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DIVISION: 03—CONCRETE
Section: 03410— Plant Precast Structural Concrete

REPORT HOLDER:

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EVALUATION SUBJECT:

HEBEL AUTOCLAVED AERATED CONCRETE (AAC) PANELS AND HEBEL THIN BED MORTAR

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- Other Codes (see Section 8.0)

Properties evaluated:

- Structural
- Sound transmission
- Thermal conductivity and resistance

2.0 USES

Hebel Autoclaved Aerated Concrete (AAC) Panels are used as structural members for roofs and floors, load-bearing and nonload-bearing wall panels and shear walls, and wall lintels and nonload-bearing curtain walls.

3.0 DESCRIPTION

3.1 General:

Hebel AAC Panels are reinforced precast, noncombustible building units manufactured from autoclaved aerated concrete, and comply with ASTM C 1452. The autoclaved aerated concrete is produced from cement, lime, gypsum, quartz sand, water, and an expanding agent (aluminum paste) admixture. The batched raw materials are mixed together with water and then cast into steel molds. Due to the chemical reactions that take place, hydrogen gas is generated in the slurry mix, causing it to expand and form nonconnecting air cells. After setting and before hardening, the AAC panel material is machine-cut into precast panels for concrete wall, roof and floor construction. The panels are steam-cured under pressure in autoclaves where the material is transformed into a hard calcium silicate.

The panels are reinforced with plain steel wire complying with ASTM A 82 as required by ASTM C 1452. Transverse

wires are welded to longitudinal reinforcement to provide anchorage. Reinforcing steel wire diameters range from $5/32$ inch (4 mm) to $5/16$ inch (8 mm). The longitudinal wire spacing is 2.36 inches (60 mm) on center, with a maximum of nine wires on each face. All reinforcing wire is protected with rust inhibitor in compliance with ASTM C 1452.

The average moisture content of the AAC panels at delivery is 20 to 35 percent by weight. Moisture content lessens gradually and moisture equilibrium is usually reached at approximately 5 percent by weight after six months to one year.

All metal connectors, fasteners and accessories used must be of corrosion-resistant material compatible with the precast panel material. The Hebel AAC panels comply with ASTM C 1452 as strength classes AAC4 or AAC6.

See Table 1 for available panel strengths, densities and thermal properties.

3.2 Hebel Floor Panels:

The floor panels are 24 inches (610 mm) wide and are manufactured with grooved edges along the longer dimension. All units have two layers of equal or unequal reinforcement. The panels are available in different strength categories and thicknesses to suit a range of spans. Thermal characteristics of Hebel AAC floor panels are shown in Table 1, and the design values are shown in Table 2.

3.3 Hebel Roof Panels:

The roof panels are similar to Hebel floor panels with respect to geometry, physical characteristics, and installation procedures. Thermal characteristics of reinforced Hebel AAC roof panels are shown in Table 1, and design values are shown in Table 2.

3.4 Hebel Horizontal and Vertical Wall Panels:

Hebel horizontal and vertical wall panels are available in the same strength categories and have the same thermal characteristics as noted in Table 1 for Hebel floor and roof panels. Design values are noted in Table 3. Wall panels have two layers of equal amounts of reinforcement and are placed either vertically or horizontally. Wall panels spanning vertically from floor to floor have either tongue-and-groove edges, groove-to-groove edges, or longitudinal square edges with square edges at supports. Tongues and grooves measure 2 inches (51 mm) in diameter. Wall panels spanning horizontally have tongue-and-groove edges or square edges perpendicular to supports, with square edges along supports.

3.4.1 Hebel Curtain Wall Panels: Hebel curtain wall panels are nonload-bearing panels. The panels are similar to the Hebel horizontal and vertical wall panels except that the curtain wall panels are only used for nonload-bearing applications. The panels can be installed horizontally or vertically.

3.4.2 Hebel Lintels: Hebel lintels are reinforced and used to span openings in walls. The AAC6 lintels can be used for load-bearing and nonload-bearing applications.

3.4.3 Hebel Thin-Bed Mortar: Hebel thin-bed mortar consists of inorganic aggregates, cement and organic additives. The mortar complies with Sections 2103.11.1 and 2103.11.2 of the IBC. Thin-bed mortar comes dry-mixed and prebagged from the factory. Each bag weighs 48.5 pounds (22 kg). Mixing instructions are printed on the bag for the addition of water and the appropriate mixing sequence. The Hebel thin-bed mortar is used with Hebel AAC panels of all densities and strengths. The working life of the thin bed mortar is four hours. Thin-bed mortar has a one-year shelf life from the date of manufacture when stored in unopened bags and protected from moisture.

4.0 DESIGN AND INSTALLATION

4.1 Design Strength of Hebel AAC Panels:

4.1.1 Design Strength: General: Design strength for the use of Hebel AAC panels must be in accordance with Section 1901.2 of the IBC, using the design information in Table 2 or Table 3, as applicable.

4.1.2 Roof and Floor Panels: Table 2 shows design values for roof and floor panels. Tables 4, 5 and 6 show allowable loads for roof and floor panels.

4.1.3 Horizontal and Vertical Wall Panels: Design values for wall panels are noted in Table 3. The design assumptions for the reinforced panels must comply with the Building Code Requirements for Reinforced Concrete (ACI 318), Section 10.2.

4.2 Installation:

4.2.1 General: The Hebel AAC panels must be installed in accordance with this report and the approved construction plans, which must comply with Section 1901.4 of the IBC. A copy of the plans and this report must be available at the jobsite at all times during installation.

Typical installation details are illustrated in Figures 1 through 4. The typical details are intended as a guide only, and must be substantiated for approval by the code official.

4.2.2 Roof and Floor Panels: Roof assemblies must be covered with an approved, fully adhered, Class A, B or C roof covering without insulation or mechanical attachments. Floor slabs must be protected from moisture and abrasion by application of an approved topping. All grooves must be reinforced with one minimum No. 3, Grade 60 deformed reinforcement bar and filled with grout. The roof and floor panels may be installed on reinforced concrete, steel, masonry, AAC or heavy timber. Minimum bearing depths for roof and floor panels on different supporting surfaces are shown in Figure 1.

4.2.3 Horizontal and Vertical Wall Panels: A waterproof course membrane may be used on top of the foundation where the panels will be placed to protect against ground moisture. Exterior walls exposed to weather and/or outside moisture must have a code-complying water-resistive barrier. The first horizontal or vertical panel must be laid in a Type M leveling cement bed mortar. The first horizontal or vertical panels may be installed without using Type M cement bed mortar if the top surface of the supporting element is even. Proper anchoring of each horizontal or vertical panel to the main structure must be in accordance with Xella's published installation manual and as illustrated in Figures 2, 3 and 4. After the first wall panel is anchored to the main structure, thin-bed mortar must be applied to the panel's longitudinal

side just before installation of the next panel. It is necessary to apply the Hebel thin-bed mortar to the joints when working with Hebel tongue-and-groove panels. Vertical joints with a 0.40-inch to 0.80-inch (10 mm to 20 mm) gap between the horizontal panels are necessary to accommodate structural movements caused by thermal expansion and shrinkage. Joints must be sealed with approved plasto-elastic compound.

4.3 Sound Transmission:

Walls, partitions and floor/ceiling assemblies constructed of minimum 8-inch-thick (203 mm) AAC panels provide a minimum STC rating of 50 in accordance with IBC Section 1207.2 and ASTM E 90. Floor/ceiling assemblies constructed of minimum 8-inch-thick (203 mm) AAC panels provide an impact insulation class (II C) rating of not less than 50 in accordance with IBC Section 1207.3 and ASTM E 492.

4.4 Thermal Insulation:

Hebel AAC panels, when tested in accordance with ASTM C 236, have overall heat transmission values as shown in Table 1.

4.5 Fasteners:

Mechanical connections using fasteners are subject to approval by the code official for each project.

4.6 Miscellaneous:

The panels must be at least 12 inches (305 mm) above an adjacent grade unless appropriately protected from absorption of moisture. Grooves for electrical wiring and holes for junction boxes are permitted to be cut or routed at the jobsite subject to submittal of substantiating data from the registered design professional and approval of the code official. Openings in roof and floor panels that are field-cut must have additional reinforcement substantiated by structural calculations or other data submitted to the code official for approval.

4.7 Special Inspection:

Special inspection of structural concrete must conform to Section 1704 of the IBC. The special inspector's duties include verifying panel and mortar identification; panel placement; reinforcement placement for field reinforcement; mortar preparation; and application.

5.0 CONDITIONS OF USE

The Hebel Autoclaved Aerated Concrete (AAC) Panels as described in this report comply with, or are suitable alternatives to what is specified in, the IBC, subject to the following conditions:

- 5.1** The published installation manual and this report must be available at all times at the jobsite during construction. The instructions within this report govern if there are any conflicts between the manufacturer's installation manual and this report.
- 5.2** Connections of the panels to the supporting structures must be designed to the satisfaction of the code official.
- 5.3** The Hebel AAC panel structures are designed using the design strength procedures outlined in this report, and the design must be in accordance with the applicable code.
- 5.4** Plans, specifications, engineering calculations and other construction documents specifying the use of Hebel AAC panels must be submitted to the code official for approval. The calculations and documents must be prepared by a registered design professional when required by the statutes of the jurisdiction where the project is to be constructed.

- 5.5** Inspection and installation of the Hebel AAC panels must comply with the requirements set forth in the IBC for structural concrete.
- 5.6** Special inspection must be provided and must comply with Section 4.7 of this report.
- 5.7** Use of Hebel AAC panels for vibratory or impact loads is out of the scope of this report.
- 5.8** Wall panels used for lateral force resisting systems must be limited to Seismic Design Category A or B.
- 5.9** The Hebel AAC panels are manufactured in Adel, Georgia, by Xella Aircrete North America, Inc., under a quality control program with inspections by Underwriters Laboratories Inc. (AA-688).
- 5.10** The Hebel thin-bed mortar is manufactured by Xella Mexicana at Carretera Dulces Nombres Km 9.1, Pesqueria, Nuevo Laredo, Mexico, under a quality control program with inspections by Underwriters Laboratories Inc. (AA-688).

6.0 EVIDENCE SUBMITTED

- 6.1** Data in accordance with the ICC-ES Acceptance Criteria for Concrete Floor, Roof and Wall Systems and Concrete Masonry Wall Systems (AC15), dated June 2007.
- 6.2** Test reports in accordance with the requirements of ASTM C 1452.

7.0 IDENTIFICATION

All Hebel AAC product labels include the evaluation report number (ESR-2448), the name of the inspection agency (Underwriters Laboratories Inc.), and the following information for field identification:

- 7.1 Hebel AAC Panels:** All pallets of AAC wall panels recognized in this report carry the manufacturer's name (Xella Aircrete North America, Inc.) and/or trademark (Xella); the brand name (Hebel); a code that indicates the production plant in Adel, Georgia, and the production date; the product type; and the strength class and density in accordance with Table 1 of this report.

- 7.2 Hebel Thin-Bed Mortar:** The packages of Hebel thin-bed mortar carry the manufacturer's name (Xella Mexicana), the brand name (Hebel), the weight, and mixing and application instructions.

8.0 OTHER CODES

8.1 Evaluation Scope:

The Hebel AAC panels and Hebel thin-bed mortars described in this report were also evaluated for compliance with the requirements of 1997 *Uniform Building Code*™ (UBC).

8.2 Uses:

See Section 2.0.

8.3 Description:

See Section 3.0.

8.4 Design and Installation:

Hebel AAC panels must be designed and installed in accordance with Section 1926 of the UBC. Specifications for tests and materials must be in accordance with Section 1903 of the UBC. Durability requirements must be in accordance with Section 1904 of the UBC.

8.5 Conditions of Use:

The Hebel AAC Panels and Hebel Thin Bed Mortars comply with, or are suitable alternatives to what is specified in, the UBC, subject to the conditions in Section 5.0 and the following:

8.5.1 Walls used as lateral force-resisting systems must be limited to Seismic Zone 0 or 1.

8.5.2 Inspection and installation of Hebel AAC panels must comply with the requirements of the UBC. Special inspection must be in accordance with Section 1701.5 of UBC.

8.6 Evidence Submitted:

See Section 6.0.

8.7 Identification:

See Section 7.0.

TABLE 1—THERMAL CHARACTERISTICS OF HEBEL FLOOR, ROOF AND WALL PANELS PER INCH OF THICKNESS

STRENGTH CATEGORY	NOMINAL DRY BULK DENSITY (pcf)	THERMAL RESISTANCE, R (ft ² · h · °F/Btu · in)	THERMAL CONDUCTIVITY, K (Btu · in / ft ² · h · °F)
AAC4	37	0.90	1.11
AAC6	44	0.76	1.32

For SI: 1 inch = 25.4 mm, 1 pcf = 16.02 kg/m³ 1 Btu · in./h · ft² · °F = 0.144 W/m · K.

TABLE 2—DESIGN VALUES FOR HEBEL FLOOR AND ROOF PANELS

STRENGTH CATEGORY	NOMINAL COMPRESSIVE STRENGTH, f'_c (psi)	MAXIMUM BULK DENSITY (pcf)	DESIGN DEAD WEIGHT (pcf)	NOMINAL SLAB THICKNESS (inches)	DEAD WEIGHT (psf)
AAC4	580	37	46	4	15
				5	19
				6	23
				7	26
				8	30
				9	34
				10	38
AAC6	870	44	54	4	18
				5	22
				6	26
				7	31
				8	35
				9	40
				10	44
				12	53

For SI: 1 inch = 25.4 mm, 1 pcf = 16.02 kg/m³.

TABLE 3—DESIGN VALUES FOR HEBEL WALL PANELS

STRENGTH CATEGORY	NOMINAL COMPRESSIVE STRENGTH, f'_c (psi)	MAXIMUM BULK DENSITY (pcf)	DESIGN DEAD WEIGHT (pcf)		NOMINAL SLAB THICKNESS (inches)	DEAD WEIGHT (psf)	
			Lightly Reinforced	Reinforced		Lightly Reinforced	Reinforced
AAC4	580	37	44	46	4	15	15
					5	18	19
					6	22	23
					7	26	26
					8	29	30
					9	33	34
					10	37	38
AAC6	870	44	50	54	4	17	18
					5	21	22
					6	25	26
					7	29	31
					8	33	35
					9	38	40
					10	42	44
				12	50	53	

For SI: 1 inch = 25.4 mm, 1 psi = 0.0069 MPa, 1 pcf = 16.02 kg/m³.

TABLE 4—ALLOWABLE LOAD TABLE FOR HEBEL FLOOR PANELS AAC6

PANEL THICKNESS (inches)	MOMENT CAPACITY (lb-ft/ft)	SUPERIMPOSED UNIFORM LOAD, w (psf)												Dead Weight (psi)	
		63	68	73	78	84	89	94	99	104	110	115	120		125
		Maximum Permissible Span (feet)													
6	1,985	13	13	13	12	12	12	12	11	11	11	11	10	10	26
7	2,776	15	15	15	14	14	14	13	13	13	13	12	12	12	31
8	3,680	17	17	17	16	16	15	15	15	15	14	14	14	14	35
9	4,732	19	19	18	18	18	17	17	17	16	16	16	15	15	40
10	5,917	19	19	19	19	19	19	19	18	18	18	17	17	17	44
12	6,333	20	20	20	20	20	20	19	19	19	19	19	19	19	53

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 psf = 47.88 Pa, 1 lb-ft./ft. = 4.448 N-m/m, 1 pcf = 16.02 kg/m³.

TABLE 5—ALLOWABLE LOAD TABLE FOR HEBEL ROOF PANELS AAC4

PANEL THICKNESS (inches)	MOMENT CAPACITY (lb-ft/ft)	SUPERIMPOSED UNIFORM LOAD, w (psf)														Dead Weight (psi)
		20	23	26	31	37	42	47	52	57	63	68	73	78	84	
		Maximum Permissible Span (feet)														
4	571	11	11	11	10	9	9	9	8	8	8	7	7	7	7	15
5	937	14	13	13	9	12	11	11	10	10	10	9	9	9	9	19
6	1,389	16	16	15	14	14	13	13	12	12	11	11	11	11	10	23
7	1,942	18	18	17	16	16	15	15	14	14	13	13	13	12	12	26
8	2,576	19	19	19	18	18	17	16	16	15	15	15	14	14	14	30
9	3,311	21	20	20	19	19	19	18	18	17	17	16	16	15	15	34
10	4,141	20	20	20	20	20	20	20	19	19	18	18	17	17	17	38
12	6,056	20	20	20	20	20	20	20	20	20	20	21	20	20	19	45

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 psf = 47.88 Pa, 1 lb-ft./ft. = 4.448 N-m/m, 1 pcf = 16.02 kg/m³.

TABLE 6—ALLOWABLE LOAD TABLE FOR HEBEL ROOF PANELS AAC 6

PANEL THICKNESS (inches)	MOMENT CAPACITY (lb-ft/ft)	SUPERIMPOSED UNIFORM LOAD, w (psf)														Dead Weight (psi)
		20	23	26	31	37	42	47	52	57	63	68	73	78	84	
		Maximum Permissible Span (feet)														
4	814	12	12	12	12	11	11	10	10	9	9	9	9	8	8	18
5	1,340	15	15	15	14	14	13	13	12	12	11	11	11	10	10	22
6	1,985	18	18	17	17	16	15	15	14	14	13	13	13	12	12	26
7	2,776	19	19	19	19	18	18	17	16	16	15	15	15	14	14	31
8	3,680	21	20	20	19	19	19	19	18	18	17	17	17	16	16	35
9	4,732	20	20	20	20	20	20	20	19	19	19	19	18	18	18	40
10	5,917	20	20	20	20	20	20	20	20	20	20	20	20	20	19	44
12	8,653	20	20	20	20	20	20	20	20	20	20	20	20	20	20	53

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 psf = 47.88 Pa, 1 lb-ft./ft. = 4.448 N-m/m, 1 pcf = 16.02 kg/m³.

Notes to Tables 4, 5 and 6:

¹The allowable superimposed loads are derived from strength design loads by removal of the load factors and capacity reduction factors used in strength design calculations.

²Design unit weights of material are 46 pcf for AAC4 and 54 pcf for AAC6.

³The roof and floor slabs are designed for dead weight and uniformly distributed downward superimposed loads only. If uplift (wind) forces are encountered, further investigation is necessary to determine the uplift load capacity.

⁴Total load deflection (DL + LL) does not exceed 1/300 of span for roof slabs having spans less than or equal to 19.4 feet or for floor slabs. Total load deflection limit for roof slabs having spans greater than or equal to 19.4 feet is 1/200 of the span.

⁵More stringent deflection limits and/or analysis of long-term deflection must be provided if slabs support nonstructural panels likely to be damaged by large deflections.

⁶Values for lightly reinforced vs. reinforced panels within Table 3 are not applicable to the actual panel design. The terms are used to estimate the design weight of the wall panels. Reinforcement within the reinforced panel is listed on the panel label.

Steel Construction

Minimum '**a**' is 2" (50 mm) or L/80,
whichever is greater.

(where L = clear span + a)

Reinforced or Plain Concrete Construction

Minimum '**a**' is 2" (50 mm) or L/80,
whichever is greater.

Timber Construction

Minimum '**a**' is 2" (50 mm) or L/80,
whichever is greater.

Masonry Construction

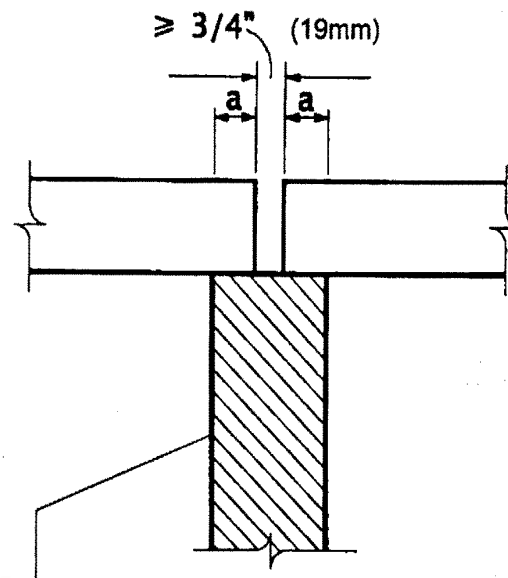
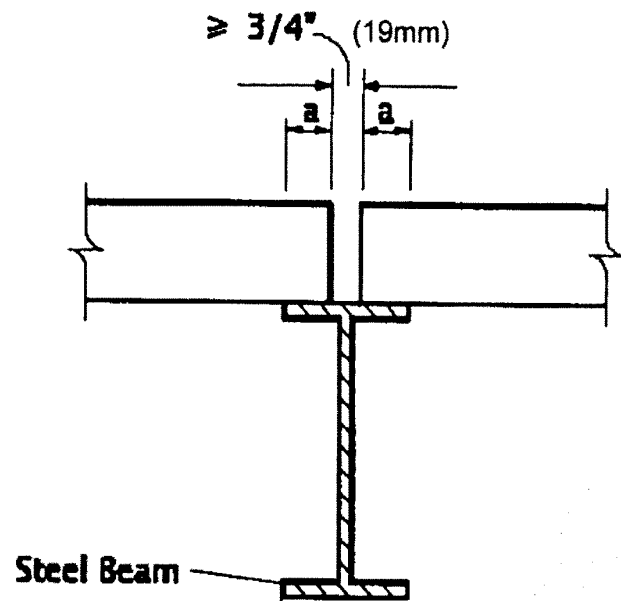
Minimum '**a**' is 2.75" (70 mm) or L/80,
whichever is greater.

AAC Material

Minimum '**a**' is 2" (50 mm) for center bearing
and 2.75" (70 mm) for end bearing.

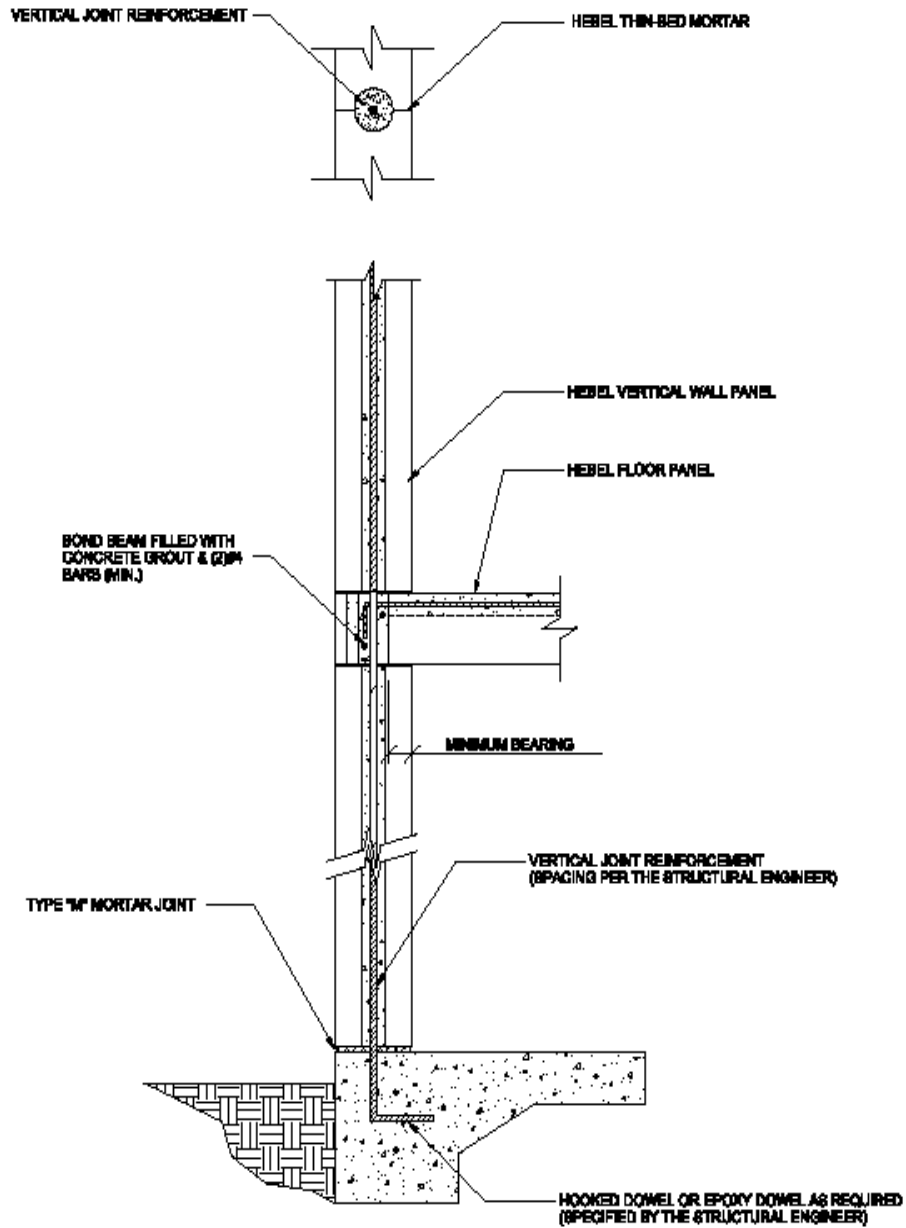
NOTE:

Larger bearing depths shall be provided to
accommodate anchorage requirements
and/or permissible bearing stresses at the
support.



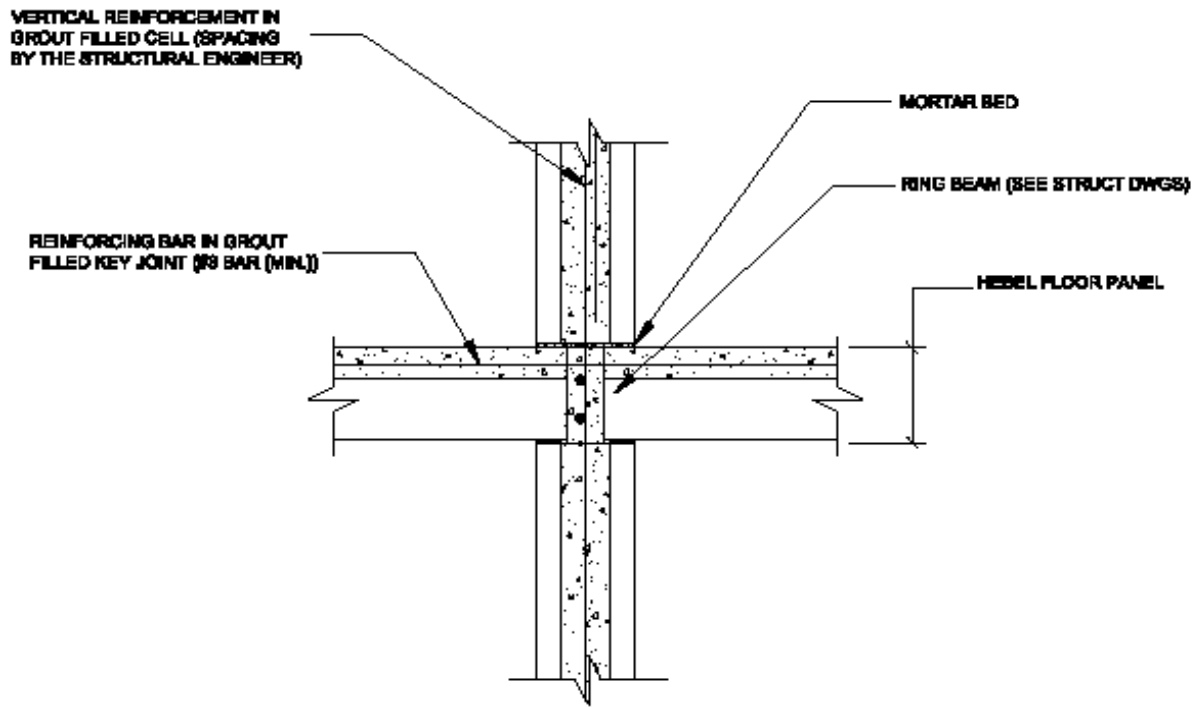
Concrete, timber, masonry or
AAC Materials

**FIGURE 1—TYPICAL HORIZONTAL WALL PANEL CONNECTION
AND MINIMUM BEARING DEPTHS OF ROOF AND FLOOR PANELS**



EXTERIOR WALL SECTION

FIGURE 2—EXTERIOR WALL SECTION



INTERIOR BEARING WALL SECTION

FIGURE 3—INTERIOR BEARING WALL

