HECKMANN BUILDING PRODUCTS INC.

MASONRY ANCHORS & TIES TECHNICAL AND ENGINEERING GUIDE

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Heckmann Building Products Inc. has been providing quality anchoring systems to the construction industry since 1923. This manual has been prepared as a reference guide to aid in the specification of our masonry accessories.

See our catalog in Sweets General Building File published by McGraw Hill Publishing Company in Section 04082/HEC. **Visit our website for detailed information, Cad DWG file downloads, and new product information at www.heckmannbuildingprods.com.**

Recommended spacings of anchors are based on average applications and are by no means to be considered valid for every situation. All testing was conducted to the ultimate failure of each item unless otherwise indicated. Please refer to “Building Code Requirements for Masonry Structures (ACI 530-99/ASCE 5-99/TMS 402-99)” and “Specification for Masonry Structures (ACI 530.1-99/ASCE 6-99/TMS 602-99)” for specification requirements.
Testing was conducted by independent laboratories.

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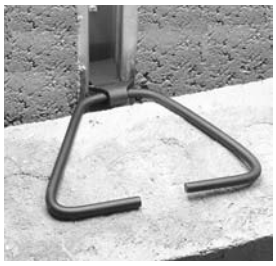
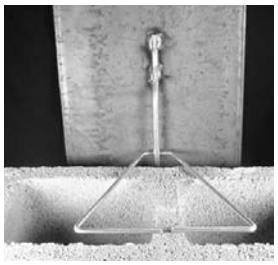


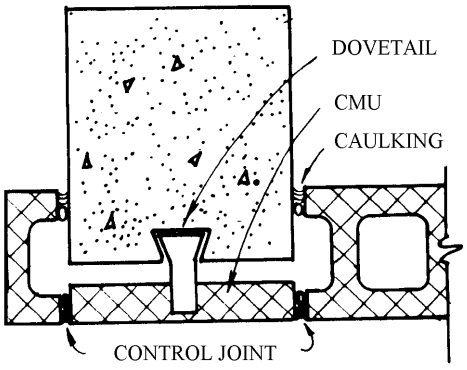


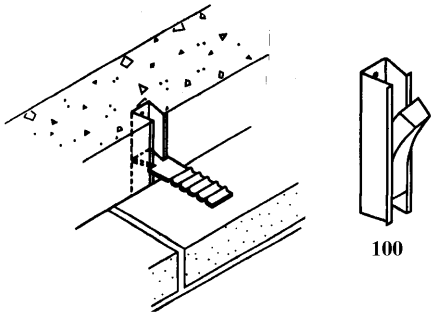
#100 DOVETAIL ANCHOR SLOTS

SIZE: 1" (25.4mm) deep x 1" (25.4mm) wide narrowing down to a 5/8" (15.87mm) throat, furnished in 10 foot (3.048 meter) lengths. Standard slot is available in 22 gage and 24 gage Mill Galvanized steel with polyurethane filler.

APPLICATION: Used to anchor stone and masonry to new concrete columns, walls, and beams. Slots are nailed to the inside of the wooden forms, before the concrete is poured. We recommend nailing the slot to the form every 12" (304.8mm). When using light gage slot in small columns we recommend attaching the slot to the form every 4" (101.6mm). After the forms are removed the dovetail anchors are inserted into the channels and adjusted vertically to fit into the joints of the exterior veneer. Anchor Slots are typically installed vertically 16" (406.4mm) o.c. and the anchors are spaced every 16" (406.4mm).

TEST CONDITIONS: 36" (914.4mm) long Anchor Slots were cast in a concrete form 3" (76.2mm) deep x 5-1/4" (133.3mm) wide x 36" (914.4mm) long. The concrete was a 3-1 ratio Portland Cement Type I which was allowed to set over 28 days. Four slabs were prepared: two 22 gage slots and two 24 gage slots both Mill Galvanized Steel. **#106 Dovetail Corrugated Anchors** were used for the test. The anchors were placed in the slot and pulled out at a 90° angle to the slot. 16 gage and 12 gage anchors were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute). Both the 22 gage and 24 gage slots and the 16 gage anchors conformed to ASTM A-653 and the 12 gage anchors conformed to ASTM A 653 CQ.





#100 Dovetail Anchor Slot (continued)

Pullout of Dovetail Anchor From Dovetail Slot				
TEST RESULTS	**22 GAGE SLOTS**		**24 GAGE SLOTS**	
	NO. ANCHORS TESTED	**AVERAGE PULLOUT**	**NO. ANCHORS TESTED**	**AVERAGE PULLOUT**
16 Gage Anchors	**5**	**600.5 lbs.**	**3**	**589.2 lbs**
12 Gage Anchors	**2**	**965 lbs.**	**4**	**939 lbs**

22 Gage Slots
16 Gage Anchors
Anchor 1: Failure 725 lbs. Dovetail end of anchor folded and pulled out of slot. Slight groove in slot. No concrete damage.
Anchor 2: Failure 737.5 lbs. Failure same as #1.
Anchor 3: Failure 712.5 lbs. Crack in concrete near one side was noted. Ears on dovetail section of anchor bent down slightly. Slot distorted on one side with indention on other side.
Anchor 4: Failure 422.5 lbs. Failure same as #3.
Anchor 5: Failure 405 lbs. Failure same as #3. Concrete broke all the way through at the hold downs.
12 Gage Anchors
Anchor 1: Load increased to 970 lbs. Channel spread and concrete block cracked causing load line to drop to 810 lbs. Load increased again to 930 lbs.; then steadily decreased as the anchor continued to be withdrawn. No apparent damage to anchor.
Anchor 2: Failure 960 lbs. Similar failure as #1 except that the concrete cracked approximately in half longitudinally under the channel.
Anchor 3: Load increased to 680 lbs. Concrete broke away and slot pulled completely out. This sample was not taken into consideration because of the extensive damage from Anchor #2.

24 Gage Slots
16 Gage Anchors
Anchor 1: Failure 667.5 lbs. Anchor dovetail ears began to bend downward. Concrete holding the slot was severely cracked.
Anchor 2: Failure 327.5 lbs. Failure same as #1.
Anchor 3: Failure 772.5 lbs. Failure same as #1.
12 Gage Anchors
Anchor 1: Load increased to 856 lbs., channel spread and a piece of the concrete broke out. Load dropped to 350 lbs. as the anchor continued to be completely withdrawn. No damage to the anchor.
Anchor 2: Load increased to 1,000 lbs. Similar failure as #1 except load dropped to 660 lbs. after the concrete broke.
Anchor 3: Load increased to 1,180 lbs. Failure same as #2.
Anchor 4: Load increased to 720 lbs. at which the concrete cracked vertically under the channel allowing the entire channel to be withdrawn by the anchor. This anchor was 4 inches from the end of the channel. No damage was done to the anchor.

#103 DOVETAIL TRIANGLE TIE WITH #100 DOVETAIL ANCHOR SLOT

SIZE: Dovetail clip portion is 12 gage hooked onto a 3/16" (4.762mm) diameter wire triangle tie available in lengths of 3" (76.2mm), 4" (101.6mm), 5" (127mm), 7" (177.8mm), 9" (228.6mm), and 11" (279.4mm). The anchors tested were the 3" (76.2mm) long triangle for the 1" (25.4mm) cavity and 5" (127mm) long triangle for the 3" (76.2mm) cavity.

APPLICATION: Dovetail Triangle Ties are hooked into dovetail slots cast into concrete walls or columns. The wire triangle portion is placed in mortar joints of Block or Brick walls. Usual installation is 16" (406.4mm) o.c. vertically.

TEST CONDITIONS: 23-5/8" (600mm) wide x 17-5/8" (447.6mm) high walls 3-5/8" (92.07mm) thick were made from ASTM C216 Clay Brick, grade SW, Type FBS. The specimens were three units long x six units high. The Dovetail Triangle Ties were positioned between the third and fourth layers, and at the vertical centerline of the test specimens. The mortar joints were 3/8" (9.525mm) to 1/2" (12.7mm) and the Triangle Tie was embedded into the bed joint 1-1/2" (38.1mm). Type N mortar was used which had a compressive strength of 2,200 psi. A 12" (304.8mm) piece of 26 gage (0.025") dovetail slot was cast into a concrete wall.
Testing was conducted by the Engineering Research Institute Iowa State University
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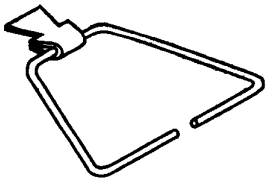
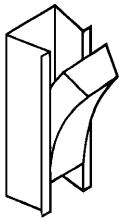




TEST RESULTS	TENSION	COMPRESSION		SHEAR
		1" Cavity (25.4mm)	3" Cavity (76.2mm)	
R.E.E.L. Loads deflection	327 lbs .039 in. (.9906mm)	509 lbs .072 in. (1.828mm)	282 lbs .044 in. (1.117mm)	138 lbs .039 in. (.9906mm)
R.E.M. Loads deflection	713 lbs .179 in. (4.546mm)	560 lbs .090 in. (2.286mm)	386 lbs .140 in. (3.556mm)	347 lbs .361 in. (9.169mm)
Peak Loads deflection	751 lbs .286 in. (7.264mm)	616 lbs .140 in. (3.556mm)	701 lbs .272 in. (6.908mm)	371 lbs .452 in. (11.48mm)

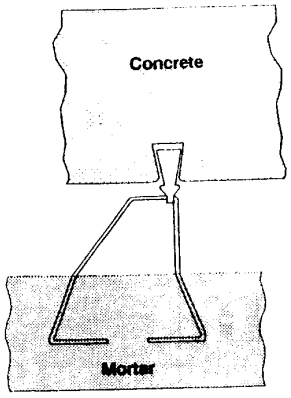
#103 Dovetail Triangle Tie & #100 Dovetail Anchor Slot (continued)

R.E.E.L. values indicate the end of the elastic region (initial straight-line portion of the graph) and the start of the inelastic region. (R.E.E.L. loads are those recommended to which the appropriate safety factors should be applied for the design values based upon elastic behavior.)
R.E.M. values indicate the load achieved at the end of the ductile (somewhat plastic) region of the load-deflection behavior, beyond which much larger deflections occur. The R.E.M is the load that the researchers felt was the appropriate "interpreted maximum" load. In most cases the peak loads beyond R.E.M were due to highly inelastic behavior, rotations, contact bearing, or exaggerated deflections that one would not want to count as part of the correct specimen peak capacity. (R.E.M. loads are those recommended to which the appropriate safety factors should be applied to arrive at the manufacturer's recommended design value based upon strength or limit states design.)
Peak Load were taken from the graphs prior to a significant decrease in load or at an abrupt failure point.

Tension Test: As the tie was loaded, the dovetail clip attached to the triangle tie bent to a 90° angle. This action was followed by the wire pulling free of the clip plate. During the R.E.E.L loads the elongation of the triangular wire tie occurred. During R.E.M there was a combination of the wire bearing on the bent clip as well as elongation of the wire.

Compression Test: The primary failure mode was a rotation of the clip plate followed by the crimped clip coming to bear on the dovetail slot, with the triangle tie eventually pushing through the crimped clip. During the R.E.E.L loads the triangle tie began to bend and there was small rotation of the clip plate. During R.E.M there was a large rotation of the clip plate prior to the connector bearing against the dovetail slot. The 1" (25.4mm) cavity resulted in three of the five connectors pushing through the clip and bearing against the column while in the 3" (76.2mm) cavity three of the five connectors tested rotated and came to bear against the concrete wall.

Shear Test: The failure mode was that of the clip plate slipping on the wire and bearing on the corner of the triangular tie which eventually deformed and pulled out of the mortar joint.



Shear Test Failure

#106 DOVETAIL CORRUGATED ANCHORS

SIZE: Anchors tested were 3-1/2" (88.9mm) long from the face of the concrete x 1" (25.4mm) wide Mill Galvanized Sheet Steel conforming to ASTM A 653 LFQ for 16 gage and ASTM A 653 LFQ for 12 gage.

APPLICATION: Anchors are installed in Dovetail Anchor Slots, which are cast into concrete columns or walls. Usual installation is 16" (406.4mm) o.c. vertically.

TEST CONDITIONS: Anchors were embedded 2-3/4" (69.85mm) deep in the horizontal joint between two common bricks with Type N Mortar mixed 3-1 ratio and allowed to stand over 28 days (Approximately 3500 psi). Mortar joints were approximately 5/8" (15.87mm) with the anchors centered in the joints permitting mortar on both sides of the anchor corrugation. The samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).

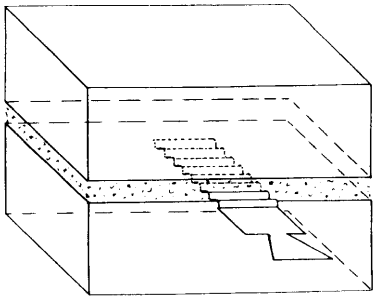
PULLOUT OF CORRUGATED SECTION FROM BRICKS

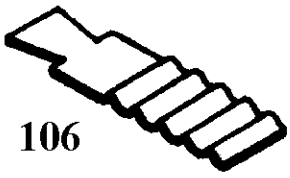
TEST RESULTS	12 GAGE ANCHORS		16 GAGE ANCHORS	
	NO. ANCHORS TESTED	AVERAGE PULLOUT	NO. ANCHORS TESTED	AVERAGE PULLOUT
	6	1,479 LBS	5	1,194 LBS

12 Gage Anchors
In all cases the force increased to the maximum limit at which the anchors began to pullout, and the bricks separated along the mortar joints. The maximum forces were: 1,198 lbs., 1,450 lbs., 1,344 lbs., 1,474 lbs., 1,788 lbs., and 1620 lbs.

16 Gage Anchors
Failure was the same as with the 12 gage anchors. The maximum forces were: 846 lbs., 1,050 lbs., 1,448 lbs., 1,374 lbs., and 1,254 lbs.

See page 1 and 2 for pullout of dovetail from the Dovetail Slot.



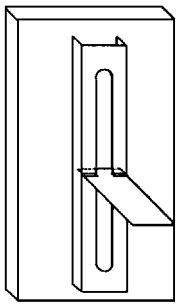


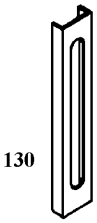
#130 WELD-ON CHANNEL SLOTS

SIZE: 8" (203.2mm) Long x 1-3/8" (34.92mm) wide between 1/2" (12.7mm) inside flanges, with one slot 9/16" (14.28mm) x 5-1/2" (139.7mm) long. Tests were performed on 11 gage and 16 gage slots in plain steel conforming to ASTM A-569.

APPLICATION: Slots are welded to steel columns and beams usually every 16" (406.4mm) vertically. Anchors are installed into the slots with a 5-1/2" (139.7mm) vertical adjustment.

TEST CONDITIONS: Four samples each of 11 gage and 16 gage slots were welded to a 3/8" (9.525mm) x 4-1/2" (114.3mm) x 9" (228.6mm) steel plate. The weld bead was 1-1/2" (38.1mm) long on each of the top two corners and the bottom two corners. #134 Corrugated Channel Slot Anchors 16 gage x 1-1/4" (31.75mm) wide x 3-1/2" (88.9mm) long from the face of the channel were used for the test. The anchors were installed in the center of the channel and were pulled out at a 90° angle to the slot. The samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).





TEST RESULTS	11 GAGE SLOTS		16 GAGE SLOTS	
	NO. ANCHORS TESTED	AVERAGE PULLOUT	NO. ANCHORS TESTED	AVERAGE PULLOUT
	4	950 lbs.	4	668.8 lbs

11 Gage Slots

Anchor 1: The anchor T-tail bent upward approximately 70°; then the ears folded downward causing the anchor to pull out of the slot. Maximum load 920 lbs. No damage to the slot.

Anchor 2: Same failure as #1. Maximum load 862.5 lbs. No damage to slot.

Anchor 3: Same failure as #1. Maximum load 1,072.5 lbs. Neck area on the anchor was slightly wider than the others which could account for the higher value and the slight upward distortion on one side of the channel slot.

Anchor 4: Same failure as #1. Maximum load 945 lbs. No damage to slot.

16 Gage Slots

Anchor 1: Same failure as 11 gage #1. Maximum load 630 lbs. Upward distortion on both sides of the channel.

Anchor 2: Same failure (anchor & slot) as #1. Maximum load 625 lbs.

Anchor 3: Same failure (anchor & slot) as #1. Maximum load 732.5 lbs.

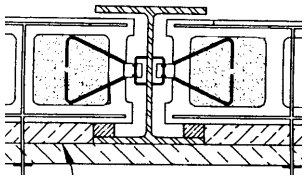
Anchor 4: same failure (anchor & slot) as #1. Maximum load 687.5 lbs.

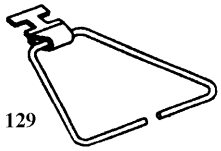
#129 CHANNEL SLOT TRIANGLE TIE WITH #130 WELD-ON CHANNEL SLOT

SIZE: Clip portion is 12 gage hooked onto a 3/16" (4.762mm) diameter wire triangle tie available in lengths of 3" (76.2mm), 4" (101.6mm), 5" (127mm), 7" (177.8mm), 9" (228.6mm), and 11" (279.4mm). The anchors tested were 3" (76.2mm) long for the 2" (50.8mm) wide cavity and 5" (127mm) long for the 4" (101.6mm) cavity.

APPLICATION: Channel Slot Triangle Ties are hooked into channel slots that are welded to steel beams. The wire triangle portion is placed in mortar joints of block or brick walls. Usual installation is 16" (406.4mm) o.c. vertically.

TEST CONDITIONS: Four CMU units conforming to ASTM C90 were assembled to form a wall 2 units wide x 2 units high (15-5/8" (396.89mm) high x 31-5/8" (803.28mm) wide x 7-5/8" (193.68mm) thick). The Triangle Ties were positioned between the two units and at the vertical centerline of the specimen. The mortar joints were 3/8" (9.525mm) to 1/2" (12.7mm) and the Triangle Tie was embedded into the bed joint 1-1/2" (38.1mm). Type N mortar was used which had a compressive strength of 2,200 psi. The cores were completely filled with mortar. The Channel Slot tested was 1/8" (3.175mm) thick Plain Steel x 8" (203.2mm) long. The Channel Slot was welded to the steel column with four welds 1/4" (6.35mm) to 3/8" (9.525mm) long. Testing was conducted by The Engineering Research Institute Iowa State University.





TEST RESULTS	TENSION no welded clip	TENSION welded clip	COMPRESSION 2" Cavity (50.8mm)	COMPRESSION 4" Cavity (101.6mm)
R.E.E.L. Loads Deflection	322 lbs .084 in. (2.1336mm)	357 lbs .269 in. (6.8326mm)	238 lbs .034 in. (.8636mm)	272 lbs .054 in. (1.3716mm)
R.E.M. Loads Deflection	832 lbs .271 in. (6.8834mm)	1,620 lbs .683 in. (17.3482mm)	271 lbs .070 in. (1.778mm)	309 lbs .091 in. (2.3114mm)
Peak Loads Deflection	935 lbs .311 in. (7.8994mm)	1,620 lbs .683 in. (17.3482mm)	515 lbs .166 in. (4.2164mm)	578 lbs .240 in. (6.096mm)

#129 Channel Slot Triangle Tie & #130 Weld-On Channel Slot (Continued)

R.E.E.L. values indicate the end of the elastic region (initial straight-line portion of the graph) and the start of the inelastic region. (R.E.E.L loads are those recommended to which the appropriate safety factors should be applied for the design values based upon elastic behavior.)

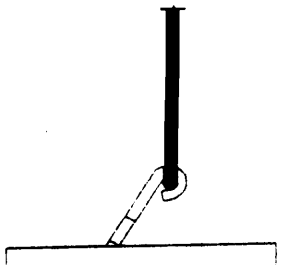
R.E.M. values indicate the load achieved at the end of the ductile (somewhat plastic) region of the load-deflection behavior, beyond which much larger deflections occur. The R.E.M is the load that the researchers felt was the appropriate "interpreted maximum" load. In most cases the peak loads beyond R.E.M were due to highly inelastic behavior, rotations, contact bearing, or exaggerated deflections that one would not want to count as part of the correct specimen peak capacity. (R.E.M loads are those recommended to which the appropriate safety factors should be applied to arrive at the manufacturer's recommended design value based upon strength or limit states design.)

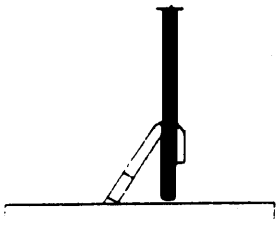
Peak Loads were taken from the graphs prior to a significant decrease in load or at an abrupt failure point.

Tension Test: As the tie was loaded, the Channel Slot clip attached to the triangle tie bent to a 90° angle. This action was followed by the wire pulling free of the clip plate. An additional series of tests were performed to investigate the effects of securing the clip by placing a puddle weld between the clip plate and the end of the crimped clip. These results are shown in the tension welded clip column. In both cases the elongation of the wire occurred during the R.E.E.L. load. The R.E.M. load period is representative of both the wire bearing on the bent clip and the further elongation of the wire. The Peak Load occurred when the wire pulled out of the crimped clip for the non-welded test and when the tabs pulled out of the channel for the welded test.

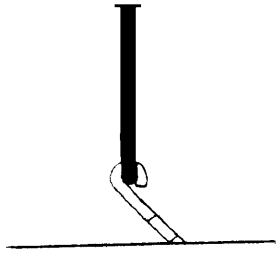
Compression Test: The compression failure mode resulted in the opening of the clip end which allowed the wire to push through the clip and bear on the channel. The behavioral characteristics of the compression test were similar with both the 2" (50.8mm) cavity and the 4" (1-1.6mm) cavity. During the R.E.E.L. load there was bending and compression of the triangular wire with a small rotation of the clip in the channel slot. During R.E.M. load the clip loop opened. Two failure modes are shown below.

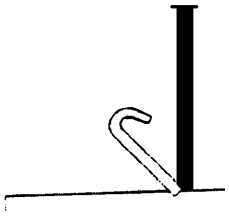
Compression Failure Mode 1





Compression Failure Mode 2





#134 CHANNEL SLOT CORRUGATED ANCHOR

SIZE: Anchors were 16 gage x 1-1/4" (31.75mm) wide x 3-1/2" (88.9mm) long from the face of the channel, made from Mill Galvanized Steel conforming to ASTM A 653.

APPLICATION: Anchors secure masonry or stone facing material to channel slots which are anchored to back-up walls or welded to steel columns and beams. Usually spaced 16" (406.4mm) o.c.

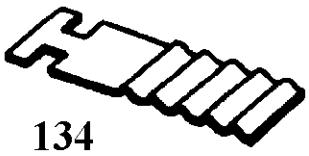
TEST CONDITIONS: Anchors were embedded 2-1/2" (63.5mm) deep in horizontal joint between two common bricks with Type N Mortar mixed 3-1 ratio and allowed to stand over 28 days (approximately 3500 psi). Mortar joints were approximately 5/8" (15.875mm) with the anchors centered in the joints permitting mortar to be on both sides of the anchor corrugation. The samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).

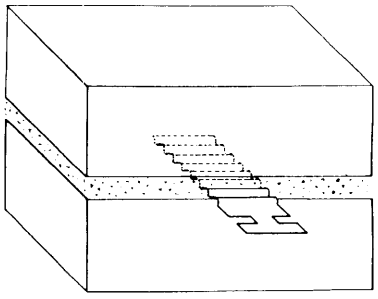
PULLOUT OF CORRUGATED SECTION FROM BRICK

TEST RESULTS	NO. ANCHORS TESTED	AVERAGE PULLOUT
	5	**1,265 lbs**

Anchor 1: Load increased to 1,260 lbs. The anchor began to pull out, at which time the bricks separated along the mortar joint. No apparent damage to the anchor.
Anchor 2: Load increased to 1,202 lbs. Same failure as #1.
Anchor 3: Load increased to 1,374 lbs. Same failure as #1.
Anchor 4: Load increased to 1,218 lbs. Same failure as #1.
Anchor 5: Load increased to 1,270 lbs. Same failure as #1.

See page 6 and 7 for channel slot anchor pullout from channel slots.





#187 BRICK VENEER ANCHORS

SIZE: Anchors are 16 gage Mill Galvanized Steel x 1-1/4" (31.75mm) wide x 3-1/2" (88.9mm) long with a 1-1/2" (38.1mm) bend. A 5/16" (7.938mm) diameter hole is centered in the bend. The steel conformed to to ASTM A 653 LFQ.

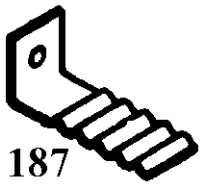
APPLICATION: The Brick Veneer Anchors are used to anchor exterior veneer to an existing wall or to a stud/sheathing wall. They are usually fastened with screws or expansion anchors, depending on conditions. Spacing is usually 16" (406.4mm) o.c. vertically and horizontally.

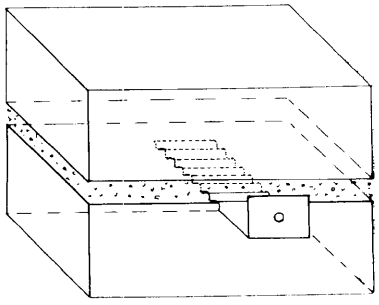
TEST CONDITIONS: The anchors were embedded 2-3/8" 60.325mm) between two common bricks with Type N Mortar mixed 3-1 ratio and allowed to stand over 28 days (approximately 3500 psi). Mortar joints were approximately 5/8" (15.875mm) with the anchors centered in the joints permitting mortar to be on both sides of the corrugation. a 1/4"-20 Machine Screw was inserted through the hole of the anchor and threaded into a pulling fixture attached to the load cell. This test was to determine pullout of the anchor from the mortar and/or failure in the hole or bend. The samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).

PULLOUT OF CORRUGATED SECTION FROM BRICKS

TEST RESULTS	NO. ANCHORS TESTED	AVERAGE PULLOUT
	6	829 lbs

Anchor 1: The 90 degree bend in the anchor gradually and finally (at approximately 300 lbs. force) became straightened. The hole started to elongate at approximately 760 lbs. force, and the metal tore at one point under the head of the screw. The screw head was ultimately pulled through the hole at a maximum force of 878 lbs. The anchor did not pull out from the bricks.
Anchor 2: Similar to the initial results from #1, (i.e. straightening and hole elongation) However, at 840 lbs. force the anchor pulled out from the mortar joint at which time the bricks separated along the mortar joint.
Anchor 3: Maximum force of 846 lbs. Failure similar to #1.
Anchor 4: Maximum force of 868 lbs. Failure similar to #1.
Anchor 5: Maximum force of 860 lbs. Failure similar to #1.
Anchor 6: Maximum force of 684 lbs. Failure similar to #2.





#189 L-TYPE COLUMN ANCHORS

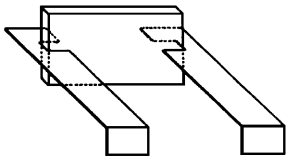
SIZE: Anchors are 1/8" (3.175mm) x 2" (50.8mm) wide x 7" (177.8mm) long with a 1-1/2" (38.1mm) bend. Anchors with two slot sizes were tested: 5/8" 15.875mm) x 1" (25.4mm) and 3/4" (19.05mm) x 1" (25.4mm). The slots started 1" (25.4mm) from the flat end of each anchor. The metal conformed to ASTM A 653 CQ Mill Galvanized Steel.
APPLICATION: Used to tie masonry walls to steel columns with the column flanges parallel to the wall. Installed in pairs 24" (609.6mm) o.c. on each side of the column.

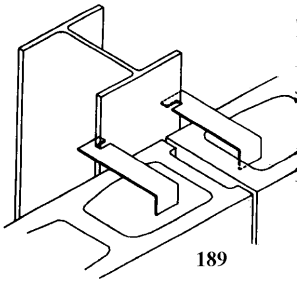
TEST 1: FAILURE OF NOTCH ONLY

TEST CONDITIONS: Anchors were tested in pairs, one left and one right. A holding fixture of 1/2" (12.7mm) thick x 4" (101.6mm) wide flat stock was fabricated to simulate a WF Steel Beam. The load was applied to the fixture through an eye bolt attached to a holding bracket designed to allow approximately 1/2" (12.7mm) of straightening of the bend on the anchors, and then brace the bend section to allow failure to occur at the slots. The anchors were tested to failure at a rate of 0.75"/minute (19.05mm/minute).

TEST RESULTS - Failure of notch only: One sample of each was tested.

5/8" x 1" (15.875mm x 25.4mm) Slot: Load increased to **6,150 lbs**. The left bracket slot spread and cracked, causing it to slide off the holding fixture. The right bracket slot had a visible spread.
3/4" x 1" (19.05mm x 25.4mm) Slot: Load increased to **6,350 lbs.** Same failure as above with a slight crack on the right slot also.
(Visible straightening was noted at the bend section on both samples at approximately 1,500 to 2,000 lbs.)





TEST 2: TESTED IN PAIRS WITH COLUMN AND CMU WALL

SIZE: Anchors tested were 1/8" (3.175mm) x 2" (50.8mm) wide with a 2-1/4" (57.15mm) o.d. bend.

APPLICATION: Used to tie masonry walls to steel columns with the column flanges parallel to the wall. Installed in pairs 24" (609.6mm) o.c. on each side of the column.

TEST CONDITIONS: Four CMU units conforming to ASTM C90 were assembled to form a wall 2 units wide x 2 units high (15-5/8" (396.88mm) high x 31-5/8" (803.28mm) wide x 7-5/8" (193.68mm) thick). The Column Anchors were positioned between the two units at an equal distance each side of the centerline of the wall. The mortar joints were 3/8" (9.525mm) to 1/2" (12.7mm) and the cores were completely mortar filled. Type N mortar was used which had a compressive strength of 2,200 psi. Testing was conducted by The Engineering Research Institute Iowa State University.

#189 -Type Column Anchors (Continued)

TEST RESULTS	TENSION	COMPRESSION 1" CAVITY (25.4mm)	COMPRESSION 4" CAVITY (101.6mm)	SHEAR
R.E.E.L. Loads deflection	2,697 lbs .031 in. (.787mm)	9,863 lbs .061 in. (1.549mm)	6,373 lbs .086 in. (2.184mm)	1,030 lbs .046 in. (1.168mm)
R.E.M. Loads deflection	3,242 lbs .095 in. (2.413mm)	9,863 lbs .061 in. (1.549mm)	6,373 lbs .086 in. (2.184mm)	1,584 lbs .081 in. (2.057mm)
Peak Loads deflection	3,242 lbs .095 in. (2.413mm)	9,863 lbs .061 in. (1.549mm)	6,373 lbs .086 in. (2.184mm)	1,584 lbs .081 in. (2.057mm)

R.E.E.L. values indicate the end of the elastic region (initial straight-line portion of the graph) and the start of the inelastic region. (REEL loads are those recommended to which the appropriate safety factors should be applied for the design values based upon elastic behavior.)

R.E.M. values indicate the load achieved at the end of the ductile (somewhat plastic) region of the load-deflection behavior, beyond which much larger deflections occur. The R.E.M is the load that the researchers felt was the appropriate "interpreted maximum" load. In most cases the peak loads beyond R.E.M were due to highly inelastic behavior, rotations, contact bearing, or exaggerated deflections that one would not want to count as part of the correct specimen peak capacity. (R.E.M loads are those recommended to which the appropriate safety factors should be applied to arrive at the manufacturer's recommended design value based upon strength or limit states design.)

Peak Loads were taken from the graphs prior to a significant decrease in load or at an abrupt failure point.

Tension Test: The Column Anchors failure in tension occurred as a combination of tensile and shear failure at the notch.

Compression Test: The primary failure occurred as a global buckling of the anchor while the secondary mode was a block and mortar failure. The peak load occurred at the primary failure.

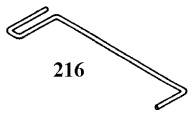
Shear Test: The primary failure was a failure of the mortar joint and the secondary failure was CMU cracking. In all shear cases the structural integrity of the anchor was not threatened.

#216 WIRE-TYPE COLUMN ANCHORS

SIZE: Anchors are 3" (76.2mm), 5" (127mm), 7" (177.8mm), and 9" (228.6mm) long from the inside of the flange loop to the masonry bend. The loop has a 1/2" (12.7mm) opening and a 2-1/2" (63.5mm) grip on the flange. The masonry bend is 2" (50.8mm). Available in 1/4" (6.35mm) diameter and 3/16" (4.763mm) diameter Mill Galvanized wires conforming to ASTM A82 were tested.

APPLICATION: Used to tie masonry walls to steel columns with the column flanges parallel to the wall. Installed in pairs 24" (609.6mm) o.c. on each side of the column.

TEST CONDITIONS: A 3/8" (9.525mm) x 6" (152.4mm) x 6" (152.4mm) steel flat stock was fabricated to simulate a WF Steel Beam. Anchors were tested in pairs by placing them onto the flat stock so that both wires were lying in the same vertical plane. The 2" (50.8mm) masonry bends were clamped and attached to a load cell. The test was to determine failure at the loop that hooks onto the beam. The samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).



TEST RESULTS	1/4" DIAMETER		3/16" DIAMETER	
	NO. ANCHORS TESTED	AVERAGE PULLOUT	NO. ANCHORS TESTED	AVERAGE PULLOUT
	4	1,542 lbs	5	816 lbs

1/4" (6.35mm) Diameter:
Anchor 1: 1 lb - 400 lbs.: Chart recorder load line was relatively linear as the sample began to slightly straighten at the 90° angle and the top half of the 180° bend.
400 lbs - 1,100 lbs.: Continued straightening at the angles, but the slope of the load line decreased, indicating a lesser resistance to bending.
1,100 lbs max.: Continued straightening of bends, very slight straightening of lower 180° bend approaching maximum. At failure the wires bent outward at jaw line and slipped out from beneath the flat stock. Maximum load 1,640 lbs.
Anchor 2: Same failure as #1. Maximum load 1,520 lbs.
Anchor 3: Same failure as #1. Maximum load 1,500 lbs.
Anchor 4: Same failure as #1. Maximum load 1,506 lbs.

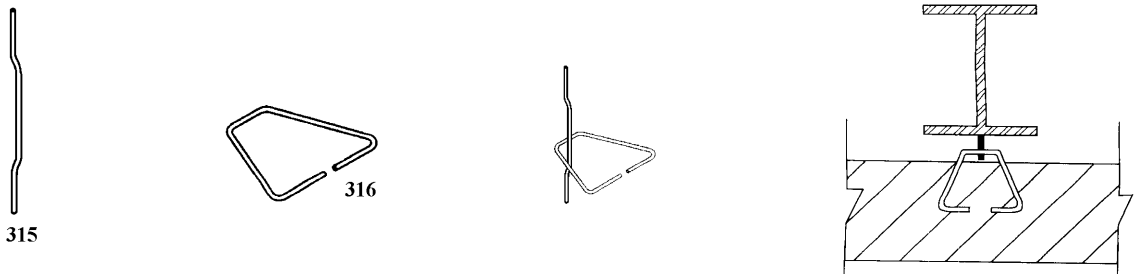
3/16" (4.7625mm) diameter:
Anchor 1: Same failure as 1/4" except the recorded loads were lower. Maximum load 824 lbs.
Anchor 2: Same failure as #1. Maximum load 854 lbs.
Anchor 3: Same failure as #1. Maximum load 808 lbs.
Anchor 4: Same failure as #1. Maximum load 808 lbs.
Anchor 5: Same failure as #1. Maximum load 786 lbs.

#315 WELD-ON ANCHOR ROD WITH #316 TRIANGLE TIE

SIZE: #315 Weld-On Anchor Rods, 1/4" (6.35mm) diameter wire x 5" (127mm) long with 2" (50.8mm) adjustment were tested with #316 Triangle Ties 3/16" (4.7625mm) diameter wire x 3" (76.2mm) long in 1" (25.4mm) cavity and 3/16" diameter wire x 4" (101.6mm) long in 2" (50.8mm) cavity.

APPLICATION: #315 Weld-On Rods are welded to steel beams. #316 Triangle Ties are inserted in the adjustable portion and installed in mortar joints of brick or block walls.

TEST CONDITIONS: Wall sections 23-5/8" (600mm) wide x 17-5/8" (447.6mm) high 3-5/8" (92.07mm) thick were made from ASTM C216 Clay Brick, grade SW, Type FBS. The specimens were three units long x six units high. The Triangle Ties were positioned between the third and fourth layers, and at the vertical centerline of the test specimens. The mortar joints were 3/8" (9.525mm) to 1/2" (12.7mm) thick and the Triangle Ties were embedded 1-1/2" (38.1mm) in the bed joint. The type N mortar used had a compressive strength of 2,200 psi. The Weld-On Rods were attached to steel columns with four 1/4" (6.35mm) to 3/8" (9.525mm) welds (two at the top and two at the bottom). Testing was conducted by The Engineering Research Institute Iowa State University.



TEST RESULTS	Tension	Compression 1" cavity (25.4mm)	Compression 2" cavity (50.8mm)
R.E.E.L Loads deflection	233 lbs .050 in. (1.27mm)	731 lbs .027 in (.686mm)	615 lbs .032 in. (.813mm)
R.E.M. Loads deflection	816 lbs .308 in. (7.823mm)	1,159 lbs .060 in. (1.524mm)	702 lbs .041 in. (1.041mm)
Peak Loads deflection	816 lbs .308 in. (7.823mm)	1,159 lbs .272 in. (6.91mm)	727 lbs .107 in. (2.718mm)

#315 Weld-On Anchor Rod & #316 Triangle Tie (continued)

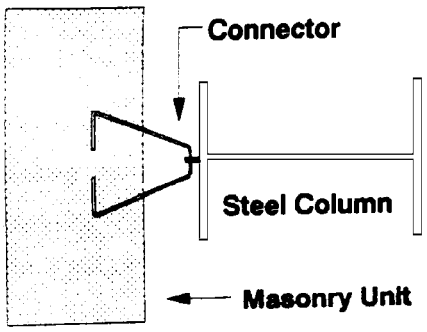
R.E.E.L. values indicate the end of the elastic region (initial straight-line portion of the graph) and the start of the inelastic region. (R.E.E.L loads are those recommended to which the appropriate safety factors should be applied for the design values based upon elastic behavior.)

R.E.M. values indicate the load achieved at the end of the ductile (somewhat plastic) region of the load-deflection behavior, beyond which much larger deflections occur. The R.E.M is the load that the researchers felt was the appropriate "interpreted maximum" load. In most cases the peak loads beyond R.E.M. were due to highly inelastic behavior, rotations, contact bearing, or exaggerated deflections that one would not want to count as part of the correct specimen peak capacity. (R.E.M loads are those recommended to which the appropriate safety factors should be applied to arrive at the manufacturer's recommended design value based upon strength or limit states design.)

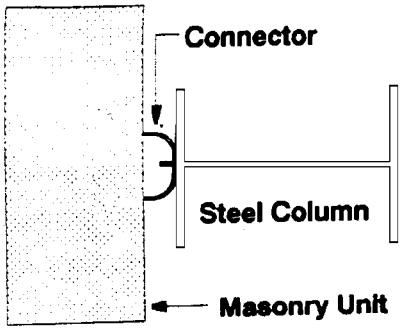
Peak Loads were taken from the graphs prior to a significant decrease in load or at an abrupt failure point.

Tension Test: The failure mode of the tension test was the elongation of the triangular tie and its eventual pullout from the mortar joint.

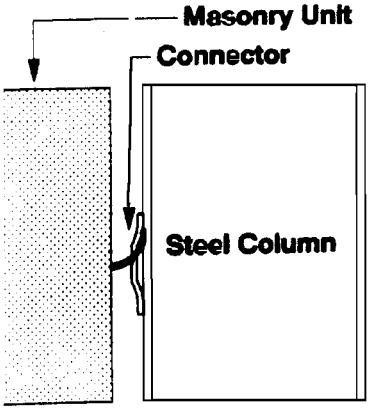
Compression Test: The primary failure mode was characterized by the deformation and buckling of the wire with a secondary failure mode of the mortar joint. As the load increased the Triangle Tie buckled upward or downward until it came in contact with the portion of the Weld-On Rod which was welded to the column.



Unloaded View



Compression Failure Top View



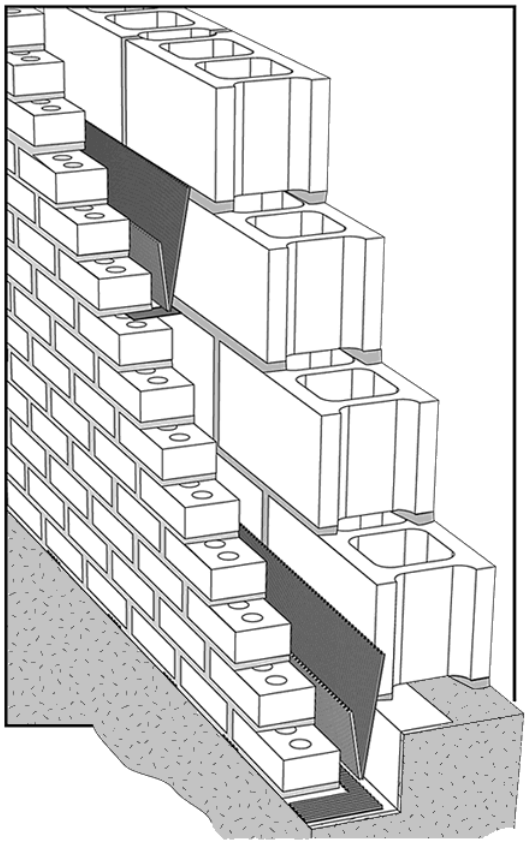
Compression Failure Side View

#365 TRASH MORTAR™ DIVERTER
#366 CAVITY VENT™ WEEP SYSTEM

Two double wythe cavity walls were constructed in accordance with ASTM E 514 requirements. The test walls consisted of clay face brick, a cavity utilizing the #365 Trash Mortar™ Diverter and the No. 366 Cavity Vent Weep System, and a six-inch CMU back-up. The wall was constructed on an inverted steel channel, and the bottom course was laid on a bed of mortar. Full bedded mortar joints were used, and the walls were constructed one course at a time by applying mortar the full length of the bed joint, then buttering the ends of a brick and a CMU one at a time before setting on the bed joint. The walls were cured according to ASTM E 514-90 which requires curing for 7 days enclosed in plastic sheeting and for a minimum of 7 days subsequent curing in laboratory air. The total curing time for the walls was 14 days.

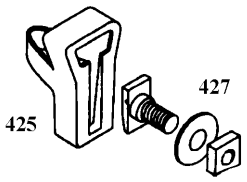
ASTM E 514-90 test procedures were followed throughout the tests. The test chambers were constructed of welded aluminum angle stock, and the observation face of the chamber was outfitted with Lexan sheet to allow full view into the chamber. All fixtures were in conformity with ASTM E 514-90, Section 4. Each frame was outfitted with a manometer to measure interior pressure and a flow meter to monitor the amount of flow. During the testing, the frame was pressurized to 10 psf, and the water flow was adjusted to 40.8 gal/hr which is equal to 3.4 gal/ft2/hr. The units were held in place with clamps, and a closed cell foam gasket material and silicone caulking provided the proper tight seal. To facilitate a tight seal, the test frame was attached to the clay brick making this the exposed face.

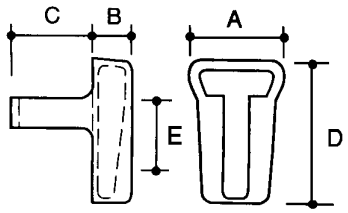
E 514 Water Penetration Test Observations	**Record of**	
72 Hour test - average of two walls tested		
Cast Date	**9/18/98**	**9/18/98**
Test Date	**10/2/98**	**10/2/98**
Time of Appearance of first dampness (min)	**None**	**None**
Time of Appearance of first visible water (min)	**None**	**None**
Area of dampness after 72 hours (%of test area)	**None**	**None**
Water collected in 72 hour test period (liter)	**None**	**None**

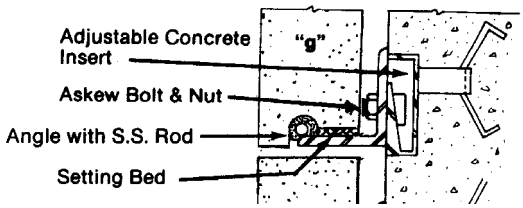


#425 WEDGE INSERTS (SHELF ANGLE INSERTS)

SIZE: Standard Sizes: Inserts: 5/8" (15.875mm), 3/4" (19.05mm), and 3/4" (19.05mm) Long. Available in Plain Malleable Iron or Hotdip Galvanized After Fabrication.
Bolts: 5/8" diameter (15.875mm) x 1-1/2" (38.1mm), 2" (50.8mm), 2-1/2" (63.5mm), and 3" (76.2mm). 3/4" diameter x (19.05mm) x 1-1/2" (38.1mm), 2" (50.8mm), 2-1/2" (63.5mm), 3" (76.2mm), and 3-1/2" (88.9mm).
Available in Plain, Electro Galvanized After Fabrication or Hotdip Galvanized After Fabrication. Bolts come with a nut and washer. Bolts extend 1/4" (6.35mm) less than above lengths when installed in inserts.







Bolt Dia.	Cat. No.	A	B	C	D	E
5/8" 15.875mm	425-5	2-1/4" 57.15mm	1-1/32" 26.194mm	1-15/16" 49.213mm	3-5/8" 92.075mm	1-5/8" 41.275mm
3/4" 19.05mm	425-6	2-5/16" 58.73mm	1-3/16" 30.163mm	2-1/2" 63.5mm	3-7/8" 98.425mm	1-3/4" 44.45mm
3/4 Long 19.05mm	425-6L	2-1/4" 57.15mm	1-1/4" 31.75mm	2-3/8" 60.325mm	5-1/2" 139.7mm	3" 76.2mm

(E is the Vertical Adjustment for Askew Head Bolts)

APPLICATION: Wedge inserts are nailed to forms and cast in place in concrete walls. Shelf Angles are attached using the Askew Head Bolts.
TESTING: The following results are from four separate tests performed on the Wedge Inserts.

TEST 1
Method of Test: Two inserts of each kind were cast in concrete blocks intended to be of 3,000 psi compressive strength. Companion 6" (152.4mm) x 12" (304.8mm) cylinders tested at the time the inserts were tested showed an actual compressive strength of 3,010 and 3,280 psi. The inserts were cast flush with the surface of blocks 16" (406.4mm) x 16" (406.4mm) having a thickness of 10" (254mm). A short length of 1/2" (12.7mm) reinforcing bar was placed through the insert loop into the concrete. Blocks were allowed to cure under room conditions for 28 days. Pullout and Shear tests were made loading the bolts in two different directions to the surface in which the inserts were cast; directly outward (perpendicular) and downward (parallel).

#425 Wedge Inserts (Continued)

PULLOUT TEST: Bolts were loaded in a direction perpendicular to the surface with the bolts at the midpoint of the slots in the inserts.

Insert	Max. Load Lbs.	Failure
5/8	9,320 lbs	Concrete broke around the inserts, then the concrete block cracked in the vicinity of the reinforcing bar. Insert did not break.
3/4	9,830 lbs	Concrete broke around insert body and cracked at reinforcing bar. Insert did not break.
3/4 Long	12,860 lbs	Lips along slot of insert broke. Concrete broke along side of body. Insert did not pull out of concrete.

SHEAR TEST: The tests pulling in a direction parallel to the surface of the concrete were made with a heavy angle block bolted at the mid point of the slot of the insert. The load was applied 2" (50.8mm) out from the surface of the concrete. This would place some tension on the bolt, but would primarily tend to force the bolt to slip downward in the slot. The following Results were obtained:

Insert	Max. Load Lbs.	Failure
5/8"	5,240 lbs	Bolt slipped in slot 1/16" (1.5875mm)
	6,600 lbs	Bolt slipped in slot 3/16" (4.7625mm)
	7,600 lbs	Bolt slipped in slot 3/8" (9.525mm). No failure in insert or concrete, but bolt was bending slightly.
	14,000 lbs	Maximum Load. Concrete broke around body of insert.
3/4"	7,600 lbs	Bolt slipped in slot 1/16" (1.5875mm)
	10,500 lbs	Bolt slipped in slot 316" (4.7625mm)
	10,960 lbs	Bolt slipped in slot 3/8" (9.525mm). No failure in insert or in concrete, but bolt was bending slightly.
	11,100 lbs	Maximum Load. Threads stripped on bolt.
3/4" Long	5,660 lbs	Bolt slipped in slot 1/16" (1.5875mm)
	7,140 lbs	Bolt slipped in slot 3/16" (4.7625mm)
	7,840 lbs	Bolt slipped in slot 3/8" (9.525mm). No failure in insert or in concrete, but bolt was bending slightly.
	19,150 lbs	Maximum Load. Bold had slipped to bottom of slot and head sheared.

TEST 2

Shear Test: METHOD OF TEST: ASTM E 488-76 Shear Strength of Anchor in Concrete. Parallel to Concrete Face from top of Anchor. (Results shown in pounds)

Insert Size	1	2	3	Average
5/8"	6,060	6,500	6,570	6,377
3/4"	7,040	7,580	7,230	7,230
3/4" Long	9.050	8,550	8,580	8,727

Concrete Fractured in all specimens, but insert did not fail. Compressive strength of concrete used at 28 days was 5,860 psi.

425 Wedge Inserts (Continued)

TEST 3

Pullout Test: METHOD OF TEST: ASTM E 488-76 Test for Strength of Anchors in Concrete. Results shown in pounds

Insert Size	1	2	3	Average
5/8"	4,450a	4,800a	4,600b	4,650 lbs
3/4"	5,400b	5,800b	5,700a	5,633 lbs
3/4" Long	6,900c	8,300c	7,100c	7,433 lbs

a: Snapped Hood - Cracked Insert Slot b: Pulled Out - Insert Intact
c: Broke Concrete - Insert Intact. Concrete Strength 6,040 psi

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TEST 4 - 3/4" Long Insert Only

Concrete was poured into molds measuring 11-1/2" (292.1mm) x 20" (508mm) x 20" (508mm). One insert was imbedded in the center of each mold. The inserts were malleable iron to the ASTM A-47 Grade 32510 specifications. No additional reinforcement, such as hairpins or rebar, were used in the concrete or inserts. The concrete used was 5,000 psi high early mix with the following proportions:

Cement - 830 lbs Sand - 1,168 lbs SSD
Stone 1/2" - 1,802 lbs SSD Water - 275 lbs
Daracem 100 - 66 ounces

Pullout tests were performed 6 days later when the concrete had reached a compressive strength of 4,758 psi as recorded from laboratory testing of 6" (152.4mm) x 12" (304.8mm) cylinders.

A Pair of I-Beams were used to span the concrete molds with a steel channel acting as a bridge. The channel held a 30 ton hydraulic jack powered by a manual pump. A hardened 3/4-10 NC threaded rod ran through the jack and bridge threading into the nut in the insert. Pressure readings were obtained using a certified calibrated gage connected to the pump. The inserts were pulled to failure:

Specimen 1 11,030 lbs
Specimen 2 10,140 lbs

Malleable Iron Specifications: ASTM A47-B4 Ferratic Malleable Iron Castings
Class/Grade 32510 Min Tensile Strength - PSI 50,000
Min. Yield Strength - psi 32,500 Elongation in tension 10%
Microstructure is Temper carbon and ferrite
For additional information on Specifications of Shelf Angle Inserts
refer to the following:

NCMA TEK 93 - National Concrete Masonry Institute - Curtain and Panel Walls of Concrete Masonry. 1977

BIA TECH NOTE 28B - Brick Institute of America - Brick Veneer Panel and Curtain Walls. Revised November 1999.

ANSI B18.2.1 1965 revised 1970 - Askew Head Bolts - American National Standards Institute.

#444 THREADED INSERTS

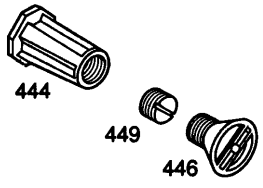
SIZE: See chart below for bolt sizes

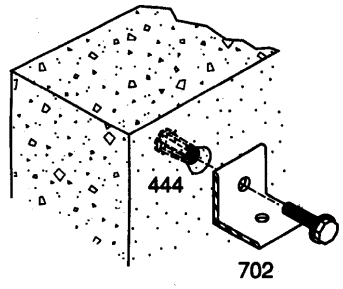
APPLICATION: Threaded inserts are cast in concrete and offer a clean and unobtrusive appearance without protrusion beyond the face of the concrete. They permit anchor bolts and eye bolts to be removed and reinstalled as often as required.

TEST CONDITIONS: The following chart is based on the average of many physical tests under proper conditions. For detailed reports please call. (To obtain maximum load of insert machine bolt thread engagement must be at least 75% of the depth of the threaded hole. Use either bolts or threaded rods when attaching fixtures to the inserts.)

Cat. No.	Full Thread Engagement	Bolt Size	Ultimate Load in Tension
P-15-T	7/8" (22.225mm)	1/4-20	2,950 lbs
P-24-T	31/32" (24.60mm)	3/8-16	5,712 lbs
P-25-T	1-1/8" (28.58mm)	3/8-16	6,797 lbs
P-35-T	1-1/4" (31.75mm)	1/2-13	8,945 lbs
P-36-T	2-1/2" (63.5mm)	1/2-13	15,482 lbs
P-45-T	1-3/8" (34.925mm)	5/8-11	11,800 lbs
P-46-T	2-1/2" (63.5mm)	5/8-11	16,969 lbs
P-55-T	1-1/2" (38.1mm)	3/4-10	6,207 lbs

* Most standards recommend one-fourth (1/4) of the average maximum proof test loads as safe working loads.





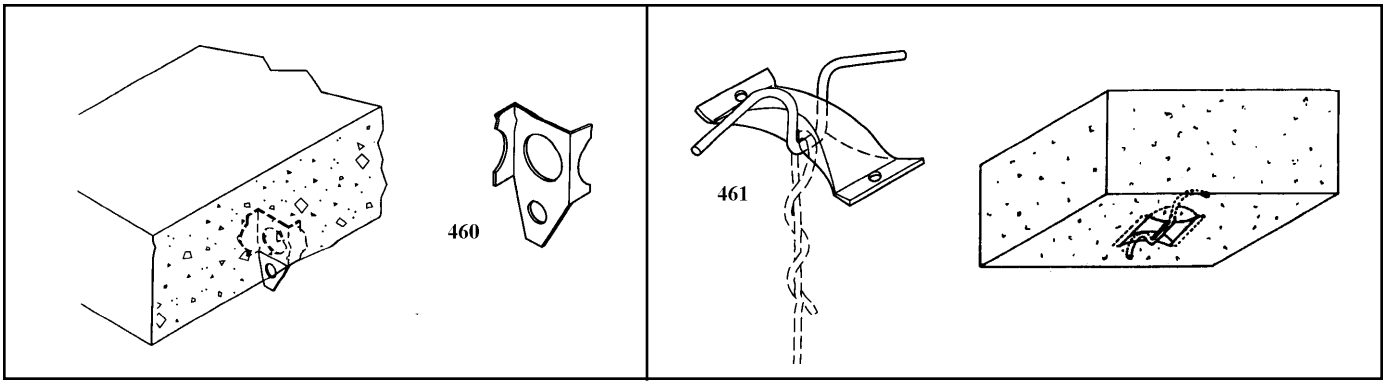
#460 NAILER CEILING INSERTS

SIZE: Inserts are 2-3/16" (55.563mm) long x 1" (25.4mm) wide, made from Mill Galvanized steel conforming to ASTM A 653 CQ.

APPLICATION: The insert is driven into the wood form wherever a hanger is required. When the form is removed, the blade, which has a 5/16 (7.94mm) diameter hole, will project below the concrete to receive a pencil rod or wire.

TEST CONDITIONS: Inserts were cast into concrete slabs 8" (203.2mm) x 10" (254mm) x 3" (76.2mm) deep made of Portland Cement Type 1 3-1 ratio allowed to set over 28 days. The inserts were centered in the slab. A 5/16" (7.94mm) bolt was placed through the hole in the insert and attached to the crossram of the test machine. Samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).

3 INSERTS TESTED	AVERAGE PULLOUT 1,259 lbs.



#461 CEILING HANGER INSERTS

SIZE: 3/16" (4.763mm) round galvanized wire loop with a 26 gage Mill Galvanized shell. The wire loop is 1-1/2" (38.1mm) high with 3-5/8" (92.08mm) spread, and the hanger opening of the loop inside the shell is 5/8" (15.875mm) wide x 3/8" (9.525mm) high. The shell is 1-3/4" (44.45mm) wide at the ends, 2-3/4" (69.85mm) long and 11/16" (17.463mm) high in the center.

APPLICATION: Used for hanging suspended ceilings, ductwork, plumbing, light fixtures, etc. in new construction. The wire loop is inserted into the shell, and the shell is nailed to the concrete form. When the form is removed, the loop is exposed to receive the hanging fixtures. The clearance for hanging is 5/8" (15.875mm) wide x 3/8" (9.525mm) high. Install as needed.

TEST CONDITIONS: Each sample was cast into a concrete form 9-1/4" (234.95mm) x 9-1/4" (234/95mm) x 3-1/4" (82.55mm) deep. Concrete mixture was Portland Cement Type I at a 3-1 ratio allowed to set over 28 days. Samples were tested to failure at a crosshead speed of 0.5"/minute (12.7mm/minute).

3 INSERTS TESTED	AVERAGE PULLOUT 1,905 lbs

POS-I-TIE® BRICK VENEER SYSTEM

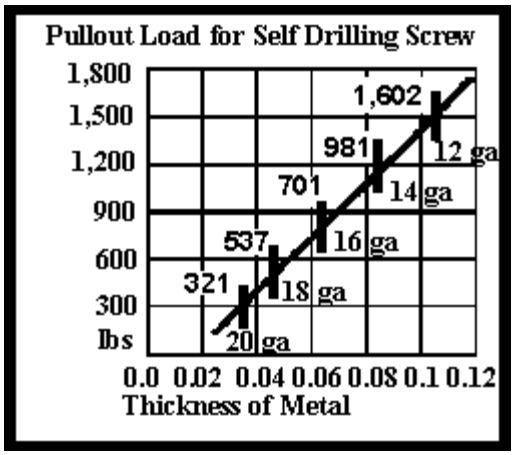
SIZE: There are three types of screws for backups of: Steel Studs (Self Drilling Screws), Concrete CMU or Brick (Tapcon® Screws), and Steel Beams (Dril-It® Screws). Each of the three screws have six different barrel lengths for no insulation or insulation up to 3". 5/8" (15.875mm), 1" (25.4mm), 1-1/2" (38mm), 2" (50.8mm), 2-1/2" (64mm), and 3" (76.2mm).

APPLICATION: Used with wire ties inserted through a hole in the barrel for attaching brick veneer to the three different backup systems listed above.

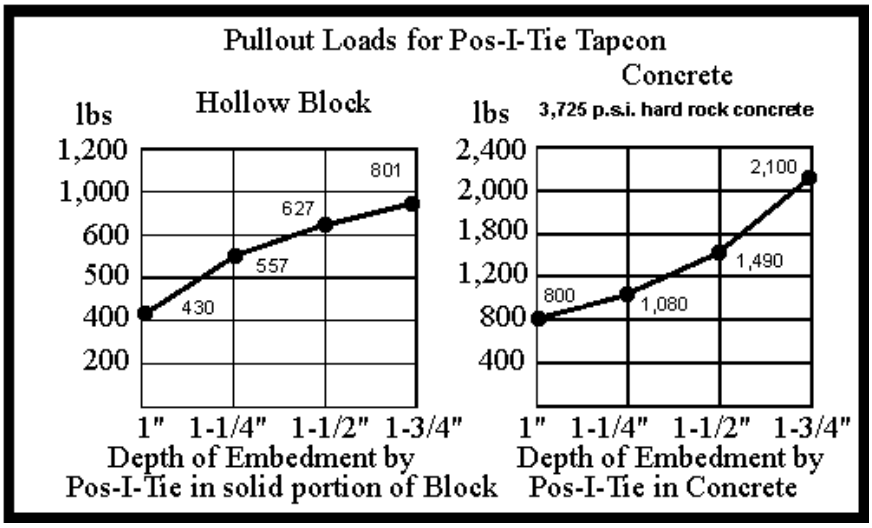
TEST RESULTS:

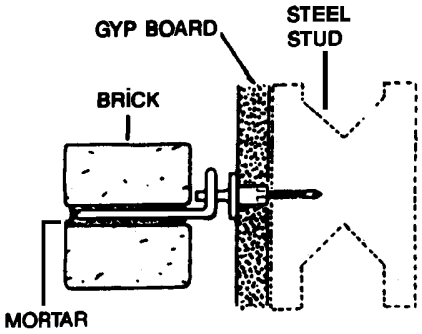
PULLOUT LOAD

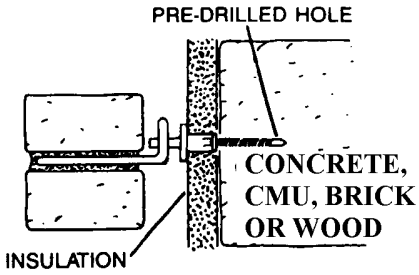
SELF DRILL SCREW



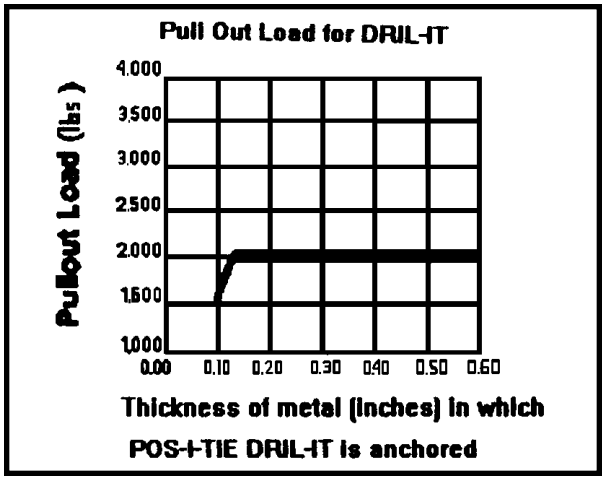
PULLOUT LOAD TAPCON® SCREW

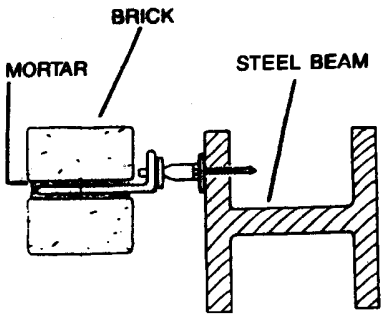






PULLOUT LOAD DRIL-IT® SCREW





Pos-I-Tie® Air and Water Penetration Test

Air Infiltration and Water Penetration Testing of a Mock-Up Air Barrier Back-Up Wall Assembly for Compliance with Chapter 13, "Energy Conservation" in the Commonwealth of Massachusetts State Building Code, Effective July 1, 2001.

TEST CONDITIONS:

A. Air Barrier Back-Up Wall Assembly

A back-up wall of 1/2" thick Georgia Pacific Dens Glass was installed over 16 gage 2" x 6" steel studs set at 17" on center. The Dens-Glass sheathing contained one horizontal and one vertical joint. The Dens-Glass back-up wall was primed with two coats of Carlisle 702 primer and allowed to dry. Carlisle 705 cavity wall membrane was installed over the primed Dens-Glass. The wall membrane was pressed into place on the sheathing and at vertical and horizontal joints in the membrane.

Dow Z-Mate 2" thick extruded polystyrene insulation boards were placed over the Carlisle membrane. 2-1/2" long Pos-I-Tie® wall tie anchors were screwed into the insulation, air barrier, Dens-Glass, and steel studs of the wall assembly in three horizontal rows spaced at 17" and three vertical columns spaced at 16", for a total of nine wall tie anchors. The completed mock-up air barrier back-up wall assembly measured 62" wide x 78" high.

B. Air Barrier Air Leakage Requirements

In Chapter 13, 'Energy Conservation.' in the Commonwealth of Massachusetts State Building Code, which took effect on July 1, 2001, Paragraph 13.04.3, 'Air Leakage,' contains the following requirements: The air barrier is to be continuous, with all joints made airtight. The air barrier shall have an air permeability not to exceed 0.004 cfm per square foot under a pressure differential of 0.3 inches of water (1.57 psf). All penetrations in the air barrier shall be made airtight.

II. TEST PROCEDURES:

Testing was performed in accordance with applicable provisions of ASTM: E 283, "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtainwalls, and Doors Under Specified Pressure Difference Across the Specimen," and ASTM E 331, "Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference."

III. TEST RESULTS

The following test results were obtained

A. Air Infiltration @ 1.57 PSF

Measured Air Leakage 0.0 cft

Calculated Air Infiltration 0.0 cfm per square foot

Allowable Air Infiltration 0.004 cfm per square foot

The mock-up air barrier back-up wall assembly met the State Code requirements for measurement of air infiltration through the air barrier back-up wall.

B. Water Penetration @ 6.24 PSF

Water was applied to the exterior side of the mock-up air barrier back-up wall assembly at the standard rate of 5.0 gallons per hour per square foot while a negative chamber pressure of 6.24 was maintained on the interior side of the mock-up.

No leakage was observed on the interior surface of the steel-framed back-up wall assembly during the 15 minute test period.

IV. COMMENTS

The mock-up air barrier back-up wall assembly met the requirements in Chapter 13, 'Energy Conservation,' in the Commonwealth of Massachusetts State Building Code, relative to air leakage through air barrier seams, air barrier membrane, and penetrations in the air barrier made by the Heckmann Pos-I-Tie® wall tie anchors.