8'-0"	10'-0"	14,100	0.484	2,590	28,600	35,400
HFXPIC2115 8x10	8'-0"	10'-0"	17,600	0.447	2,330	27,100	33,900
HFXPIC1212 9x10	9'-0"	10'-0"	8,400	0.499	2,050	24,900	N/A
HFXPIC1512 9x10	9'-0"	10'-0"	9,900	0.499	2,220	28,100	34,300
HFXPIC1515 9x10	9'-0"	10'-0"	12,800	0.499	2,000	26,800	33,000
HFXPIC1812 9x10	9'-0"	10'-0"	12,100	0.499	2,000	29,100	35,500
HFXPIC1815 9x10	9'-0"	10'-0"	15,500	0.479	1,830	27,100	33,400
HFXPIC2112 9x10	9'-0"	10'-0"	13,900	0.499	2,080	29,400	36,200
HFXPIC2115 9x10	9'-0"	10'-0"	17,600	0.459	2,190	27,500	34,200
HFXPIC1212 10x10	10'-0"	10'-0"	8,200	0.499	1,690	25,300	N/A
HFXPIC1512 10x10	10'-0"	10'-0"	9,600	0.499	1,850	28,700	34,900
HFXPIC1515 10x10	10'-0"	10'-0"	12,600	0.499	1,650	27,500	33,700
HFXPIC1812 10x10	10'-0"	10'-0"	11,700	0.499	1,740	29,800	36,200
HFXPIC1815 10x10	10'-0"	10'-0"	15,500	0.492	1,400	27,900	34,300
HFXPIC2112 10x10	10'-0"	10'-0"	13,400	0.499	1,840	30,200	37,000
HFXPIC2115 10x10	10'-0"	10'-0"	17,600	0.481	1,670	28,300	35,000
HFXPIC1212 11x10	11'-0"	10'-0"	8,000	0.499	1,430	25,700	N/A
HFXPIC1512 11x10	11'-0"	10'-0"	9,300	0.499	1,590	29,100	35,300
HFXPIC1515 11x10	11'-0"	10'-0"	12,300	0.499	1,420	28,000	34,200
HFXPIC1812 11x10	11'-0"	10'-0"	11,200	0.499	1,530	30,400	36,800
HFXPIC1815 11x10	11'-0"	10'-0"	15,300	0.499	1,160	28,800	35,100
HFXPIC2112 11x10	11'-0"	10'-0"	12,800	0.499	1,650	30,900	37,700
HFXPIC2115 11x10	11'-0"	10'-0"	17,600	0.488	1,310	28,900	35,600
HFXPIC1212 12x10	12'-0"	10'-0"	7,800	0.499	1,230	26,000	N/A
HFXPIC1512 12x10	12'-0"	10'-0"	9,000	0.499	1,040	31,800	38,300
HFXPIC1515 12x10	12'-0"	10'-0"	12,100	0.499	1,240	28,400	34,700
HFXPIC1812 12x10	12'-0"	10'-0"	10,800	0.499	1,360	30,900	37,300
HFXPIC1815 12x10	12'-0"	10'-0"	14,900	0.499	1,060	29,300	35,700
HFXPIC2112 12x10	12'-0"	10'-0"	12,300	0.499	1,490	31,500	38,300
HFXPIC2115 12x10	12'-0"	10'-0"	17,400	0.499	1,110	29,500	36,200
HFXPIC1212 13x10	13'-0"	10'-0"	7,600	0.499	1,060	26,300	N/A
HFXPIC1512 13x10	13'-0"	10'-0"	8,800	0.499	1,210	29,800	36,000
HFXPIC1515 13x10	13'-0"	10'-0"	11,800	0.499	1,080	28,800	35,000
HFXPIC1812 13x10	13'-0"	10'-0"	10,400	0.499	1,220	31,300	37,700
HFXPIC1815 13x10	13'-0"	10'-0"	14,500	0.499	970	29,800	36,200
HFXPIC2112 13x10	13'-0"	10'-0"	11,800	0.499	1,350	32,000	38,700
HFXPIC2115 13x10	13'-0"	10'-0"	16,900	0.499	1,040	30,100	36,800
HFXPIC1212 14x10	14'-0"	10'-0"	7,400	0.499	930	26,500	N/A
HFXPIC1512 14x10	14'-0"	10'-0"	8,500	0.499	1,060	30,100	36,200
HFXPIC1515 14x10	14'-0"	10'-0"	11,600	0.499	970	29,100	35,300
HFXPIC1812 14x10	14'-0"	10'-0"	10,100	0.499	1,100	31,600	38,000

TABLE 2B: Lateral Load Capacity for PICTURE Frame on Concrete [1,2,5,8] (continued)

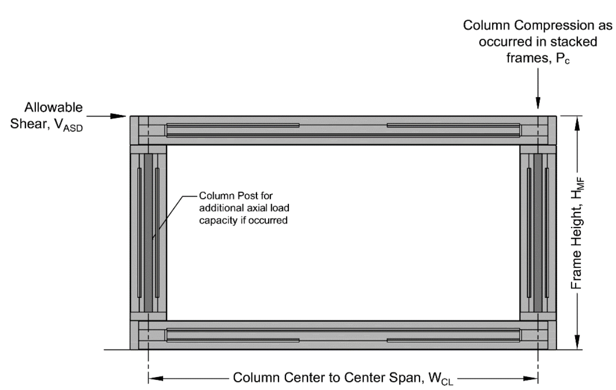
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD} [3]	Story Drift Δ_{ASD} [4]	Unfactored Gravity Load w_g [6]	Axial Load on Column (w/o col post) P_c [7]	Axial Load on Column (w/ col post) P_c [7]
			lbs.	in.	lbs/ft	lbs	Lbs
HFXPIC1815 14x10	14'-0"	10'-0"	14,100	0.499	900	30,200	36,600
HFXPIC2112 14x10	14'-0"	10'-0"	11,300	0.499	1,230	32,400	39,100
HFXPIC2115 14x10	14'-0"	10'-0"	16,400	0.499	970	30,600	37,300
HFXPIC1212 16x10	16'-0"	10'-0"	7,000	0.499	740	26,800	N/A
HFXPIC1512 16x10	16'-0"	10'-0"	8,000	0.499	860	30,500	36,600
HFXPIC1515 16x10	16'-0"	10'-0"	11,100	0.499	790	29,600	35,800
HFXPIC1812 16x10	16'-0"	10'-0"	9,400	0.499	900	32,100	38,500
HFXPIC1815 16x10	16'-0"	10'-0"	13,400	0.499	770	30,800	37,200
HFXPIC2112 16x10	16'-0"	10'-0"	10,500	0.499	1,020	33,000	39,700
HFXPIC2115 16x10	16'-0"	10'-0"	15,400	0.499	860	31,400	38,000
HFXPIC1212 18x10	18'-0"	10'-0"	6,700	0.499	610	27,100	N/A
HFXPIC1512 18x10	18'-0"	10'-0"	7,600	0.499	700	30,800	36,900
HFXPIC1515 18x10	18'-0"	10'-0"	10,600	0.499	660	30,000	36,100
HFXPIC1812 18x10	18'-0"	10'-0"	8,800	0.499	760	32,500	38,800
HFXPIC1815 18x10	18'-0"	10'-0"	12,700	0.499	670	31,300	37,600
HFXPIC2112 18x10	18'-0"	10'-0"	9,800	0.499	860	33,400	40,100
HFXPIC2115 18x10	18'-0"	10'-0"	14,500	0.499	750	31,900	38,600
HFXPIC1212 20x10	20'-0"	10'-0"	6,400	0.499	500	27,200	N/A
HFXPIC1512 20x10	20'-0"	10'-0"	7,200	0.499	590	31,000	37,100
HFXPIC1515 20x10	20'-0"	10'-0"	10,200	0.499	550	30,200	36,400
HFXPIC1812 20x10	20'-0"	10'-0"	8,300	0.499	650	32,800	39,100
HFXPIC1815 20x10	20'-0"	10'-0"	12,100	0.499	580	31,700	38,000
HFXPIC2112 20x10	20'-0"	10'-0"	9,100	0.499	740	33,800	40,500
HFXPIC2115 20x10	20'-0"	10'-0"	13,700	0.499	660	32,400	39,000

Table Notes:

1. These table values reflect Allowable Strength Design (ASD) with *Tensioned* bolt connections at the Panel Zones and installation on 2,500 psi minimum compressive strength concrete or nuts and washers elevated up to 1½ inches above concrete with 5,000 psi minimum compressive strength non-shrink grout.
2. Hardy Frame CFS Moment Frames are designed to conform to strength and deflection limitations in accordance with applicable code requirements (AISI-S100, AISI-S240, AISI- S400, AISC-360, and IBC) using Load and Resistance Factored Design (LRFD).
3. V_{ASD} in this table are seismic capacities for R = 6.5 and C_d = 4.0. For wind design, allowable shear loads may be determined by multiplying values in the table with a factor of 0.85.
   $V_{ASD\text{-}wind} = 0.85V_{ASD}$
4. Δ_{ASD} represents inter-story drift at allowable shear load (V_{ASD}) that does not exceed the code required limitation for the seismic load (Δ_s = 0.025h) and is limited to h/267 for ASD wind load.
5. Tabulated allowable axial load on the column excludes the overstrength (Ω_0) factor.
6. w_g is the maximum unfactored uniform gravity loads applied on the beam in combination with V_{ASD} as shown in Case A illustration below.
7. P_c is the maximum axial load that can be applied on the column in combination with V_{ASD} as shown in Case B illustration below. When uniform gravity loads on the beam, w, are combined with both V_{ASD} and P_c, reduce P_c by ω x W_{CL}/2 as follows: P_c - ω x W_{CL}/2.
8. Anchor bolts to concrete shall comply with ASTM A193 Grade B7 or equivalent.



CASE A ILLUSTRATION



CASE B ILLUSTRATION

TABLE 2C: Lateral Load Capacity for PICTURE Frame on Wood [1,2,5]

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXPIC1212 8x8	8'-0"	8'-0"	11,800	0.399	1,800	31,000	N/A
HFXPIC1512 8x8	8'-0"	8'-0"	13,600	0.399	1,890	34,400	42,000
HFXPIC1515 8x8	8'-0"	8'-0"	18,000	0.399	1,440	30,000	37,100
HFXPIC1812 8x8	8'-0"	8'-0"	16,600	0.399	2,000	35,500	43,200
HFXPIC1815 8x8	8'-0"	8'-0"	21,100	0.375	1,800	31,600	38,900
HFXPIC2112 8x8	8'-0"	8'-0"	18,800	0.392	2,280	35,900	43,900
HFXPIC2115 8x8	8'-0"	8'-0"	24,000	0.362	2,220	32,800	40,600
HFXPIC1212 9x8	9'-0"	8'-0"	11,500	0.399	1,320	31,600	N/A
HFXPIC1512 9x8	9'-0"	8'-0"	13,200	0.399	1,630	35,200	42,800
HFXPIC1515 9x8	9'-0"	8'-0"	17,700	0.399	1,050	30,900	38,100
HFXPIC1812 9x8	9'-0"	8'-0"	16,000	0.399	1,500	36,300	44,000
HFXPIC1815 9x8	9'-0"	8'-0"	21,100	0.385	1,310	32,600	40,000
HFXPIC2112 9x8	9'-0"	8'-0"	18,300	0.399	1,710	36,800	44,800
HFXPIC2115 9x8	9'-0"	8'-0"	24,000	0.371	1,640	34,000	41,800
HFXPIC1212 10x8	10'-0"	8'-0"	11,200	0.399	1,150	32,100	N/A
HFXPIC1512 10x8	10'-0"	8'-0"	12,800	0.399	1,410	35,800	43,300
HFXPIC1515 10x8	10'-0"	8'-0"	17,300	0.399	780	31,700	38,800
HFXPIC1812 10x8	10'-0"	8'-0"	15,400	0.399	1,380	37,000	44,700
HFXPIC1815 10x8	10'-0"	8'-0"	21,100	0.395	990	33,500	40,900
HFXPIC2112 10x8	10'-0"	8'-0"	17,600	0.399	1,530	37,600	45,700
HFXPIC2115 10x8	10'-0"	8'-0"	24,000	0.385	1,250	35,000	42,800
HFXPIC1212 11x8	11'-0"	8'-0"	10,900	0.399	1,020	32,500	N/A
HFXPIC1512 11x8	11'-0"	8'-0"	12,400	0.399	1,240	36,300	43,800
HFXPIC1515 11x8	11'-0"	8'-0"	16,900	0.399	730	33,000	40,300
HFXPIC1812 11x8	11'-0"	8'-0"	14,800	0.399	1,170	38,100	45,900
HFXPIC1815 11x8	11'-0"	8'-0"	20,800	0.399	770	34,200	41,600
HFXPIC2112 11x8	11'-0"	8'-0"	16,800	0.399	1,420	38,300	46,400
HFXPIC2115 11x8	11'-0"	8'-0"	24,000	0.397	980	35,800	43,600
HFXPIC1212 12x8	12'-0"	8'-0"	10,600	0.399	890	32,800	N/A
HFXPIC1512 12x8	12'-0"	8'-0"	12,000	0.399	1,110	36,700	44,200
HFXPIC1515 12x8	12'-0"	8'-0"	16,500	0.399	700	34,500	41,900
HFXPIC1812 12x8	12'-0"	8'-0"	14,300	0.399	1,150	38,100	45,800
HFXPIC1815 12x8	12'-0"	8'-0"	20,100	0.399	620	34,900	42,300
HFXPIC2112 12x8	12'-0"	8'-0"	16,100	0.399	1,300	38,900	46,900
HFXPIC2115 12x8	12'-0"	8'-0"	23,400	0.399	790	36,400	44,300
HFXPIC1212 13x8	13'-0"	8'-0"	10,300	0.399	810	33,100	N/A
HFXPIC1512 13x8	13'-0"	8'-0"	11,700	0.399	1,000	37,000	44,500
HFXPIC1515 13x8	13'-0"	8'-0"	16,100	0.399	670	35,700	43,200
HFXPIC1812 13x8	13'-0"	8'-0"	13,700	0.399	1,050	38,500	46,200
HFXPIC1815 13x8	13'-0"	8'-0"	19,700	0.399	620	36,400	44,000
HFXPIC2112 13x8	13'-0"	8'-0"	15,500	0.399	1,200	39,400	47,400
HFXPIC2115 13x8	13'-0"	8'-0"	22,600	0.399	730	37,500	45,500
HFXPIC1212 14x8	14'-0"	8'-0"	10,000	0.399	730	33,300	N/A
HFXPIC1512 14x8	14'-0"	8'-0"	11,300	0.399	890	37,300	44,700
HFXPIC1515 14x8	14'-0"	8'-0"	15,800	0.399	630	36,500	44,100
HFXPIC1812 14x8	14'-0"	8'-0"	13,300	0.399	960	38,900	46,500
HFXPIC1815 14x8	14'-0"	8'-0"	19,100	0.399	620	37,600	45,300
HFXPIC2112 14x8	14'-0"	8'-0"	14,800	0.399	1,100	39,800	47,800
HFXPIC2115 14x8	14'-0"	8'-0"	21,900	0.399	730	38,000	46,000
HFXPIC1212 16x8	16'-0"	8'-0"	9,500	0.399	600	33,600	N/A
HFXPIC1512 16x8	16'-0"	8'-0"	10,700	0.399	740	37,700	45,100
HFXPIC1515 16x8	16'-0"	8'-0"	15,100	0.399	550	37,000	44,500
HFXPIC1812 16x8	16'-0"	8'-0"	12,400	0.399	820	39,300	47,000
HFXPIC1815 16x8	16'-0"	8'-0"	18,100	0.399	580	38,200	45,800
HFXPIC2112 16x8	16'-0"	8'-0"	13,700	0.399	940	40,400	48,300
HFXPIC2115 16x8	16'-0"	8'-0"	20,600	0.399	680	38,800	46,700
HFXPIC1212 18x8	18'-0"	8'-0"	9,000	0.399	510	33,800	N/A
HFXPIC1512 18x8	18'-0"	8'-0"	10,100	0.399	630	37,900	45,400
HFXPIC1515 18x8	18'-0"	8'-0"	14,500	0.399	490	37,300	44,800
HFXPIC1812 18x8	18'-0"	8'-0"	11,600	0.399	690	39,700	47,300
HFXPIC1815 18x8	18'-0"	8'-0"	17,100	0.399	530	38,600	46,300
HFXPIC2112 18x8	18'-0"	8'-0"	12,800	0.399	810	40,800	48,700

TABLE 2C: Lateral Load Capacity for PICTURE Frame on Wood [1,2,5] (continued)

HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs.	lbs.
HFXPIC2115 18x8	18'-0"	8'-0"	19,400	0.399	640	39,300	47,200
HFXPIC1212 20x8	20'-0"	8'-0"	8,600	0.399	440	34,000	N/A
HFXPIC1512 20x8	20'-0"	8'-0"	9,600	0.399	530	38,100	45,600
HFXPIC1515 20x8	20'-0"	8'-0"	13,900	0.399	440	37,600	45,100
HFXPIC1812 20x8	20'-0"	8'-0"	10,900	0.399	600	40,000	47,500
HFXPIC1815 20x8	20'-0"	8'-0"	16,300	0.399	480	39,000	46,500
HFXPIC2112 20x8	20'-0"	8'-0"	12,000	0.399	700	41,100	49,000
HFXPIC2115 20x8	20'-0"	8'-0"	18,400	0.399	580	39,700	47,600
HFXPIC1212 8x9	8'-0"	9'-0"	9,800	0.449	2,070	27,500	N/A
HFXPIC1512 8x9	8'-0"	9'-0"	11,400	0.449	2,350	30,900	37,800
HFXPIC1515 8x9	8'-0"	9'-0"	14,700	0.449	1,860	27,500	34,100
HFXPIC1812 8x9	8'-0"	9'-0"	14,000	0.449	2,210	31,900	38,900
HFXPIC1815 8x9	8'-0"	9'-0"	17,900	0.433	2,200	29,000	35,800
HFXPIC2112 8x9	8'-0"	9'-0"	16,100	0.446	2,490	32,200	39,600
HFXPIC2115 8x9	8'-0"	9'-0"	20,300	0.414	2,280	30,100	37,400
HFXPIC1212 9x9	9'-0"	9'-0"	9,500	0.449	1,700	28,200	N/A
HFXPIC1512 9x9	9'-0"	9'-0"	11,100	0.449	1,940	31,600	38,500
HFXPIC1515 9x9	9'-0"	9'-0"	14,400	0.449	1,410	28,600	35,300
HFXPIC1812 9x9	9'-0"	9'-0"	13,500	0.449	1,780	32,700	39,700
HFXPIC1815 9x9	9'-0"	9'-0"	17,900	0.444	1,610	30,000	36,900
HFXPIC2112 9x9	9'-0"	9'-0"	15,600	0.449	1,870	33,000	40,500
HFXPIC2115 9x9	9'-0"	9'-0"	20,300	0.426	1,950	31,100	38,500
HFXPIC1212 10x9	10'-0"	9'-0"	9,300	0.449	1,430	28,600	N/A
HFXPIC1512 10x9	10'-0"	9'-0"	10,700	0.449	1,650	32,200	39,100
HFXPIC1515 10x9	10'-0"	9'-0"	14,200	0.449	1,240	30,100	36,900
HFXPIC1812 10x9	10'-0"	9'-0"	13,000	0.449	1,570	33,400	40,500
HFXPIC1815 10x9	10'-0"	9'-0"	17,600	0.449	1,220	30,900	37,700
HFXPIC2112 10x9	10'-0"	9'-0"	14,900	0.449	1,690	33,900	41,300
HFXPIC2115 10x9	10'-0"	9'-0"	20,300	0.438	1,490	32,000	39,300
HFXPIC1212 11x9	11'-0"	9'-0"	9,000	0.449	1,230	29,000	N/A
HFXPIC1512 11x9	11'-0"	9'-0"	10,400	0.449	1,430	31,500	38,300
HFXPIC1515 11x9	11'-0"	9'-0"	13,900	0.449	1,090	31,400	38,300
HFXPIC1812 11x9	11'-0"	9'-0"	12,500	0.449	1,400	34,000	41,100
HFXPIC1815 11x9	11'-0"	9'-0"	17,200	0.449	950	31,600	38,500
HFXPIC2112 11x9	11'-0"	9'-0"	14,300	0.449	1,540	34,600	42,000
HFXPIC2115 11x9	11'-0"	9'-0"	20,200	0.449	1,170	32,600	40,000
HFXPIC1212 12x9	12'-0"	9'-0"	8,800	0.449	1,060	29,400	N/A
HFXPIC1512 12x9	12'-0"	9'-0"	10,100	0.449	880	35,700	43,000
HFXPIC1515 12x9	12'-0"	9'-0"	13,600	0.449	990	32,000	38,900
HFXPIC1812 12x9	12'-0"	9'-0"	12,100	0.449	1,260	34,500	41,500
HFXPIC1815 12x9	12'-0"	9'-0"	16,800	0.449	860	32,800	39,800
HFXPIC2112 12x9	12'-0"	9'-0"	13,700	0.449	1,400	35,200	42,600
HFXPIC2115 12x9	12'-0"	9'-0"	19,600	0.449	940	33,200	40,500
HFXPIC1212 13x9	13'-0"	9'-0"	8,600	0.449	940	29,600	N/A
HFXPIC1512 13x9	13'-0"	9'-0"	9,800	0.449	1,100	33,400	40,200
HFXPIC1515 13x9	13'-0"	9'-0"	13,300	0.449	880	32,400	39,300
HFXPIC1812 13x9	13'-0"	9'-0"	11,700	0.449	1,140	34,900	41,900
HFXPIC1815 13x9	13'-0"	9'-0"	16,300	0.449	810	33,400	40,400
HFXPIC2112 13x9	13'-0"	9'-0"	13,200	0.449	1,270	35,700	43,100
HFXPIC2115 13x9	13'-0"	9'-0"	19,000	0.449	890	33,800	41,100
HFXPIC1212 14x9	14'-0"	9'-0"	8,400	0.449	840	29,800	N/A
HFXPIC1512 14x9	14'-0"	9'-0"	9,500	0.449	990	33,600	40,500
HFXPIC1515 14x9	14'-0"	9'-0"	13,000	0.449	810	32,700	39,600
HFXPIC1812 14x9	14'-0"	9'-0"	11,300	0.449	1,040	35,200	42,200
HFXPIC1815 14x9	14'-0"	9'-0"	15,900	0.449	770	33,800	40,800
HFXPIC2112 14x9	14'-0"	9'-0"	12,700	0.449	1,170	36,100	43,400
HFXPIC2115 14x9	14'-0"	9'-0"	18,400	0.449	860	34,300	41,600
HFXPIC1212 16x9	16'-0"	9'-0"	7,900	0.449	670	30,100	N/A
HFXPIC1512 16x9	16'-0"	9'-0"	9,000	0.449	800	34,100	40,900
HFXPIC1515 16x9	16'-0"	9'-0"	12,500	0.449	670	33,200	40,100
HFXPIC1812 16x9	16'-0"	9'-0"	10,500	0.449	860	35,700	42,700
HFXPIC1815 16x9	16'-0"	9'-0"	15,100	0.449	670	34,500	41,400

TABLE 2C: Lateral Load Capacity for PICTURE Frame on Wood [1,2,5] (continued)

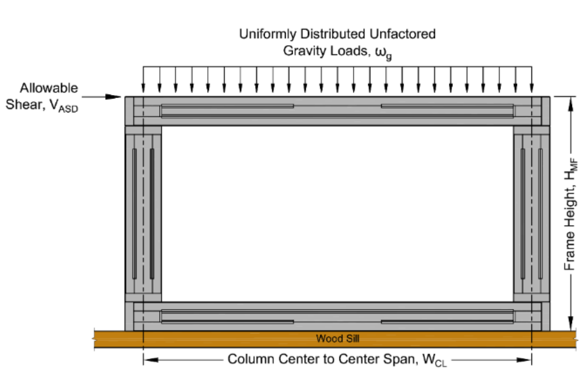
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3] lbs.	Story Drift Δ_{ASD}[4] in.	Unfactored Gravity Load w_g[6] lbs/ft	Axial Load on Column (w/o col post) P_c[7] lbs.	Axial Load on Column (w/ col post) P_c[7] lbs.
HFXPIC2112 16x9	16'-0"	9'-0"	11,800	0.449	990	36,700	44,000
HFXPIC2115 16x9	16'-0"	9'-0"	17,300	0.449	780	35,000	42,300
HFXPIC1212 18x9	18'-0"	9'-0"	7,600	0.449	560	30,400	N/A
HFXPIC1512 18x9	18'-0"	9'-0"	8,500	0.449	670	34,300	41,100
HFXPIC1515 18x9	18'-0"	9'-0"	12,000	0.449	580	33,600	40,400
HFXPIC1812 18x9	18'-0"	9'-0"	9,900	0.449	730	36,100	43,100
HFXPIC1815 18x9	18'-0"	9'-0"	14,400	0.449	600	34,900	41,900
HFXPIC2112 18x9	18'-0"	9'-0"	10,900	0.449	840	37,100	44,500
HFXPIC2115 18x9	18'-0"	9'-0"	16,300	0.449	690	35,600	42,800
HFXPIC1212 20x9	20'-0"	9'-0"	7,200	0.449	480	30,600	N/A
HFXPIC1512 20x9	20'-0"	9'-0"	8,100	0.449	560	34,600	41,300
HFXPIC1515 20x9	20'-0"	9'-0"	11,500	0.449	490	33,800	40,700
HFXPIC1812 20x9	20'-0"	9'-0"	9,300	0.449	630	36,400	43,300
HFXPIC1815 20x9	20'-0"	9'-0"	13,700	0.449	530	35,200	42,200
HFXPIC2112 20x9	20'-0"	9'-0"	10,200	0.449	720	37,400	44,800
HFXPIC2115 20x9	20'-0"	9'-0"	15,500	0.449	620	36,000	43,200
HFXPIC1212 8x10	8'-0"	10'-0"	8,200	0.499	2,570	24,300	N/A
HFXPIC1512 8x10	8'-0"	10'-0"	9,700	0.499	2,740	27,400	33,600
HFXPIC1515 8x10	8'-0"	10'-0"	12,400	0.499	2,460	25,400	31,500
HFXPIC1812 8x10	8'-0"	10'-0"	12,000	0.499	2,380	28,200	34,600
HFXPIC1815 8x10	8'-0"	10'-0"	15,500	0.493	2,510	26,100	32,400
HFXPIC2112 8x10	8'-0"	10'-0"	14,000	0.499	2,590	28,600	35,400
HFXPIC2115 8x10	8'-0"	10'-0"	17,600	0.468	2,330	27,100	33,900
HFXPIC1212 9x10	9'-0"	10'-0"	8,100	0.499	2,050	24,900	N/A
HFXPIC1512 9x10	9'-0"	10'-0"	9,500	0.499	2,220	28,100	34,300
HFXPIC1515 9x10	9'-0"	10'-0"	12,100	0.499	2,000	26,800	33,000
HFXPIC1812 9x10	9'-0"	10'-0"	11,600	0.499	2,000	29,100	35,500
HFXPIC1815 9x10	9'-0"	10'-0"	15,300	0.499	1,830	27,100	33,400
HFXPIC2112 9x10	9'-0"	10'-0"	13,500	0.499	2,080	29,400	36,200
HFXPIC2115 9x10	9'-0"	10'-0"	17,600	0.481	2,190	27,500	34,200
HFXPIC1212 10x10	10'-0"	10'-0"	7,900	0.499	1,690	25,300	N/A
HFXPIC1512 10x10	10'-0"	10'-0"	9,200	0.499	1,850	28,700	34,900
HFXPIC1515 10x10	10'-0"	10'-0"	11,900	0.499	1,650	27,500	33,700
HFXPIC1812 10x10	10'-0"	10'-0"	11,200	0.499	1,740	29,800	36,200
HFXPIC1815 10x10	10'-0"	10'-0"	15,000	0.499	1,400	27,900	34,300
HFXPIC2112 10x10	10'-0"	10'-0"	12,900	0.499	1,840	30,200	37,000
HFXPIC2115 10x10	10'-0"	10'-0"	17,600	0.494	1,670	28,300	35,000
HFXPIC1212 11x10	11'-0"	10'-0"	7,700	0.499	1,430	25,700	N/A
HFXPIC1512 11x10	11'-0"	10'-0"	8,900	0.499	1,590	29,100	35,300
HFXPIC1515 11x10	11'-0"	10'-0"	11,700	0.499	1,420	28,000	34,200
HFXPIC1812 11x10	11'-0"	10'-0"	10,800	0.499	1,530	30,400	36,800
HFXPIC1815 11x10	11'-0"	10'-0"	14,600	0.499	1,160	28,800	35,100
HFXPIC2112 11x10	11'-0"	10'-0"	12,400	0.499	1,650	30,900	37,700
HFXPIC2115 11x10	11'-0"	10'-0"	17,200	0.499	1,310	28,900	35,600
HFXPIC1212 12x10	12'-0"	10'-0"	7,500	0.499	1,230	26,000	N/A
HFXPIC1512 12x10	12'-0"	10'-0"	8,700	0.499	1,040	31,800	38,300
HFXPIC1515 12x10	12'-0"	10'-0"	11,500	0.499	1,240	28,400	34,700
HFXPIC1812 12x10	12'-0"	10'-0"	10,400	0.499	1,360	30,900	37,300
HFXPIC1815 12x10	12'-0"	10'-0"	14,200	0.499	1,060	29,300	35,700
HFXPIC2112 12x10	12'-0"	10'-0"	11,900	0.499	1,490	31,500	38,300
HFXPIC2115 12x10	12'-0"	10'-0"	16,800	0.499	1,110	29,500	36,200
HFXPIC1212 13x10	13'-0"	10'-0"	7,300	0.499	1,060	26,300	N/A
HFXPIC1512 13x10	13'-0"	10'-0"	8,400	0.499	1,210	29,800	36,000
HFXPIC1515 13x10	13'-0"	10'-0"	11,200	0.499	1,080	28,800	35,000
HFXPIC1812 13x10	13'-0"	10'-0"	10,100	0.499	1,220	31,300	37,700
HFXPIC1815 13x10	13'-0"	10'-0"	13,900	0.499	970	29,800	36,200
HFXPIC2112 13x10	13'-0"	10'-0"	11,500	0.499	1,350	32,000	38,700
HFXPIC2115 13x10	13'-0"	10'-0"	16,200	0.499	1,040	30,100	36,800
HFXPIC1212 14x10	14'-0"	10'-0"	7,100	0.499	930	26,500	N/A
HFXPIC1512 14x10	14'-0"	10'-0"	7,400	0.499	1,060	30,100	36,200

TABLE 2C: Lateral Load Capacity for PICTURE Frame on Wood [1,2,5] (continued)

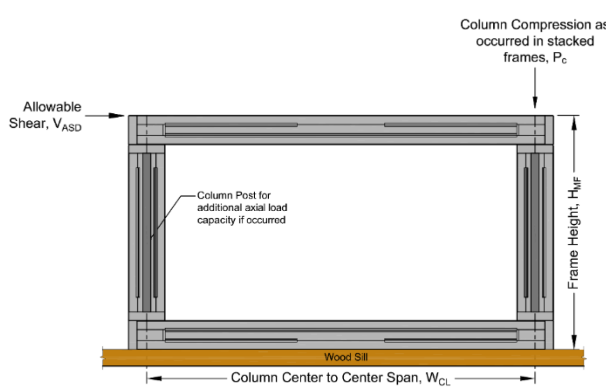
HFXMF Model Numbers	Column Center to Center Span W_{CL}	Frame Height H_{MF}	Allowable Shear Load (R = 6.5) V_{ASD}[3]	Story Drift Δ_{ASD}[4]	Unfactored Gravity Load w_g[6]	Axial Load on Column (w/o col post) P_c[7]	Axial Load on Column (w/ col post) P_c[7]
			lbs.	in.	lbs/ft	lbs	lbs
HFXPIC1815 14x10	14'-0"	10'-0"	13,500	0.499	900	30,200	36,600
HFXPIC2112 14x10	14'-0"	10'-0"	11,000	0.499	1,230	32,400	39,100
HFXPIC2115 14x10	14'-0"	10'-0"	15,800	0.499	970	30,600	37,300
HFXPIC1212 16x10	16'-0"	10'-0"	6,800	0.499	740	26,800	N/A
HFXPIC1512 16x10	16'-0"	10'-0"	7,700	0.499	860	30,500	36,600
HFXPIC1515 16x10	16'-0"	10'-0"	10,600	0.499	790	29,600	35,800
HFXPIC1812 16x10	16'-0"	10'-0"	9,100	0.499	900	32,100	38,500
HFXPIC1815 16x10	16'-0"	10'-0"	12,900	0.499	770	30,800	37,200
HFXPIC2112 16x10	16'-0"	10'-0"	10,200	0.499	1,020	33,000	39,700
HFXPIC2115 16x10	16'-0"	10'-0"	14,900	0.499	860	31,400	38,000
HFXPIC1212 18x10	18'-0"	10'-0"	6,500	0.499	610	27,100	N/A
HFXPIC1512 18x10	18'-0"	10'-0"	7,300	0.499	700	30,800	36,900
HFXPIC1515 18x10	18'-0"	10'-0"	10,200	0.499	660	30,000	36,100
HFXPIC1812 18x10	18'-0"	10'-0"	8,600	0.499	760	32,500	38,800
HFXPIC1815 18x10	18'-0"	10'-0"	12,300	0.499	670	31,300	37,600
HFXPIC2112 18x10	18'-0"	10'-0"	9,500	0.499	860	33,400	40,100
HFXPIC2115 18x10	18'-0"	10'-0"	14,100	0.499	750	31,900	38,600
HFXPIC1212 20x10	20'-0"	10'-0"	6,200	0.499	500	27,200	N/A
HFXPIC1512 20x10	20'-0"	10'-0"	7,000	0.499	590	31,000	37,100
HFXPIC1515 20x10	20'-0"	10'-0"	9,800	0.499	550	30,200	36,400
HFXPIC1812 20x10	20'-0"	10'-0"	8,100	0.499	650	32,800	39,100
HFXPIC1815 20x10	20'-0"	10'-0"	11,700	0.499	580	31,700	38,000
HFXPIC2112 20x10	20'-0"	10'-0"	8,900	0.499	740	33,800	40,500
HFXPIC2115 20x10	20'-0"	10'-0"	13,300	0.499	660	32,400	39,000
HFXPIC1515 14x10	14'-0"	10'-0"	11,000	0.499	970	29,100	35,300
HFXPIC1812 14x10	14'-0"	10'-0"	9,700	0.499	1,100	31,600	38,000

Table Notes:

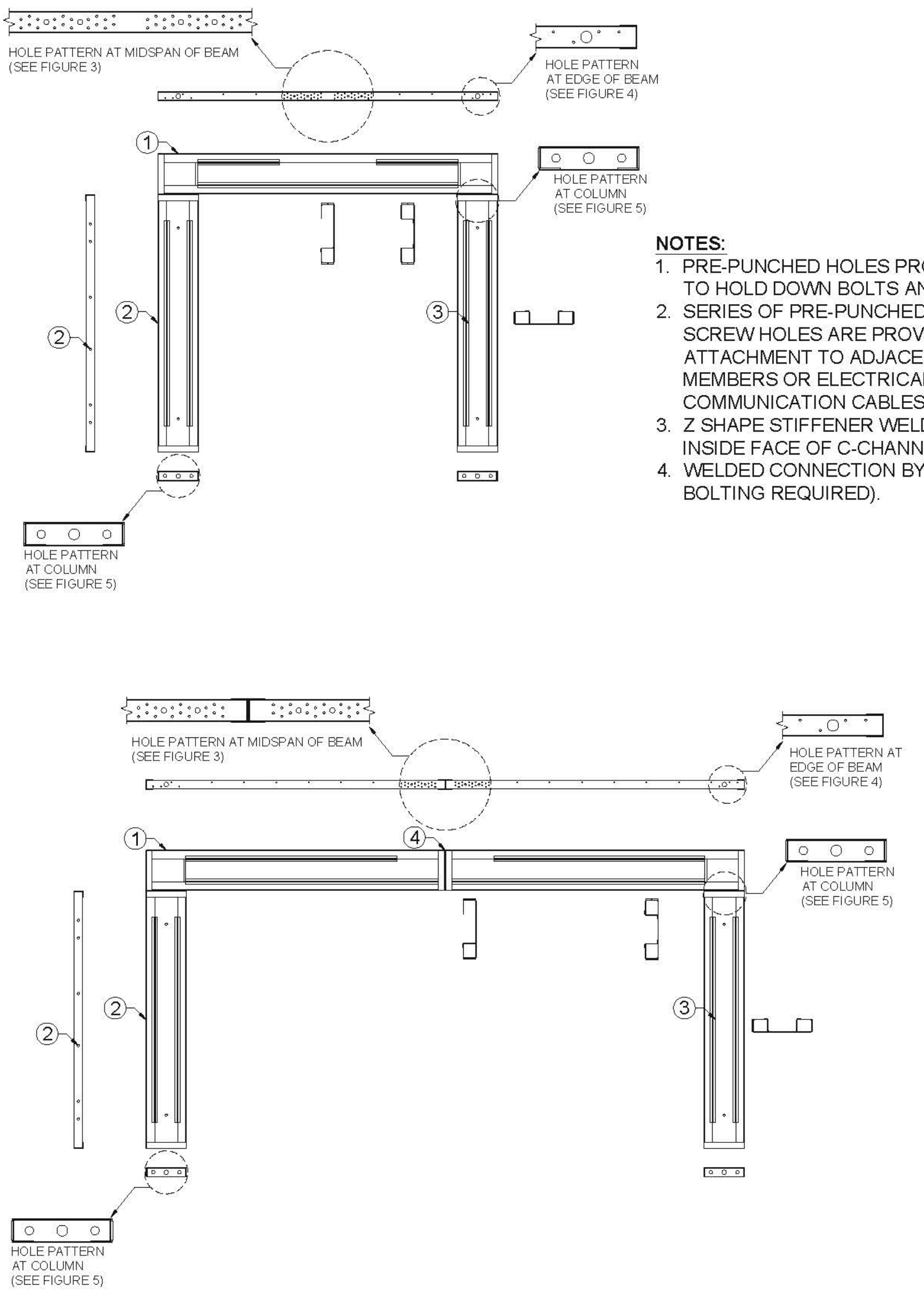
1. These table values reflect Allowable Strength Design (ASD) with *Tensioned* bolt connections at the Panel Zones and installation on Douglas Fir Larch wood sill, beam, or equivalent with a minimum compressive strength of 625 psi.
2. Hardy Frame CFS Moment Frames are designed to conform to strength and deflection limitations in accordance with applicable code requirements (AISI-S100, AISI-S240, AISI- S400, AISC-360, and IBC) using Load and Resistance Factored Design (LRFD).
3. V_{ASD} in this table are seismic capacities for R = 6.5 and C_d = 4.0. For wind design, allowable shear loads may be determined by multiplying values in the table with a factor of 0.85.
   $V_{ASD\text{-}wind} = 0.85V_{ASD}$
4. Δ_{ASD} represents inter-story drift at allowable shear load (V_{ASD}) that does not exceed the code required limitation for the seismic load (Δ_s = 0.025h) and is limited to h/267 for ASD wind load.
5. Tabulated allowable axial load on the column excludes the overstrength (Ω_0) factor.
6. w_g is the maximum unfactored uniform gravity loads applied on the beam in combination with V_{ASD} as shown in Case A illustration below.
7. P_c is the maximum axial load that can be applied on the column in combination with V_{ASD} as shown in Case B illustration below. When uniform gravity loads on the beam, w, are combined with both V_{ASD} and P_c, P_c shall be reduced by ω x W_{CL}/2 as follows: P_c - ω x W_{CL}/2.



CASE A ILLUSTRATION



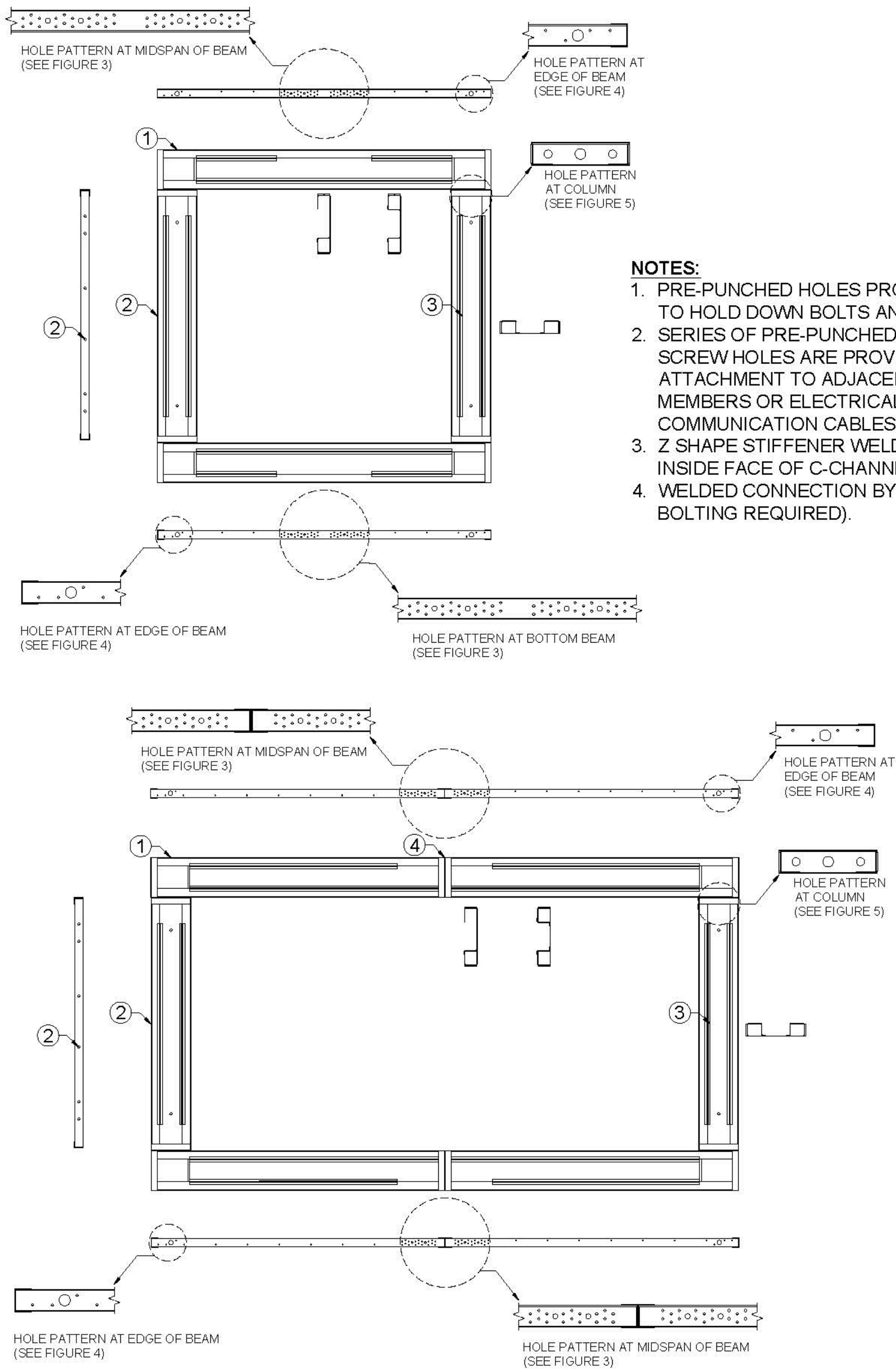
CASE B ILLUSTRATION



NOTES:

1. PRE-PUNCHED HOLES PROVIDE ATTACHMENT TO HOLD DOWN BOLTS AND WOOD SCREWS.
2. SERIES OF PRE-PUNCHED 5/16" DIAMETER SCREW HOLES ARE PROVIDED FOR OPTIONAL ATTACHMENT TO ADJACENT FRAMING MEMBERS OR ELECTRICAL WIRING AND COMMUNICATION CABLES.
3. Z SHAPE STIFFENER WELDED TO LIP AND INSIDE FACE OF C-CHANNEL.
4. WELDED CONNECTION BY MITEK (NO FIELD BOLTING REQUIRED).

FIGURE 1: HFCFS PORTAL FRAME



NOTES:

1. PRE-PUNCHED HOLES PROVIDE ATTACHMENT TO HOLD DOWN BOLTS AND WOOD SCREWS.
2. SERIES OF PRE-PUNCHED 5/16" DIAMETER SCREW HOLES ARE PROVIDED FOR OPTIONAL ATTACHMENT TO ADJACENT FRAMING MEMBERS OR ELECTRICAL WIRING AND COMMUNICATION CABLES.
3. Z SHAPE STIFFENER WELDED TO LIP AND INSIDE FACE OF C-CHANNEL.
4. WELDED CONNECTION BY MITEK (NO FIELD BOLTING REQUIRED).

FIGURE 2: HFCFS PICTURE FRAME

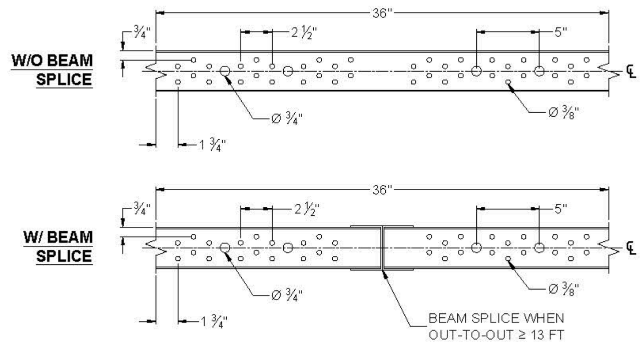


FIGURE 3: HOLE PATTERN AT MIDSPAN OF BEAM

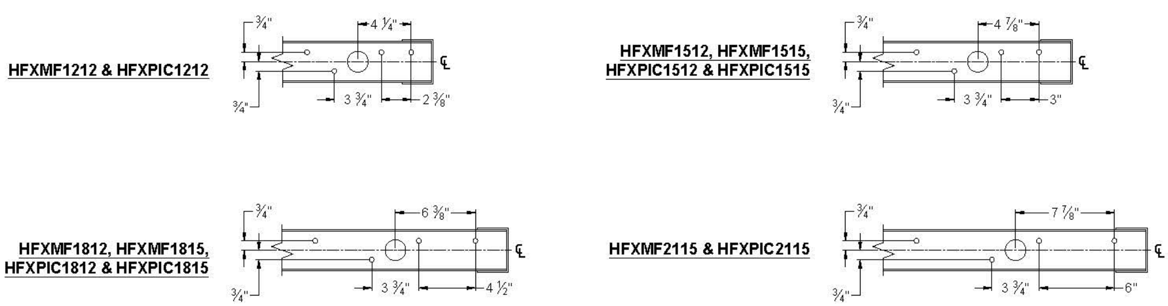


FIGURE 4: HOLE PATTERN AT EDGE OF BEAM

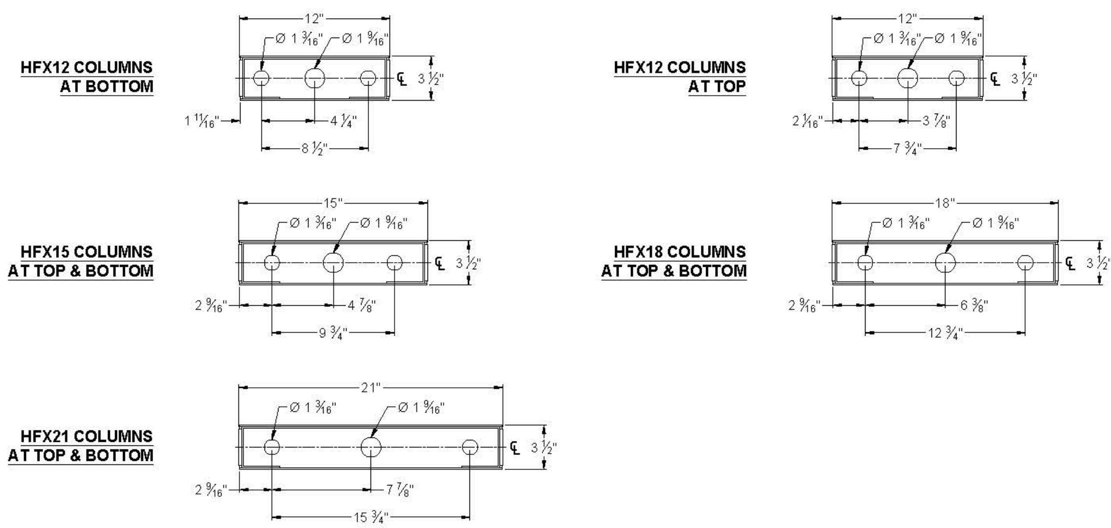


FIGURE 5: HOLE PATTERN AT COLUMNS

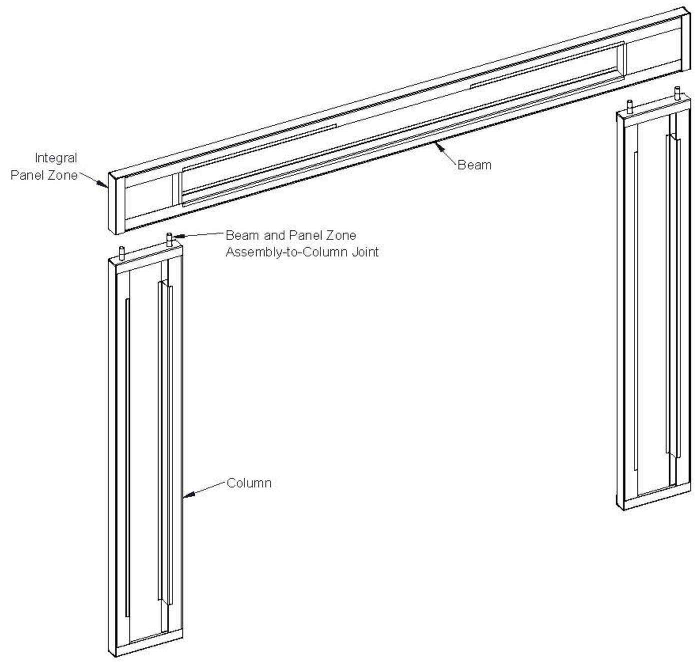


FIGURE 6: HARDY FRAME CFS WITH INTEGRAL PANEL ZONE

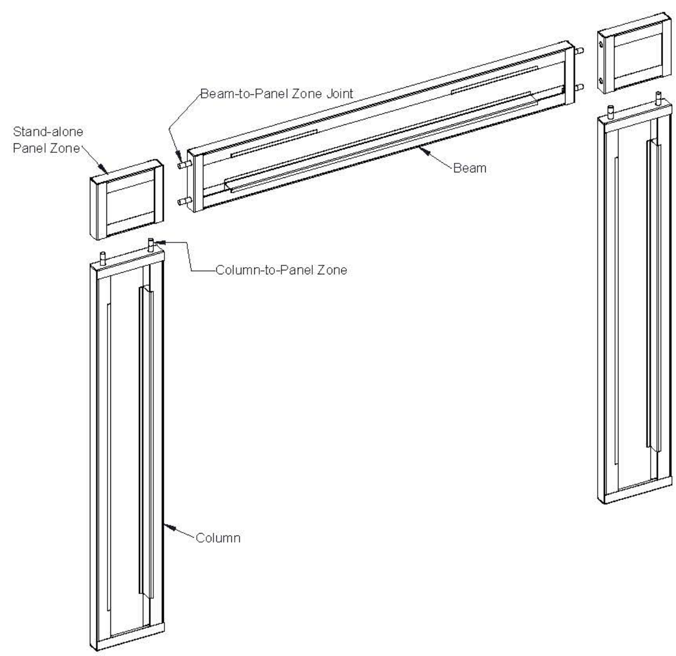


FIGURE 7: HARDY FRAME CFS WITH STAND-ALONE PANEL ZONE

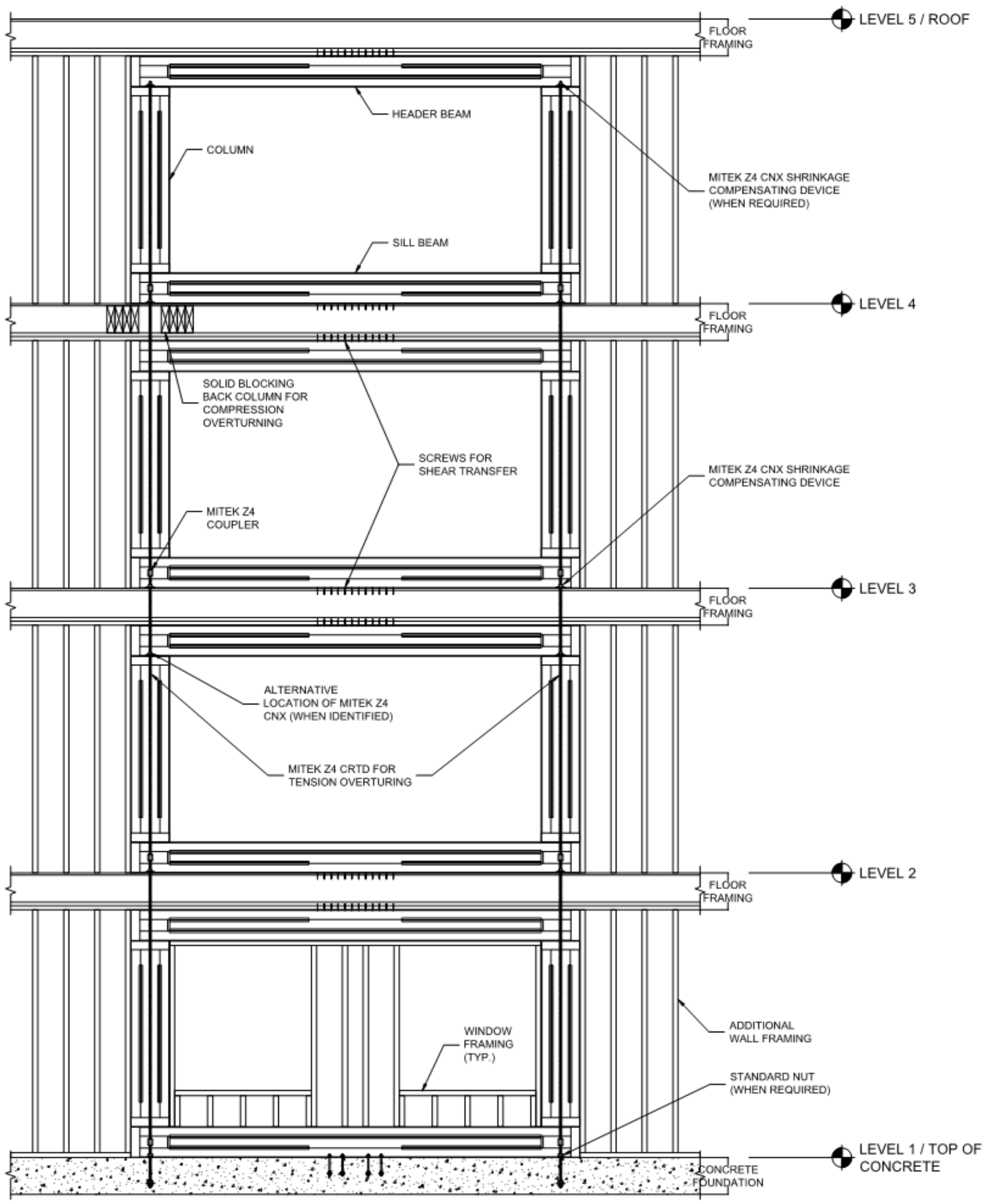


FIGURE 8: MULTISTORY APPLICATION

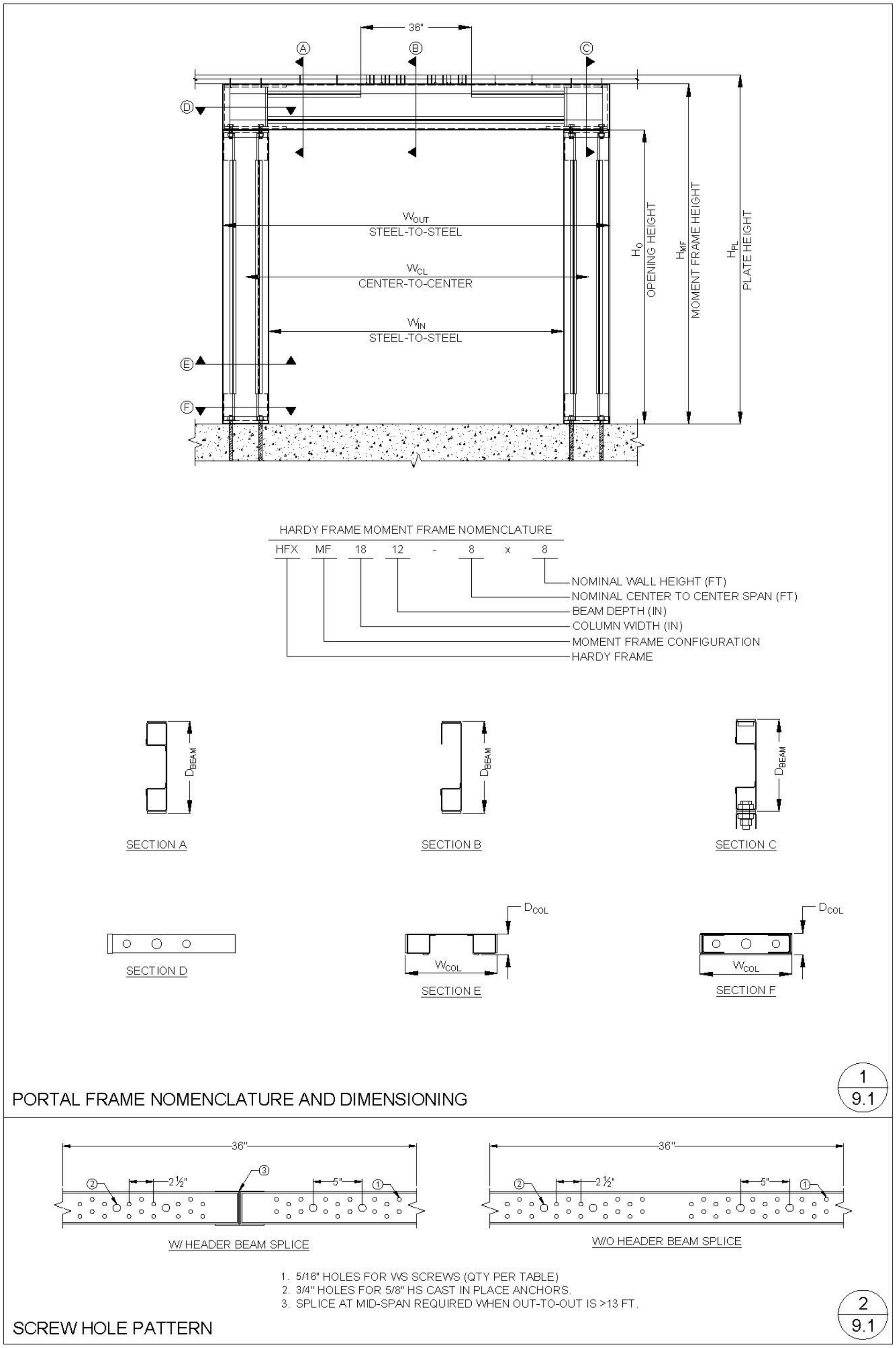


FIGURE 9.1: PORTAL FRAME INSTALLATION DETAILS

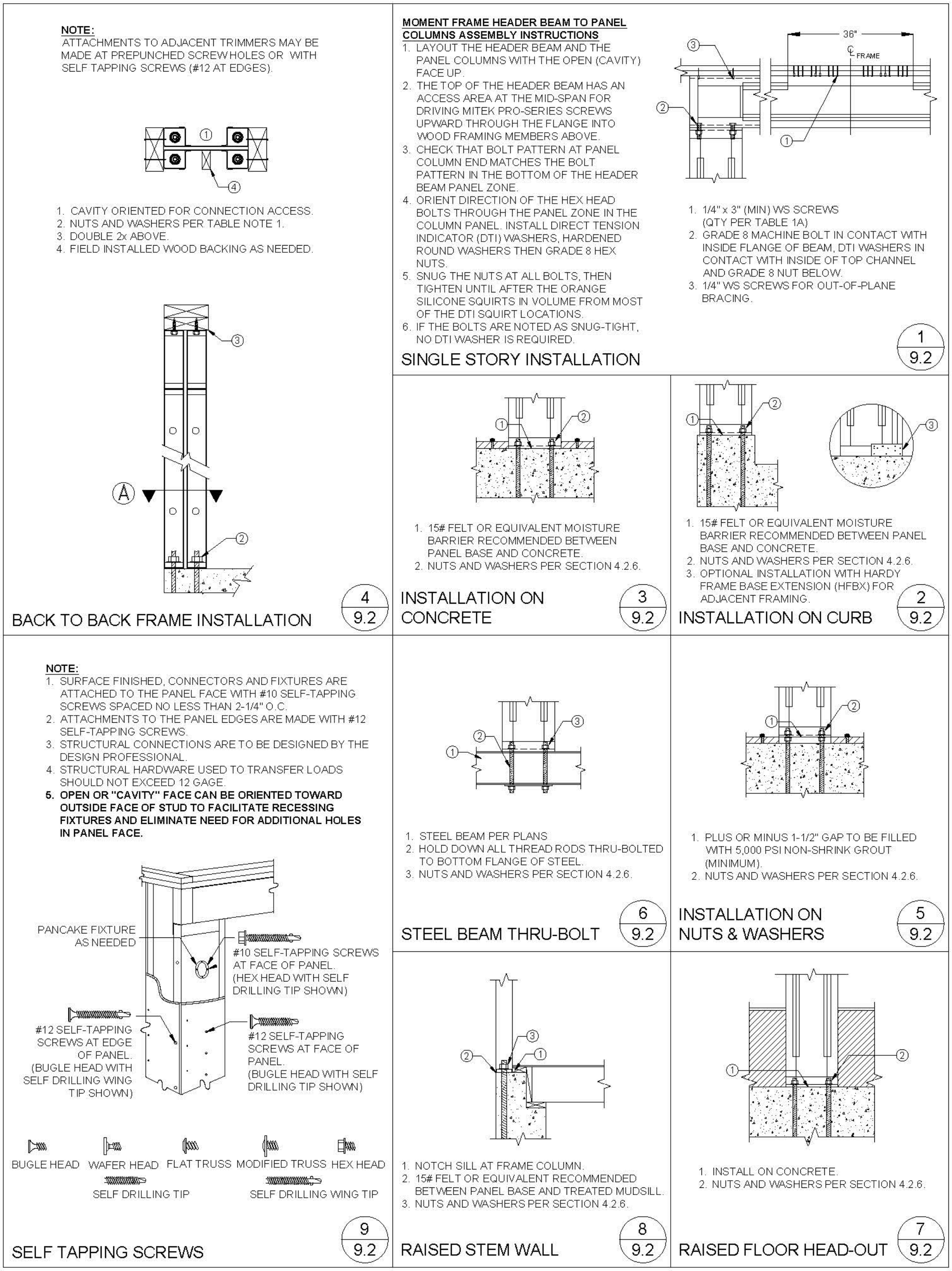
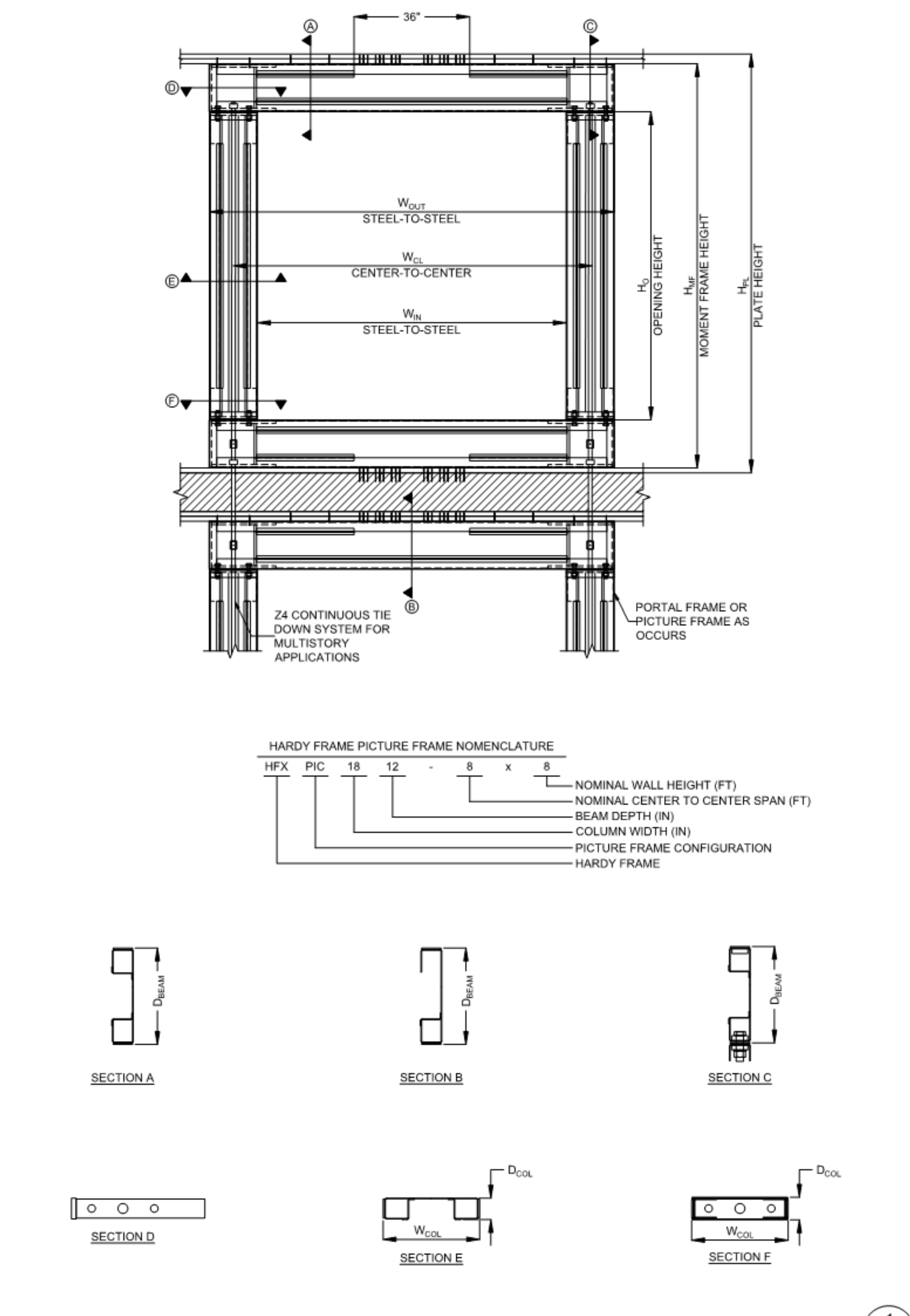


FIGURE 9.2: PORTAL FRAME INSTALLATION DETAILS

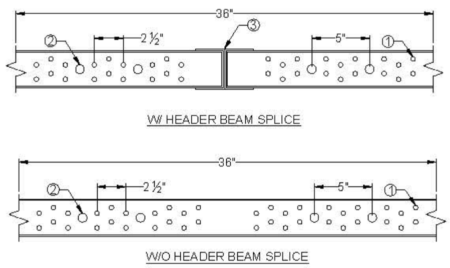


PICTURE FRAME NOMENCLATURE AND DIMENSIONING

FIGURE 10.1: PICTURE FRAME INSTALLATION DETAILS

1. AT LOCATIONS OF PICTURE FRAME INSTALLATIONS FRAME WITH A 4X (MINIMUM) RIM, 4X BLOCKING AT CANTILEVER CONDITIONS. SHEET THE FLOOR THEN LAYOUT THE 2X SILL PLATE FOR WALL FRAMING.
2. DETERMING THE LOCATION OF PICTURE FRAME AND USE TEMPLATES BY MANUFACTURER TO PULL COLUMN CENTERLINE DIMENSIONS WHILE CHECKING FOR END AND EDGE DISTANCES. SLOTTED HOLES ARE PROVIDED IN TEMPLATES FOR PULLING THE COLUMN CENTERLINE DIMENSION. MARK FOR DRILLING THE CONTINUOUS TIE-DOWN SYSTEM ROD.
3. PRIOR TO DRILLING CONFIRM THAT THE SLOT TO SLOT DIMENSION ACCURATELY CORRESPONDS TO THE COLUMN CENTERLINE DIMENSION FOR THE PICTURE FRAME MODEL NUMBER BEING INSTALLED OR PER PLAN CALLOUTS BY THE DESIGN PROFESSIONAL.
4. DRILL THROUGH THE SILL PLATE, FLOOR SYSTEM AND TOP PLATES OF WALL BELOW. INSTALL THE CONTINUOUS ALL-THREAD ROD (PER PLANS) TO A COUPLER NUT IN WALL FRAMING BELOW. WITH TOP OF ROD EXTENDING 7-1/2 INCHES ABOVE TOP OF FLOOR SHEETING INSTALL THE 2X SILL PLATE.

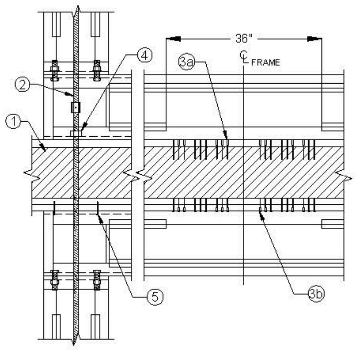
FLOOR SYSTEM PREPARATION INSTRUCTIONS 2 / 10.2



1. 5/16" HOLES FOR WS SCREWS (QTY PER TABLE)
2. 3/4" HOLES FOR 5/8" HS CAST IN PLACE ANCHORS.
3. SPLICE AT MID-SPAN REQUIRED WHEN OUT-TO-OUT IS >13 FT.

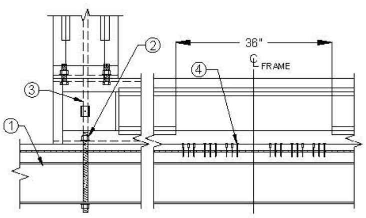
SCREW HOLE PATTERN 1 / 10.2

1. 4x RIM (MIN)
2. Z4 CONTINUOUS TIE DOWN SYSTEM.
3. a) 1/4" x 4-1/2" (MIN) WS SCREWS (QTY PER TABLE 1A)
   b) 1/4" x 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
4. CINCH NUT (CNX). LOCATED AT TOP PANEL ZONE WHEN PANEL RUN ENDS (AS OCCURS).
5. 1/4" WS SCREWS FOR OUT-OF-PLANE BRACING.



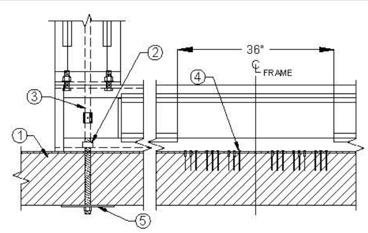
MOMENT FRAME HEADER BEAM TO PANEL COLUMNS ASSEMBLY INSTRUCTIONS
1. LAYOUT THE HEADER BEAM AND THE PANEL COLUMNS WITH THE OPEN (CAVITY) FACE UP.
2. BE SURE TO ORIENT THE ACCESS AREA AT THE MID-SPAN OF BEAMS FOR DRIVING MITEK PRO-SERIES SCREWS THROUGH THE FLANGES INTO WOOD FRAMING MEMBERS ABOVE AND BELOW.
3. ORIENT DIRECTION OF THE HEX HEAD BOLTS THROUGH THE PANEL ZONES IN THE COLUMN PANEL. INSTALL DIRECT TENSION INDICATOR (DTI) WASHERS, HARDENED ROUND WASHERS THEN GRADE 8 HEX NUTS.
4. SNUG THE NUTS AT ALL BOLTS, THEN TIGHTEN UNTIL AFTER THE ORANGE SILICONE SQUIRTS IN VOLUME FROM MOST OF THE DTI SQUIRT LOCATIONS.
5. IF THE BOLTS ARE NOTED AS SNUG-TIGHT, NO DTI WASHER IS REQUIRED.

MULTISTORY INSTALLATION 3 / 10.2



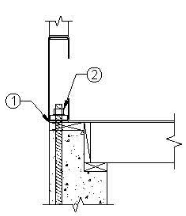
1. STEEL BEAM PER PLANS.
2. NUTS AND WASHERS PER TABLE 2 NOTE 1.
3. Z4 CONTINUOUS TIE DOWN SYSTEM WHEN OCCURS.
4. 1/4" x 4-1/2" (MIN) WS SCREWS (QTY PER TABLE 1A)

STEEL BEAM THRU-BOLT 5 / 10.2



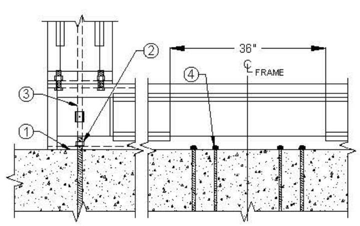
1. WOOD BEAM PER PLAN.
2. CINCH (NUT) CNX
3. Z4 CONTINUOUS TIE DOWN SYSTEM WHEN OCCURS.
4. 1/4" x 4-1/2" (MIN) WS SCREWS (QTY PER TABLE 1A)
5. PLATE PER EOR.

WOOD BEAM THRU-BOLT 4 / 10.2



1. 15# FELT OR EQUIVALENT RECOMMENDED BETWEEN PANEL BASE AND TREATED MUDSILL.
2. NUTS AND WASHERS PER SECTION 4.2.6.

RAISED STEM WALL 7 / 10.2



1. 15# FELT OR EQUIVALENT MOISTURE BARRIER RECOMMENDED BETWEEN PANEL BASE AND CONCRETE.
2. NUTS AND WASHERS PER SECTION 4.2.6.
3. Z4 CONTINUOUS TIE DOWN SYSTEM WHEN OCCURS.
4. CAST IN PLACE ANCHORS.

INSTALLATION ON CONCRETE 6 / 10.2

FIGURE 10.2: PICTURE FRAME INSTALLATION DETAILS

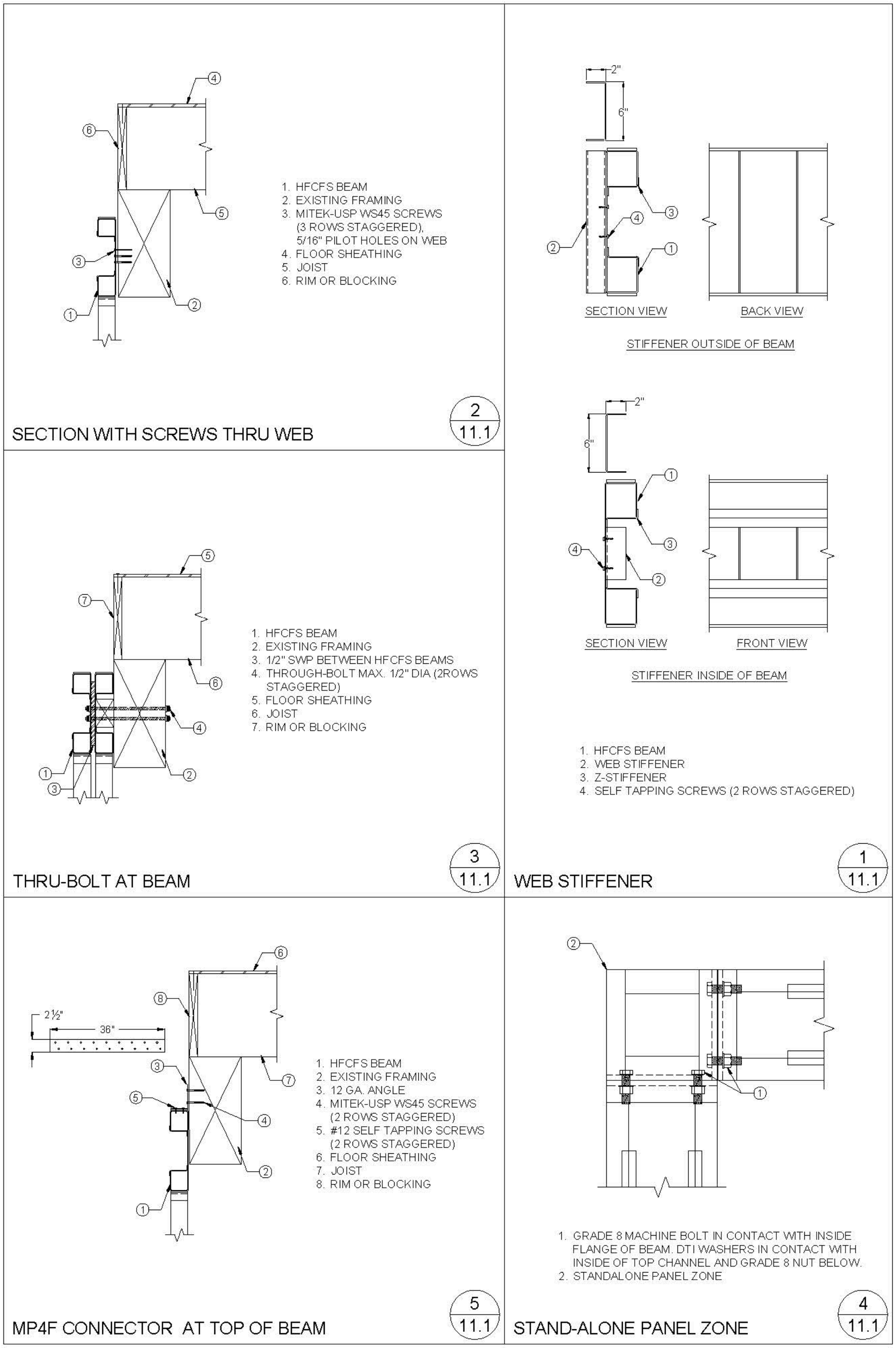
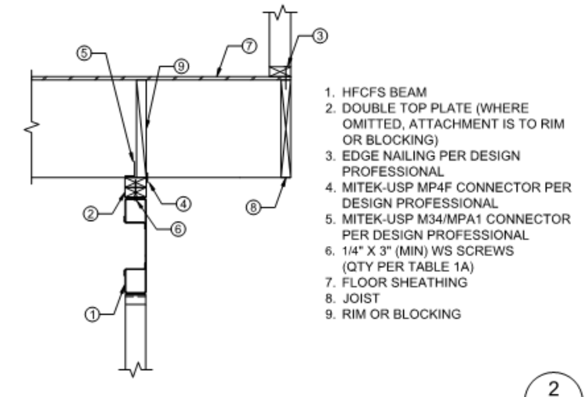
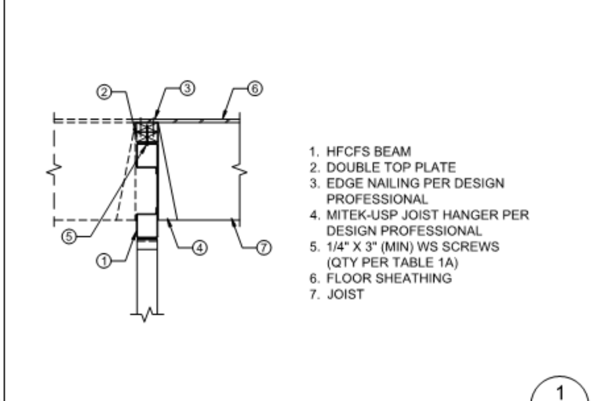


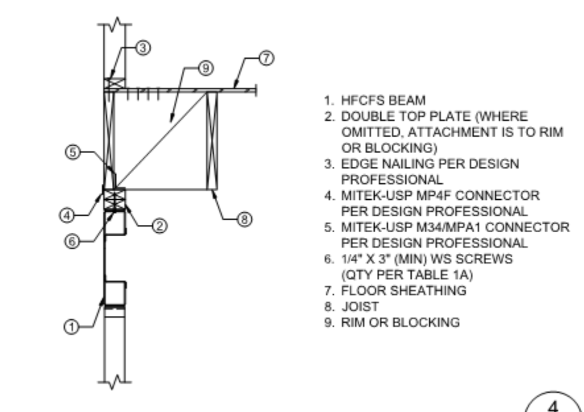
FIGURE 11.1: ADDITIONAL INSTALLATION DETAILS



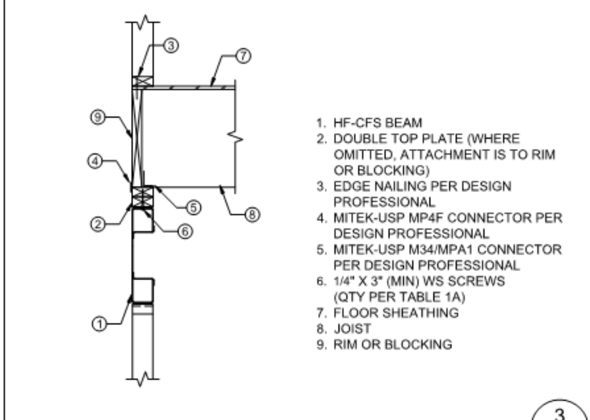
SECTION AT HEADER WITH CANTILEVER



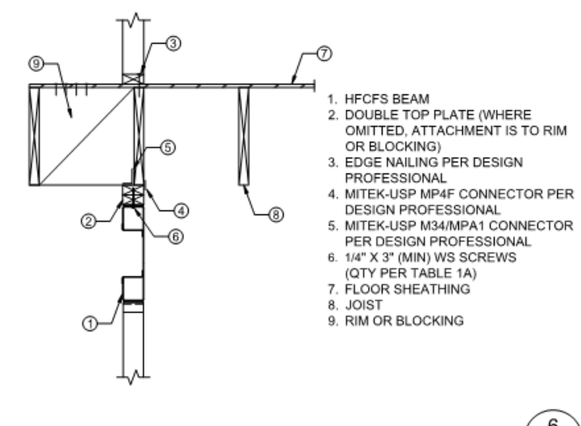
SECTION AT HEADER WITH HANGING JOISTS



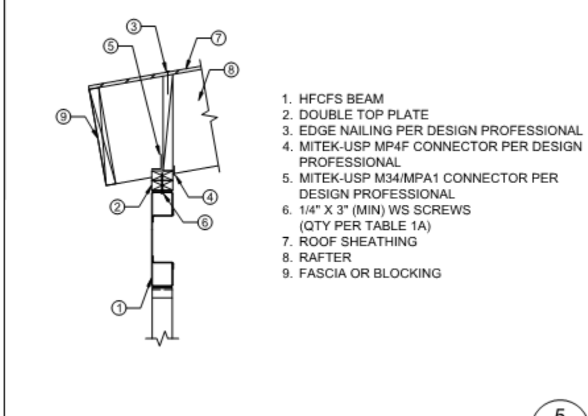
SECTION AT EXTERIOR PARALLEL JOISTS



SECTION AT HEADER WITH BEARING JOISTS



SECTION AT INTERIOR PARALLEL JOISTS



SECTION AT HEADER WITH SLOPED ROOF

FIGURE 11.2: ADDITIONAL INSTALLATION DETAILS

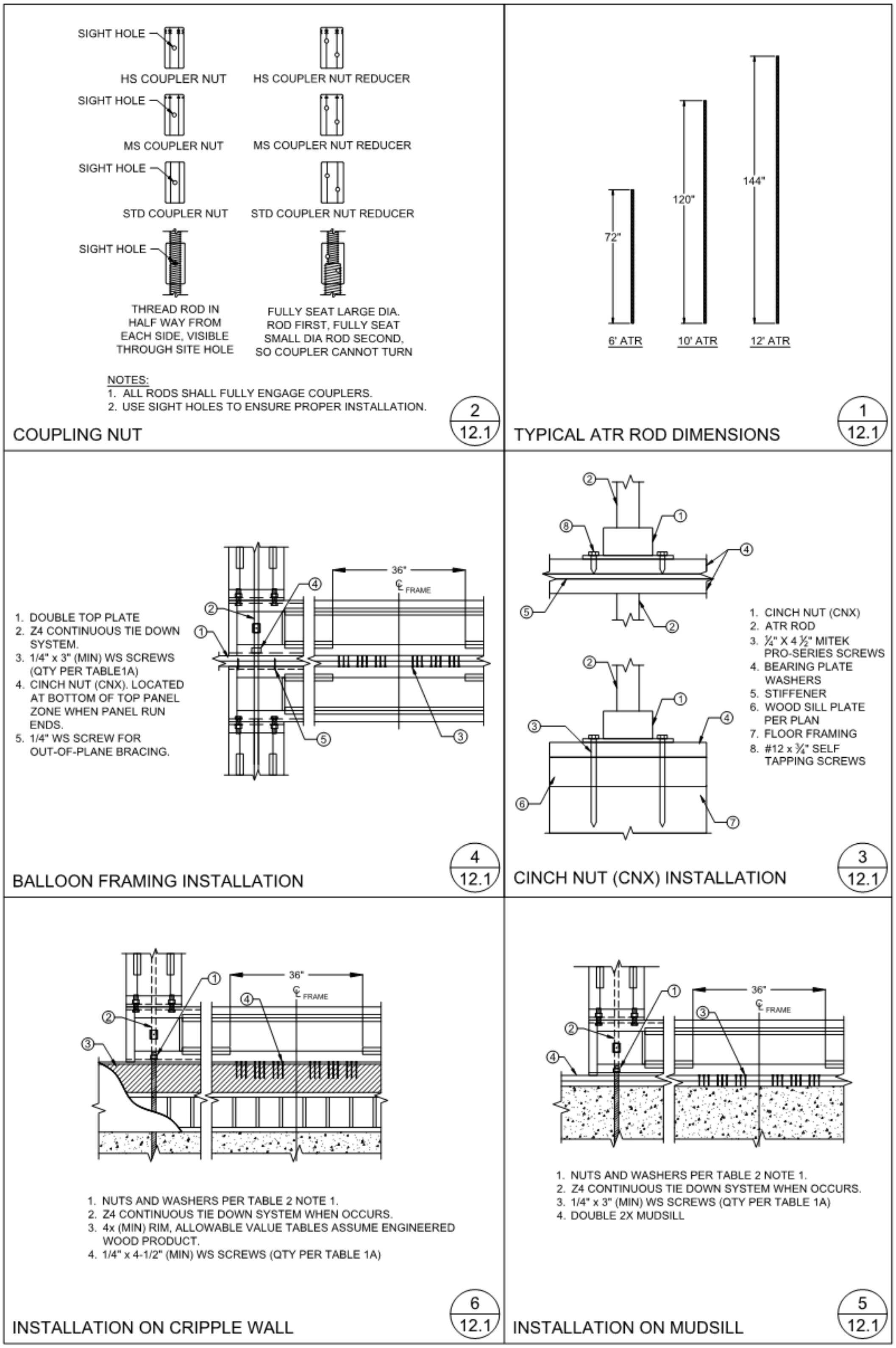
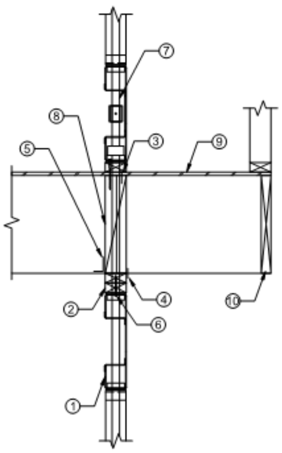
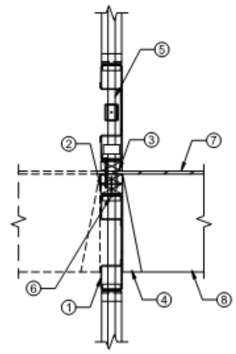


FIGURE 12.1: ADDITIONAL INSTALLATION DETAILS



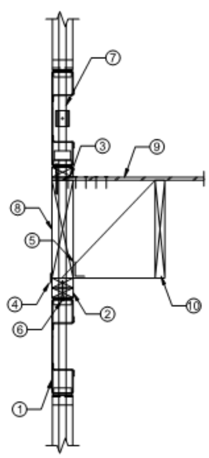
1. HFCFS BEAM
2. DOUBLE TOP PLATE (WHERE OMITTED, ATTACHMENT IS TO RIM OR BLOCKING)
3. EDGE NAILING PER DESIGN PROFESSIONAL
4. MITEK-USP MP4F CONNECTOR PER DESIGN PROFESSIONAL
5. MITEK-USP M34/MPA1 CONNECTOR PER DESIGN PROFESSIONAL
6. 1/4" X 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
7. Z4 CONTINUOUS TIE DOWN SYSTEM
8. 4X RIM (MIN)
9. FLOOR SHEATHING
10. JOIST

SECTION AT HEADER WITH CANTILEVER (2 / 12.2)



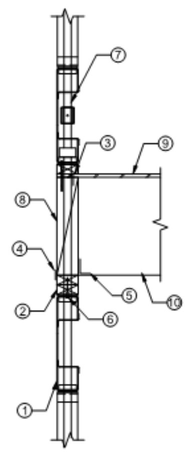
1. HFCFS BEAM
2. DOUBLE TOP PLATE
3. EDGE NAILING PER DESIGN PROFESSIONAL
4. MITEK-USP JOIST HANGER PER DESIGN PROFESSIONAL
5. Z4 CONTINUOUS TIE DOWN SYSTEM
6. 1/4" X 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
7. FLOOR SHEATHING
8. JOIST

SECTION AT HEADER WITH HANGING JOISTS (1 / 12.2)



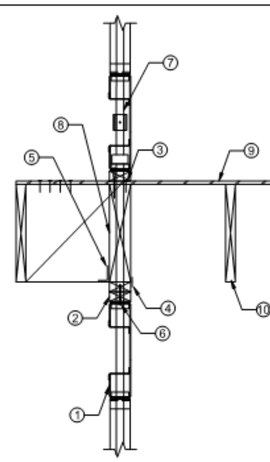
1. HFCFS BEAM
2. DOUBLE TOP PLATE (WHERE OMITTED, ATTACHMENT IS TO RIM OR BLOCKING)
3. EDGE NAILING PER DESIGN PROFESSIONAL
4. MITEK-USP MP4F CONNECTOR PER DESIGN PROFESSIONAL
5. MITEK-USP M34 OR MPA1 CONNECTOR PER DESIGN PROFESSIONAL
6. 1/4" X 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
7. Z4 CONTINUOUS TIE DOWN SYSTEM
8. 4X RIM (MIN)
9. FLOOR SHEATHING
10. JOIST

SECTION AT EXTERIOR PARALLEL JOISTS (4 / 12.2)



1. HFCFS BEAM
2. DOUBLE TOP PLATE (WHERE OMITTED, ATTACHMENT IS TO RIM OR BLOCKING)
3. EDGE NAILING BY DESIGN PROFESSIONAL
4. MITEK-USP MP4F CONNECTOR PER DESIGN PROFESSIONAL
5. MITEK-USP M34/MPA1 CONNECTOR PER DESIGN PROFESSIONAL
6. 1/4" X 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
7. Z4 CONTINUOUS TIE DOWN SYSTEM
8. 4X RIM (MIN)
9. FLOOR SHEATHING
10. JOIST

SECTION AT HEADER WITH BEARING JOISTS (3 / 12.2)



1. HFCFS BEAM
2. DOUBLE TOP PLATE (WHERE OMITTED, ATTACHMENT IS TO RIM OR BLOCKING)
3. EDGE NAILING PER DESIGN PROFESSIONAL
4. MITEK-USP MP4F CONNECTOR PER DESIGN PROFESSIONAL
5. MITEK-USP M34/MPA1 CONNECTOR PER DESIGN PROFESSIONAL
6. 1/4" X 3" (MIN) WS SCREWS (QTY PER TABLE 1A)
7. Z4 CONTINUOUS TIE DOWN SYSTEM
8. 4X RIM (MIN)
9. FLOOR SHEATHING
10. JOIST

SECTION AT INTERIOR PARALLEL JOISTS (5 / 12.2)

FIGURE 12.2: ADDITIONAL INSTALLATION DETAILS

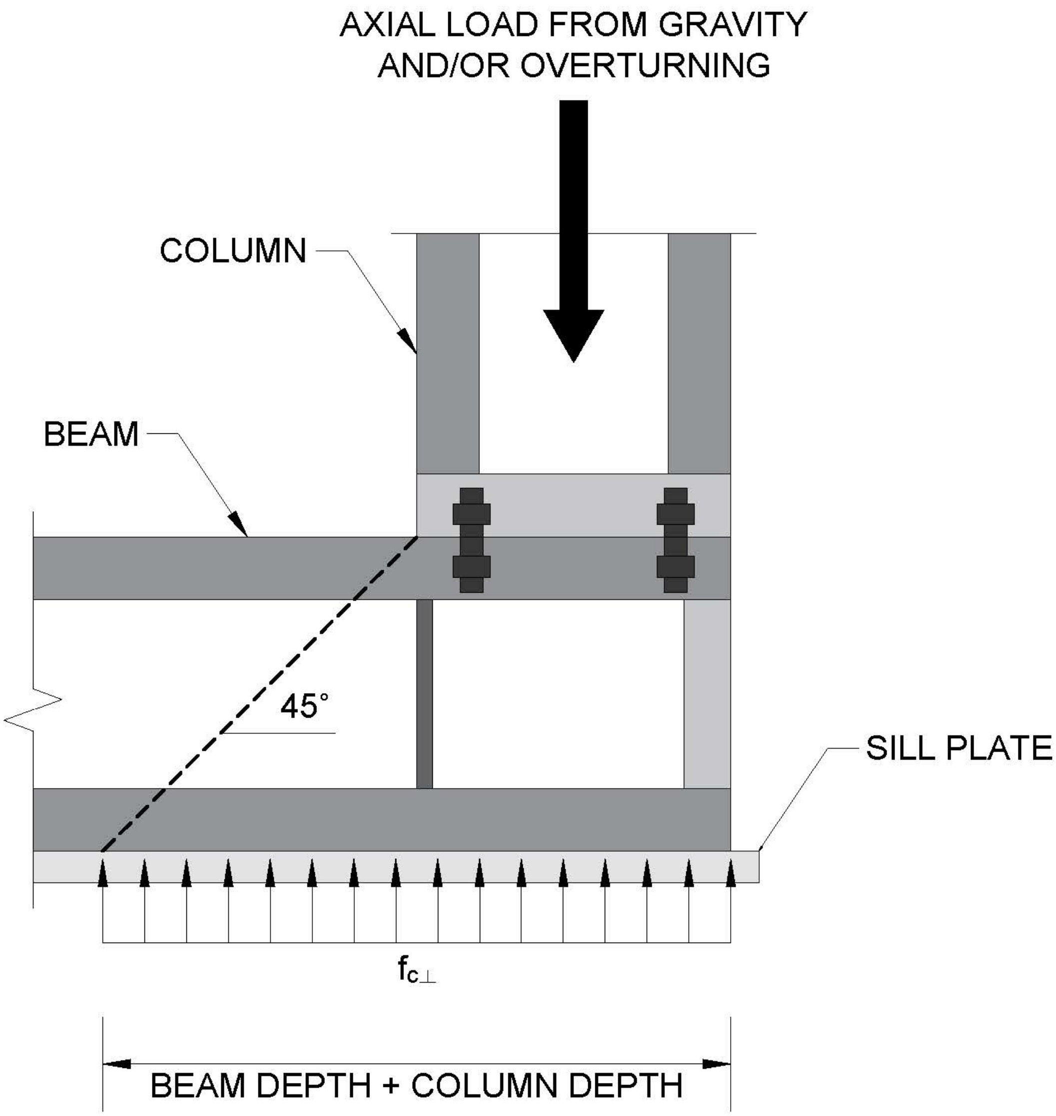
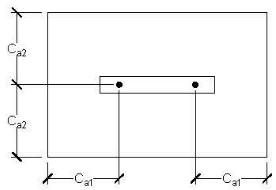


FIGURE 13: DISTRIBUTION OF COMPRESSION FORCES ON WOOD

SINGLE UNREINFORCED ANCHORAGE (UA) IN HFXMF

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE [1,2,3]	l_e [4]	C_{a1} [5]	C_{a2} [6]	SHEAR TIES [7,8]	HOOKED BARS
HFXMF12	12"	1-1/8" HS	30"	45"	45"	#4 (MIN) @ 4" O.C.	4 - #5 (MIN) @ 2" O.C.
HFXMF15	15"						
HFXMF18	18"						
HFXMF21	21"						

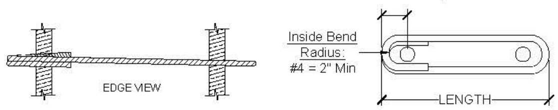


2
14.1

TABLE NOTES

1. DESIGNS ARE TO RESIST LOADING PER ACI 318-14, SECTION 17.2.3.4.3.
2. STD INDICATES ANCHORS COMPLYING WITH ASTM F1554 GRADE 36 WITH A HARDY FRAME BOLT BRACE (HFXBB) INSTALLED WITH DOUBLE NUTS ON THE EMBED END.
3. HS INDICATES ANCHORS COMPLYING WITH ASTM A193 GRADE B7 WITH A 1/2" X 3"X 3"(MIN) HFPW PLATE WASHER INSTALLED WITH DOUBLE NUTS ON THE EMBED END (HFXBB NOT REQUIRED).
4. l_e = LENGTH OF EMBEDMENT FROM THE TOP OF FOOTING OR GRADE BEAM TO THE TOP OF THE HFXBB BOLT BRACE (TOP OF THE EMBEDDED HFPW PLATE WASHER @ HS ANCHORS)
5. C_{a1} = DISTANCE FROM HD CENTERLINE TO THE END OF THE FOOTING OR GRADE BEAM.
6. C_{a2} = DISTANCE FROM HD CENTERLINE TO BOTH THE FRONT AND THE BACK FACE OF THE FOOTING OR GRADE BEAM.
7. SHEAR TIES ARE GRADE 60 (MIN) REBAR AND REQUIRED FOR NEAR EDGE DISTANCE CONDITIONS PER ACI-318-14, F'C = 2,500 PSI. CURBS AND STEM WALLS MUST BE 6 INCH (MIN) WIDTH FOR UA AND RA, 12 INCH (MIN) WIDTH FOR BB-RA. IN ANY CASE, THE MINIMUM CONCRETE COVERAGE SHOULD BE PROVIDED PER ACI 318-14.
8. FOR UA APPLICATIONS, ADDITIONAL TIES MAY BE REQUIRED AT STEM WALLS. SHEAR TIES ARE NOT REQUIRED FOR INSTALLATION ON SLAB, INSTALLATION ON WOOD FRAMING, OR FOR IRC BRACED WALL PANEL APPLICATIONS.
9. STIRRUPS ARE GRADE 60 (MIN) REBAR. SEE TABLE FOR SIZE AND SPACING. SEE "STIRRUP LAYOUT" DIAGRAMS AND "KEY" FOR LAYOUT PATTERNS.
10. CONCRETE EDGE DISTANCES MUST COMPLY WITH ACI 318-14, SECTION 17.7.1

1
14.1



SHEAR TIES

MODEL	LENGTH
HFXMF12	10-1/2"
HFXMF15	12"
HFXMF18	15"
HFXMF21	18"

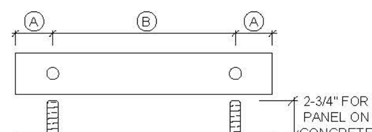
UA SHEAR TIES

4
14.1

1. DETERMINE LOCATION AND LAYOUT OF THE MOMENT FRAME TEMPLATES PER PLANS.
2. INSTALL TEMPLATES AND ANCHORS PER PLAN DETAILS. REFER TO INSTALLATION INSTRUCTIONS AND PRODUCT LABELING FOR CORRECT TEMPLATE ORIENTATION, ANCHOR ASSEMBLIES, ANCHOR HEIGHT ABOVE CONCRETE AND SPACING BETWEEN TEMPLATES FOR FINISH FRAME WIDTH.
3. SLOTTED HOLES ARE PROVIDED IN TEMPLATES FOR PULLING THE COLUMN CENTERLINE DIMENSIONS. PRIOR TO POURING CONCRETE, CONFIRM THE SLOT TO SLOT DIMENSION ACCURATELY CORRESPONDS TO THE COLUMN CENTERLINE DIMENSION FOR THE MOMENT FRAME MODEL NUMBER BEING INSTALLED OR PER PLAN CALLOUTS BY THE DESIGN PROFESSIONAL.

CONCRETE PREPARATION INSTRUCTIONS

3
14.1



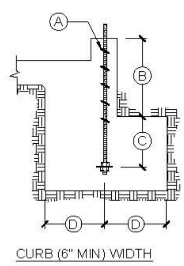
TOP OF CONCRETE

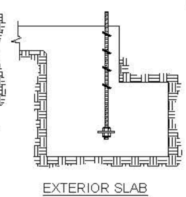
Model	Width	A	B
HFXMF12	12"	1-3/4"	8-1/2"
HFXMF15	15"	2-5/8"	9-3/4"
HFXMF18	18"		12-3/4"
HFXMF21	21"		15-3/4"

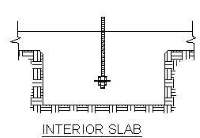
HFXMF ANCHOR CENTERLINES

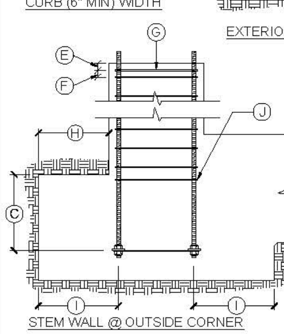
5
14.1

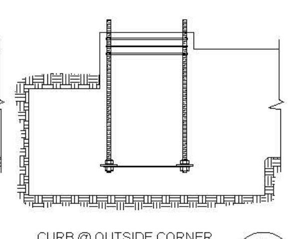
A. Shear Ties per UA Table
B. 10" Max or per Plans
C. le per Table
D. Ca2 per Table
E. ±1" from Top of Concrete to CL of Shear Tie
F. 1" CL @ Upper Two Ties
G. Shear Ties per RA Table when Top of Concrete is ≥ 8" above Top of Slab
H. 12" Min
I. Ca1 per Table
J. First tie in the footing











UA SECTIONS & ELEVATIONS

7
14.1

IMPORTANT!

1. ANCHORAGE IS DESIGNED FOR SINGLE STORY APPLICATIONS ONLY.
2. ANCHORAGE IS DESIGNED FOR TENSION AND SHEAR TRANSFER ONLY, FOUNDATION DESIGN PER EOR.
3. REINFORCEMENT SHOWN IS THE MINIMUM REQUIREMENT AND IS NOT INTENDED TO REPLACE REINFORCEMENT DESIGNED BY THE EOR.
4. FOR RA AND BB-RA INSTALLATIONS, THE HFXBB BOLT BRACE MAY BE PLACED ON TOP OF THE STIRRUPS WITH DOUBLE-NUTS INSTALLED AT EMBED END OF STANDARD GRADE ANCHOR RODS. (NOTE: ½" x 3" x 3" MIN. HFPW PLATE WASHERS ARE REQUIRED TO BE DOUBLE-NUTTED AT EMBED END OF HIGH STRENGTH ANCHOR RODS.)
5. HIGH STRENGTH ALL-THREAD RODS PROVIDED BY MITEK ARE STAMPED ON BOTH ENDS.

HF
B7

IMPORTANT NOTES

6
14.1

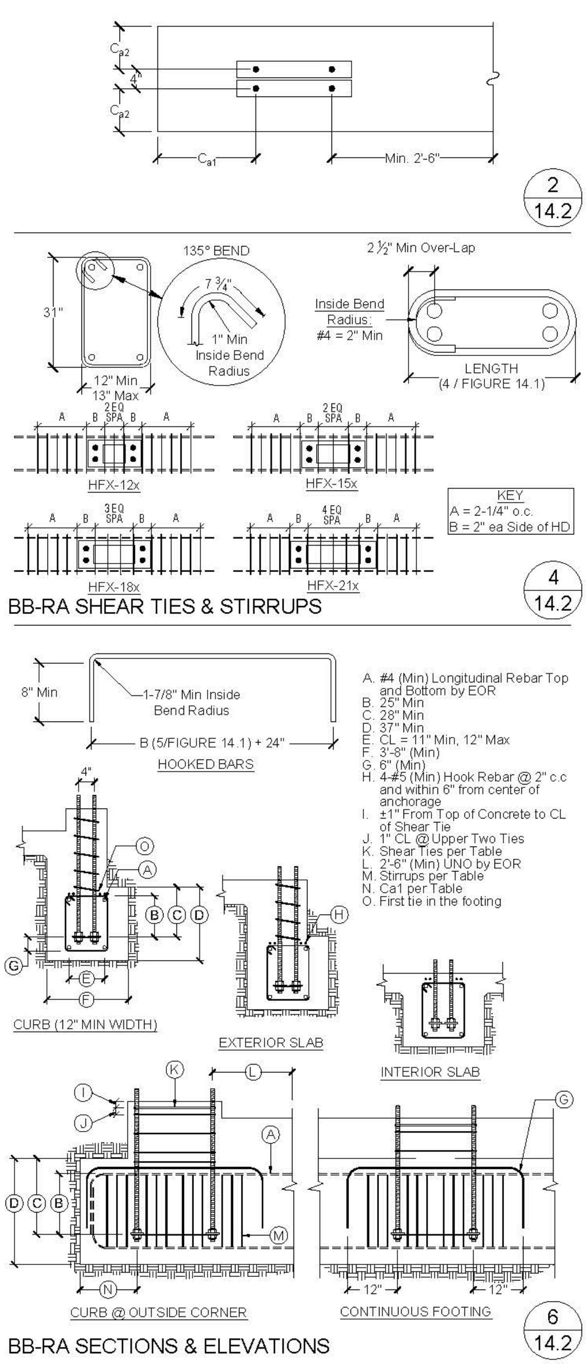
FIGURE 14.1: PORTAL FRAME ANCHORAGE DETAILS

BACK TO BACK REINFORCED ANCHORAGE (BB-RA) IN HFXMF

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE 1,2,3	l_e 4	C_{a1} 5	C_{a2} 6	STIRRUPS 9	SHEAR TIES 7	HOOKED BARS
HFXMF12	12"	1-1/8" HS	28"	18"	18"	15 - #4	#4 (MIN) @ 4" O.C.	4 - #5 (MIN) @ 2" O.C.
HFXMF15	15"					15 - #4		
HFXMF18	18"					16 - #4		
HFXMF21	21"					15 - #4		

SINGLE REINFORCED ANCHORAGE (RA) IN HFXMF

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE 1,2,3	l_e 4	C_{a1} 5	C_{a2} 6	STIRRUPS 9	SHEAR TIES 7	HOOKED BARS
HFXMF12	12"	1-1/8" HS	16"	18"	18"	9 - #4	#4 (MIN) @ 4" O.C.	4 - #5 (MIN) @ 2" O.C.
HFXMF15	15"					9 - #4		
HFXMF18	18"					10 - #4		
HFXMF21	21"					11 - #4		



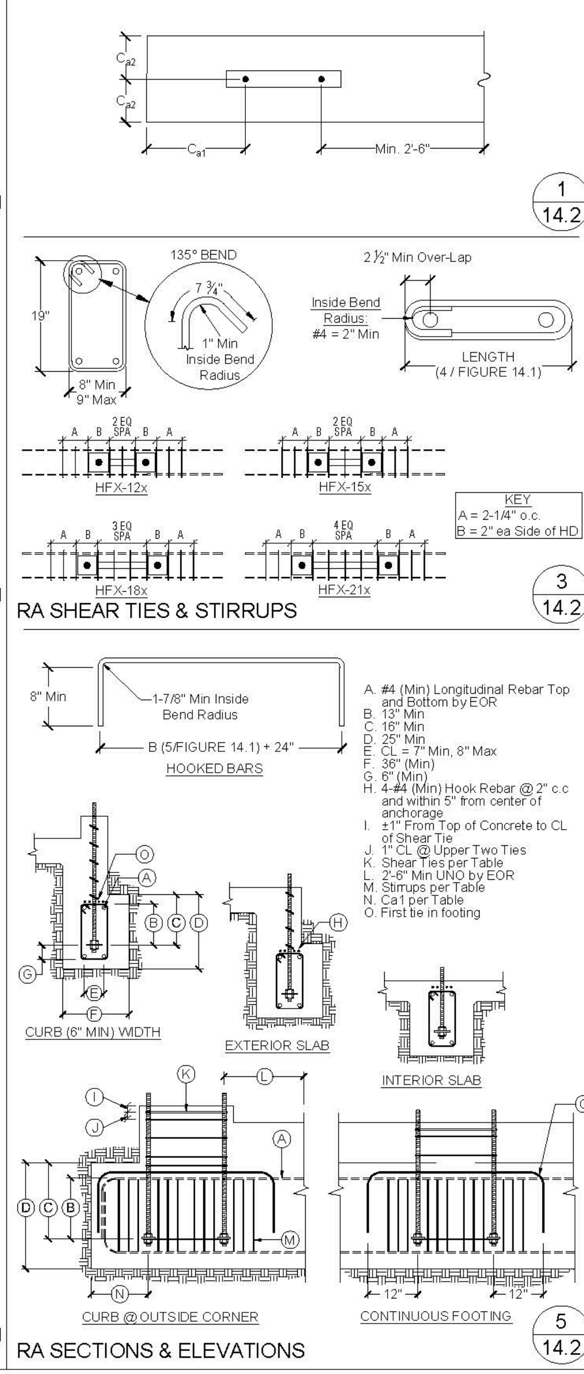
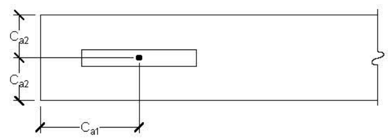


FIGURE 14.2: PORTAL FRAME ANCHORAGE DETAILS

SINGLE REINFORCED ANCHORAGE (RA)
@ BOTTOM PANEL ZONE IN HFXPIC

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE [1,2,3]	EMBED DEPTH, l_e [4]	MIN END DIST, C_{a1} [5]	MIN EDGE DIST, C_{a2} [6]	STIRRUPS [9]
HFXPIC12	12"	1-1/8" HS	16"	21"	18"	4 - #4
HFXPIC15	15"					6 - #4
HFXPIC18	18"					6 - #4
HFXPIC21	21"					6 - #4

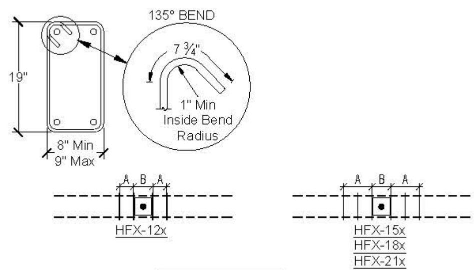


2 / 15.1

TABLE NOTES

1. DESIGNS ARE TO RESIST LOADING PER ACI 318-14, SECTION 17.2.3.4.3.
2. STD INDICATES ANCHORS COMPLYING WITH ASTM F1554 GRADE 36 WITH A HARDY FRAME BOLT BRACE (HFXBB) INSTALLED WITH DOUBLE NUTS ON THE EMBED END.
3. HS INDICATES ANCHORS COMPLYING WITH ASTM A193 GRADE B7 WITH A 1/2" X 3" X 3"(MIN) HFPW PLATE WASHER INSTALLED WITH DOUBLE NUTS ON THE EMBED END (HFXBB NOT REQUIRED).
4. l_e = LENGTH OF EMBEDMENT FROM THE TOP OF FOOTING OR GRADE BEAM TO THE TOP OF THE HFXBB BOLT BRACE (TOP OF THE EMBEDDED HFPW PLATE WASHER @ HS ANCHORS)
5. C_{a1} = DISTANCE FROM HD CENTERLINE TO THE END OF THE FOOTING OR GRADE BEAM.
6. C_{a2} = DISTANCE FROM HD CENTERLINE TO BOTH THE FRONT AND THE BACK FACE OF THE FOOTING OR GRADE BEAM.
7. SHEAR TIES ARE GRADE 60 (MIN) REBAR AND REQUIRED FOR NEAR EDGE DISTANCE CONDITIONS PER ACI-318-14, F'C = 2,500 PSI. CURBS AND STEM WALLS MUST BE 6 INCH (MIN) WIDTH FOR UA AND RA, 12 INCH (MIN) WIDTH FOR BB-RA. IN ANY CASE, THE MINIMUM CONCRETE COVERAGE SHOULD BE PROVIDED PER ACI 318-14.
8. FOR UA APPLICATIONS, ADDITIONAL TIES MAY BE REQUIRED AT STEM WALLS. SHEAR TIES ARE NOT REQUIRED FOR INSTALLATION ON SLAB INSTALLATION ON WOOD FRAMING, OR FOR IRC BRACED WALL PANEL APPLICATIONS.
9. STIRRUPS ARE GRADE 60 (MIN) REBAR. SEE TABLE FOR SIZE AND SPACING. SEE "STIRRUP LAYOUT" DIAGRAMS AND "KEY" FOR LAYOUT PATTERNS.
10. CONCRETE EDGE DISTANCES MUST COMPLY WITH ACI 318-14, SECTION 17.7.1

1 / 15.1



KEY
A = 2-1/4" o.c.
B = 2" ea Side of HD

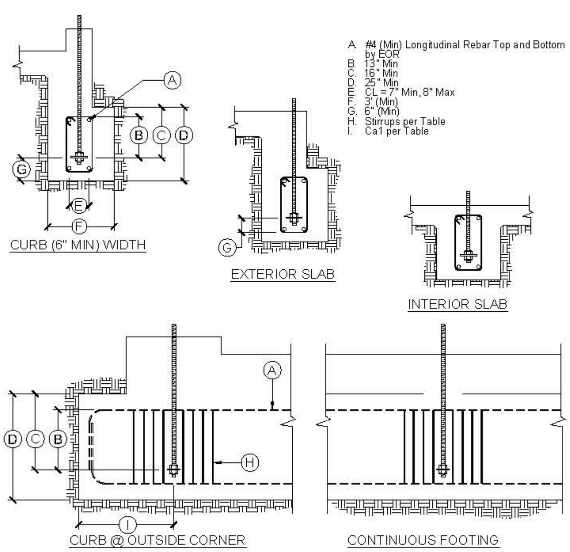
RA SHEAR TIES & STIRRUPS

4 / 15.1

1. DETERMINE LOCATION AND LAYOUT OF THE MOMENT FRAME TEMPLATES PER PLANS.
2. INSTALL TEMPLATES AND ANCHORS PER PLAN DETAILS. REFER TO INSTALLATION INSTRUCTIONS AND PRODUCT LABELING FOR CORRECT TEMPLATE ORIENTATION, ANCHOR ASSEMBLIES, ANCHOR HEIGHT ABOVE CONCRETE AND SPACING BETWEEN TEMPLATES FOR FINISH FRAME WIDTH.
3. SLOTTED HOLES ARE PROVIDED IN TEMPLATES FOR PULLING THE COLUMN CENTERLINE DIMENSIONS. PRIOR TO POURING CONCRETE, CONFIRM THE SLOT TO SLOT DIMENSION ACCURATELY CORRESPONDS TO THE COLUMN CENTERLINE DIMENSION FOR THE MOMENT FRAME MODEL NUMBER BEING INSTALLED OR PER PLAN CALLOUTS BY THE DESIGN PROFESSIONAL.

CONCRETE PREPARATION INSTRUCTIONS

3 / 15.1



RA SECTIONS & ELEVATIONS AT BOTTOM PANEL ZONE

6 / 15.1

IMPORTANT!

1. ANCHORAGE IS DESIGNED FOR SINGLE STORY APPLICATIONS ONLY.
2. ANCHORAGE IS DESIGNED FOR TENSION AND SHEAR TRANSFER ONLY, FOUNDATION DESIGN PER EOR.
3. REINFORCEMENT SHOWN IS THE MINIMUM REQUIREMENT AND IS NOT INTENDED TO REPLACE REINFORCEMENT DESIGNED BY THE EOR.
4. FOR RA AND BB-RA INSTALLATIONS, THE HFXBB BOLT BRACE MAY BE PLACED ON TOP OF THE STIRRUPS WITH DOUBLE-NUTS INSTALLED AT EMBED END OF STANDARD GRADE ANCHOR RODS. (NOTE: ½" x 3" x 3" MIN. HFPW PLATE WASHERS ARE REQUIRED TO BE DOUBLE-NUTTED AT EMBED END OF HIGH STRENGTH ANCHOR RODS.)
5. HIGH STRENGTH ALL-THREAD RODS PROVIDED BY MITEK ARE STAMPED ON BOTH ENDS.

HF
B7

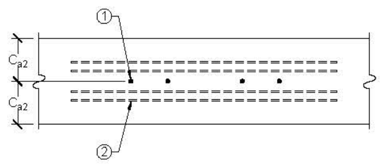
IMPORTANT NOTES

5 / 15.1

FIGURE 15.1: PICTURE FRAME ANCHORAGE DETAILS

SINGLE REINFORCED ANCHORAGE (RA) @ BOTTOM BEAM IN HFXPIC &
BACK TO BACK REINFORCED ANCHORAGE (BB-RA) @ BOTTOM BEAM IN HFXPIC

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE [1,2,3]	EMBED DEPTH, l_e [4]	MIN EDGE DIST, C_{a2} [6]	STRAIGHT BARS @ SINGLE FRAME	STRAIGHT BARS @ BACK TO BACK FRAME
HFXMF12	12"	5/8" HS	16"	15"	4 - #6	8 - #6
HFXMF15	15"				4 - #6	8 - #6
HFXMF18	18"				4 - #6	8 - #6
HFXMF21	21"				4 - #6	8 - #6

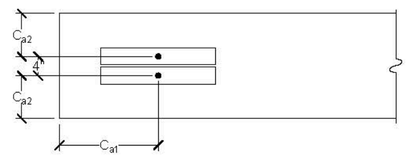


1. CAST-IN-PLACE ANCHORS.
2. #6 STRAIGHT BARS OR EQUIVALENT WITHIN 4-1/2" FROM CENTER OF ANCHORS.

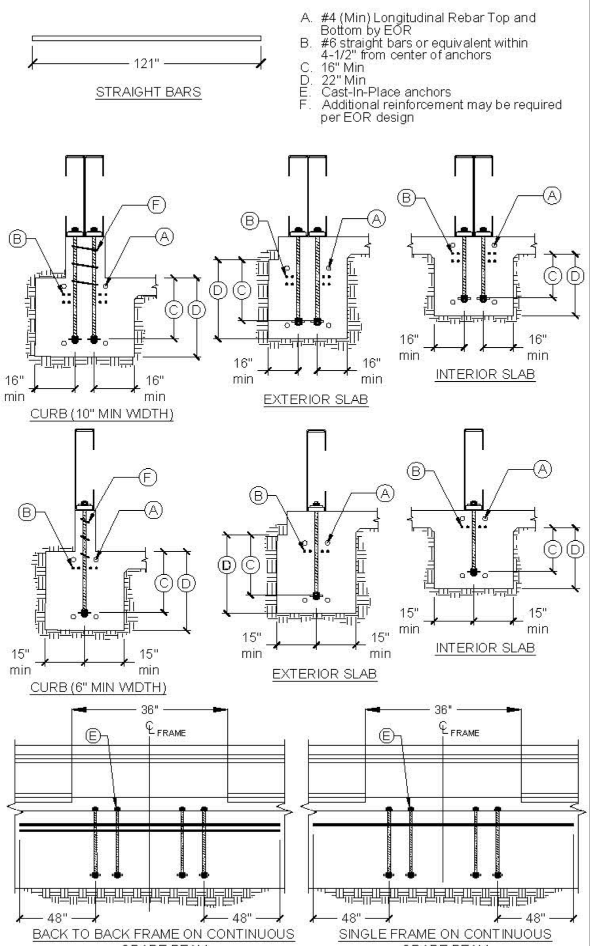
2
15.2

BACK-TO-BACK REINFORCED ANCHORAGE (BB-RA)
@ BOTTOM PANEL ZONE IN HFXPIC

MODEL NUMBER	COLUMN WIDTH	ANCHOR DIA & GRADE [1,2,3]	EMBED DEPTH, l_e [4]	MIN END DIST, C_{a1} [5]	MIN EDGE DIST, C_{a2} [6]	STIRRUPS [9]
HFXPIC12	12"	1-1/8" HS	28"	21"	20"	8 - #4
HFXPIC15	15"					10 - #4
HFXPIC18	18"					10 - #4
HFXPIC21	21"					12 - #4

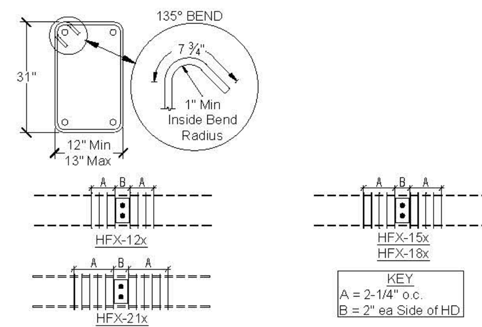


1
15.2



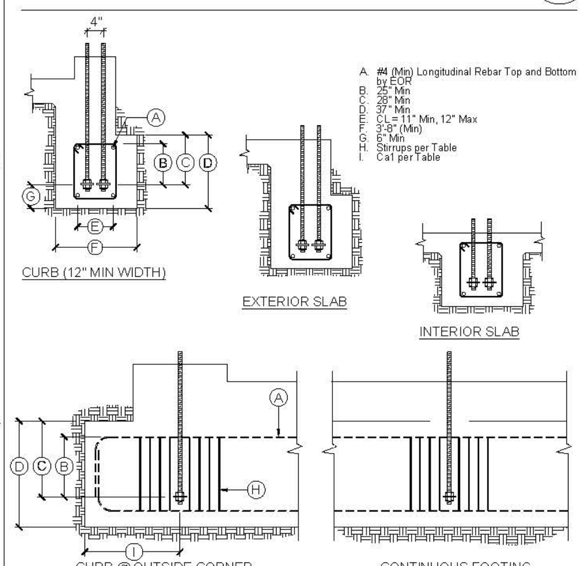
RA & BB-RA SECTIONS & ELEVATIONS AT CENTER OF BOTTOM BEAM

5
15.2



RA SHEAR TIES & STIRRUPS

3
15.2



BB-RA SECTIONS & ELEVATIONS AT BOTTOM PANEL ZONE

4
15.2

FIGURE 15.2: PICTURE FRAME ANCHORAGE DETAILS

CALIFORNIA SUPPLEMENT

MITEK INC.
16023 Swingley Ridge Road
Chesterfield, MO 63017
(805) 477-0793
www.hardyframe.com

HARDY FRAME® COLD-FORMED STEEL (CFS) MOMENT FRAMES: PORTAL AND PICTURE FRAMES

CSI Sections:

05 40 00 Cold-Formed Metal Framing
05 40 19 Cold-Formed Shear Wall Panels
06 12 19 Shear Wall Panels

1.0 RECOGNITION

MiTek's Hardy Frame® Cold-Formed Steel (CFS) Moment Frames evaluated in IAPMO UES ER-491 comply with the intent of the provisions of the following codes and regulations:

- 2019 California Building Code® (CBC)
- 2019 California Residential Code® (CRC)

2.0 LIMITATIONS

MiTek's Hardy Frame® Cold-Formed Steel (CFS) Moment Frames, described in this report, comply with the codes listed in Section 1.0 of this supplement, subject to the following limitations.

2.1 The Hardy Frame® Cold-Formed Steel (CFS) Moment Frames: Portal And Picture Frames shall comply with the provisions in IAPMO UES ER-491 applicable to the 2018 IBC or 2018 IRC for use under the 2019 CBC or 2019 CRC.

2.2 The limitations in Section 2.0 of ER-491 shall apply.

2.3 For applications regulated by DSA or HCAi (formerly OSHPD), construction documents shall comply with CBC Section 1603A.

2.4 Inspections shall comply with CBC Chapter 17A as applicable.

2.5 For applications regulated by DSA, applicable provisions in CBC Section 2212.5 shall be observed.

2.6 This supplement expires concurrently with ER-491.

CITY OF LOS ANGLES SUPPLEMENT

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Chesterfield, MO 63017
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05 40 00 Cold-Formed Metal Framing
05 40 19 Cold-Formed Shear Wall Panels
06 12 19 Shear Wall Panels

1.0 RECOGNITION

MiTek's Hardy Frame® Cold-Formed Steel (CFS) Moment Frames have been evaluated in IAPMO UES ER-491 and this LABC and LARC supplement for use as lateral force-resisting system elements in Light-Framed Buildings of wood or CFS construction to resist earthquake or wind forces. The structural properties of the frames were evaluated for compliance with the following codes and regulations:

- 2020 City of Los Angeles Building Code (LABC)
- 2020 City of Los Angeles Residential Code (LARC)

2.0 LIMITATIONS

Use of the Hardy Frame® CFS Moment Frame lateral force resisting system (Portal Frame or Picture Frame) recognized in this supplement is subject to the following limitations:

2.1 Use and installation shall be in accordance with the provisions of ER-491 applicable to the 2018 IBC or 2018 IRC, the California Supplement, the manufacturer's published installation instructions, and the City of Los Angeles Building and Residential Codes, as applicable. A copy of the manufacturer's installation instructions shall be available on-site for Registered Deputy Inspectors. Where conflicts occur, the more restrictive shall govern.

2.2 Design loads shall be determined in accordance with 2020 LABC Chapter 16 or 2020 LARC Section R301, as applicable. Allowable load values shall not be further increased for short-duration loading such as wind and seismic.

2.3 Construction documents and calculations shall be approved and stamped by an engineer or architect licensed in the state of California and approved by the structural plan check engineer for each moment frame system installation.

2.4 When Hardy Frame® Cold-Formed Steel (CFS) Moment Frames are used in line with other types of lateral force resisting systems, only one type shall be considered as the lateral resistance element, except approved by structural plan check on a case-by-case basis.

2.5 Fabrication of Hardy Frame® Products shall be in a shop of a fabricator licensed by the City of Los Angeles Building Department, in accordance with the Manufacturing Standards submitted to the Department.

2.6 Periodic inspection by Deputy Inspectors shall be provided during installation of anchorage prior to pouring concrete.

2.7 Structural observations in accordance with Section 1704.6 of the 2020 LABC shall be conducted.

2.8 This supplement expires concurrently with ER-491.

For additional information about this evaluation report please visit www.uniform-es.org or email us at info@uniform-es.org