WEAVER CONSTRUCTION MANAGEMENT, INC.
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SUBMITTAL TRANSMITAL

July 28, 2011
WGC Submittal No: 05500-002

PROJECT: **Harold Thompson Regional WRF**
Birdsall Rd.
Fountain, CO 80817
Job No. 2908

ENGINEER: **GMS, Inc.**
611 No. Weber St., #300
Colorado Springs, CO 80903
719-475-2935 Roger Sams

OWNER: **Lower Fountain Metropolitan Sewage Disposal District**
901 S. Santa Fe Ave.
Fountain, CO 80817
719-382-5303 James Heckman

CONTRACTOR: **American Fabricators, Inc**
10290 E. 106th Ave.
Brighton, Co 80601
303-296-6223 Chuck Allen
amerfab@msn.com

SUBJECT: Shop Drawing for Stairs – (SD-01 through SD-24)
Product Data for Galvanizing, Handrails, Aluminum Grating, and Adhesive Anchoring System.

SPEC SECTION: 05500 – Metal Fabrications

PREVIOUS SUBMISSION DATES: n/a

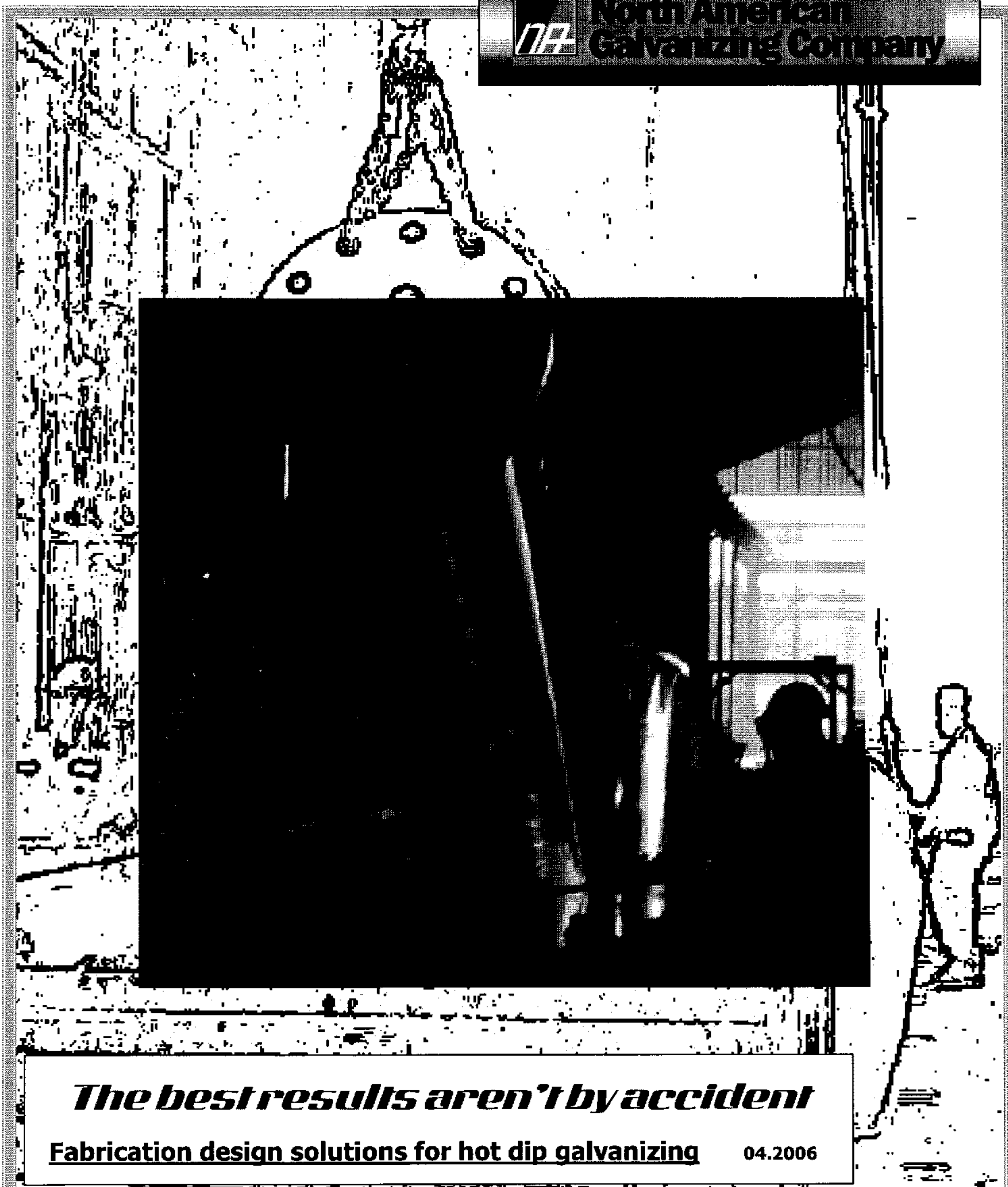
DEVIATIONS FROM SPEC: ____ YES __X__ NO

CONTRACTOR'S STAMP: This submittal has been reviewed by Weaver General Construction and approved with respect to the means, methods, techniques, & safety precautions & programs incidental thereto. Weaver General Construction also warrants that this submittal complies with contracted documents and comprises on deviations thereto:

Contractor's Stamp:	Engineer's Stamp:
Date: 7/28/11 Reviewed by: H.C. Myers (X) Reviewed Without Comments ( ) Reviewed With Comments	

ENGINEER'S COMMENTS:____

North American Galvanizing Company



The best results aren't by accident

Fabrication design solutions for hot dip galvanizing

04.2006

North American Galvanizing Company

The best results aren't by accident

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North American Galvanizing Company

Facility Locations

Dallas / Ft. Worth

625 West Hurst Blvd.
Hurst, TX 76053
(817) 268-2414
Fax: (817) 282-7793
Kettle: 42'L x 6'6"W x 7'6"D
Single lift capacity: 30,000 lbs

Kansas City

7700 East 12th Street
Kansas City, MO 64126
(816) 241-4300
Fax: (816) 241-4303
Kettle: 30'L x 4'6"W x 5'6"D
Single lift capacity: 12,000 lbs

St. Louis

1461 Kin Ark Court
St. Louis, MO 63132
(314) 993-1562
Fax: (314) 993-3556
Kettle: 51'L x 7'3"W x 10'D
Single lift capacity: 30,000 lbs

Denver

4400 East
Commerce City
(303) 288-
Fax: (303)
Single lift capacity

Louisville

6310 Kenjoy Drive
Louisville, KY
(502) 367-
Fax: (502) 368-
Single lift capacity

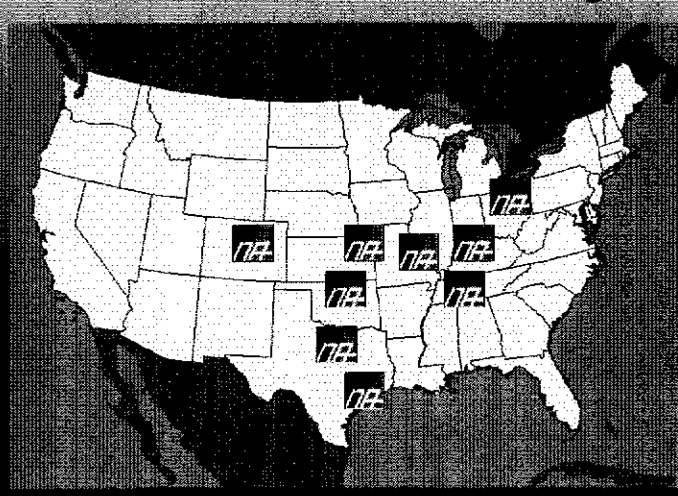
Tulsa

1800 West
Tulsa, OK
(918) 584-0304
Fax: (918) 584-
Single lift capacity

Avenue
OH 44707
6'4"W x 8'6"D
4'6"W x 5'6"D
capacity: 25,000

Road
4323
W x 10'D
capacity: 40,000 lbs

North
37209
9582
6'6"W x 8'6"D
capacity: 20,000 lbs



North American Galvanizing Company

Hot Dip Galvanizing Customer Checklist

Avoid costly errors and delays by providing material that meets all design and fabrication requirements for hot dip galvanizing. High quality galvanizing results are contingent on design & fabrication compliance to ASTM A385 & A384.

1. **Coating requirements:** Verify coating specification/requirements (ASTM, AASHTO etc).

2. **Certification:** Check project for job specific certification (ASTM or other) requirements. Notify Galvanizer (in writing) prior to material processing. Additional charge may apply.

3. **Expectations:** Are there requirements beyond the normal ASTM specifications? What is the application & aesthetic expectations? Understand coating appearance characteristics. Consult NAGC.

4. **Steel composition:** Steel chemistry is the primary determining factor in both thickness and appearance of the galvanized coating. Certain elements like phosphorus (in excess of .04%) and silicon (in excess of .04%) or a combination of the two (exceeding .055%), can have a profound affect on appearance (color/luster) as well as coating thickness and smoothness, but not on the corrosion resistant properties. Refer to ASTM A385, section 3 "Steel Selection". Consult NAGC for review of steel composition mill certifications when aesthetics are important. Mixed material fabrications will have varying material compositions, potentially resulting in coating thickness, appearance and color (shiny/dull) variations. Due to concentrations of certain elements within the material, it is not uncommon to have coating color, luster (shiny/dull) variations on a single piece of steel. The corrosion resistance of normal and abnormal coatings is, for all practical purposes equal.

5. **Design & fabrication for galvanizing:** As required per ASTM A123, 5.2 design and fabrication shall comply with the ASTM A385, A384 & A143 guidelines. Consult NAGC for specific design (for galvanizing) instruction. Always provide a drawing or sketch in order to prevent any potential miscommunication.

6. **Size:** Check fabrication size in relation to the zinc kettle size. Will it fit, with room to maneuver?

7. **Angle Rule:** Whenever possible material will enter and exit the kettle at an angle. The objective is to prevent any portion of the fabrication from exiting the molten zinc completely horizontal or flat. Processing at an angle promotes the runoff of excess zinc, helping to minimize drips and runs. All fabrication for galvanizing designs including vent and drain hole locations for hollow/blocked sections, cropping corners for flow as well as determining suspending hole locations, should begin with this rule in mind. Small hanging rack material should have suspending holes located as to prevent a flat exit. Example: small, square or rectangular plates should always be suspended by a corner.

8. **Splice (double) dip:** If more than one dip is required in order to provide complete hot dip galvanized coverage (due to the size of the fabrication), the coating will have visible splice lines. All parties should have a clear understanding of the resulting splice line, overlap coating & possible splash.

9. **Provide clean material:** Surface contaminants can prevent the formation of the galvanized coating. It is the customers responsibility to remove all paint, mill lacquer, paint pen, mill markings, sticker-adhesive, grease, heavy rust, excessively heavy or rolled in mill scale and/or other foreign coatings or markings. Surface rust is ok. Consult NAGC regarding approved marking pen options that are easily and completely removable in the normal galvanizing process **(LA Co Markal Paint Stick #83420)**.

10. **Castings and forgings:** All iron and steel castings and rod iron forged/sculptured pieces must be blasted (white blast) prior to galvanizing.

11. **Welding:** Select weld material with a similar composition to base steel. Most standard weld material contains reactive (>.50%) levels of silicon, resulting in a heavier than normal galvanized coating at the weld. Consult NAGC on low silicon weld material sources. All welds and the surrounding area must be clean and free of flux, slag or other foreign remnants or deposits. Note: the use of some anti- splatter chemicals (if not removed) can create voids in the galvanized coating.

12. **Stitch vs. seal welding:** Hot Dip Galvanizing requires a minimum separation of 3/32″ between pieces in order to galvanize. Stitch welding of overlapped or contacting surfaces will not allow for galvanizing in between and eventual rust bleeding is a possibility. Furthermore, cleaning solutions between these surfaces can volatize during the galvanizing process and interfere with coating the adjacent areas. Seal welding prevents this problem, but may require additional venting (see **#**14).

13. **Venting and draining hollow fabrications:** While not always realistic, the objective is to vent or vacate 100% of the air in all hollow fabrications. All blocked ends require properly sized (min 15%), precisely located vent & drain holes to enable the free flow of cleaning solutions, fluxes, air & zinc, in order to achieve complete internal coating protection. Keep in mind the <u>angle rule (see #7).</u>
    a. **Vent and drain hole location**: Consider how your material is suspended for processing. Note- whenever possible, material is suspended at a 30°- 45° angle, in order to promote zinc run off and produce a consistent, uniform coating. Determine high (air exit) points and low (zinc entry) points for precise, offset vent & drain hole locations. Always follow a consistent hole pattern across the fabrication. Place these <u>offset</u> vent holes directly up against the weld or edge. Note: The normal hole location requirements may change if the fabrication requires splice (double) dipping. Consult NAGC for specific instruction.
    b. **Vent and drain hole size:** Calculate vent and drain hole sizes to equal a minimum of 15% of each hollow cross sectional area. Multiple, smaller holes that equal the same 15% is also acceptable. Vent and drain holes must always exceed the thickness of the material and an absolute minimum of 3/8″. Consult NAGC for specific instruction.
    c. **Internal venting:** See ASTM A385, section 11.3 & *fig* 7. Internal holes shall be the full inside diameter of the connecting piece. <u>In addition, there shall be one 3/8″ (minimum) external hole at each connection to prevent any possible explosion, in the event that an internal hole is missed.</u> Always consult NAGC regarding internal venting.

14. **Destructive pressure vent holes:** Trapped air and/or moisture between overlapped, seal-welded surfaces can result in the buildup of destructive pressures during galvanizing. Seal welded areas >16 square inches, up to 50 square inches will require a single, centrally located vent hole through one or both of the connecting pieces. The vent hole size should be ≥ the thickness of the material and an absolute minimum of 3/8″. Additional, equally spaced (over surface area), destructive pressure vent holes are required for each additional 50 square inches of surface area. Example: 16-50 sq in = 1 hole, 51-100 sq in = 2 holes, 101-150 sq in =3-holes etc.

15. **Cropping corners & flow holes:** Gussets, stiffeners, end plates and other fabrication designs that create corner pockets or blocked areas will prevent the free flow of cleaning solutions, fluxes, air & zinc. These areas require cropped corners or flow hole openings in order to prevent trapped ash, coating voids or pooled zinc and produce a complete, consistent coating. Cropped or flow hole size openings should always exceed the thickness of the material and an absolute minimum of 3/8″. Consult your galvanizer.

16. **Suspending (hanging) holes:** Some pieces may require hanging holes (3/8″ minimum) or other means in order to suspend for processing. Consult your NAGC facility for specific requirements. Small hanging rack material should have suspending holes located as such to prevent a flat exit from the molten zinc. Example: square or rectangular plates should always be suspended by a corner.

17. **Heat distortion/warping:** Refer to ASTM A384. Avoid mixed material thickness (due to varying expansion and contraction rates) on the same fabrication. Design structures to be single dipped rather than splice (double) dipped. Whenever possible use symmetrical shaped material (I-beam, pipe, tube) over non-symmetrical (angle, channel etc). Avoid long fabricated sections of thin material. Fabricate handrail separate from structures and keep handrail lengths to 20' or less.

18. **Loose identification tags:** Secure loose metal tags with a minimum 12 gage steel wire.

19. **Secondary coatings over galvanizing:** Advise the galvanizer (in advance) if the material will receive a secondary coating over the galvanizing in order to prevent the use of zinc rich touch up paints that could react to the secondary coating. Refer to ASTM D6386 for preparation of the galvanized material to accept secondary coatings. If sweep blasting is utilized to profile (etch) the galvanized coating, use only approved media and measure the coating thickness after blasting to ensure that sufficient coating thickness remains.
Regardless of method, once profiled, the application of secondary coatings should take place in a timely manner(48-72 hours typ), prior to the formation of zinc oxides (white rust). Always wash the profiled surface with clean water and allow to dry prior to applying secondary coatings. Consult your NAGC sales representative or facility for available profiling options including chemical etching.

20. **Preventing galvanizing on specific areas:** Consult galvanizer on approved methods for preventing galvanizing on specific areas for field welding or protecting male or female threads etc.

21. **Moving Parts:** Avoid hot dip galvanizing connected, moving pieces. Remove or disassemble any hinged pieces, doors, lids, sliding pieces, locks etc. and reassemble after galvanizing.

22. **Repair options for damaged or uncoated areas:** ASTM A780 – Standard Practice for Repair of Hot Dip Galvanized Coatings. These ASTM approved repair methods include metalizing (flame sprayed zinc), zinc based alloys and ASTM approved zinc dust repair paint. Consult NAGC or refer to ASTM A780 for preparation and application requirements.

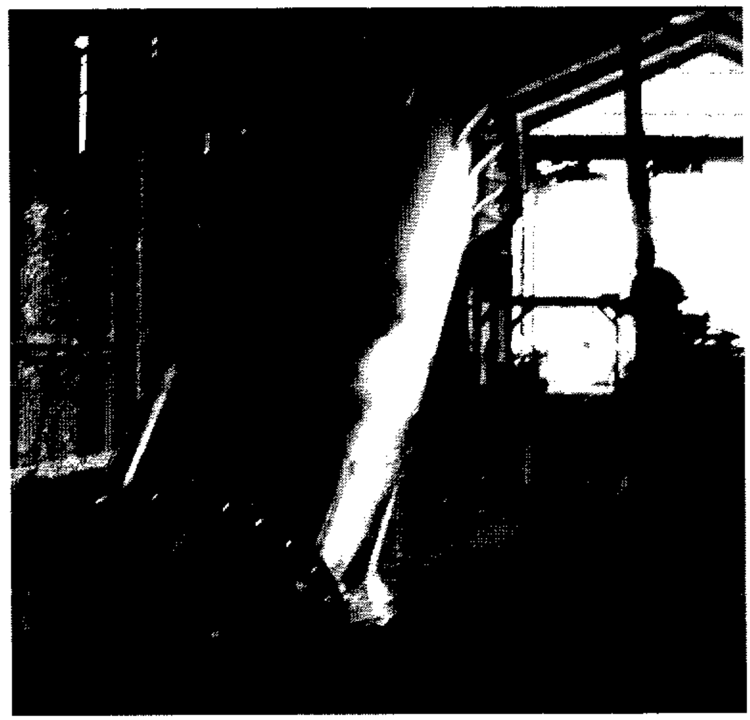
23. **Inbound & outbound loads:** Make sure that incoming loads are elevated and or palletized on flat bed trailers for easy fork-truck offloading. Keep individual lifts to 5-tons maximum. Do not nest I-beams. Prevent manual handling of small/loose pieces (secure to pallets or place in containers). Providing adequate dunnage, skids/pallets, crates etc, in order to facilitate a safe secure load and protect the galvanized coating is the responsibility of the customer. 4"x 4"x 8' spacing dunnage will provide sufficient separation. 2"x 4", 2"x 2" and smaller spacing dunnage can create problems and possible damage to the galvanized coating during reloading due to lift truck forks being 3-1/2" thick. Use straps (not chains) to secure and protect all outbound loads.

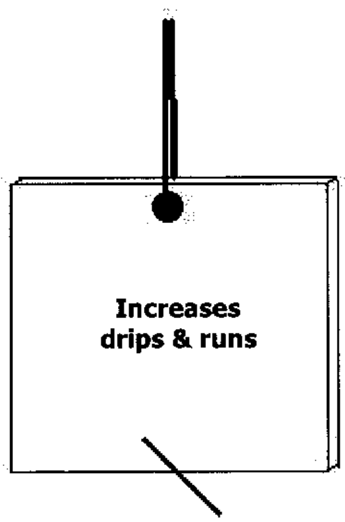
24. **Wet storage stain:** Trapped moisture between poorly ventilated, galvanized pieces can develop wet storage stain or white oxidation (aka white rust). Storage of galvanized material requires separation of individual pieces to allow free flowing air to all coated surfaces. Material stored outside should rest at a slight incline to prevent pooling of water. Wet storage staining is not usually detrimental to the corrosion protection and generally disappears during the normal weathering process of the galvanized coating.

The Angle Rule
How your material is suspended

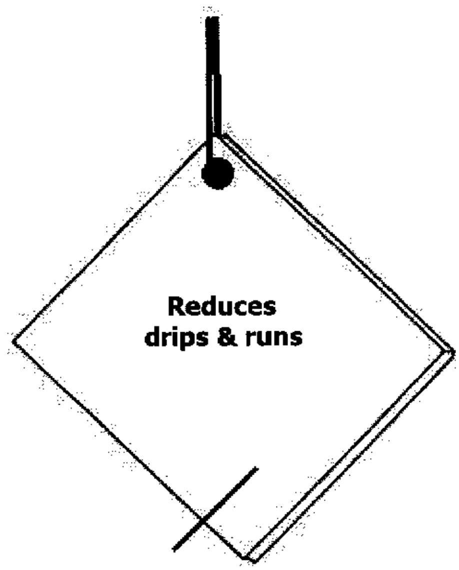
Whenever possible, material will enter and exit the kettle at an angle. The objective is to prevent any portion of the fabrication from exiting the molten zinc completely horizontal or flat. Processing at an angle promotes the runoff of excess zinc, helping to minimize drips and runs.

All fabrication for galvanizing designs including vent and drain hole locations, cropping corners and flow holes as well as determining suspending hole locations, should begin with the angle rule in mind.





Flat sides exiting molten zinc increases drips and runs.



Hanging by a corner promotes runoff of excess zinc, minimizing drips & runs.

Small hanging rack material that cannot be manipulated at an angle (for processing) should always have suspending holes located as to prevent a flat exit from the molten zinc. Example: square or rectangular plates should always be suspended by a corner. See *figure left.*

Venting and draining hollow fabrications

All hollow, sealed fabrications must be properly vented in order to <u>prevent dangerous explosions</u> and safely process hollow material to achieve a complete, internal and external hot dip galvanized coating as described in ASTM A385.

The galvanizers ability to meet ASTM A123 and provide high quality results, are contingent on adequate venting and draining practices. These vent and drain openings allow for the free flow of cleaning and pickling solutions as well as the flow of air and molten zinc.

Correctly sized and precisely located vent and drain openings are essential in preparing the internal steel surfaces to accept the formation of the galvanized coating.

Any entrapment of chemicals or air during the galvanizing process will result in coating voids and/or other coating related defects.

When uncertain about the venting and draining requirements for your specific fabrication or project, please contact your North American Galvanizing Company representative for instruction.

Providing a drawing or sketch of the hollow fabrication or structural member is highly recommended as a means to insure precise instruction and reduce the potential for costly miscommunications.

The vent hole size requirements on each hollow fabrication are directly related to the (inside) cross-sectional area of each blocked section, within the piece in question. Complete open ends or openings of 30%-50% of the cross sectional area will produce the best hot dip galvanizing results and allow for faster processing.

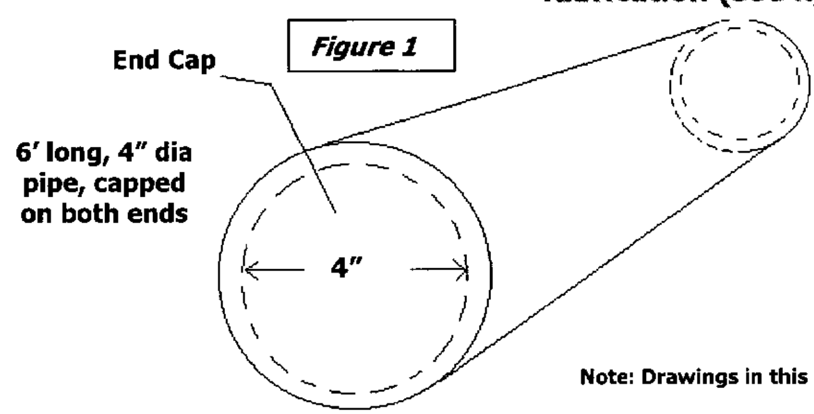
Most (fabrication design for galvanizing) publications including ASTM A385 require minimum vent opening of 25 - 30% of the cross sectional area. North American Galvanizing Company does allow a minimum vent hole size equal to 15% of the (inside) cross sectional area. If desired, this 15% can be made up of 2 or more smaller holes that provide equivalent openings.

The precise placement of these correctly sized vent and drain openings are crucial to obtaining high quality results. It is essential to understand how the specific fabrication or structure will be suspended during processing.

Whenever possible, material enters and exits each step of the process at an angle (30-45° typ). This helps promote the flow and draining of the chemical solutions as well as effective runoff of excess zinc, required to produce a complete, consistent coating, while minimizing drips and runs.

The following information will illustrate basic vent and drain opening designs beginning with a simple (sealed) pipe fabrication (*see figure 1*).

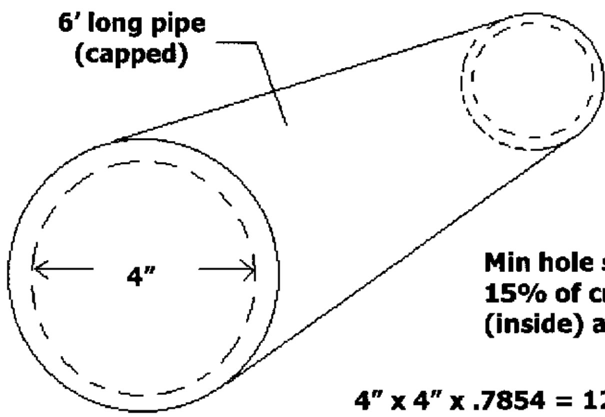
Figure 1



Note: Drawings in this publication are not to scale.

Determining Vent Hole Size & Location

Figure 2



Min hole size calculation: 15% of cross-sectional (inside) area.

4" x 4" x .7854 = 12.57 sq. in.

12.57" x .15 = 1.89 sq. in.

For the above fabrication, the minimum opening should be 1.89 sq. in. or a single, round hole diameter of 1.55". Multiple holes equal to the same 15% can also be used. All vent and drain openings must be ≥ the thickness of the material and an absolute minimum of 3/8".

First determine the square inch cross sectional (inside) area of the fabrication to be galvanized.

For the simple pipe fabrication as shown in *figure 2*, calculate the inside cross-sectional square inch area as shown: I.D.(inside dia) x I.D. x .7854 = cross sectional inside area.

Multiply the cross sectional area by .15 to determine the 15% minimum square inch vent and drain opening requirement. If desired, this 15% can be made up of 2 or more smaller holes that provide equivalent openings.

In order to prevent the vent holes from trying to fill in during the galvanizing process, the vent hole size must always be greater than the thickness of the material and an absolute minimum of 3/8".

As mentioned previously, whenever possible, the material will enter and exit the kettle at an angle (*see figure 3*).

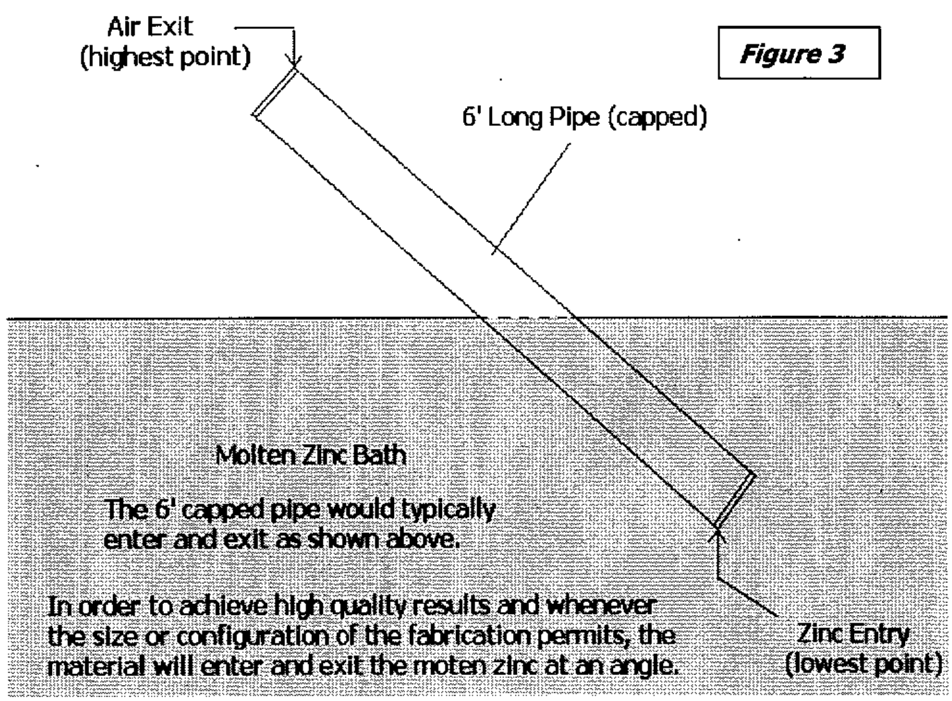
It is important to understand how each different fabrication will be suspended for processing in order to determine the highest (air exit) and the lowest (zinc entry) points.

Keep in mind, due to the material processing at an angle, the resulting (high and low) locations are most often offset.

Determining the high and low points of each blocked, hollow section of the fabrication will provide the means to remove up to 100% of the air, thus allowing for a complete internal coating.

Consider how the material will enter and exit the kettle.

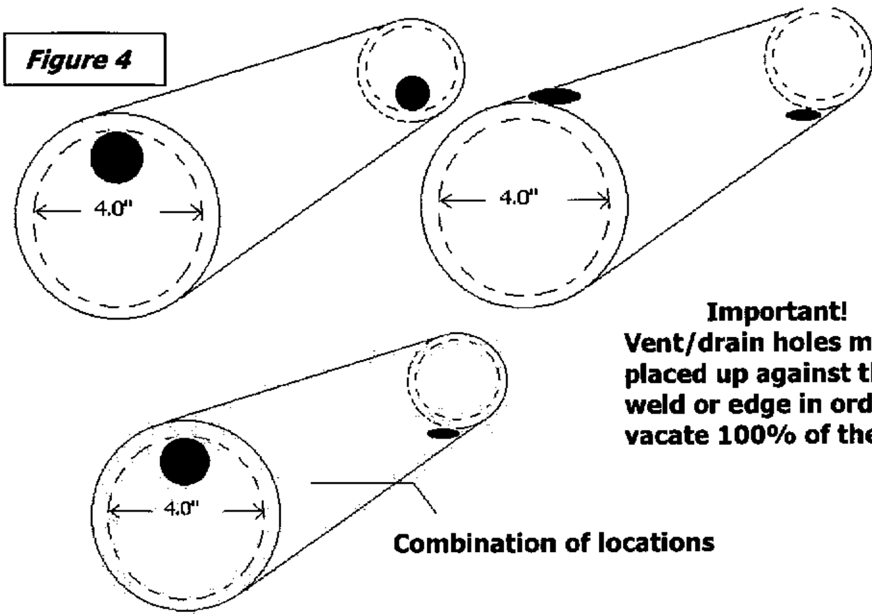
Figure 3



Vent Hole Location Options

The minimum (single hole) vent/drain requirements can be met by locating the correctly sized, <u>offset holes</u> through the cap or the pipe or combination of the two.

Figure 4



Important!
Vent/drain holes must be placed up against the weld or edge in order to vacate 100% of the air.

In many cases, once the high and low points are determined, more than one vent hole location option may be available.

In the case of the 6′ long, capped pipe *(figure 4)*, effective venting can be accomplished by <u>offset</u> holes located either through the end caps or through the pipe itself.

Holes should always be placed up against the weld or edge in order to vacate 100% of the air.

A combination of the locations (one hole in the pipe and the other in the cap) would also produce equal results as long as the high and low point requirements are met.

Figure 5 shows how these vent/drain hole options will function.

Determining the vent hole location is as important as the hole size.

Trapped air creates voids in the galvanized coating as well as increasing the potential for other defects including ash inclusions and trapped or pooled zinc.

While not always realistic (due to design issues or cosmetic requirements) the goal remains to vent or vacate as close to 100% of the air as possible in all hollow fabrications.

The same holes that allow the molten zinc to enter the hollow areas of the fabrication become drain holes as the piece is being extracted from the kettle.

Figure 5

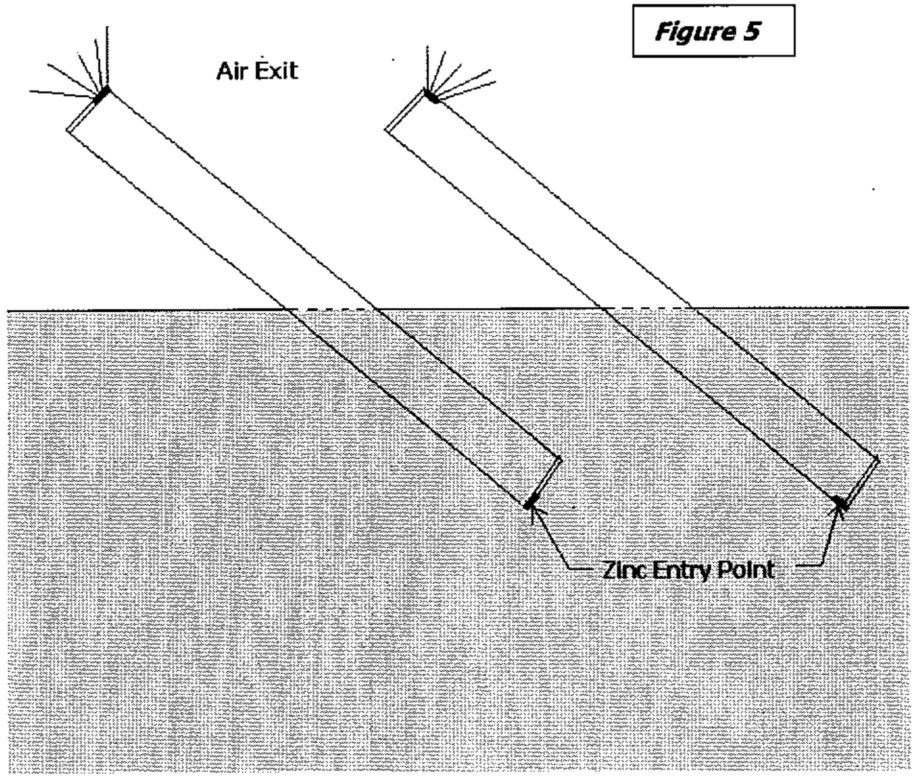
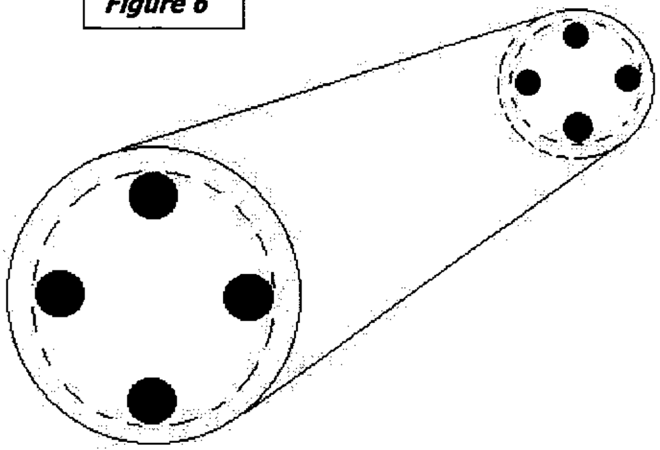


Figure 6



Multiple, smaller vent and drain holes, combined to meet or exceed the same minimum (15%) opening requirement, will produce equal results as long as the high (air exit) and low (zinc entry) points are covered (see *figure 6*).

Refer to the following minimum vent/drain hole sizing charts for specific pipe and square tube sizes utilizing 1, 2 & 4 hole designs. The square inch, or equivalent round hole size is based on the minimum 15% of the cross sectional area for the specific pipe and square tube sizes listed.

The following minimum (non-handrail) vent/drain hole sizes reflect the size requirement per hole. Example: The 4-vent size is the required per hole size if four equal holes are used per blocked section as pictured above. See page 15 for the minimum vent/drain hole size requirements for handrail.

Vent and drain holes for hollow (pipe) fabrications

NAGC minimum vent/drain hole requirement (15% of cross sectional area)
(non - handrail)

Pipe Inside Dia"	Cross Sec Sq In.	15% of Cross Sec (sq. in.)	Single Vent Hole Dia	2 - Vent Min Sq In.	2 - Vent Hole Dia	4 - Vent Min Sq In.	4 - Vent Hole Dia
2.00	3.14	0.47	0.77	0.24	0.55	0.12	0.39
2.50	4.91	0.74	0.97	0.37	0.68	0.18	0.48
3.00	7.07	1.06	1.16	0.53	0.82	0.27	0.58
3.50	9.62	1.44	1.36	0.72	0.96	0.36	0.68
4.00	12.57	1.88	1.55	0.94	1.10	0.47	0.77
4.50	15.90	2.39	1.74	1.19	1.23	0.60	0.87
5.00	19.64	2.95	1.94	1.47	1.37	0.74	0.97
5.50	23.76	3.56	2.13	1.78	1.51	0.89	1.07
6.00	28.27	4.24	2.32	2.12	1.64	1.06	1.16
7.00	38.48	5.77	2.71	2.89	1.92	1.44	1.36
8.00	50.27	7.54	3.10	3.77	2.19	1.88	1.55
10.00	78.54	11.78	3.87	5.89	2.74	2.95	1.94
12.00	113.10	16.96	4.65	8.48	3.29	4.24	2.32

NAGC minimum vent/drain hole requirement (same as above in 16ths)

Pipe Inside Dia"	Cross Section Sq In.	15% of Cross Sec (sq. in.)	Single Vent Hole Dia	2 - Vent Min Sq In.	2 - Vent Hole Dia	4 - Vent Min Sq In.	4 - Vent Hole Dia
2	3 2/16	0.47	12/16	0.24	9/16	0.12	6/16
2 1/2	4 15/16	0.74	15/16	0.37	11/16	0.18	8/16
3	7 1/16	1.06	1 3/16	0.53	13/16	0.27	9/16
3 1/2	9 10/16	1.44	1 6/16	0.72	15/16	0.36	11/16
4	12 9/16	1.88	1 9/16	0.94	1 2/16	0.47	12/16
4 1/2	15 14/16	2.39	1 12/16	1.19	1 4/16	0.60	14/16
5	19 10/16	2.95	1 15/16	1.47	1 6/16	0.74	15/16
5 1/2	23 12/16	3.56	2 2/16	1.78	1 8/16	0.89	1 1/16
6	28 4/16	4.24	2 5/16	2.12	1 10/16	1.06	1 3/16
7	38 8/16	5.77	2 11/16	2.89	1 15/16	1.44	1 6/16
8	50 4/16	7.54	3 2/16	3.77	2 3/16	1.88	1 9/16
10	78 9/16	11.78	3 14/16	5.89	2 12/16	2.95	1 15/16
12	113 2/16	16.96	4 10/16	8.48	3 5/16	4.24	2 5/16

Vent and drain holes for hollow (square tube) fabrications

NAGC minimum vent/drain hole requirement (15% of cross sectional area)
(non - handrail)

Square Tube size "	Cross Sec Sq In.	15% of Cross Sec (sq. in.)	Single Vent Hole Dia	2 - Vent Min Sq In.	2 - Vent Hole Dia	4 - Vent Min Sq In.	4 - Vent Hole Dia
2.00	4.00	0.60	0.87	0.30	0.62	0.15	0.44
2.50	6.25	0.94	1.09	0.47	0.77	0.23	0.55
3.00	9.00	1.35	1.31	0.68	0.93	0.34	0.66
3.50	12.25	1.84	1.53	0.92	1.08	0.46	0.76
4.00	16.00	2.40	1.75	1.20	1.24	0.60	0.87
4.50	20.25	3.04	1.97	1.52	1.39	0.76	0.98
5.00	25.00	3.75	2.19	1.88	1.55	0.94	1.09
5.50	30.25	4.54	2.40	2.27	1.70	1.13	1.20
6.00	36.00	5.40	2.62	2.70	1.85	1.35	1.31
7.00	49.00	7.35	3.06	3.68	2.16	1.84	1.53
8.00	64.00	9.60	3.50	4.80	2.47	2.40	1.75
10.00	100.00	15.00	4.37	7.50	3.09	3.75	2.19
12.00	144.00	21.60	5.24	10.80	3.71	5.40	2.62

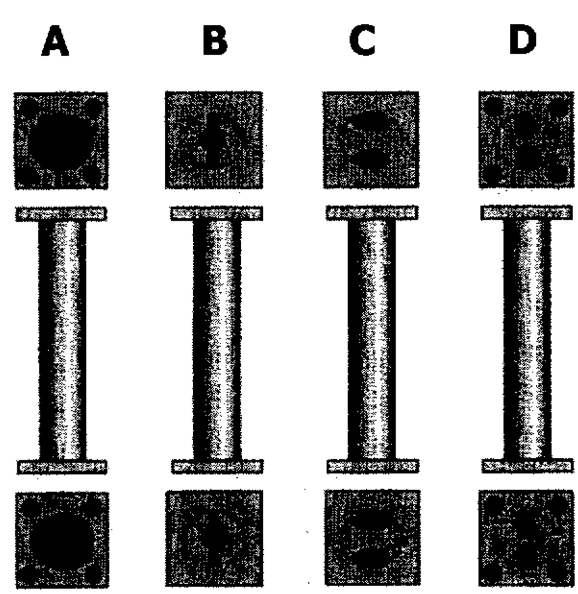
NAGC minimum vent/drain hole requirement (same as above in 16ths)

Square Tube size "	Cross Section Sq In.	15% of Cross Sec (sq. in.)	Single Vent Hole Dia	2 - Vent Min Sq In.	2 - Vent Hole Dia	4 - Vent Min Sq In.	4 - Vent Hole Dia
2	4	10/16	14/16	0.30	10/16	0.15	7/16
2 1/2	6 4/16	15/16	1 1/16	0.47	12/16	0.23	9/16
3	9	1 6/16	1 5/16	0.68	15/16	0.34	10/16
3 1/2	12 4/16	1 13/16	1 8/16	0.92	1 1/16	0.46	12/16
4	16	2 6/16	1 12/16	1.20	1 4/16	0.60	14/16
4 1/2	20 4/16	3 1/16	1 15/16	1.52	1 6/16	0.76	1
5	25	3 12/16	2 3/16	1.88	1 9/16	0.94	1 1/16
5 1/2	30 4/16	4 9/16	2 6/16	2.27	1 11/16	1.13	1 3/16
6	36	5 6/16	2 10/16	2.70	1 14/16	1.35	1 5/16
7	49	7 6/16	3 1/16	3.68	2 3/16	1.84	1 8/16
8	64	9 10/16	3 8/16	4.80	2 8/16	2.40	1 12/16
10	100	15	4 6/16	7.50	3 1/16	3.75	2 3/16
12	144	21 10/16	5 4/16	10.80	3 11/16	5.40	2 10/16

Pipe columns, poles or other straight pipe or round tube fabrications with base plates or end caps can be adequately vented utilizing the various vent hole designs illustrated in *figure 7*.

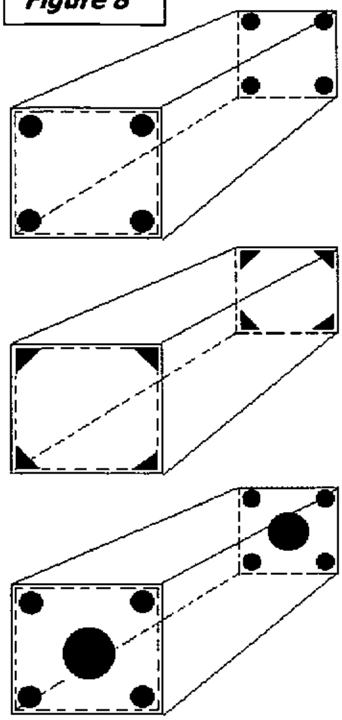
These vent hole designs are preferable and provide excellent results as illustration A is completely open and B, C & D provide both high and low openings on each end.

Figure 7



Vent/drain designs for square/rectangular tube fabrications

Figure 8



The same venting principles apply to square and rectangular fabrications as the material will, in most cases, enter and exit the kettle at an angle.

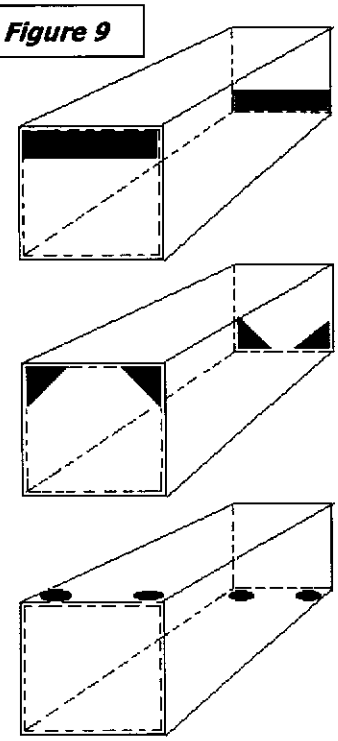
The same minimum 15% vent opening is required.

Parallelogram shapes run better if all corners are open as shown in *figure 8*.

Offset openings (*figure 9*) are also permitted as long as the minimum 15% requirement is met.

As was the case on the pipe fabrication, offset vent openings in the tube (*figure 8 bottom)*, rather than the end cap or base plate can also meet the minimum requirements, if properly located.

Figure 9



Square or rectangular shapes vent and drain better if a minimum of 2 corners are opened at each end (*see figure 10)*, rather than a single, centrally located hole as shown in *figure 11*.

Material can shift and tilt during the hot dip galvanizing process, potentially trapping zinc in the corners when the single vent/drain hole system is used on square or rectangular shapes.

Trapped zinc increases the galvanizing prices, as CWT prices are generally applied to the actual post-galvanizing weights.

Keep in mind that covering two corners allows for smaller sized holes.

Figure 10

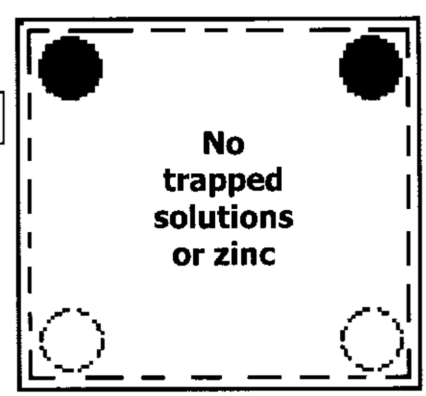
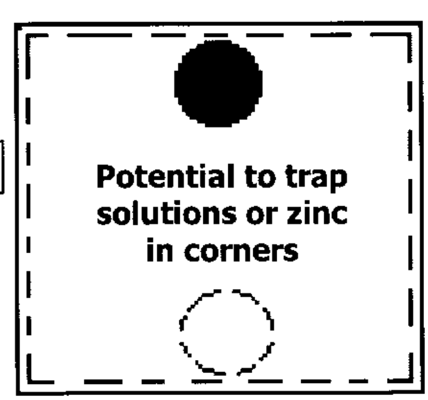


Figure 11



Tube Frame

By applying these same practices to the (single dip size) tube frame (*figure 12*), near 100% internal coverage is achievable.

By keeping in mind that the tube frame will enter and exit the kettle at an angle, the high (air exit) and low (zinc entry) points of each section can be determined.

In this case the fabricator is using (2) zinc entry holes and (2) air exit holes in each blocked tube section. The combined opening for 2 holes meets the minimum 15% opening requirement for each end of every blocked section.

As shown in (*figure 13*) locating the holes directly in the corners provide the best opportunity for optimum flow, resulting in complete internal coverage.

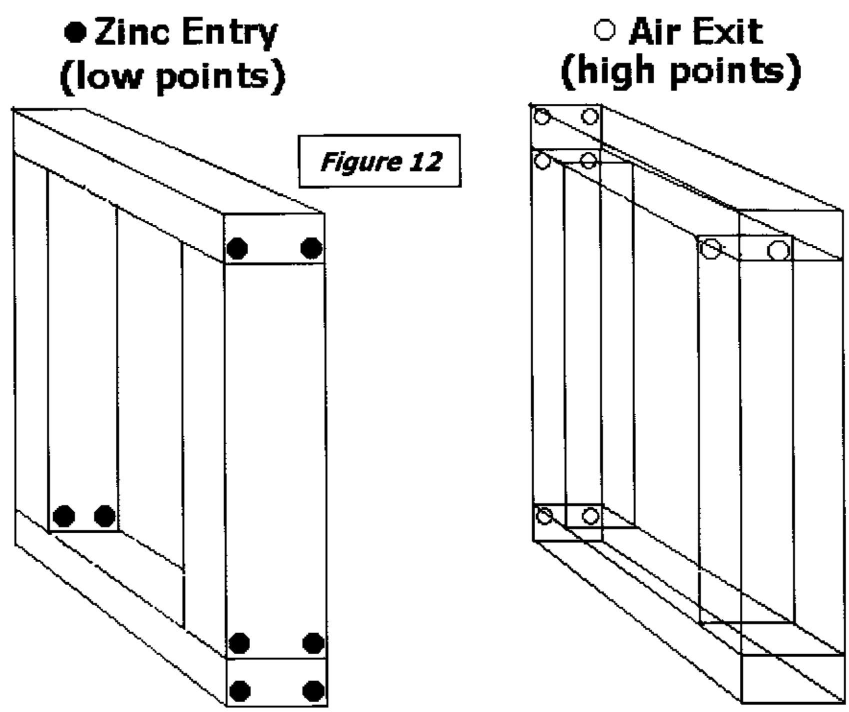


Figure 12

Tube Frame (entering zinc)

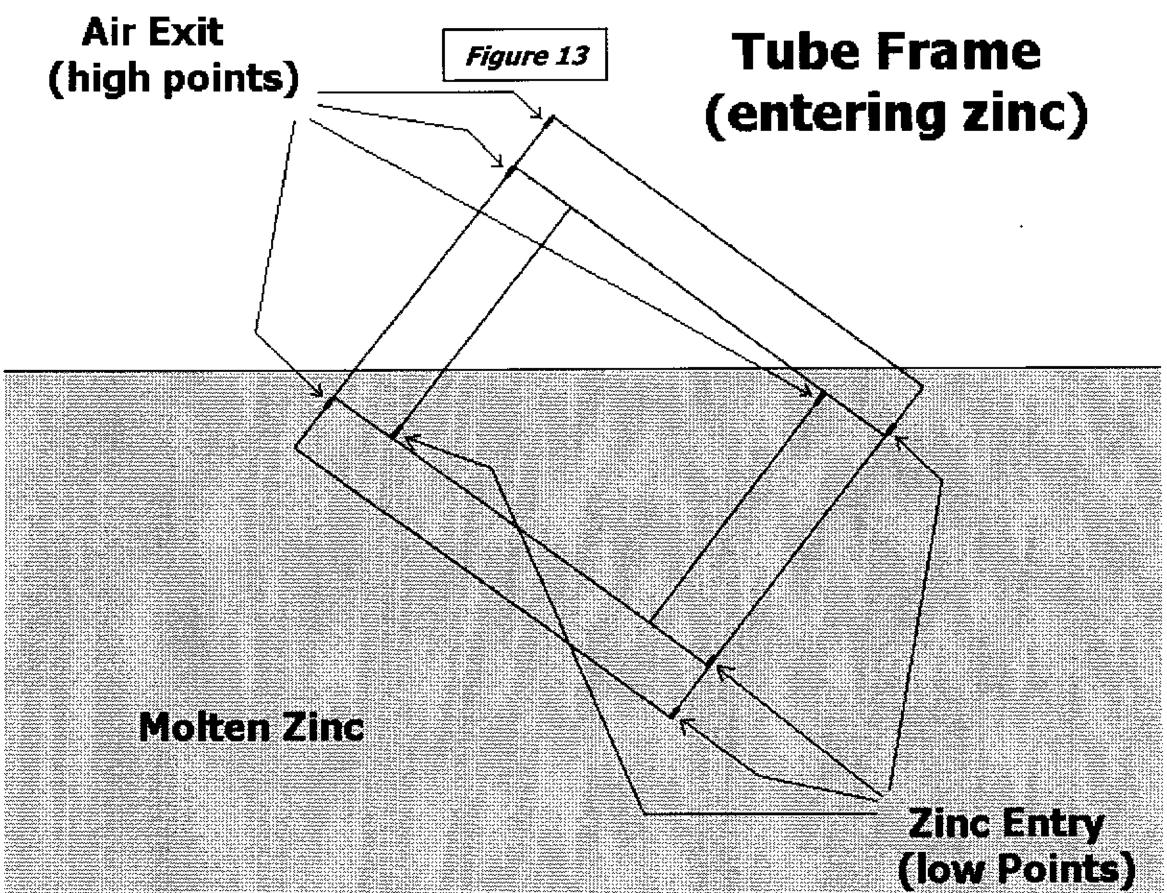
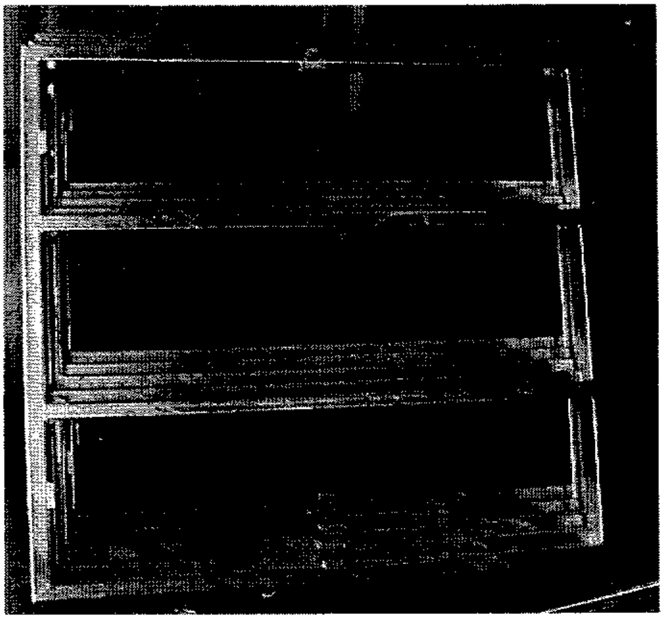


Figure 13



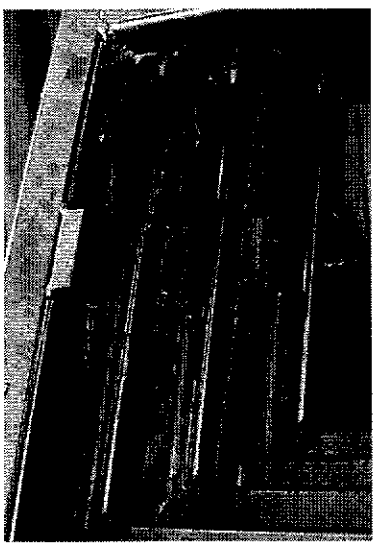
This tube frame (left) was vented with a single hole (per blocked end) design. The vent holes were incorrectly located approximately 1.5" from the weld.

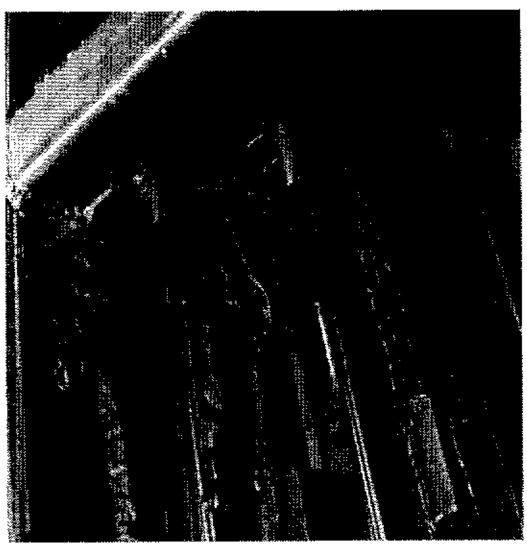
As the frame exited the kettle at an angle, molten zinc was trapped back, behind the vent holes.

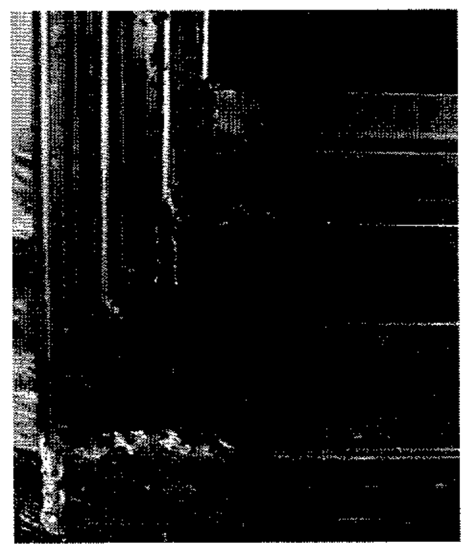
Once out of the kettle, the frame is stood straight and the trapped molten zinc begins to escape through the poorly located vent/drain holes.

This results in heavy drips and runs (see photos below) on the vertical sections as well as spilling onto the horizontal lines beneath the leaking holes.

Seemingly minor details like these critical hole locations can have a major impact on the coating results.







Venting smaller (hanging rack) fabrications

Larger fabrications typically allow for standard processing fixtures providing a means to enter and exit the process at an angle.

Smaller fabrications are generally suspended by a single wire on a hanging rack and are more difficult to manipulate at specific angles.

Figure 14 shows a small plate & pipe fabrication. This piece should hang from a single corner to prevent any plate sections from exiting the kettle flat.

Once the suspending hole location is determined, the placement of the correctly sized (min 15%) high and low vent/drain holes can follow (*fig 15*).

Understanding how the piece will hang from the suspending hole will help locate the high and low points of the hollow section (*fig 16*).

The suspending hole size should be ≥ the thickness of the material and an absolute minimum of 3/8".

Figure 14

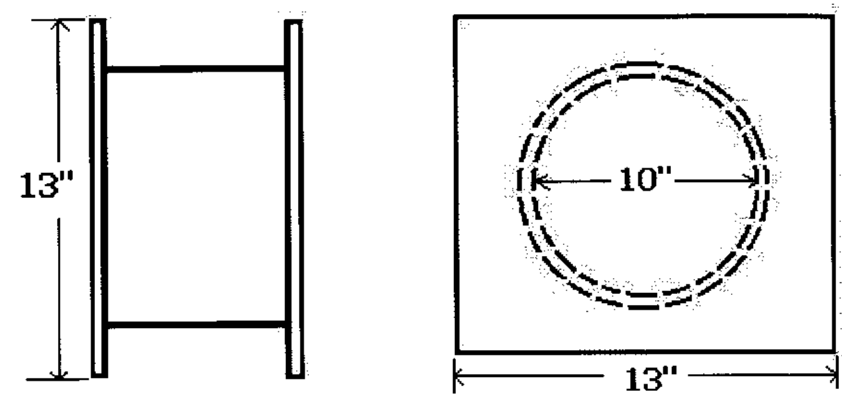


Figure 15

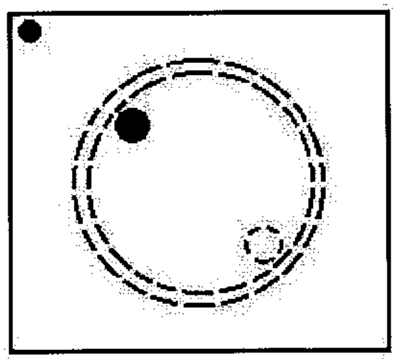
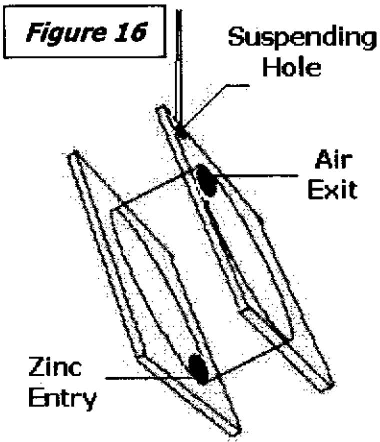


Figure 16



Vent/drain pipe handrail - External system

In most cases, handrail will enter and exit the kettle standing upright (rather than laying down) but also at an angle to insure fluid runoff of excess zinc.

Review the typical, single dip, handrail venting illustration (*figure 17*).

For optimum results, handrail should always be fabricated and galvanized separate from platforms or stair stringers.

Due to the visibility and cosmetic aspirations for handrail, both vent and drain holes are permitted underneath on the horizontal sections, as long as the handrail can be single dipped. Smaller sized vent & drain holes are also permitted for the same aesthetic reasons.

Keep in mind that drilled (rather than torched) holes provide a more consistent flow during processing and are more easily repaired without damaging the galvanized coating. Contact NAGC about tapered vent/drain hole plugs (see page 20) for repairing drilled vent & drain holes.

Drilled vent and drain holes should be placed prior to assembly of the fabrication in order to insure that the holes will be located up against the weld as shown in *figure 17*.

NAGC will accept round vent and drain holes with a minimum diameter measuring ≥ 25% of the inside diameter of the pipe. This is the absolute minimum vent /drain hole size permitted on **HANDRAIL ONLY.** The minimum hole size must meet or exceed the thickness of the material in question and never less than 3/8" (*see min hole size charts below*).

Note the hole pattern on *figure 17*. All vent holes are located on the same side of the vertical posts. Processing material at an angle necessitates that a consistent vent hole location pattern be followed across the fabrication.

Base plate holes into the posts must be completely open as shown.

Each blocked end must have a vent hole, including short extensions.

Additional or relocated holes will be required for splice (double) dipping if the height of the fabricated handrail exceeds the depth of the galvanizer's kettle.

Vent holes on 90 degree turns (*figure 17*) should be located in the center of the bend as shown below.

External venting for single dip handrail

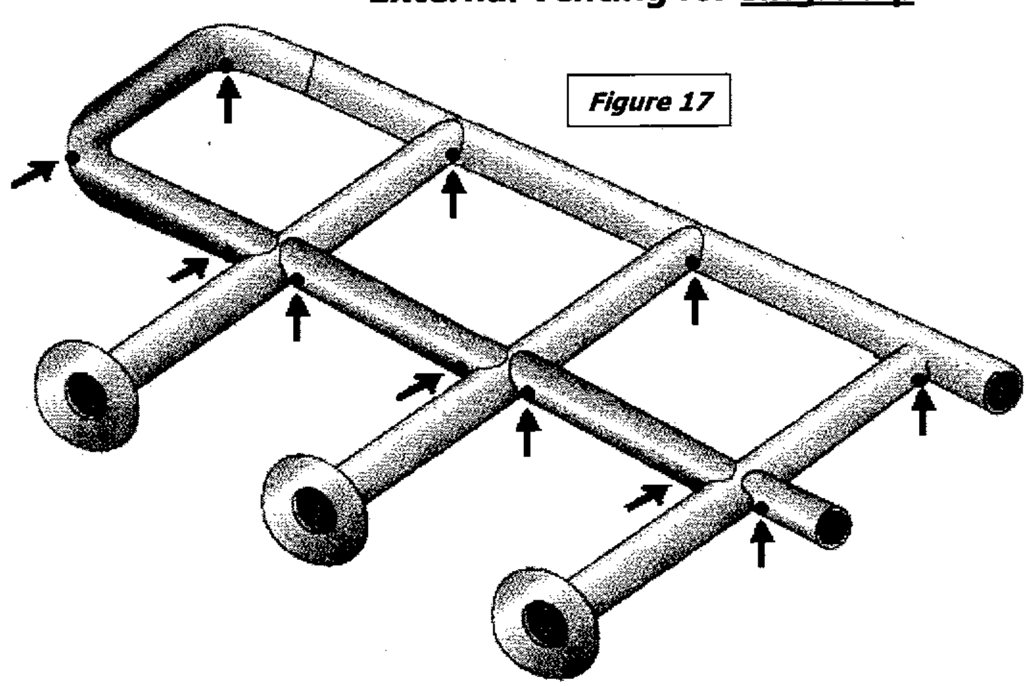


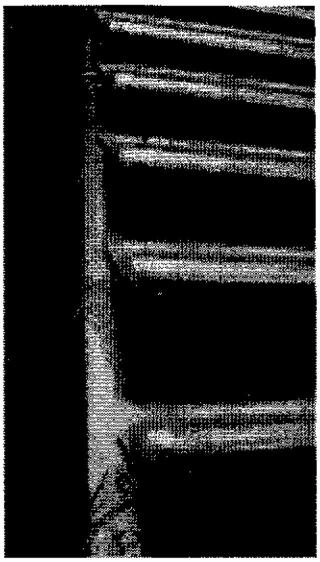
Figure 17

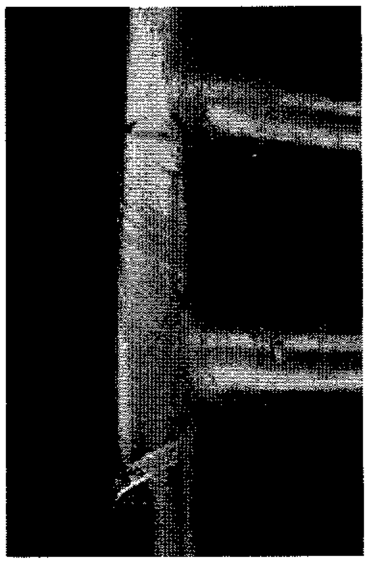
Minimum vent/drain Hole size handrail only (25% of the diameter) absolute minimum of 3/8"

Pipe diameter	Minimum hole size
1"	3/8"
1-1/2"	3/8"
2"	1/2"
2-1/2"	5/8"
3"	3/4"

Venting pipe handrail (examples)

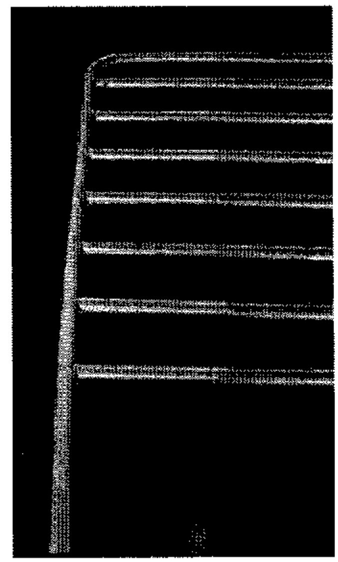
Vent /drain holes too far away from weld

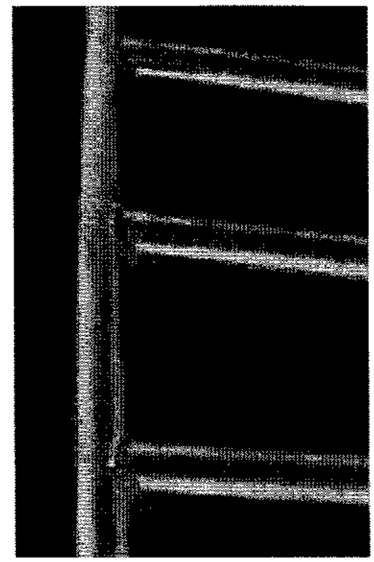




Increases runs and drips

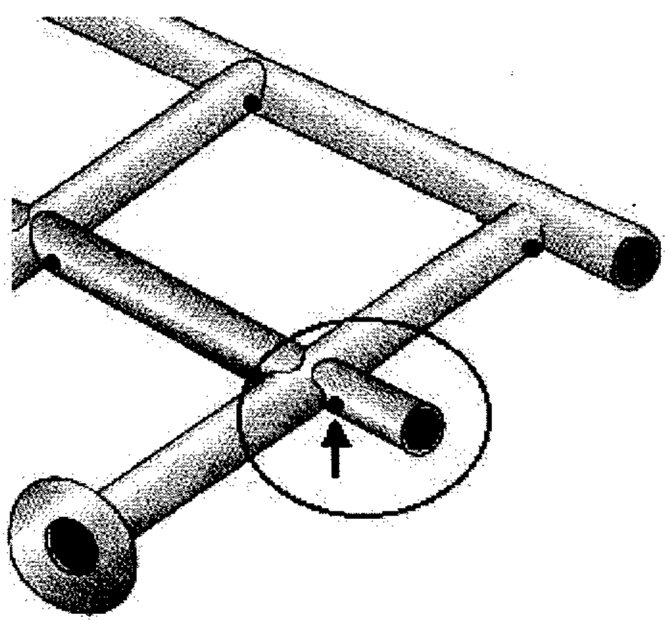
Vent /drain holes up against the weld



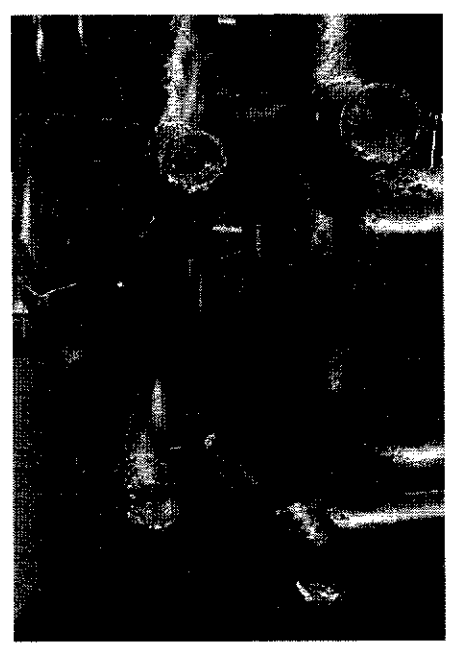


Smoother more consistent coating

Extensions require vent holes



Results if extensions not vented



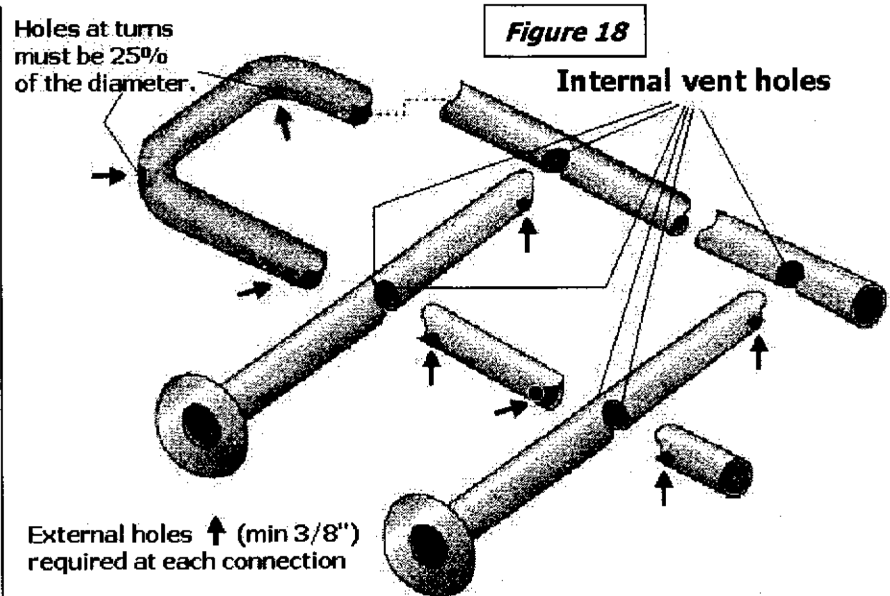
Vent/drain pipe handrail - <u>Internal</u> system

Internal Venting as shown in *figure 18* is an effective method for providing free flow of solutions, air and zinc.

However, this design does require additional fabrication time and can produce a weaker structure as all internal holes must be sized equal to the inside opening of the connecting piece.

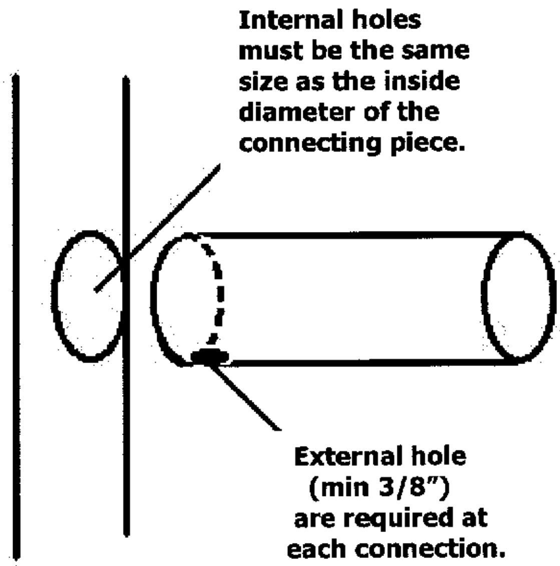
The possibility exists that an internal hole could be missed. This is a serious safety concern for the galvanizer's kettle workers, due to the potential for an explosion caused by trapped air, thus <u>external</u> holes are required at each connection.

Figure 18



As per ASTM A385, section 11.3, external holes (min 3/8") are required at each connection, to prevent any possible explosion in the event that an internal hole is missing.
All internal vent/drain holes must equal the inside diameter/dimension of the connecting piece.
Holes at the turn or bend must be 25% of the inside diameter and located as shown above at the 90° bends.

Figure 19



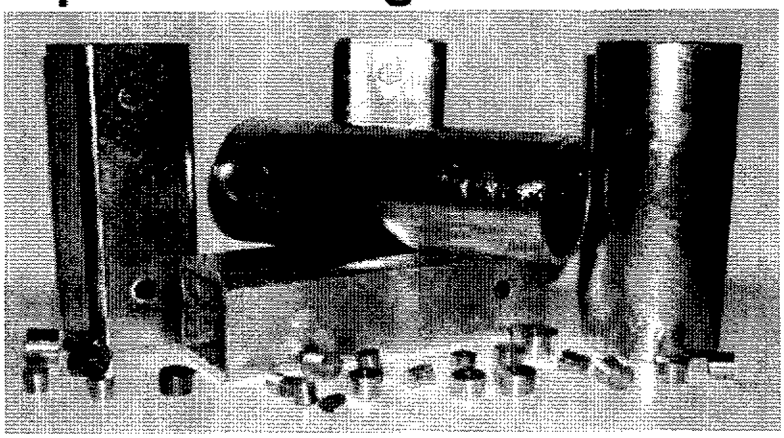
NAGC as well as ASTM A385 require that all internal vent holes include an <u>external</u> (minimum 3/8") vent hole (*see figure 19*) at each connection as a safety precaution

As per *ASTM A 385, section 11.3*, internal vent holes or openings must be the same size as the inside diameter or square inch opening of the connecting piece.

Much the same as externally vented handrail, internally vented rail still requires <u>external</u> holes in the center of each turn or bend. Holes at the turn/bend must have a diameter that is ≥ 25% of the inside diameter of the pipe and not less than 3/8" (*see figure 18*).

North American Galvanizing Company

Hot Dip Galvanizing - Vent Hole Plugs



Repair vent holes without damaging the galvanized coating!

Eliminate cold galvanizing repairs!

Quick & Easy - Save time & $$ by plugging holes!!

Prevent exposure to zinc fumes!

2006 Pricing

Tapered Vent Hole Plugs - Aluminum & Zinc

Plug Size	Per Plug <100	100 Count	Per Plug 100 - 249	250 Count	Per Plug 250 - 499	500 Count	Per Plug 500 - 999	1000 Count	Per Plug 1,000-UP
3/8"	$0.50	$ 42.00	$ 0.42	$ 80.00	$0.320	$ 142.00	$0.284	$ 264.00	$ 0.264
7/16"	$0.50	$ 42.00	$ 0.42	$ 80.00	$0.320	$ 142.00	$0.284	$ 264.00	$ 0.264
1/2"	$0.75	$ 50.00	$ 0.50	$ 96.00	$0.384	$ 170.00	$0.340	$ 314.00	$ 0.314
9/16"	$0.75	$ 50.00	$ 0.50	$ 96.00	$0.384	$ 170.00	$0.340	$ 314.00	$ 0.314
5/8"	$0.80	$ 67.00	$ 0.67	$ 129.00	$0.516	$ 228.00	$0.456	$ 421.00	$ 0.421
11/16"	$0.80	$ 67.00	$ 0.67	$ 129.00	$0.516	$ 228.00	$0.456	$ 421.00	$ 0.421
3/4"	$1.40	$118.00	$ 1.18	$ 226.00	$0.904	$ 400.00	$0.800	$ 740.00	$ 0.740
13/16"	$1.40	$118.00	$ 1.18	$ 226.00	$0.904	$ 400.00	$0.800	$ 740.00	$ 0.740
7/8"	$1.60	$123.00	$ 1.23	$ 234.00	$0.936	$ 414.00	$0.828	$ 766.00	$ 0.766
15/16"	$1.60	$136.00	$ 1.36	$ 260.00	$1.040	$ 459.00	$0.918	$ 850.00	$ 0.850
3/8" Z	$0.65	$ 52.00	$ 0.52	$ 98.00	$0.392	$ 173.00	$0.346	$ 321.00	$ 0.321
1/2" Z	$0.80	$ 62.00	$ 0.62	$ 116.00	$0.464	$ 207.00	$0.414	$ 382.00	$ 0.382
5/8" Z	$1.00	$ 81.00	$ 0.81	$ 157.00	$0.628	$ 277.00	$0.554	$ 513.00	$ 0.513

Note: These plugs are designed for drilled holes and must have a uniform circumference. Torched vent holes may require additional preparation with a larger drill or reamer.

Zinc Plugs (3/8"Z, 1/2"Z & 5/8"Z) are also available but not currently stocked at NAGC.

Larger (over 15/16") plug sizes are available on a made-to-order basis.

Destructive pressure vent holes
(for overlapping seal welded surfaces)

Due to the temperatures involved with the hot dip galvanizing process, overlapped surfaces that are seal welded can produce a buildup of destructive pressures, resulting in explosions, due to trapped air, moisture or a combination of the two.

This presents serious safety concerns for the galvanizer's kettle operators as well as the potential for severe damage to the fabrication or galvanizing equipment.

NAGC requires that all overlapped, seal-welded areas exceeding 16 square inches must be vented through one or both of the connecting pieces. A single vent hole is adequate up to 50 square inches.

Each additional 50 square inch area requires one additional vent hole. For example, 72 square inches (*figure 20*) requires 2 holes. The hole size must always exceed the thickness of the material with an absolute minimum of 3/8".

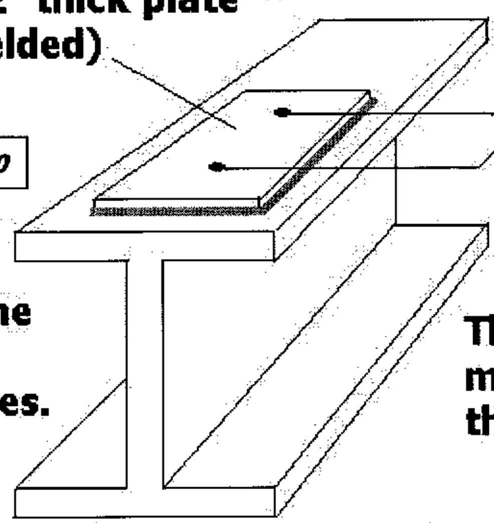


Figure 20

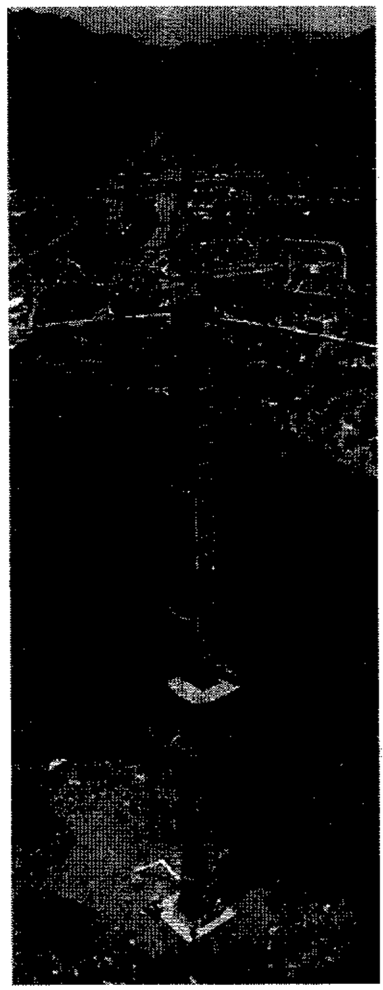
Total sealed area = 72 square inches: Hole requirement is 2 - 5/8" Holes

The 1st centrally located vent hole is required at 16 square inches of sealed surface area. The single hole is sufficient up to a 50 sq. in. area. A second equally spaced hole is required from 51 - 100 sq. inches. Each additional 50 sq. inches will require one additional hole all equally spaced over the total seal welded surface area.

North American Galvanizing Company

Take the shine off!

Ask for "Dull & Oil"



North American Galvanizing Company offers reduced reflectivity

Newly hot dip galvanized material is immersed in a specially formulated zinc phosphate treatment for a period of 3-6 minutes. Through this process, the shiny zinc surface is converted to a dull crystalline phosphate coating without affecting the corrosion resistant properties of the hot dip galvanized coating.

The zinc phosphate treatment is followed by a light application of oil in order to prevent the formation of zinc oxides (white rust). The oil used by North American Galvanizing to prevent zinc oxidation, is specifically designed to dry quickly, but it can under certain atmospheric conditions, remain wet for longer periods of time. In these circumstances the material is more susceptible to attracting dirt or other foreign airborne particles. This however, has no effect on the corrosion resistant properties of the dulled, galvanized material. The oil evaporates over time, leaving a normal, protective, weathered, galvanized coating.

Please be advised that North American Galvanizing Company cannot control the degree of reflectivity reduction on a given material as the steel composition is the primary determining factor in both the original color/luster of the hot dip galvanized coating, as well as how dark or dull of a coating the zinc phosphate treatment will achieve. In short, varying steel chemistries will reflect inconsistent results and thus our ability to achieve a specific darkness or dullness is limited at best.

This process currently available in Denver (only), is the same process that North American Galvanizing Company has provided to reduce reflectivity on hot dip galvanized coatings for transmission towers, substation structures, USDA Forest Service structures and the ski lift industry in Colorado, neighboring states and Canada for over 15 years.

Please contact North American Galvanizing for all your hot dip galvanizing and other corrosion protective coating requirements.

Other NAGC Plant Locations / Kettle Sizes (length, width, depth)

CANTON, OH 52'Lx6'4"Wx8'6"D & 16'Lx4'6"Wx5'6"D PHONE: 330-477-4800	HURST, TX (DFW) 42'L x 6'6"W x 7'6"D PHONE: 817-268-2414	HOUSTON, TX 62'L x 8'W x 10'D PHONE: 832-467-3772	KANSAS CITY, MO 30'L x 4'6"W x 5'6"D PHONE: 816-241-4300	LOUISVILLE, KY 42'L x 5'W x 6'D PHONE: 502-367-6146
NASHVILLE, TN 51'L x 6'5"W x 8'5"D PHONE: 615-297-9581	ST. LOUIS, MO 51'L x 7'3"W x 10'D PHONE: 314-993-1562	TULSA, OK #1 56'L x5'3"W x 7'D PHONE: 918-584-0303	TULSA , OK #2 43'L x 6'6"-4'6"(taper)W x -6'6"D PHONE:	REINFORCING SVCS 36'6"L x 4'2"W x 6'D PHONE: 918-379-0090

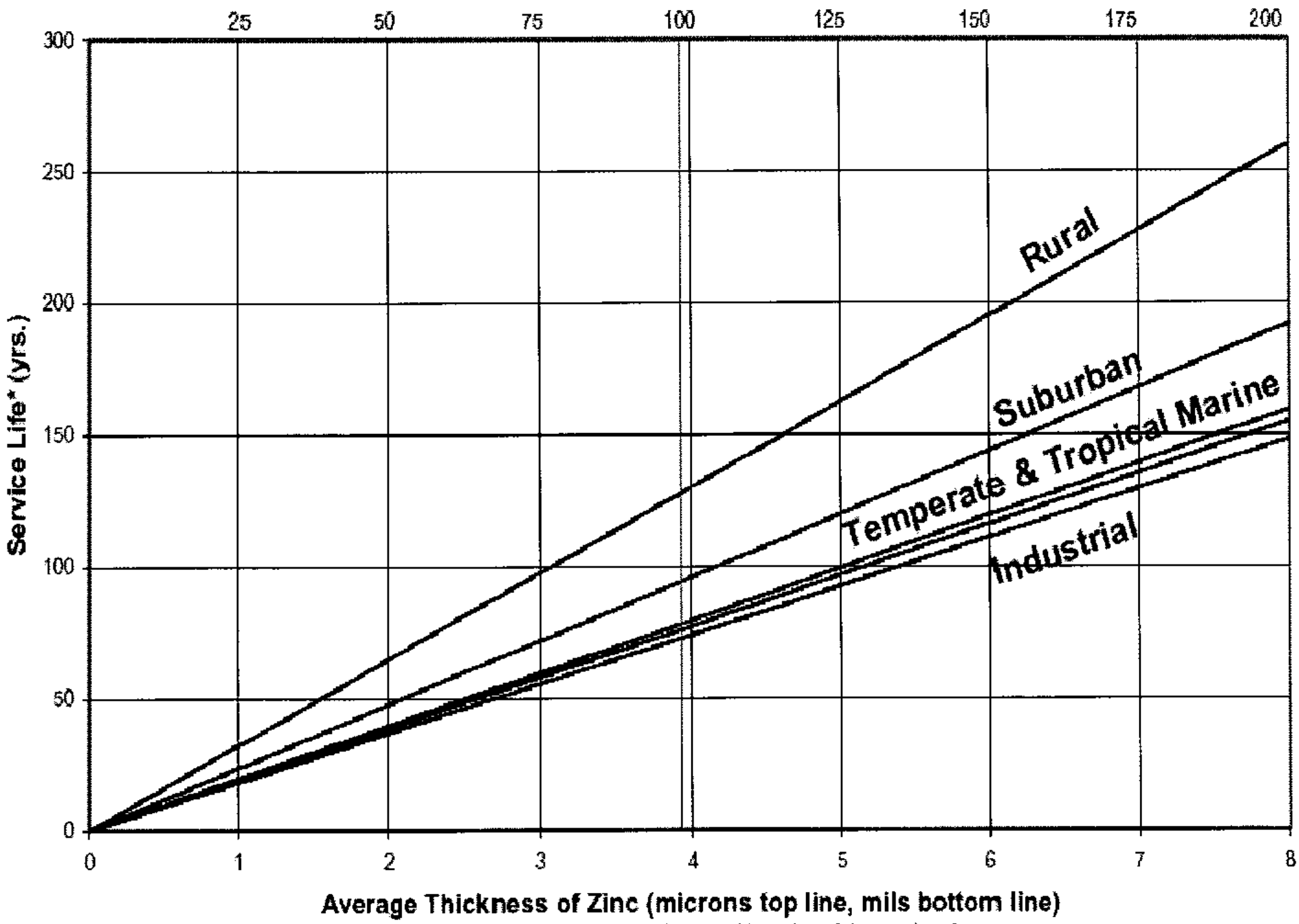
North American Galvanizing Company CORPORATE HEADQUARTERS: 5314 South Yale, Suite 1000, Tulsa, OK 74135, (918)488-9420, Fax: (918)488-8172

North American Galvanizing Company

New Service-Life Predictor Chart for Hot Dip Galvanized Steel

Service Life Chart for Hot-Dip Galvanized Coatings

Derived from The Zinc Coating Life Predictor



*Service Life is defined as the time to 5% rusting of the steel surface

Note: 1 oz./ft^2 ~ 1.8 mils

Note: 3.9 mils of zinc coating is the minimum average thickness for 1/4" structural steel per ASTM A123-01, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron & Steel Products

Source: American Galvanizers Association - American Galvanizer Publication April 2002.

INFRASHIELD℠ TECHNICAL DATA

North American Galvanizing Company

POLYURETHANE PROTECTIVE LINING AND COATING

INFRASHIELD℠ coating is a multi-part polymer coating application system designed to be applied in conjunction with hot dip galvanizing. INFRASHIELD℠ coating application technology allows specialty designed polymer coatings to be applied to galvanized surfaces resulting in superior corrosion protection offered by combining cathodic protection with a non-conductive coating.

INFRASHIELD℠ coating technology expands the range of use and effectiveness for a variety of dependable polymer coatings. The fast cure time and one coat application allow for consistent coating quality with virtually unlimited film build. These products offer reliable flexibility and are impact, chemical and abrasion resistant. Typical uses can range from direct soil contact structural components, fresh water and waste water treatment and transportation, hazardous waste storage, chemical processing, power generation and many other applications that have unique corrosion issues.

TECHNICAL INFORMATION

PROPERTY	TEST DESCRIPTION	RESULTS
Application Temperatures	N/A	-40° C(-40° F) to 65° C(150° F)
Curing Time Before Handling	@ 20° C/70° F	10 - 120 minutes
Curing Time Before Immersion	@ 20° C/70° F	48 hours
Ultimate Cure	@ 20° C/70° F	2 - 5 days
Recoat Time	@ 20° C/70° F	1 to 6 hours
Solids Content	ASTM D-1259	99+/-1%
Abrasion Resistance	ASTM D-4060 (Taper CS-17)	80 mg @ 1 kg per 1000 cycles
Permeability	ASTM E-968 (15 mils)	0.002 perm inches
Adhesion to steel	ASTM D-4541	(SSPC 5) Greater than 1500 p.s.i.
Hardness	ASTM D-2240	Shore D 70+/-5
Flexibility	ASTM D-412	180° over 1" mandrel
Resistance to Cathodic	ASTM G-8 -72(STP, 28 days)	Excellent, less than 10 mm radius
Disbondment	ASTM G-8- 72(650 C,28 days)	Excellent, 20 mm radius.
Impact Resistance	ASTM G-2794 (20 mils)	40 in. lbs.
Chemical Resistance	ASTM D-543	Excellent
Ultraviolet Resistance	ASTM G-53	Excellent * Consult Company
Service Temperature	ASTM D-870, ASTM D-2485	-40° C(-40° F) to 90° C(195° F)
Colors	N/A	Consult Company

NORTH AMERICAN GALVANIZING LOCATIONS

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Houston, TX
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D/FW, Texas
817.268.2414

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Nashville, TN
615.297.9581

St. Louis, MO
314.993.1562

Kansas City, MO
816.241.4300

Tulsa, OK
918.584.0304

www.nagalv.com

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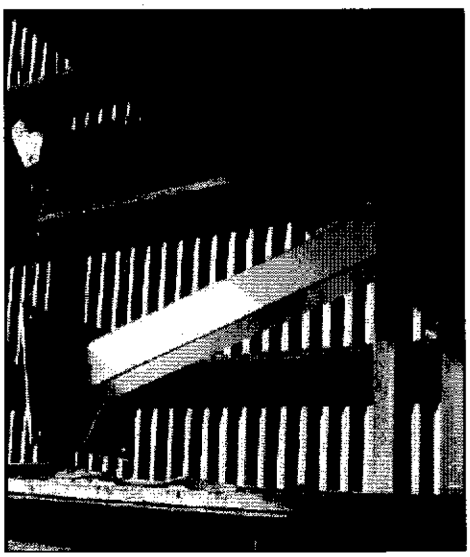
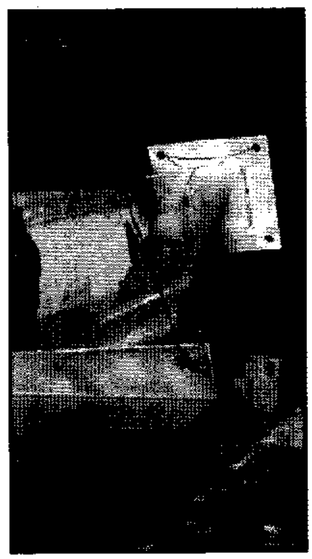
North American Galvanizing Company

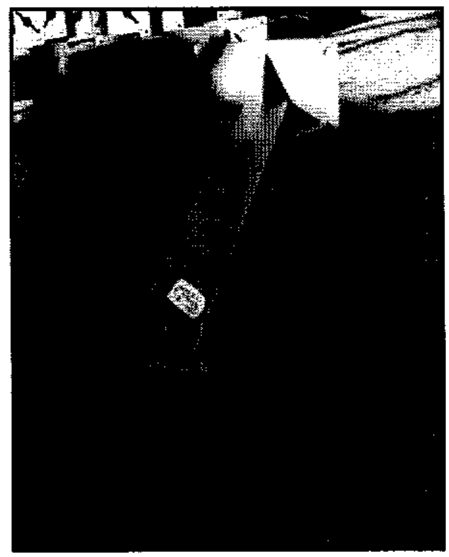
Profile your galvanizing without removing protection!

Ask for chemical etch, for secondary coatings!

North American Galvanizing Company offers chemical etching for secondary coatings







Today's budgets just don't seem to include the critical maintenance dollars needed to maintain our existing (painted only) exposed steel structures. Secondary coatings over hot dip galvanizing are becoming much more popular as life cycle cost calculations on exposed steel structures are demanding the corrosion protection advantages of hot dip galvanizing, along with color coat options to meet aesthetic preferences.

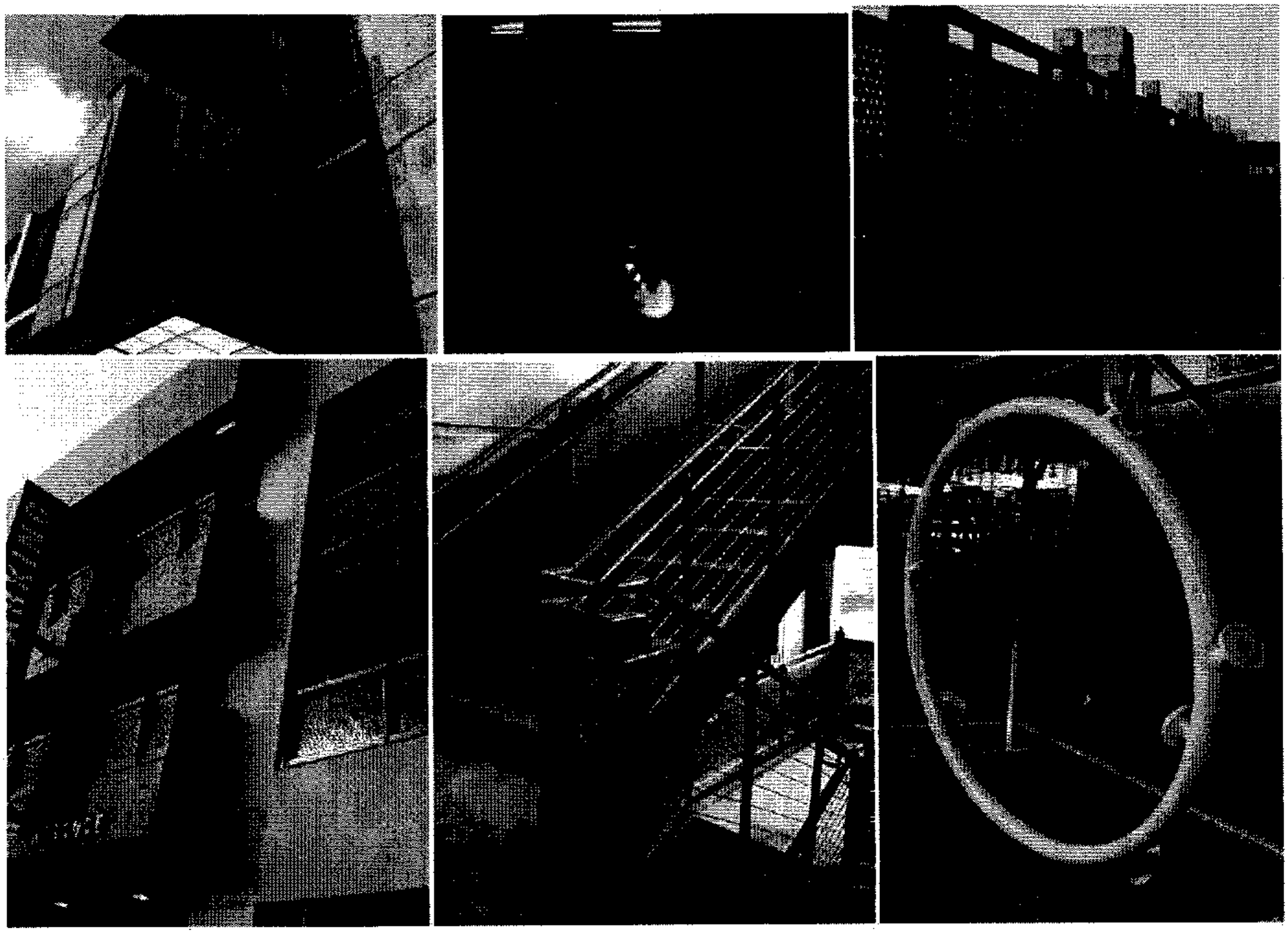
Hot Dip Galvanizing provides both barrier and cathodic protection to all internal as well as external surfaces, slowly sacrificing itself to protect the underlying steel, providing protection that can well exceed 100 years (depending on environment and application conditions).

Sweep blasting of the galvanized coating does provide an adequate surface for secondary coatings, however, at the expense of precious coating thickness, thus reducing the total service life of the galvanized coating.

Now you can have it all, without compromising the galvanized protection. North American Galvanizing Company provides a chemically profiled surface, without affecting the corrosion resistant properties, nor the thickness of the original hot dip galvanized coating.

At NAGC Denver, newly hot dip galvanized material is immersed (see above photos) in a specially formulated, heated zinc phosphate treatment for a period of 3-6 minutes. As described in ASTM D6386 *Standard practice for preparation of zinc -(hot dip galvanized) coated surfaces for painting*, through this chemical process, the smooth zinc surface is converted to a dull crystalline phosphate coating.

The resulting anchor surface profile typically exceeds 2.0 mils, providing an excellent surface for secondary coating adhesion as was performed on the following structures.



Important: As described in ASTM D6386, the zinc phosphate treated material must be washed with clean water and allowed to dry completely prior to applying the secondary coating.

Always select secondary coatings that are compatible with hot dip galvanizing.

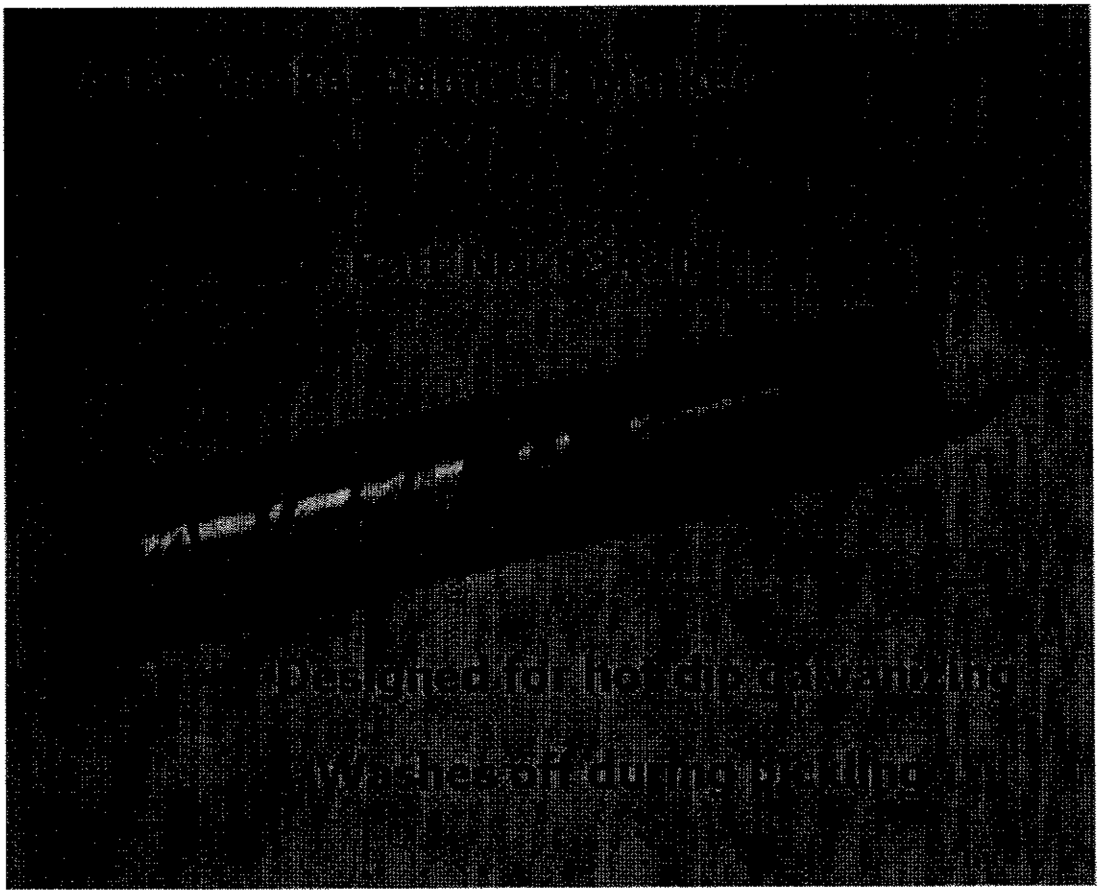
Due to newly galvanized coatings being in a constant state of change, application of secondary coatings should take place within 48-72 hours (Colorado environment) from the time the material is chemically etched and before the formation of zinc oxides. Other environments may require a tighter timeline.

This process, currently available in Denver (only), is the same process that North American Galvanizing Company has provided for 15 years to effectively profile (etch) hot dip galvanized surfaces, in preparation for secondary coatings or systems. Please contact North American Galvanizing for all your hot dip galvanizing and other corrosion protective coating requirements.

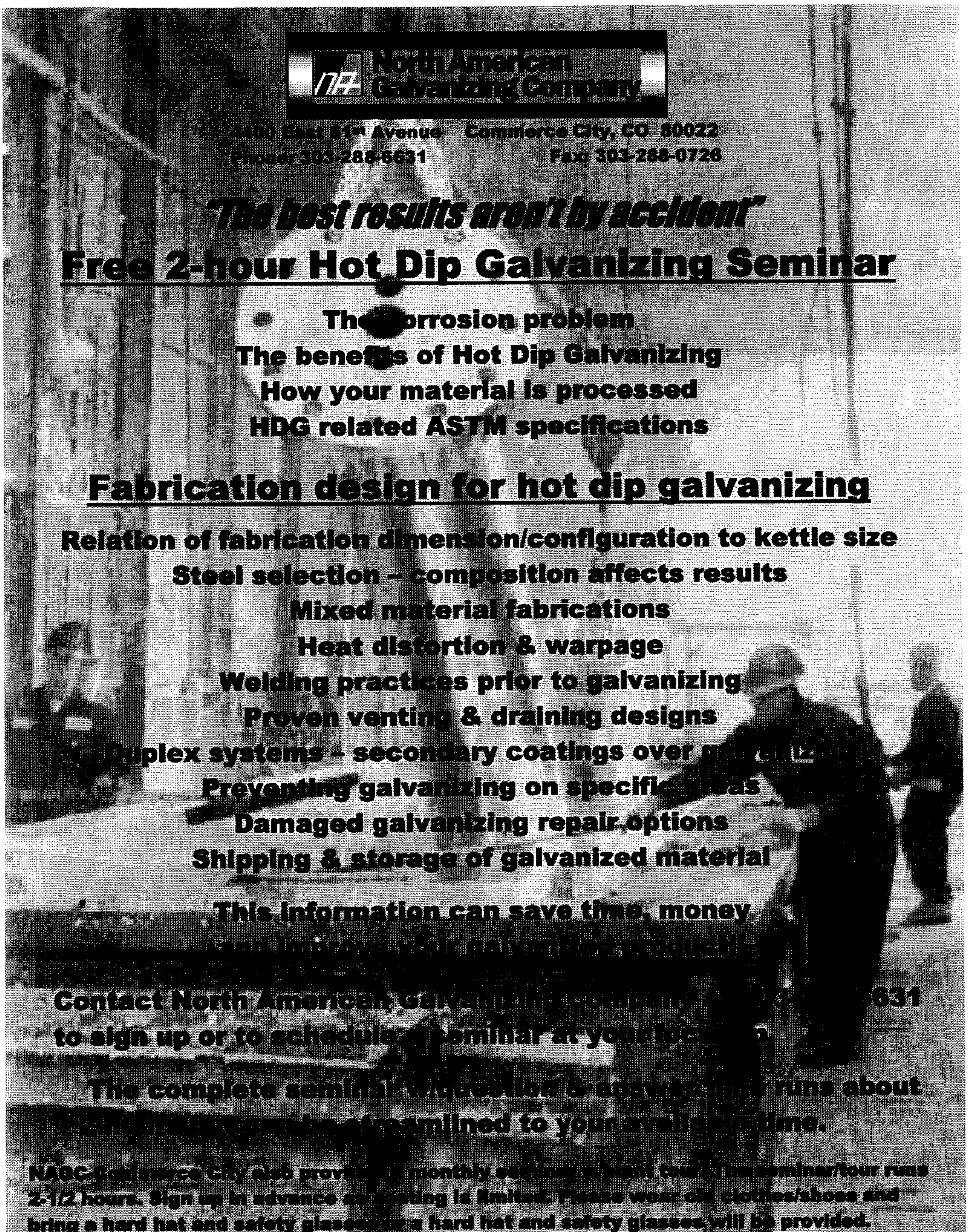
Other NAGC Plant Locations / Kettle Sizes (length, width, depth)

CANTON, OH 52'Lx6'4"Wx8'6"D & 16'Lx4'6"Wx5'6"D PHONE: 330-477-4800	HURST, TX (DFW) 42'L x 6'6"W x 7'6"D PHONE: 817-268-2414	HOUSTON, TX 62'L x 8'W x 10'D PHONE: 832-467-3772	KANSAS CITY, MO 30'L x 4'6"W x 5'6"D PHONE: 816-241-4300	LOUISVILLE, KY 42'L x 5'W x 6'D PHONE: 502-367-6145
NASHVILLE, TN 51'L x 6'5"W x 8'5"D PHONE: 615-297-9581	ST. LOUIS, MO 51'L x 7'3"W x 10'D PHONE: 314-993-1562	TULSA, OK #1 56'L x5'3"W x 7'D PHONE: 918-584-0303	TULSA , OK #2 43'L x 6'6"-4'6"(taper)W x -6'6"D PHONE:	REINFORCING SVCS 36'6"L x 4'2"W x 6'D PHONE: 918-379-0090

NAGC approved marking pen



Pen # 83420 <u>ONLY</u>



North American Galvanizing Company

4400 East 51st Avenue Commerce City, CO 80022
Phone: 303-288-6631 Fax: 303-288-0726

"The best results aren't by accident"

Free 2-hour Hot Dip Galvanizing Seminar

The corrosion problem
The benefits of Hot Dip Galvanizing
How your material is processed
HDG related ASTM specifications

Fabrication design for hot dip galvanizing

Relation of fabrication dimension/configuration to kettle size
Steel selection – composition affects results
Mixed material fabrications
Heat distortion & warpage
Welding practices prior to galvanizing
Proven venting & draining designs
Duplex systems – secondary coatings over galvanizing
Preventing galvanizing on specific areas
Damaged galvanizing repair options
Shipping & storage of galvanized material

This information can save time, money
and improve your galvanized product.

Contact North American Galvanizing Company at 303-288-6631
to sign up or to schedule a seminar at your location.

The complete seminar w/question & answer time runs about
2 hours and can be streamlined to your available time.

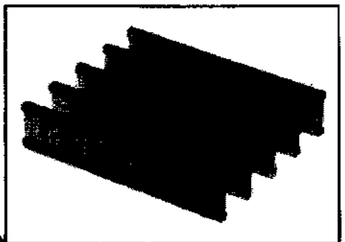
NAGC-Commerce City also provides a monthly seminar w/plant tour. The seminar/tour runs 2-1/2 hours. Sign up in advance as seating is limited. Please wear old clothes/shoes and bring a hard hat and safety glasses or a hard hat and safety glasses will be provided.

ALUMINUM GRATING

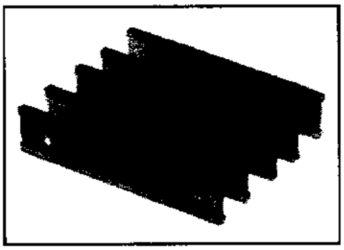
DREXEL SUPPLY CO.

I-BAR SWAGE-LOCKED

1-3/16" Center to Center of Bearing Bars



19-SI-4
Cross Rods 4" C/C



~~19-SI-2~~
~~Cross Rods 2" C/C~~

LOAD & DEFLECTION TABLE

SPAN (Length of Bearing Bar)

Bar Size	Symbol	Approx Weight psf	Sec Mod Per Ft. of Width		2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	8'-0"	9'-0"
1" x 1/4"	19-4-44	2.00	0.316	U	632	404	281	206	158	125							
				D	0.144	0.225	0.324	0.441	0.576	0.729							
	19-2-44	2.30		C	632	505	421	361	316	281							
				D	0.115	0.180	0.259	0.353	0.461	0.583							
1-1/4" x 1/4"	19-4-54	2.38	0.493	U	987	632	439	322	247	195	158						
				D	0.115	0.180	0.259	0.353	0.461	0.583	0.720						
	19-2-54	2.68		C	987	789	658	564	493	439	395						
				D	0.092	0.144	0.207	0.282	0.369	0.467	0.576						
1-1/2" x 1/4"	19-4-64	2.74	0.711	U	1421	909	632	464	355	281	227	188					
				D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726					
	19-2-64	3.04		C	1421	1137	947	812	711	632	568	517					
				D	0.077	0.120	0.173	0.235	0.307	0.389	0.480	0.581					
1-3/4" x 1/4"	19-4-74	3.09	0.967	U	1934	1238	860	632	484	382	309	256	215	183			
				D	0.082	0.129	0.185	0.252	0.329	0.417	0.514	0.622	0.741	0.869			
	19-2-74	3.39		C	1934	1547	1289	1105	967	860	774	703	645	595			
				D	0.066	0.103	0.148	0.202	0.263	0.333	0.411	0.498	0.592	0.695			
2" x 1/4"	19-4-84	3.49	1.263	U	2526	1617	1123	825	632	499	404	334	281	239	206		
				D	0.072	0.113	0.162	0.221	0.288	0.365	0.450	0.545	0.648	0.761	0.882		
	19-2-84	3.79		C	2526	2021	1684	1444	1263	1123	1011	919	842	777	722		
				D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706		
2-1/4" x 1/4"	19-4-94	3.89	1.599	U	3197	2046	1421	1044	799	632	512	423	355	303	261	200	
				D	0.064	0.100	0.144	0.196	0.256	0.324	0.400	0.484	0.576	0.676	0.784	1.024	
	19-2-94	4.14		C	3197	2558	2132	1827	1599	1421	1279	1163	1066	984	914	799	
				D	0.051	0.080	0.115	0.157	0.205	0.259	0.320	0.387	0.461	0.541	0.627	0.819	
2-1/2" x 1/4"	19-4-104	4.23	1.974	U	3947	2526	1754	1289	987	780	632	522	439	374	322	247	195
				D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706	0.922	1.166
	19-2-104	4.53		C	3947	3158	2632	2256	1974	1754	1579	1435	1316	1215	1128	987	877
				D	0.046	0.072	0.104	0.141	0.184	0.233	0.288	0.348	0.415	0.487	0.564	0.737	0.933

U = safe uniform load, psf
C = safe concentrated load, plw
D = deflection, inches
E = modulus of elasticity, 10,000,000 psi
F = fiber stress, 12,000 psi

Material: ASTM B-221, 6063 or 6061

Deflection: Spans and loads to the right of the bold line exceed 1/4" deflection for uniform load of 100 psf which provides safe pedestrian comfort. These can be exceeded for other types of loads with engineer's approval.

General: Loads and deflections are theoretical and based on static loading.

Finish: Mill finish unless otherwise specified.

SI-19 PANEL WIDTH (inches)

Note: Includes 1/4" (1/8" each side) for extended cross rods on swage-locked (SI).

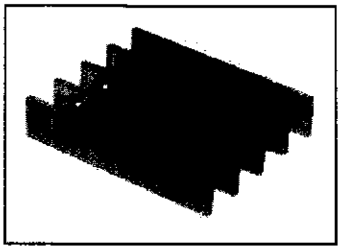
No. of Bars	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1/4" Bar	1 11/16	2 7/8	4 1/16	5 1/4	6 7/16	7 5/8	8 13/16	10	11 3/16	12 3/8	13 9/16	14 3/4	15 15/16	17 1/8	18 5/16	19 1/2	20 11/16	21 7/8	23 1/16

No. of Bars	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
1/4" Bar	24 1/4	25 7/16	26 5/8	27 13/16	29	30 3/16	31 3/8	32 9/16	33 3/4	34 15/16	36 1/8

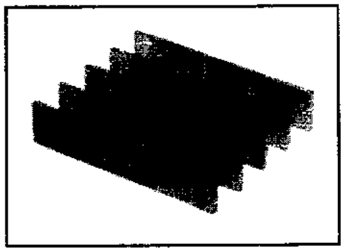
ALUMINUM GRATING

RECTANGULAR BAR SWAGE-LOCKED

1-3/16" Center to Center of Bearing Bars



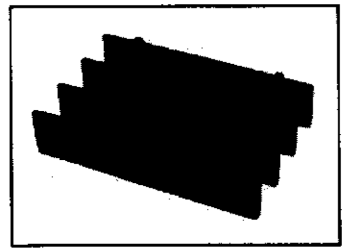
19-SR-4
Cross Rods 4" C/C



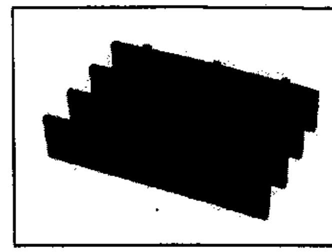
19-SR-2
Cross Rods 2" C/C

PRESS-LOCKED

1-3/16" Center to Center of Bearing Bars



19-AP-4
Cross Rods 4" C/C



19-AP-2
Cross Rods 2" C/C

LOAD & DEFLECTION TABLE

Bar Size	Symbol		Approx Weight psf	Sec Mod Per Ft of Width		SPAN (Length of Bearing Bar) 2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	8'-0"	9'-0"
3/4" x 1/8"	19-4-32	SR	1.5	0.118	U	237	152	105	77									
		AP	1.5		D	0.192	0.300	0.432	0.588									
	19-2-32	SR	1.8		C	237	189	158	135									
		AP	1.8		D	0.154	0.240	0.346	0.470									
3/4" x 3/16"	19-4-33	SR	2.1	0.178	U	355	227	158	116									
		AP	2.3		D	0.192	0.300	0.432	0.588									
	19-2-33	SR	2.4		C	355	284	237	203									
		AP	2.8		D	0.154	0.240	0.346	0.470									
1" x 1/8"	19-4-42	SR	1.9	0.211	U	421	269	187	137	105								
		AP	1.9		D	0.144	0.225	0.324	0.441	0.576								
	19-2-42	SR	2.2		C	421	337	281	241	211								
		AP	2.2		D	0.115	0.180	0.259	0.353	0.461								
1" x 3/16"	19-4-43	SR	2.7	0.316	U	632	404	281	206	158	125							
		AP	2.8		D	0.144	0.225	0.324	0.441	0.576	0.729							
	19-2-43	SR	3.0		C	632	505	421	361	316	281							
		AP	3.3		D	0.115	0.180	0.259	0.353	0.461	0.583							
1-1/4" x 1/8"	19-4-52	SR	2.3	0.329	U	658	421	292	215	164	130							
		AP	2.4		D	0.115	0.180	0.259	0.353	0.461	0.583							
	19-2-52	SR	2.6		C	658	526	439	376	329	292							
		AP	2.8		D	0.092	0.144	0.207	0.282	0.369	0.467							
1-1/4" x 3/16"	19-4-53	SR	3.2	0.493	U	987	632	439	322	247	195	158						
		AP	3.6		D	0.115	0.180	0.259	0.353	0.461	0.583	0.720						
	19-2-53	SR	3.6		C	987	789	658	564	493	439	395						
		AP	4.3		D	0.092	0.144	0.207	0.282	0.369	0.467	0.576						
1-1/2" x 1/8"	19-4-62	SR	2.7	0.474	U	947	606	421	309	237	187	152						
		AP	2.8		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600						
	19-2-62	SR	3.0		C	947	758	632	541	474	421	379						
		AP	3.2		D	0.077	0.120	0.173	0.235	0.307	0.389	0.480						
1-1/2" x 3/16"	19-4-63	SR	3.8	0.711	U	1421	909	632	464	355	281	227	188					
		AP	4.2		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726					
	19-2-63	SR	4.1		C	1421	1137	947	812	711	632	568	517					
		AP	4.8		D	0.077	0.120	0.173	0.235	0.307	0.389	0.480	0.581					
1-3/4" x 3/16"	19-4-73	SR	4.4	0.967	U	1934	1238	860	632	484	382	309	256	215	183			
		AP	4.8		D	0.082	0.129	0.185	0.252	0.329	0.417	0.514	0.622	0.741	0.869			
	19-2-73	SR	4.7		C	1934	1547	1289	1105	967	860	774	703	645	595			
		AP	5.4		D	0.066	0.103	0.148	0.202	0.263	0.333	0.411	0.498	0.592	0.695			
2" x 3/16"	19-4-83	SR	5.0	1.263	U	2526	1617	1123	825	632	499	404	334	281	239	206		
		AP	5.3		D	0.072	0.113	0.162	0.221	0.288	0.365	0.450	0.545	0.648	0.761	0.882		
	19-2-83	SR	5.3		C	2526	2021	1684	1444	1263	1123	1011	919	842	777	722		
		AP	6.0		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706		
2-1/4" x 3/16"	19-4-93	SR	5.6	1.599	U	3197	2046	1421	1044	799	632	512	423	355	303	261	200	
		AP	5.9		D	0.064	0.100	0.144	0.196	0.256	0.324	0.400	0.484	0.576	0.676	0.784	1.024	
	19-2-93	SR	5.9		C	3197	2558	2132	1827	1599	1421	1279	1163	1066	984	914	799	
		AP	6.6		D	0.051	0.080	0.115	0.157	0.205	0.259	0.320	0.387	0.461	0.541	0.627	0.819	
2-1/2" x 3/16"	19-4-103	SR	6.2	1.974	U	3947	2526	1754	1289	987	780	632	522	439	374	322	247	195
		AP	6.5		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706	0.922	1.166
	19-2-103	SR	6.5		C	3947	3158	2632	2256	1974	1754	1579	1435	1316	1215	1128	987	877
		AP	7.2		D	0.046	0.072	0.104	0.141	0.184	0.233	0.288	0.348	0.415	0.487	0.564	0.737	0.933

U = safe uniform load, psf
C = safe concentrated load, plw
D = deflection, inches
E = modulus of elasticity, 10,000,000 psi
F = fiber stress, 12,000 psi

Material: ASTM B-221, 6063 or 6061

Deflection: Spans and loads to the right of the bold line exceed 1/4" deflection for uniform load of 100 psf which provides safe pedestrian comfort. These can be exceeded for other types of loads with engineer's approval.

Serrated Bars: For serrated grating, the depth of grating required for a specified load is 1/4" deeper than that shown in the table.

General: Loads and deflections are theoretical and based on static loading.

Finish: Mill finish unless otherwise specified.

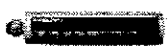
SR/AP-19 PANEL WIDTH (inches)

Note: Includes 1/4" (1/8" each side) for extended cross rods on swage-locked (SR) and extended cross bars on press-locked (AP)

No. of Bars	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1/8" Bar	1 9/16	2 3/4	3 15/16	5 1/8	6 5/16	7 1/2	8 11/16	9 7/8	11 1/16	12 1/4	13 7/16	14 5/8	15 13/16	17	18 3/16
3/16" Bar	1 5/8	2 13/16	4	5 3/16	6 3/8	7 9/16	8 3/4	9 15/16	11 1/8	12 5/16	13 1/2	14 11/16	15 7/8	17 1/16	18 1/4
No. of Bars	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
1/8" Bar	19 3/8	20 9/16	21 3/4	22 15/16	24 1/8	25 5/16	26 1/2	27 11/16	28 7/8	30 1/16	31 1/4	32 7/16	33 5/8	34 13/16	36
3/16" Bar	19 7/16	20 5/8	21 13/16	23	24 3/16	25 3/8	26 9/16	27 3/4	28 15/16	30 1/8	31 5/16	32 1/2	33 11/16	34 7/8	36 1/16

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

4.2.5 HIT-ICE/HIT-HY 150



HIT-ICE Cartridge

HIT-HY 150 Refill Pack

Listings/Approvals

ICC-ES (International Code Council)
ER-5193 (HIT-HY 150 only)

City of Los Angeles
Research Report # 25257
(HIT-HY 150 only)

NSF/ANSI Standard 61
Certification for use of HIT-HY 150 in potable water

Metro-Dade County
Approval 06-1127.06
(HIT-HY 150 only)

Europan Technical Approval
(HIT-HY 150 only)
ETA-05/0049
ETA-05/0050
ETA-05/0051

Code Compliance

IBC®/IRC® 2000 (ICC-ES AC58, HIT-HY 150 only)

UBC® 1997 (ICC-ES AC58, HIT-HY 150 only)

LEED®: Credit 4.1-Low Emitting Materials

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating system™ is the nationally accepted benchmark for the design, construction and operation of high performance green buildings.

4.2.5.1 Product Description

Hilti HIT-HY 150 is a hybrid adhesive consisting of a methacrylate resin, hardener, cement and water. It is formulated for fast curing and installation in a wide range of solid base material temperatures from 104°F (40°C) down to 23°F (–5°C). For colder environmental installations, HIT-ICE adhesive is a winter formulation of for base material temperatures down to –10°F (–23°C). HIT-ICE consists of an epoxy acrylate and hardener.

The systems consist of adhesive refill packs, a mixing nozzle, a HIT dispenser and either a threaded rod, rebar, HIS internally threaded insert or eyebolts. HIT-ICE/HY 150 is specifically designed for fastening into solid base materials such as concrete, grout, stone or grout filled block.

The Hilti HIT-TZ is an innovative threaded rod installed with HIT-HY 150 hybrid adhesive or HIT-ICE. Please refer to section 4.2.3 for details on HIT-TZ. With the combination of HIT-ICE/HY 150 and the innovative design of the HIT-TZ rod, anchoring into uncleaned holes, wet holes (including standing water) and/or Hilti matched tolerance diamond-cored holes does not adversely affect tensile capacity. **Use HIT-ICE in base material temperatures below 40° F (5° C).**

Product Features of HIT-ICE/HY 150

- Small edge distance and anchor spacing allowance
- Mixing tube provides proper mixing and accurate dispensing of mixed resin
- Contains no styrene; virtually odorless
- Cures quickly over a large range of base material temperatures
- Excellent weathering resistance; high temperature resistance
- High load capacities
- HIT-ICE has equivalent load performance to HIT-HY 150
- Seismic qualified per IBC®/IRC® 2000 and UBC® 1997 (ICC-ES AC58). HIT-HY 150 only. Please refer to ER-5193

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

Guide Specifications

Master Format Section:
03250 (Concrete accessories)
Related Sections:
03200 (Concrete Reinforcing)
05050 (Metal Fabrication)
05120 (Structural Steel; Masonry Accessories)

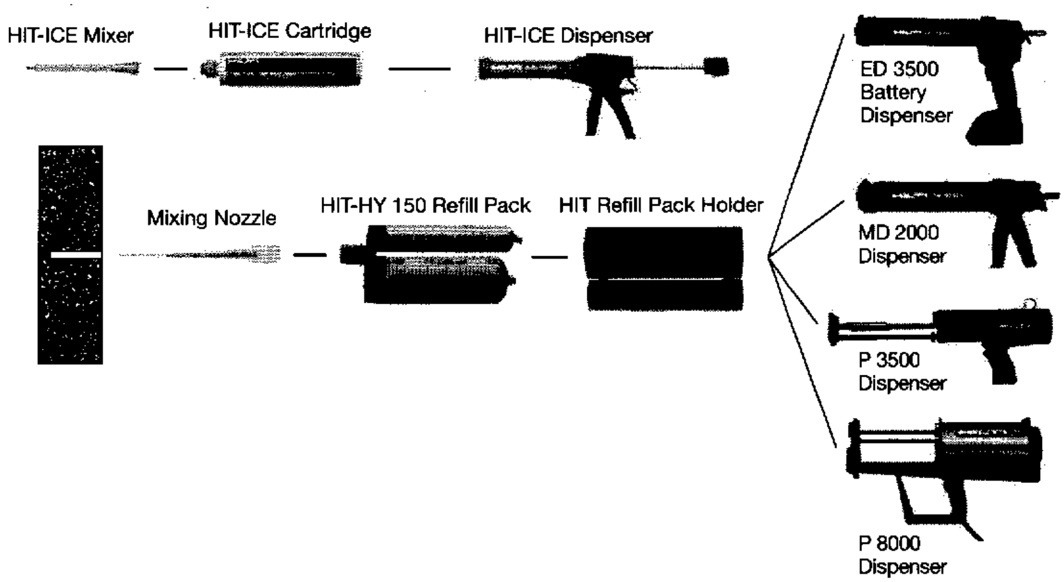
Injectable adhesive shall be used for installation of all reinforcing steel dowels or threaded anchor rods and inserts into new or existing concrete. Adhesive shall be furnished in containers which keep component A and component B separate. Containers shall be designed to accept static mixing nozzle which thoroughly blends component A and component B and allows injection directly into drilled hole. Only injection tools and static mixing nozzles as recommended by manufacturer shall be used. Manufacturer's instructions shall be followed. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness. Typical curing time at 68°F shall be 50 minutes for HIT-HY 150 and 1 hour for HIT-ICE. Injection adhesive shall be HIT-HY 150 or HIT-ICE, as furnished by Hilti.

Anchor Rods shall be furnished with chamfered ends so that either end will accept a nut and washer. Alternatively, anchor rods shall be furnished with a 45 degree chisel point on one end to allow for easy insertion into the adhesive-filled hole. Anchor rods shall be manufactured to meet the following requirements: **1.** ISO 898 Class 5.8 **2.** ASTM A 193, Grade B7 (high strength carbon steel anchor); **3.** AISI 304 or AISI 316 stainless steel, meeting the requirements of ASTM F 593 (condition CW).

Special order length HAS Rods may vary from standard product.

Nuts and Washers shall be furnished to meet the requirements of the above anchor rod specifications.

Fastener Components



4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

4.2.5.2 Material Specifications

Material Properties for Cured Adhesive	HIT-HY 150		HIT-ICE	
Compressive Strength ASTM C 579 (HIT-HY 150) DIN 53454 (HIT-ICE)	71.8 MPa	10,420 psi	72 MPa	10,440 psi
Tensile Strength ASTM C 307 (HY 150) DIN/EN 527-1 (HIT-ICE)	15.9 MPa	2310 psi	12 MPa	1740 psi
Flexural Strength ASTM C 580	29.3 MPa	4250 psi	—	—
Modulus of Elasticity ASTM C 307	7032 MPa	1.02×10^6 psi	—	—
Water Absorption ASTM D 570 (HIT-HY 150) DIN 53495 (HIT-ICE)	0.12%	0.12%	2.4%	2.4%
Electrical Resistance DIN/VDE 0303T3 (HIT-HY 150) DIN/VDE 0303T3 (HIT-ICE)	$2x10^{11}$ OHM/cm	$5.1x10^{11}$ OHM/in.	$2x10^{11}$ OHM/in.	$5.1x10^{11}$ OHM/in.

Material

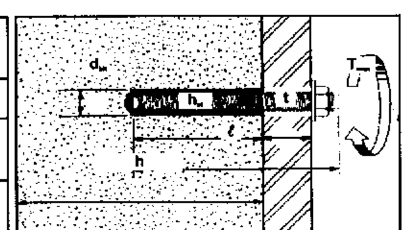
Material	Mechanical Properties f_y ksi (MPa)	min. f_u ksi (MPa)
Standard HAS-E rod material meets the requirements of ISO 898 Class 5.8	58 (400)	72.5 (500)
High Strength or 'Super HAS' rod material meets the requirements of ASTM A 193, Grade B7	105 (724)	125 (862)
Stainless HAS rod material meets the requirements of ASTM F 593 (AISI 304/316) Condition CW 3/8" to 5/8"	65 (448)	100 (689)
Stainless HAS rod material meets the requirements of ASTM F 593 (AISI 304/316) Condition CW 3/4" to 1-1/4"	45 (310)	85 (586)
HIS Insert 11MnPb30+C Carbon Steel conforming to DIN 10277-3	54.4 (375)	66.7 (460)
HIS-R Insert X5CrNiMo17122 K700 Stainless Steel conforming to DIN EN 10088-3	50.8 (350)	101.5 (700)
HAS Super & HAS-E Standard Nut material meets the requirements of ASTM A 563, Grade DH		
HAS Stainless Steel Nut material meets the requirements of ASTM F 594		
HAS Standard and Stainless Steel Washers meet dimensional requirements of ANSI B18.22.1 Type A Plain		
HAS Stainless Steel Washers meet the requirements of AISI 304 or AISI 316 conforming to ASTM A 240		
HAS Super & HAS-E Standard Washers meet the requirements of ASTM F 436		
All HAS Super Rods (except 7/8") & HAS-E Standard, HIS inserts, nuts & washers are zinc plated to ASTM B 633 SC 1		
7/8" HAS Super rods hot-dip galvanized in accordance with ASTM A 153		

Note: Special Order threaded rods may vary from standard materials.

4.2.5.3 Technical Data

HIT-ICE/HIT-HY 150 Installation Specification Table for HAS Rods

Details \ HAS Rod Size			in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)	1 (25.4)	1-1/4 (31.8)
d_{bit} bit diameter[1]			in.	7/16	9/16	11/16	13/16	15/16	1-1/16	1-1/2
$h_{ef} = h_{nom}$ std. depth of embed.[2]			in. (mm)	3-1/2 (90)	4-1/4 (110)	5 (125)	6-5/8 (170)	7-1/2 (190)	8-1/4 (210)	12 (305)
T_{max} max. tighening torque	All HILTI Threaded Rods	$h_{ef} \geq h_{nom}$	ft lb (Nm)	18 (24)	30 (41)	75 (102)	150 (203)	175 (237)	235 (319)	400 (540)
		$h_{ef} < h_{nom}$	ft lb (Nm)	15 (20)	20 (27)	50 (68)	105 (142)	125 (169)	165 (224)	280 (375)
h minimum base material thickness[3]		$h_{ef} = h_{nom}$	in. (mm)	5-1/2 (140)	6-1/4 (160)	7 (180)	8-5/8 (220)	9-1/2 (240)	10-1/2 (270)	15 (380)
		$h_{ef} \neq h_{nom}$	in. (mm)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2-1/4 (57)	1.0 hef+ 3 (76)
Approximate number of fastenings at standard embedment										
HIT-ICE/HIT-HY 150 Small Refill Pack				45/50	28/31	16/18	9/10	7/8	5/6	2/2
HIT-HY 150 Jumbo Cartridge				236	145	85	45	38	29	7



1 Use Hilti matched tolerance carbide tipped bits.

2 Data available for varying embedments; see Load Tables.

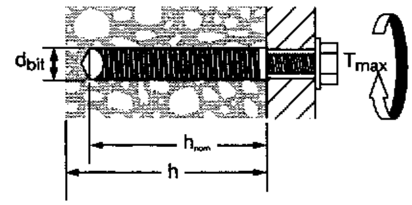
3 Minimum base material thickness given to avoid backside blowout during drilling process. Ability of base material to withstand loads applied (e.g. bending of concrete slab) should be determined by design engineer.

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

HIT-ICE/HIT-HY 150 Installation Specification Table for HIS Inserts

Details / HIS Insert		in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
d_{bit}	bit diameter[1]	in.	**11/16**	**7/8**	**1-1/8**	**1-1/4**
h_{nom}	std. depth of embed.	in. (mm)	**4-1/4** (110)	**5** (125)	**6-5/8** (170)	**8-1/4** (210)
ℓ_{th}	useable thread length	in. (mm)	**1** (25)	**1-3/16** (30)	**1-1/2** (40)	**2** (50)
T_{max}	Max. tightening torque	ft-lb (Nm)	**18** (24)	**35** (47)	**80** (108)	**160** (217)
h	min. base material thickness	in. (mm)	**6-3/8** (162)	**7-1/2** (191)	**10** (254)	**12-3/8** (314)
Recommended Hilti Rotary Hammer Drill			TE 6, 16, 25, 35	TE 16, 25, 35, 46,	TE 46, 56 76	

1 Hilti matched tolerance carbide tipped drill bits



HIT-ICE/HIT-HY 150 Installation Specification Table for Rebar in Concrete

Details / Rebar Size:			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
d_{bit}:	bit diameter[1,2]	in.	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-5/8

1 Rebar diameters may vary. Use smallest drill bit which will accommodate rebar.

2 Hilti matched tolerance carbide tipped drill bits

HIT-ICE/HIT-HY 150 Installation Specification Table for Metric Rebar in Concrete (Canada Only)

Rebar Number :	10M	15M	20M	25M	30M	35M
d_{bit} : bit diameter[1,2]	14 mm	3/4"	24mm	1-1/8"	37mm	1-9/16"

1 Rebar diameters may vary. Use smallest drill bit which will accommodate rebar.

2 Hilti matched tolerance carbide tipped drill bits

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \text{ (Ref. Section 4.1.8.3)}$$

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

HIT-ICE/HIT-HY 150 Allowable and Ultimate Bond/Concrete Capacity for HAS Rods in Normal-Weight Concrete[1,2,3]

Anchor Diameter in (mm)	Embedment Depth in (mm)	HIT-ICE/HIT-HY 150 Allowable Bond/Concrete Capacity				HIT-ICE/HIT-HY 150 Ultimate Bond/Concrete Capacity			
		Tensile		Shear		Tensile		Shear	
		f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)
3/8 (9.5)	1-3/4 (44)	720 (3.2)	1265 (5.6)	1395 (6.2)	1970 (8.8)	2710 (12.1)	4750 (21.1)	4175 (18.6)	5900 (26.2)
	3-1/2 (89)	1895 (8.4)	2705 (12.0)	3335 (14.8)	4715 (21.0)	7120 (31.7)	10160 (45.2)	10000 (44.5)	14140 (62.9)
	5-1/4 (133)	2635 (11.7)	2800 (12.5)	6120 (27.2)	8655 (38.5)	9880 (44.0)	10510 (46.8)	18360 (81.7)	25960 (115.5)
1/2 (12.7)	2-1/8 (54)	1220 (5.4)	1575 (7.0)	1980 (8.8)	2800 (12.5)	4580 (20.4)	5910 (26.3)	5940 (26.4)	8400 (37.4)
	4-1/4 (108)	2725 (12.1)	3935 (17.5)	5150 (22.9)	7280 (32.4)	10220 (44.5)	14760 (65.7)	15440 (68.7)	21840 (97.1)
	6-3/8 (162)	4300 (19.1)	5295 (23.6)	9455 (42.1)	13375 (59.5)	16140 (71.8)	19860 (88.3)	28360 (126.2)	40120 (178.5)
5/8 (15.9)	2-1/2 (64)	1620 (7.2)	1985 (8.8)	2460 (10.9)	3480 (15.5)	6090 (27.1)	7460 (33.2)	7380 (32.8)	10440 (46.4)
	5 (127)	4395 (19.6)	5250 (23.4)	7350 (32.7)	10390 (46.2)	16480 (73.3)	19690 (87.6)	22040 (98.0)	31160 (138.6)
	7-1/2 (191)	6025 (26.8)	8225 (36.6)	13495 (60.0)	19080 (84.9)	22595 (100.5)	30850 (137.2)	40480 (180.0)	57240 (254.6)
3/4 (19.1)	3-3/8 (86)	2365 (10.5)	3925 (17.5)	5435 (24.2)	7680 (34.2)	8870 (39.5)	14720 (65.5)	16295 (72.5)	23040 (102.5)
	6-5/8 (168)	4655 (20.7)	8885 (39.5)	12270 (54.6)	17355 (77.2)	17460 (77.7)	33330 (148.3)	36800 (163.7)	52060 (231.6)
	10 (254)	9515 (42.3)	12140 (54.0)	22755 (101.2)	32180 (143.1)	35695 (158.8)	45530 (202.5)	68260 (303.6)	96540 (429.4)
7/8 (22.2)	3-3/4 (95)	3080 (13.7)	4800 (21.4)	6705 (29.8)	9480 (42.4)	11555 (51.4)	18000 (80.1)	20105 (89.4)	28430 (126.5)
	7-1/2 (191)	7845 (34.9)	11020 (49.0)	15960 (71.0)	22575 (100.4)	29430 (130.9)	41000 (182.3)	47880 (213.0)	67720 (301.2)
	11-1/4 (286)	13330 (59.3)	16645 (74.0)	29330 (130.5)	41475 (184.5)	49990 (222.4)	62425 (277.7)	87980 (391.4)	124420 (553.4)
1 (25.4)	4-1/8 (105)	3445 (15.3)	4865 (21.6)	8265 (36.8)	11685 (52.0)	12920 (57.5)	18250 (81.2)	24790 (110.3)	35050 (155.9)
	8-1/4 (210)	8330 (37.1)	11635 (51.8)	19690 (87.6)	27840 (123.8)	31250 (139.0)	43640 (194.1)	59060 (262.7)	83520 (371.5)
	12-3/8 (314)	15540 (69.1)	19525 (86.85)	36170 (160.9)	51150 (227.5)	58280 (259.3)	73220 (325.7)	108500 (482.6)	153440 (682.5)
1-1/4 (31.8)	6 (152)	4645 (20.7)	7000 (31.1)	14760 (65.7)	20870 (92.8)	17430 (77.5)	26265 (116.8)	44280 (197.0)	62610 (278.5)
	12 (305)	15490 (68.9)	20770 (92.4)	38615 (171.8)	54610 (242.9)	58085 (258.4)	77900 (346.5)	115840 (515.3)	163820 (728.7)
	15 (381)	19210 (85.5)	26815 (119.3)	53960 (240.0)	76315 (339.5)	72040 (320.5)	100560 (447.3)	161880 (720.1)	228940 (1018.4)

1 Influence factors for spacing and/or edge distance are applied to concrete/bond values above, and then compared to the steel value. The lesser of the values is to be used for the design.

2 For $h_{ef} \geq h_{nom}$ average ultimate concrete shear capacity based on Concrete Capacity Design (CCD) method. For $h_{ef} < h_{nom}$ average ultimate concrete shear values based on testing.

3 All values based on holes drilled with carbide bit and cleaned with compressed air and a wire brush per manufacturer's instructions.

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

Allowable Steel Strength for HAS Rods[1]

Rod Diameter in. (mm)	HAS-E Standard ISO 898 Class 5.8		HAS Super ASTM A 193 B7		HAS SS AISI 304/316 SS	
	Tensile lb (kN)	Shear lb (kN)	Tensile lb (kN)	Shear lb (kN)	Tensile lb (kN)	Shear lb (kN)
3/8 (9.5)	**2640** (11.7)	**1360** (6.0)	**4555** (20.3)	**2345** (10.4)	**3645** (16.2)	**1875** (8.3)
1/2 (12.7)	**4700** (20.9)	**2420** (10.8)	**8100** (36.0)	**4170** (18.5)	**6480** (28.8)	**3335** (14.8)
5/8 (15.9)	**7340** (32.7)	**3780** (16.8)	**12655** (56.3)	**6520** (29.0)	**10125** (45.0)	**5215** (23.2)
3/4 (19.1)	**10570** (47.0)	**5445** (24.2)	**18225** (81.1)	**9390** (41.8)	**12390** (55.1)	**6385** (28.4)
7/8 (22.2)	**14385** (64.0)	**7410** (33.0)	**24805** (110.3)	**12780** (56.9)	**16865** (75.0)	**8690** (38.6)
1 (25.4)	**18790** (83.6)	**9680** (43.0)	**32400** (144.1)	**16690** (74.2)	**22030** (98.0)	**11350** (50.5)
1-1/4 (31.8)	**29360** (130.6)	**15125** (67.3)	**50620** (225.2)	**26080** (116.0)	**34425** (153.1)	**17735** (78.9)

1 Steel strength as defined in AISC Manual of Steel Construction (ASD):

Tensile = 0.33 x F_u x Nominal Area
Shear = 0.17 x F_u x Nominal Area

Ultimate Steel Strength for HAS Rods[1]

Rod Diameter in. (mm)	HAS-E Standard ISO 898 Class 5.8			HAS Super ASTM A 193 B7			HAS SS AISI 304/316 SS		
	Yield lb (kN)	Tensile lb (kN)	Shear lb (kN)	Yield lb (kN)	Tensile lb (kN)	Shear lb (kN)	Yield lb (kN)	Tensile lb (kN)	Shear lb (kN)
3/8 (9.5)	**4495** (20.0)	**6005** (26.7)	**3605** (16.0)	**8135** (36.2)	**10350** (43.4)	**6210** (27.6)	**5035** (22.4)	**8280** (36.8)	**4970** (22.1)
1/2 (12.7)	**8230** (36.6)	**10675** (47.5)	**6405** (28.5)	**14900** (66.3)	**18405** (79.0)	**11040** (49.1)	**9225** (41.0)	**14720** (65.5)	**8835** (39.3)
5/8 (15.9)	**13110** (58.3)	**16680** (74.2)	**10010** (44.5)	**23730** (105.6)	**28760** (125.7)	**17260** (76.8)	**14690** (65.3)	**23010** (102.4)	**13805** (61.4)
3/4 (19.1)	**19400** (86.3)	**24020** (106.9)	**14415** (64.1)	**35120** (156.2)	**41420** (185.7)	**24850** (110.5)	**15050** (66.9)	**28165** (125.3)	**16800** (75.2)
7/8 (22.2)	**26780** (119.1)	**32695** (145.4)	**19620** (87.3)	**48480** (215.7)	**56370** (256.9)	**33825** (150.5)	**20775** (92.4)	**38335** (170.5)	**23000** (102.3)
1 (25.4)	**35130** (156.3)	**42705** (190.0)	**25625** (114.0)	**63600** (282.9)	**73630** (337.0)	**44180** (196.5)	**27255** (121.2)	**50070** (222.7)	**30040** (133.6)
1-1/4 (31.8)	**56210** (250.0)	**66730** (296.8)	**40035** (178.1)	**101755** (452.6)	**115050** (511.8)	**69030** (307.1)	**43610** (194.0)	**78235** (348.0)	**46940** (208.8)

1 Steel strength as defined in AISC Manual of Steel Construction 2nd Ed. (LRFD):

Yield = F_y x Tensile Stress Area
Tensile = 0.75 x F_u x Nominal Area
Shear = 0.45 x F_u x Nominal Area

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

HIT-ICE/HIT-HY 150 Allowable Bond/Concrete Capacity and Steel Strength for HIS Carbon Steel and HIS-R Stainless Steel Internally Threaded Inserts

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	HIT-ICE/HIT-HY 150 Allowable Bond/Concrete Capacity		Allowable Bolt Strength[1,2]			
		Tensile f'c ≥2000 psi (13.8 MPa) lb (kN)	Shear f'c ≥2000 psi (13.8 MPa) lb (kN)	ASTM A 325 Carbon Steel		ASTM F 593 Stainless Steel	
				Tensile[1] lb (kN)	Shear[1] lb (kN)	Tensile[1] lb (kN)	Shear[1] lb (kN)
3/8 (9.5)	**4-1/4** (108)	**2750** (12.2)	**1605** (7.1)	**4370** (19.4)	**2250** (10.0)	**3645** (16.2)	**1875** (8.3)
1/2 (12.7)	**5** (127)	**4195** (18.7)	**3040** (13.5)	**7775** (34.6)	**4005** (17.8)	**6480** (28.8)	**3335** (14.8)
5/8 (15.9)	**6-5/8** (168)	**6700** (29.8)	**4575** (20.4)	**12150** (54.0)	**6260** (27.8)	**10125** (45.0)	**5215** (23.2)
3/4 (19.1)	**8-1/4** (210)	**7855** (34.9)	**6305** (28.0)	**17495** (77.8)	**9010** (40.1)	**12395** (55.1)	**6385** (28.4)

HIT-ICE/HIT-HY 150 Ultimate Bond/Concrete Capacity and Steel Strength for HIS Carbon Steel and HIS-R Stainless Steel Internally Threaded Inserts

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	HIT-ICE/HIT-HY 150 Ultimate Bond/Concrete Capacity[2]		Ultimate Bolt Strength[1,2]			
		Tensile f'c ≥2000 psi (13.8 MPa) lb (kN)	Shear f'c ≥2000 psi (13.8 MPa) lb (kN)	ASTM A 325 Carbon Steel		ASTM F 593 Stainless Steel	
				Tensile[1] lb (kN)	Shear[1] lb (kN)	Tensile[1] lb (kN)	Shear[1] lb (kN)
3/8 (9.5)	**4-1/4** (108)	**11000** (48.9)	**6425** (28.6)	**9935** (44.2)	**5960** (26.5)	**8280** (36.8)	**4970** (22.1)
1/2 (12.7)	**5** (127)	**16790** (74.7)	**12170** (54.1)	**17665** (78.6)	**10600** (47.2)	**14720** (65.5)	**8835** (39.3)
5/8 (15.9)	**6-5/8** (168)	**26795** (119.2)	**18310** (81.5)	**27610** (122.8)	**16565** (73.7)	**23010** (102.4)	**13805** (61.4)
3/4 (19.1)	**8-1/4** (210)	**31430** (139.8)	**25215** (112.2)	**39760** (176.9)	**23855** (106.1)	**28165** (125.3)	**16900** (75.1)

1 Steel values in accordance with AISC
ASTM A 325 bolts: $F_y = 92$ ksi, $F_u = 120$ ksi
ASTM F 593 (AISI 304/316): $F_y = 65$ ksi, $F_u = 100$ ksi for 3/8" thru 5/8"
$F_y = 45$ ksi, $F_u = 85$ ksi for 3/4"

Allowable Load Values
Tension = $0.33 \times F_u \times A_{nom}$
Shear = $0.17 \times F_u \times A_{nom}$

Ultimate Load Values
Tension = $0.75 \times F_u \times A_{nom}$
Shear = $0.45 \times F_u \times A_{nom}$

2 Use lower value of either bond/concrete capacity or steel strength.

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

HIT-ICE/HIT-HY 150 Allowable and Ultimate Bond/Concrete Capacity for HAS Rods Installed in Lightweight Concrete 3000 psi (20.7 MPa)[2]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Allowable Bond/Concrete Capacity[1] lb (kN)		Ultimate Bond/Concrete Capacity lb (kN)	
		Tensile	Shear	Tensile	Shear
3/8 (9.5)	1-3/4 (44)	745 (3.3)	1285 (5.7)	2980 (13.3)	5150 (22.9)
	3-1/2 (89)	1220 (5.4)	1580 (7.0)	4920 (21.9)	6320 (28.1)
1/2 (12.7)	2-1/8 (54)	975 (4.3)	2130 (9.5)	3900 (17.3)	8520 (37.9)
	4-1/4 (108)	1210 (5.4)	2910 (12.9)	4840 (21.5)	11640 (51.8)
5/8 (15.9)	2-1/2 (63)	1200 (5.3)	2480 (11.0)	4800 (21.4)	9920 (44.1)
3/4 (19.1)	3-3/8 (86)	1760 (7.8)	4000 (17.8)	7040 (31.3)	15985 (71.1)

1 Influence factors for spacing and/or edge distance are applied to allowable concrete/bond values above, and then compared to the allowable steel value (See page 210). The lesser of these values is to be used for design.

2 All values based on holes drilled with matched tolerance carbide tipped bit and cleaned with a wire brush per manufacturer's instructions..

HIT-ICE/HIT-HY 150 Allowable Bond/Concrete Capacity for Sill Plate Applications

Allowable Loads for Attachment of Sill Plates to f'_c = 2000 PSI Normal Weight Concrete with HIT-ICE/HIT-HY 150[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Edge Distance in. (mm)	Tension lb (kN)	Shear lb (kN)	
				Load II to Edge	Load ⊥ to Edge
1/2 (12.7)	4-1/4 (108.0)	1-3/4 (44.5)	1280 (5.3)	1445 (6.4)	400 (1.8)
		2-3/4 (69.9)	1800 (8.1)	2100 (9.5)	845 (3.8)
5/8 (15.9)	5 (127.0)	1-3/4 (44.5)	1700 (7.6)	1445 (6.4)	400 (1.8)
		2-3/4 (69.9)	2725 (12.1)	2455 (10.9)	960 (4.3)

Allowable Loads for Attachment of Sill Plates to top of grout filled block wall with HIT-ICE/HIT-HY 150[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Edge Distance in. (mm)	Tension lb (kN)	Shear lb (kN)	
				Load II to Edge	Load ⊥ to Edge
1/2 (12.7)	4-1/4 (108.0)	1-3/4 (44.5)	1395 (6.2)	1425 (6.3)	560 (2.5)
		2-3/4 (69.9)	1795 (8.0)	2085 (9.3)	1110 (4.9)
5/8 (15.9)	5 (127.0)	1-3/4 (44.5)	1840 (8.2)	1800 (8.0)	680 (3.0)
		2-3/4 (69.9)	1965 (8.7)	3070 (13.7)	1110 (4.9)

1 Loads are based on concrete or masonry failure. Steel strength must be checked separately. Values based on safety factor of 4.0

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

HIT-ICE/HIT-HY 150 Allowable Loads for Threaded Rods in Grout-Filled Concrete Masonry Units (ASTM C 90 Block)[1, 2, 3, 4]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Distance from Edge in.	(mm)	Tension[5] lb	(kN)	Shear lb (kN)[5] HAS-E	HAS Super	HAS SS
3/8 (9.5)	3-1/2 (88.9)	4	(101.6)	1550	(6.9)	1360 (6.0)	2020 (9.0)	1875 (8.3)
		≥12	(304.8)					
1/2 (12.7)	4-1/4 (108)	4	(101.6)	1785	(7.9)	2020 (9.0)	2020 (9.0)	2020 (9.0)
		≥12	(304.8)			2420 (10.8)	4170 (18.5)	3335 (14.8)
5/8 (15.9)	5 (127)	4	(101.6)	2265	(10.1)	2020 (9.0)	2020 (9.0)	2020 (9.0)
		≥12	(304.8)			3780 (16.8)	5625 (25.0)	5215 (23.2)
3/4 (19.1)	6-5/8 (168.3)	4	(101.6)	3740	(16.6)	2020 (9.0)	2020 (9.0)	2020 (9.0)
		≥12	(304.8)			5445 (24.2)	5625 (25.0)	5625 (25.0)

HIT-ICE/HIT-HY 150 Ultimate Loads for Threaded Rods in Grout-Filled Concrete Masonry Units (ASTM C 90 Block)[1, 2, 3, 4]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Distance from Edge in.	(mm)	Tension lb (kN)[5] HAS-E	HAS Super	HAS SS (304SS)	Shear lb (kN)[5] HAS-E	HAS Super	HAS SS
3/8 (9.5)	3-1/2 (88.9)	4	(101.6)	6005 (26.7)	6200 (27.6)	6200 (27.6)	3605 (16.0)	6210 (27.6)	4970 (22.1)
		≥12	(304.8)						
1/2 (12.7)	4-1/4 (108)	4	(101.6)	7140 (31.8)	7140 (31.8)	7140 (31.8)	6405 (28.5)	8075 (35.9)	8075 (35.9)
		≥12	(304.8)					11040 (49.1)	8835 (39.3)
5/8 (15.9)	5 (127)	4	(101.6)	9060 (40.3)	9060 (40.3)	9060 (40.3)	8075 (35.9)	8075 (35.9)	8075 (35.9)
		≥12	(304.8)				10010 (44.2)	17260 (76.8)	13805 (61.4)
3/4 (19.1)	6-5/8 (168.3)	4	(101.6)	14970 (66.6)	14970 (66.6)	14970 (66.6)	8075 (44.2)	8075 (35.9)	8075 (35.9)
		≥12	(304.8)				14415 (64.1)	22500 (100.1)	16800 (75.2)

1 Values are for lightweight, medium weight or normal weight concrete masonry units conforming to ASTM C 90 with 2000 psi grout conforming to ASTM C 476.

2 Embedment depth is measured from the outside face of the concrete masonry unit.

3 Values are for anchors located in the grouted cell, head joint, bed joint, "T" joint, cross web or any combination of the above.

4 Values for edge distances between 4 inches and 12 inches can be calculated by linear interpolation.

5 Loads are based on the lesser of bond strength, steel strength or base material strength.

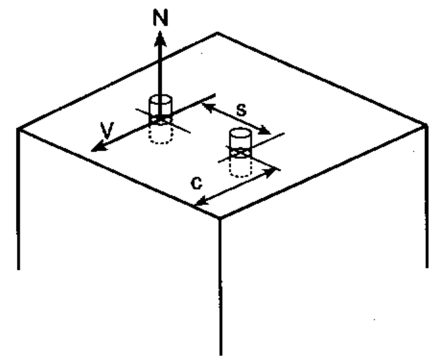
HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

Anchor Spacing and Edge Distance Guidelines for Grout-Filled Block

Influence of Anchor Spacing and Edge Distance

Anchor Size	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.8)	3/4 (19.1)
h_{nom}	in. (mm)	3-1/2 (90)	4-1/4 (110)	5 (125)	6-5/8 (170)

h_{nom} = standard embedment depth



Edge Distance for Shear and Tension:
Grout Filled, Normal Weight and Lightweight Block

c_{cr} = 12 in. (305 mm) minimum from free edge

c_{min} = 4 in. (102 mm) minimum from free edge

Anchor Spacing for Shear and Tension:
Grout Filled, Normal Weight and Lightweight Block

s_{cr} = s_{min} = One (1) anchor per cell (max), and 8 in. (203mm) (min)

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

HIT-ICE/HIT-HY 150 Ultimate Bond Strength and Steel Strength for Rebar in Concrete

Nominal Rebar Size	Embed. Depth in. (mm)	Concrete Compressive Strength						Grade 60 Rebar	
		f'c = 2000 psi (13.8 MPa)			f'c = 4000 psi (27.6 MPa)				
		Ultimate Bond Strength lb (kN)	Embed. to Develop Yield Strength[1] in. (mm)	Embed. to Develop Tensile Strength[1] in. (mm)	Ultimate Bond Strength lb (kN)	Embed. to Develop Yield Strength[1] in. (mm)	Embed. to Develop Tensile Strength[1] in. (mm)	Yield Strength lb (kN)	Tensile Strength lb (kN)
#3	1-1/2 (38)	2500 (11.1)	3-3/4 (95.3)	5-1/2 (139.7)	3800 (16.9)	2-3/4 (69.9)	4-1/4 (108.0)	6600 (29.4)	9900 (44.0)
	3-1/2 (89)	6300 (28.0)			8200 (36.5)				
	7 (178)	12600 (56.0)			16500 (73.4)				
#4	2 (51)	4200 (18.7)	5-1/2 (139.7)	8 (203.2)	6000 (26.7)	4-1/4 (108.0)	6-1/4 (158.8)	12000 (53.4)	18000 (80.1)
	4 (102)	9000 (40.0)			11800 (52.5)				
	8 (203)	18000 (80.1)			23600 (105.0)				
#5	2-1/2 (64)	5600 (24.9)	7 (177.8)	10-1/4 (260.4)	6900 (30.7)	5-1/4 (133.4)	8 (203.2)	18600 (82.7)	27900 (124.1)
	5 (127)	13500 (60.1)			17700 (78.7)				
	10 (254)	27000 (120.1)			35300 (157.0)				
#6	3-1/2 (90)	10200 (45.4)	8-1/2 (215.9)	12-3/4 (323.9)	12800 (56.9)	6-1/2 (165.1)	9-3/4 (247.7)	26400 (117.4)	39600 (176.2)
	7 (178)	22100 (98.3)			28900 (128.6)				
	14 (356)	44200 (196.6)			57700 (256.7)				
#7	3-3/4 (95)	10700 (47.6)	10 (254.0)	15 (381)	15800 (70.3)	7-3/4 (196.9)	11-1/2 (292.1)	36000 (160.1)	54000 (240.2)
	7-1/2 (190)	27100 (120.6)			35300 (157.0)				
	15 (380)	54200 (241.1)			70700 (314.5)				
#8	4 (102)	14100 (62.7)	11-3/4 (298.5)	17-1/2 (444.5)	18100 (80.5)	9 (228.6)	13-1/2 (342.9)	47450 (211.1)	71100 (316.3)
	8 (204)	32500 (144.6)			42400 (188.6)				
	16 (408)	65000 (289.1)			84800 (377.2)				
#9	5 (127)	16700 (74.3)	12-3/4 (323.9)	19 (482.6)	21800 (97.0)	10 (254.0)	15-3/4 (400.1)	60000 (266.9)	90000 (400.4)
	10 (254)	47400 (210.9)			61800 (274.9)				
	18 (457)	85300 (379.4)			111300 (495.1)				
#10	6 (152)	23300 (103.6)	15-1/2 (393.7)	23 (584.2)	32400 (144.1)	12 (304.8)	17-3/4 (450.9)	76200 (339.0)	114300 (508.5)
	12 (304)	59600 (265.1)			77700 (345.6)				
	20 (508)	99300 (441.7)			129600 (576.5)				
#11	7 (178)	32000 (142.3)	17-1/4 (438.2)	26 (660.4)	41300 (183.7)	13-1/2 (342.9)	20 (508.0)	93600 (416.4)	140400 (624.6)
	14 (356)	75800 (337.2)			99000 (440.4)				
	20 (508)	108400 (482.2)			141400 (629.0)				

1 Based on comparison of average ultimate adhesive bond test values versus minimum yield and ultimate tensile strength of rebar; for more information, contact Hilti.

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

HIT-ICE/HIT-HY 150 Bond Strength and Steel Strength for Metric Rebar in Concrete (Canada Only)[3,4]

Rebar Size	HIT-ICE Tensile Bond Strength[2,3,4]					Strength Properties of Metric Rebar[2,3]	
		f'_c = 14 MPa		f'_c = 28 MPa		f_y = 400 MPa	
	Embedment Depth (mm)	Ultimate Bond (kN)	Allowable Bond (kN)	Ultimate Bond (kN)	Allowable Bond (kN)	Yield Strength (kN)	Tensile Strength (kN)
10M (#3)	40	11.1	2.8	16.9	4.2	40	60
	90	28.0	7.0	36.5	9.1		
	180	56.0	14.0	73.4	18.3		
15M (#5)	65	24.9	6.2	30.7	7.7	80	120
	130	60.1	15.0	78.7	19.7		
	250	120	30.0	157	39.2		
20M (#6)	90	45.4	11.3	56.9	14.2	120	180
	180	98.3	24.6	129	32.2		
	355	197	49.2	257	64.2		
25M (#8)	100	62.7	15.7	80.5	20.1	200	300
	200	145	36.2	189	47.2		
	405	289	72.2	377	94.2		
30M (#9)	125	74.3	18.6	97.0	24.2	280	420
	250	211	52.8	275	68.8		
	455	379	94.8	495	124		
35M (#11)	180	142	35.5	184	46.0	400	600
	355	337	84.2	440	110		
	510	482	120	629	157		

1 Use lesser value of bond strength or rebar's steel strength for tensile capacity.

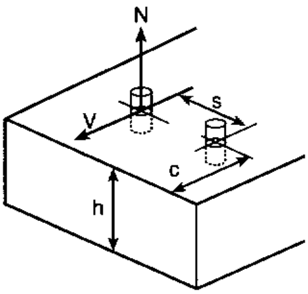
2 Actual tensile bond test data developed for imperial-sized rebar. Yield and ultimate rebar strengths are for metric sizes.

3 Test data developed for hammer-drilled holes. For diamond cored holes, contact Hilti Engineering.

4 For anchoring spacing and edge distance guidelines, please refer to page 212 of this HIT-ICE/HIT-HY 150 Injection Adhesive Anchor section.

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

Anchor Spacing and Edge Distance Guidelines in Concrete for HIT-ICE/HIT-HY 150



Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing Tension/Shear

$s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$

$f_A = 0.3(s/h_{ef}) + 0.55$

for $s_{cr} > s > s_{min}$

Edge Distance Tension

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$

$f_{RN} = 0.4(c/h_{ef}) + 0.40$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (⊥ toward edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV1} = 0.54(c/h_{ef}) - 0.09$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (II to or away from edge)

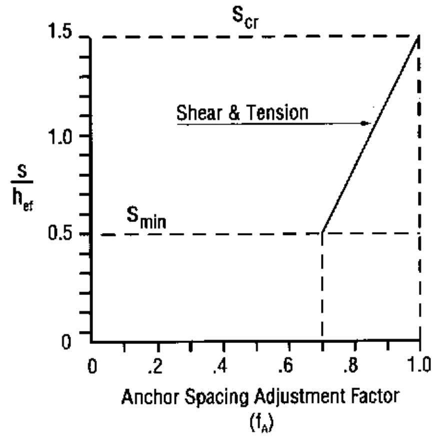
$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV2} = 0.36(c/h_{ef}) + 0.28$

for $c_{cr} > c > c_{min}$

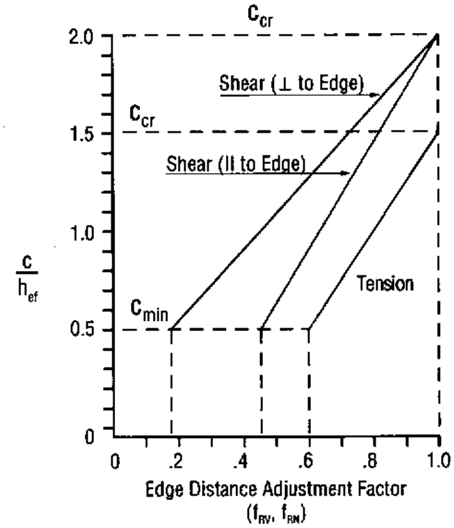
Anchor Spacing Adjustment Factors

s = Actual spacing
$s_{min} = 0.5\ h_{ef}$
$s_{cr} = 1.5\ h_{ef}$
h_{ef} = Actual embedment



Edge Distance Adjustment Factors

c = Actual edge distance
$c_{min} = 0.5\ h_{ef}$
$c_{cr} = 1.5\ h_{ef}$ Tension
$= 2.0\ h_{ef}$ for Shear
h_{ef} = Actual embedment



Load Adjustment Factors for 3/8" Diameter Anchor

Anchor Diameter	3/8" diameter											
Adjustment Factor	Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (II to or away from edge), f_{RV2}		
Embedment Depth, in.	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4	1-3/4	3-1/2	5-1/4
Spacing (s)/Edge Distance (c), in. 7/8	0.70			0.60			0.18			0.46		
1-1/4	0.76			0.69			0.30			0.54		
1-3/4	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
2	0.89	0.72		0.86	0.63		0.53	0.22		0.69	0.49	
2-5/8	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
3		0.81	0.72		0.74	0.63	0.84	0.37	0.22	0.90	0.59	0.49
3-1/2		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
4		0.89	0.78		0.86	0.70		0.53	0.32		0.69	0.55
4-1/2		0.94	0.81		0.91	0.74		0.60	0.37		0.74	0.59
5-1/4		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
6-1/2			0.92			0.90		0.91	0.58		0.95	0.73
7			0.95			0.93		1.00	0.63		1.00	0.76
7-7/8			1.00			1.00			0.72			0.82
9									0.84			0.90
10-1/2									1.00			1.00

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

Load Adjustment Factors for 1/2" Diameter Anchor

Anchor Diameter		1/2" diameter											
Adjustment Factor		Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (ll to or away from edge), f_{RV2}		
Embedment Depth, in.		2-1/8	4-1/4	6-3/8	2-1/8	4-1/4	6-3/8	2-1/8	4-1/4	6-3/8	2-1/8	4-1/4	6-3/8
Spacing (s)/Edge Distance (c), in.	1-1/16	0.70			0.60			0.18			0.46		
	1-1/2	0.76			0.68			0.29			0.53		
	2	0.83			0.78			0.42			0.62		
	2-1/8	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
	2-3/4	0.94	0.74		0.92	0.66		0.61	0.26		0.75	0.51	
	3	0.97	0.76		0.96	0.68		0.67	0.29		0.79	0.53	
	3-3/16	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
	4		0.83	0.74		0.78	0.65	0.93	0.42	0.25	0.96	0.62	0.51
	4-1/4		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
	5		0.90	0.79		0.87	0.71		0.55	0.33		0.70	0.56
	6		0.97	0.83		0.96	0.78		0.67	0.42		0.79	0.62
	6-3/8		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
	7			0.88			0.84		0.80	0.50		0.87	0.68
	7-1/2			0.90			0.87		0.86	0.55		0.92	0.70
	8-1/2			0.95			0.93		1.00	0.63		1.00	0.76
	9			0.97			0.96			0.67			0.79
	9-9/16			1.00			1.00			0.72			0.82
	10									0.76			0.84
	11									0.84			0.90
	12-3/4									1.00			1.00

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing Tension/Shear

$s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$

$f_A = 0.3(s/h_{ef}) + 0.55$

for $s_{cr}>s>s_{min}$

Edge Distance Tension

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$

$f_{RN} = 0.4(c/h_{ef}) + 0.40$

for $c_{cr}>c>c_{min}$

Edge Distance Shear (⊥ toward edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV1} = 0.54(c/h_{ef}) - 0.09$

for $c_{cr}>c>c_{min}$

Edge Distance Shear (ll to or away from edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV2} = 0.36(c/h_{ef}) + 0.28$

for $c_{cr}>c>c_{min}$

Load Adjustment Factors for 5/8" and 3/4" Diameter Anchors

Anchor Diameter		5/8" diameter											
Adjustment Factor		Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (ll to or away from edge), f_{RV2}		
Embedment Depth, in.		2-1/2	5	7-1/2	2-1/2	5	7-1/2	2-1/2	5	7-1/2	2-1/2	5	7-1/2
Spacing (s)/Edge Distance (c), in.	1-1/4	0.70			0.60			0.18			0.46		
	1-11/16	0.75			0.67			0.27			0.52		
	2	0.79			0.72			0.34			0.57		
	2-1/2	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
	3	0.91	0.73		0.88	0.64		0.56	0.23		0.71	0.50	
	3-5/16	0.95	0.75		0.93	0.67		0.63	0.27		0.76	0.52	
	3-3/4	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
	4		0.79	0.71		0.72	0.61	0.77	0.34	0.20	0.86	0.57	0.47
	4-1/2		0.82	0.73		0.76	0.64	0.88	0.40	0.23	0.93	0.60	0.50
	5		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
	5-1/16		0.85	0.75		0.81	0.67		0.46	0.27		0.64	0.52
	5-1/2		0.88	0.77		0.84	0.69		0.50	0.31		0.68	0.54
	6		0.91	0.79		0.88	0.72		0.56	0.34		0.71	0.57
	6-3/4		0.96	0.82		0.94	0.76		0.64	0.40		0.77	0.60
	7-1/2		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
	8			0.87			0.83		0.77	0.49		0.86	0.66
	8-1/2			0.89			0.85		0.83	0.52		0.89	0.69
	9			0.91			0.88		0.88	0.56		0.93	0.71
	9-15/16			0.95			0.93		0.98	0.63		1.00	0.76
	10			0.95			0.93		1.00	0.63			0.76
	11-1/4			1.00			1.00			0.72			0.82
	12									0.77			0.86
	13-1/4									0.86			0.92
	14									0.92			0.95
	15									1.00			1.00
	16												
	18												
	20												

Anchor Diameter		3/4" diameter											
Adjustment Factor		Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (ll to or away from edge), f_{RV2}		
Embedment Depth, in.		3-3/8	6-5/8	10	3-3/8	6-5/8	10	3-3/8	6-5/8	10	3-3/8	6-5/8	10
Spacing (s)/Edge Distance (c), in.	1-1/4												
	1-11/16	0.70			0.60			0.18			0.46		
	2	0.73			0.64			0.23			0.49		
	2-1/2	0.77			0.70			0.31			0.55		
	3	0.82			0.76			0.39			0.60		
	3-5/16	0.84	0.70		0.79	0.60		0.44	0.18		0.63	0.46	
	3-3/4	0.88	0.72		0.84	0.63		0.51	0.22		0.68	0.48	
	4	0.91	0.73		0.87	0.64		0.55	0.24		0.71	0.50	
	4-1/2	0.95	0.75		0.93	0.67		0.63	0.28		0.76	0.52	
	5	0.99	0.78	0.70	0.99	0.70	0.60	0.71	0.32	0.18	0.81	0.55	0.46
	5-1/16	1.00	0.78	0.70	1.00	0.71	0.60	0.72	0.32	0.18	0.82	0.56	0.46
	5-1/2		0.80	0.72		0.73	0.62	0.79	0.36	0.21	0.87	0.58	0.48
	6		0.82	0.73		0.76	0.64	0.87	0.40	0.23	0.92	0.61	0.50
	6-3/4		0.86	0.75		0.81	0.67	1.00	0.46	0.27	1.00	0.65	0.52
	7-1/2		0.89	0.78		0.85	0.70		0.52	0.32		0.69	0.55
	8		0.91	0.79		0.88	0.72		0.56	0.34		0.71	0.57
	8-1/2		0.93	0.81		0.91	0.74		0.60	0.37		0.74	0.59
	9		0.96	0.82		0.94	0.76		0.64	0.40		0.77	0.60
	9-15/16		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
	10			0.85			0.80		0.73	0.45		0.82	0.64
	11-1/4			0.89			0.85		0.83	0.52		0.89	0.69
	12			0.91			0.88		0.89	0.56		0.93	0.71
	13-1/4			0.95			0.93		1.00	0.63		1.00	0.76
	14			0.97			0.96			0.67			0.78
	15			1.00			1.00			0.72			0.82
	16									0.77			0.86
	18									0.88			0.93
	20									1.00			1.00

4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

Load Adjustment Factors for 7/8" Diameter Anchor

Anchor Diameter	7/8" diameter											
Adjustment Factor	Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (II to or away from edge), f_{RV2}		
Embedment Depth, in.	3-3/4	7-1/2	11-1/4	3-3/4	7-1/2	11-1/4	3-3/4	7-1/2	11-1/4	3-3/4	7-1/2	11-1/4
Spacing (s)/Edge Distance (c), in.												
1-7/8	0.70			0.60			0.18			0.46		
2-1/2	0.75			0.67			0.27			0.52		
3	0.79			0.72			0.34			0.57		
3-3/4	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
4	0.87	0.71		0.83	0.61		0.49	0.20		0.66	0.47	
4-1/2	0.91	0.73		0.88	0.64		0.56	0.23		0.71	0.50	
5	0.95	0.75		0.93	0.67		0.63	0.27		0.76	0.52	
5-5/8	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
6		0.79	0.71		0.72	0.61	0.77	0.34	0.20	0.86	0.57	0.47
6-1/2		0.81	0.72		0.75	0.63	0.85	0.38	0.22	0.90	0.59	0.49
7		0.83	0.74		0.77	0.65	0.92	0.41	0.25	0.95	0.62	0.50
7-1/2		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
8		0.87	0.76		0.83	0.68		0.49	0.29		0.66	0.54
8-1/2		0.89	0.78		0.85	0.70		0.52	0.32		0.69	0.55
9		0.91	0.79		0.88	0.72		0.56	0.34		0.71	0.57
9-15/16		0.95	0.82		0.93	0.75		0.63	0.39		0.76	0.60
10		0.95	0.82		0.93	0.76		0.63	0.39		0.76	0.60
11-1/4		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
12			0.87			0.83		0.77	0.49		0.86	0.66
14			0.92			0.90		0.92	0.58		0.95	0.73
15			0.95			0.93		1.00	0.63		1.00	0.76
16-7/8			1.00			1.00			0.72			0.82
18									0.77			0.86
20									0.87			0.92
22-1/2									1.00			1.00

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing Tension/Shear

$s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$

$f_A = 0.3(s/h_{ef}) + 0.55$

for $s_{cr}>s>s_{min}$

Edge Distance Tension

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$

$f_{RN} = 0.4(c/h_{ef}) + 0.40$

for $c_{cr}>c>c_{min}$

Edge Distance Shear (⊥ toward edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV1} = 0.54(c/h_{ef}) - 0.09$

for $c_{cr}>c>c_{min}$

Edge Distance Shear (II to or away from edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV2} = 0.36(c/h_{ef}) + 0.28$

for $c_{cr}>c>c_{min}$

Load Adjustment Factors for 1" and 1 1/4" Diameter Anchors

Anchor Diameter	1" diameter											
Adjustment Factor	Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (II to or away from edge), f_{RV2}		
Embedment Depth, in.	4-1/8	8-1/4	12-3/8	4-1/8	8-1/4	12-3/8	4-1/8	8-1/4	12-3/8	4-1/8	8-1/4	12-3/8
Spacing (s)/Edge Distance (c), in.												
2-1/16	0.70			0.60			0.18			0.46		
3	0.77			0.69			0.30			0.54		
3-1/2	0.80			0.74			0.37			0.59		
4-1/8	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
5	0.91	0.73		0.88	0.64		0.56	0.24		0.72	0.50	
5-1/2	0.95	0.75		0.93	0.67		0.63	0.27		0.76	0.52	
6	0.99	0.77		0.98	0.69		0.70	0.30		0.80	0.54	
6-3/16	1.00	0.78	0.70	1.00	0.70	0.60	0.72	0.32	0.18	0.82	0.55	0.46
7-1/2		0.82	0.73		0.76	0.64	0.89	0.40	0.24	0.93	0.61	0.50
8-1/4		0.85	0.75		0.80	0.67	1.00	0.45	0.27	1.00	0.64	0.52
9		0.88	0.77		0.84	0.69		0.50	0.30		0.67	0.54
9-1/2		0.90	0.78		0.86	0.71		0.53	0.32		0.69	0.56
10		0.91	0.79		0.88	0.72		0.56	0.35		0.72	0.57
10-1/2		0.93	0.80		0.91	0.74		0.60	0.37		0.74	0.59
12		0.99	0.84		0.98	0.79		0.70	0.43		0.80	0.63
12-3/8		1.00	0.85		1.00	0.80		0.72	0.45		0.82	0.64
14			0.89			0.85		0.83	0.52		0.89	0.69
16-1/2			0.95			0.93		1.00	0.63		1.00	0.76
18			0.99			0.98			0.70			0.80
18-9/16			1.00			1.00			0.72			0.82
20									0.78			0.86
22-1/2									0.89			0.93
24									0.96			0.98
24-3/4									1.00			1.00
26												
28												
30												

Anchor Diameter	1 1/4" diameter											
Adjustment Factor	Spacing Tension/Shear, f_A			Edge Distance Tension, f_{RN}			Edge Distance Shear (⊥ toward edge), f_{RV1}			Edge Distance Shear (II to or away from edge), f_{RV2}		
Embedment Depth, in.	6	12	15	6	12	15	6	12	15	6	12	15
Spacing (s)/Edge Distance (c), in.												
2-1/16												
3	0.70			0.60			0.18			0.46		
3-1/2	0.73			0.63			0.23			0.49		
4-1/8	0.76			0.68			0.28			0.53		
5	0.80			0.73			0.36			0.58		
5-1/2	0.83			0.77			0.41			0.61		
6	0.85	0.70		0.80	0.60		0.45	0.18		0.64	0.46	
6-3/16	0.86	0.70		0.81	0.61		0.47	0.19		0.65	0.47	
7-1/2	0.93	0.74	0.70	0.90	0.65	0.60	0.59	0.25	0.18	0.73	0.51	0.46
8-1/4	0.96	0.76	0.72	0.95	0.68	0.62	0.65	0.28	0.21	0.78	0.53	0.48
9	1.00	0.78	0.73	1.00	0.70	0.64	0.72	0.32	0.23	0.82	0.55	0.50
9-1/2		0.79	0.74		0.72	0.65	0.77	0.34	0.25	0.85	0.57	0.51
10		0.80	0.75		0.73	0.67	0.81	0.36	0.27	0.88	0.58	0.52
10-1/2		0.81	0.76		0.75	0.68	0.86	0.38	0.29	0.91	0.60	0.53
12		0.85	0.79		0.80	0.72	1.00	0.45	0.34	1.00	0.64	0.57
12-3/8		0.86	0.80		0.81	0.73		0.47	0.36		0.65	0.58
14		0.90	0.83		0.87	0.77		0.54	0.41		0.70	0.62
16-1/2		0.96	0.88		0.95	0.84		0.65	0.50		0.78	0.68
18		1.00	0.91		1.00	0.88		0.72	0.56		0.82	0.71
18-9/16			0.92			0.90		0.75	0.58		0.84	0.73
20			0.95			0.93		0.81	0.63		0.88	0.76
22-1/2			1.00			1.00		0.92	0.72		0.96	0.82
24								1.00	0.77		1.00	0.86
24-3/4									0.80			0.87
26									0.85			0.90
28									0.92			0.95
30									1.00			1.00

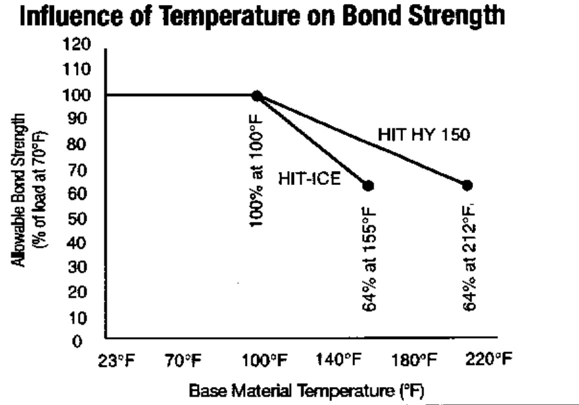
HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

Resistance of HIT-ICE/HIT-HY 150 to Chemicals

Chemical		Behavior
Sulphuric acid	conc.	–
	30%	•
	10%	+
Hydrochloric acid	conc.	•
	10%	+
Nitric acid	conc.	–
	10%	•
Phosphoric acid	conc.	+
	10%	+
Acetic acid	conc.	•
	10%	+
Formic acid	conc.	–
	10%	•
Lactic acid	conc.	+
	10%	+
Citric acid	10%	+
Sodium Hydroxide (Caustic soda)	40%	•
	20%	+
	5%	+
Ammonia	conc.	•
	5%	+
Soda solution	10%	+
Common salt solution	10%	+
Chlorinated lime solution	10%	+
Sodium hypochlorite	2%	+
Hydrogen peroxide	10%	+
Carbolic acid solution	10%	–
Ethanol		–
Sea water		+
Glycol		+
Acetone		–
Carbon tetrachloride		–
Toluene		+
Petrol/Gasoline		•
Machine oil		•
Diesel oil		•

Key: – non-resistant + resistant • limited resistance

Influence of Temperature on Bond Strength



Note: Test procedure involves the concrete being held at the elevated temperature for 24 hours them removing it from the controlled environment and testing to failure.

Long term creep test in accordance with AC58 is available; please contact Hilti Technical Services.

Samples of the HIT-ICE/HIT-HY 150 resin were immersed in the various chemical compounds for up to one year. At the end of the test period, the samples were analyzed. Any samples showing no visible damage and having less than a 25% reduction in bending (flexural) strength were classified as **"Resistant"**. Samples that had slight damage, such as small cracks, chips, etc. or reduction in bending strength of 25% or more, were classified as **"Partially Resistant"**. Samples that were heavily damaged or destroyed were classified as **"Not Resistant"**.

Note: In actual use, the majority of the resin is encased in the base material, leaving very little surface area exposed. In some cases, this would allow the HIT-ICE, HIT-HY 150 to be used where it would be exposed to the **"Partially Resistant"** chemical compounds.

Open Gel Time Table (Approximate)[1]

Base Material Temperature		HIT-HY 150[2]	HIT-ICE
°F	°C		
–10	–23	–	1.5 hrs
0	–18	–	1.5 hrs
23	–5	25 min	40 min
32	0	18 min	26 min
41	5	13 min	11 min
68	20	5 min	4 min
86	30	4 min	1.5 min
104	40	2 min	–

Final Cure Time Table (Approximate)[1]

Base Material Temperature		HIT-HY 150[2]	HIT-ICE
°F	°C		
–10	–23	–	36 hrs
0	–18	–	24 hrs
23	–5	6 hrs	6 hrs
32	0	3 hrs	4 hrs
41	5	90 min	2 hrs
68	20	50 min	1 hrs
86	30	40 min	30 min
104	40	30 min	–

1 Product temperatures must be maintained above 41°F (5°C), with the exception of HIT-ICE which must be above 0°F (–18°C).

2 Use of HIT-HY 150 and HIT-TZ rods must be installed in base material temperatures 40° F (5° C).

Influence of High Energy Radiation on HIT-HY 150[1]

Radiation Exposure[2, 3]	Detrimental Effect	Recommendation for Use
< 10 Mrad	Insignificant	Full Use
10 – 100 Mrad	Moderate	Restricted Use $F_{rec.} = 0.5\ F_{perm.}$
> 100 Mrad	Medium to strong	No recommendation for use

1 HIT-ICE information is unavailable.

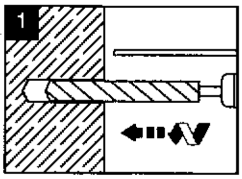
2 Mrad = Megarad

3 Dosage over a life span.

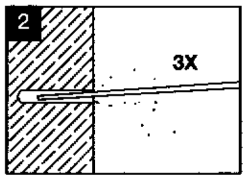
4.2.5 HIT-ICE/HIT-HY 150 Adhesive Anchoring System

4.2.5.4 Installation Instructions

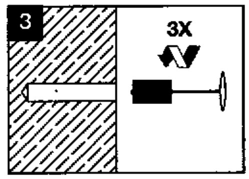
HAS, Rebar and Insert Installation Instructions



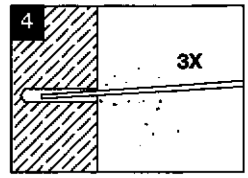
1. Drill anchor hole with a carbide bit. Contact Hilti for use of Diamond Core bits.



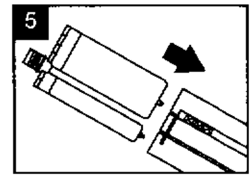
2. Insert air nozzle to bottom of hole and blow out hole using a pump, or compressed air.



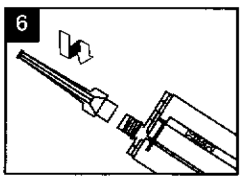
3. Clean hole with wire brush. Proper hole cleaning is essential.



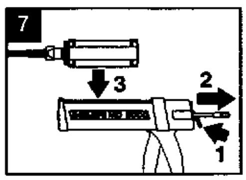
4. Insert air nozzle to bottom of hole and blow out hole using a pump, or compressed air.



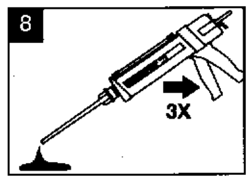
5. HIT-HY 150 only: Put refill pack into holder. Remove cap covering threaded projection.



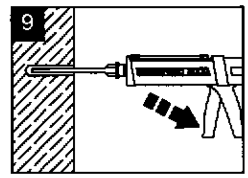
6. Screw on static mixer.



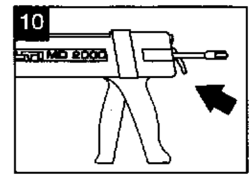
7. Put holder/cartridge into appropriate dispenser.



8. **Discard first three trigger pulls of adhesive from each refill pack or cartridge.**

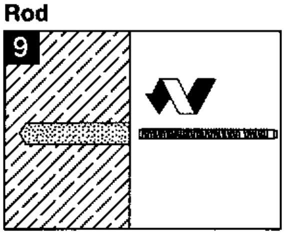


9. Inject adhesive into hole starting at the bottom until 1/2 to 2/3 full. Use mixer filler tube extensions when needed to reach the hole bottom.

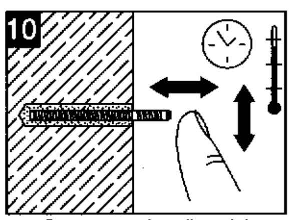


10. Unlock dispenser.

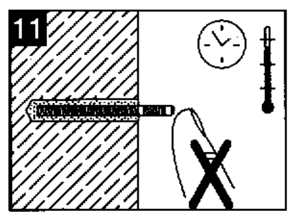
Rod



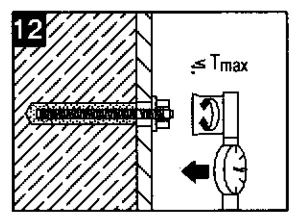
9. Insert rod. Twist during installation.



10. Fastener may be adjusted during specified gel time.

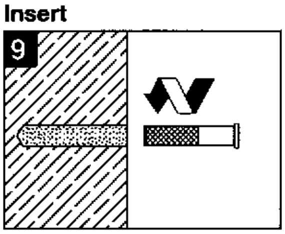


11. Do not disturb anchor between specified gel time and cure time.

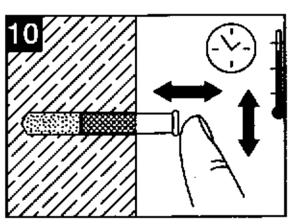


12. Apply specified torque as required to secure items to be fastened. Do not exceed maximum torque specified.

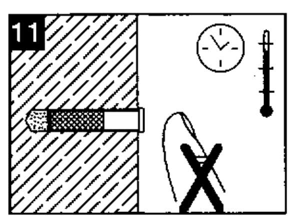
Insert



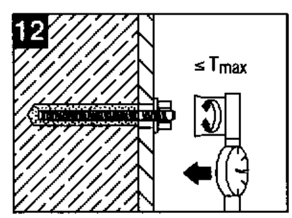
9. Insert threaded insert. Twist during installation.



10. Fastener may be adjusted during specified gel time.

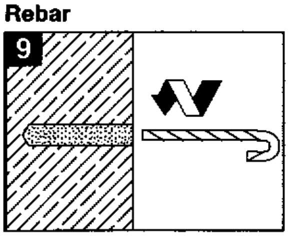


11. Do not disturb anchor between specified gel time and cure time.

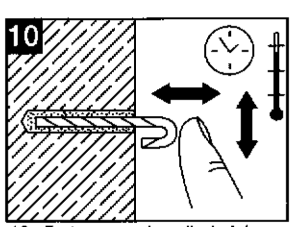


12. Apply specified torque as required to secure items to be fastened. Do not exceed maximum torque specified.

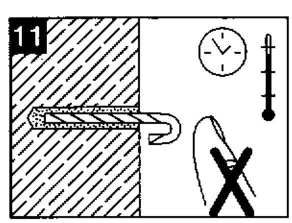
Rebar



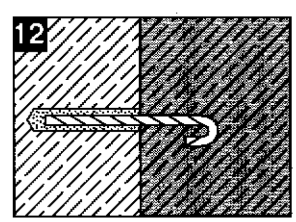
9. Insert rebar. Twist during installation.



10. Fastener may be adjusted during specified gel time.



11. Do not disturb anchor between specified gel time and cure time.



12. Apply specified torque as required to secure items to be fastened. Do not exceed maximum torque specified.

HIT-ICE/HIT-HY 150 Adhesive Anchoring System 4.2.5

HIT HIT-ICE/HIT-HY 150 Volume Charts

Threaded Rod & HIT-TZ Rod Installation

Rod Diameter (in.)	Drill Bit[1] Diameter (in.)	Adhesive Volume Required per Inch of embedment (in^3)
1/4	5/16	0.055
3/8	7/16	0.095
1/2	9/16	0.133
5/8	11/16	0.184
3/4	13/16	0.232
7/8	24mm	0.272
1	1-1/16	0.366
1-1/4	1-1/2	0.918

Example: Determine approximate fastenings for 5/8" rod embedded 10" deep.

10 x 0.184 = 1.84 in^3 of adhesive per anchor

- HIT-HY 150 small cartridge:
  16.5 ÷ 1.84 ≈ 9 fastenings
- HIT-HY 150 medium cartridge:
  26.9 ÷ 1.84 ≈ 15 fastenings
- HIT-HY 150 jumbo cartridge:
  81.8 ÷ 1.84 ≈ 45 fastenings
- HIT-ICE cartridge:
  18.0 ÷ 1.84 ≈ 10 fastenings

Rebar Installation

Rod Diameter (in.)	Drill Bit[1] Diameter (in.)	Adhesive Volume Required per Inch of embedment (in^3)
#3 or 3/8	1/2	0.110
#4 or 1/2	5/8	0.146
#5 or 5/8	3/4	0.176
#6 or 3/4	7/8	0.218
#7 or 7/8	1	0.252
#8 or 1	1-1/8	0.299
#9 or 1-1/8	1-3/8	0.601
#10 or 1-1/4	1-1/2	0.659
#11 or 1-3/8	1-9/16	0.547

Note: Useable volume of:

- HIT-HY 150 refill pack is 16.5 in^3 (270ml).
- HIT-HY 150 medium cartridges is 26.9 in^3 (440ml).
- HIT-HY 150 jumbo cartridges is 81.8 in^3 (1340 ml).
- HIT-ICE is 18 in^3 (297 ml)

Metric Rebar Installation (Canada Only)

Bar Diameter	Drill Bit[1] Diameter	Adhesive Volume Required per Inch of embedment (in^3)
10M	14 mm	0.101
15M	3/4"	0.176
20M	24 mm	0.268
25M	1-1/8"	0.309
30M	37 mm	0.644
35M	1-9/16"	0.480

1 Rebar diameter may vary. Use smallest drill bit which will accommodate rebar. Use Hilti matched tolerance carbide tipped drill bits.

Aluminum Alternating Tread Stair

What is an alternating tread stair and why would I use one? *Click here to find out*

The alumium alternating tread stair:

Utilizes a central stringer with curved treads that weld directly to the handrail
Ideal for outdoor areas where corrosion and rust are a concern, as well as rooftop applications where weight is a major consideration.
Shipped as one complete welded unit, ready to bolt into place.

Stair Design Details

Table 1: Aluminum Alternating Tread Stair Design Details

MATERIAL	ALUMINUM
STAIR FINISHES	**Natural finish only** Landings, Treads and Foot Castings: Aluminum alloy F356F Guards/Handrails: Aluminum Alloy 6063-T4 Central Stringer: Aluminum Alloy 6063-T52
ANGLES	68°
HEIGHTS	Custom height built to exact vertical height Standard Rails: 24" to 216" Optional Rails: 55" to 246"

Handrail Options

Standard Narrow handrail: extends 42" above the top landing of the stair
Optional Narrow Handrail: designed for roof hatch applications, extends 3-3/4" above the top landing.

The "narrow" design encloses the user for additional upper body support .

Table 2: Handrail tech specs

CONFIGURATIONS	RAIL HEIGHT -- FROM TOP LANDING	INSIDE HANDRAIL DIMENSIONS	OUTSIDE HANDRAIL DIMENSIONS	VIEW DRAWINGS
STANDARD NARROW HANDRAIL (ORIGINAL RAIL)	42"	17"	23"	View
OPTIONAL NARROW HANDRAIL	3-3/4" Steel	17"	23"	View

Images

Click here to see more...

Technical Data

Specifications
Technical Data/Formulas Chart
Horizontal Projection Table
Weight Table
Pricing
Building Codes
Installation Instructions

Sample Dimensional Prints

Standard Handrail
Optional Handrail

Related Products

Safety Gates
Crossover and Platform Systems

Alternating Tread Stairs

The Lapeyre® Alternating Tread Stair features a unique tread design which provides greater tread depth than vertical ladders or ship's ladders.

The alternating tread stair:

- Allows comfortable face forward descents at steep angles.
- Includes close fitting handrails which provide support.
- Has a cushioned central stringer which virtually eliminates the possibility of hitting the nosing of a tread.

Common applications include:mezzanine access, roof tops or roof hatches, equipment access, conveyors, catwalks, storage tanks, crossover systems, or just about anywhere you would use a fixed ladder or need steep stairs.

Stair Design Details

Table 1: Alternating Tread Stair Options

STAIR SPECS	STEEL	ALUMINUM	MOBILE
HEIGHTS	Custom height built **Standard Handrails:** 56° - 36" to 240" 68° - 42" to 240" **Optional Handrails:** 48" to 240" **Flush Handrail:** 48" to 240"	Custom height built **Standard Handrails:** 24" to 216" **Optional Handrails:** 55" to 216" inches	Standard Sizes Only 3', 4', 5', 6', 7', and 8'
ANGLES	56° AND 68°	68° ONLY	68° ONLY
MATERIAL WITH FINISHES	-Carbon Steel in Safety Yellow Powder Coat -Carbon Steel in Gray Primer Powder Coat -Carbon Steel in Iron Gray Powder Coat -Carbon Steel, choice of colors . -Carbon Steel in Hot Dip Galvanized -Stainless Steel with Natural	Natural Finish ONLY	-Carbon Steel in Safety Yellow Powder Coat -Carbon Steel with choice of colors. Powder Coat Finish -Hot Dip Galvanized -Stainless Steel with Natural

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Contact

Email:
Ls.sales@ lapeyrestair.com
Toll-Free:
800-535-7631
Phone:
504-733-6009
Fax:
504-733-4393

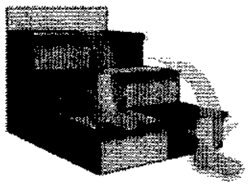
Quick Links

Steel Specifications
Aluminum Specifications
Who is using our Alternating Tread Stairs?
Where can our Alternating Tread Stairs be used?
Stair Pricing

Codes

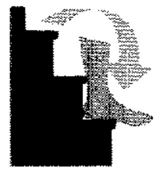
Our Code Compliance
OSHA
IBC
BOCA

How the Alternating Tread Stair Works



Conventional Stair

Imagine walking down (or up) a conventional stair. Each foot normally uses only about half of each tread, stepping out and over the unused section (shaded red).



Steep Stair

On a steeper stair or ladder, the unused half tread becomes an obstacle, significantly reducing the usable tread depth of the tread directly below. As the angle increases, the problem becomes worse.

Alternating Tread Stair

In contrast, the Lapeyre stair removes the unused half of each tread, allowing the foot to reach the next tread in a straight, direct line, providing more usable tread depth.

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SECTION 05 51 33.23- ALTERNATING TREAD ALUMINUM STAIRS

PART 1- GENERAL

1.1 <u>SCOPE OF WORK</u>

Fabricate and Install metal alternating tread stair assemblies in accordance with the requirements set forth in this section.

(Note: Terminology used for the component covered by this specification varies among the codes or standards that address the component. This specification uses the term alternating tread stair. MasterFormat 2004 uses the term alternating tread ladder. The International Building Code (IBC) and NFPA-101 (Life Safety Code) use the term alternating tread device.)

1.2 <u>ADDITIONAL WORK INCLUDED IN THIS SECTION</u>

Some items of work are usually specified in sections other than 05 51 33.23. If they are to be part of the metal alternating tread stair contractor's work, they must be specified here.

***NOTE: Delete any sections below not relevant to this project; add others as required.*

** A. Field measurements of alternating tread device installation sites and verification of vertical distance between floors.
B. Other as required____________________________________

1.3 <u>WORK SPECIFICALLY EXCLUDED IN THIS SECTION</u>

The items in this section are not to be included in the metal stair contractor's work:

A. Temporary shoring or bracing.
B. Demolition and removal of existing work.
C. Clean up of site prior to installation.
D. Concrete supports or other concrete work
E. Cutting; preparation of pockets; setting of plates, inserts, adapters, or other hardware of built-in items
F. Placement of wire mesh and re-bar for concrete fill
G. Temporary lights or electricity.
H. Temporary safety rails.
I. Protection after erection.
J. Wood trim or moldings, for treads or stringers.
K. Rubber treads or carpets.
L. Slip resistant concrete treatments.
M. Field painting other than touch up of damaged surfaces.
N. Final surface cleaning, passivation, or application of surface protectant after installation.

1.4 <u>RELATED DOCUMENTS:</u>

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Cross over and landing platforms used with alternating tread stairs are addressed in section 05 51 36.

1.5 SUMMARY:

A. Provide all material, labor, equipment and services and perform all operations necessary or required for the work of this section, in accordance with the Drawings and Specifications, and including fabrication and installation of alternating tread aluminum Stairs.

B. Related work specified elsewhere includes but is not limited to:

1. Conventional Metal Stairs in another Division 5 section
2. Metal Fabrications in another Division 5 section
3. Cross over and landing platforms used with alternating tread stairs are addressed in section 05 51 36.

1.6 REFERENCES

National Association of Architectural Metal Manufacturers (NAAM)

A. NAAMM, STANDARD AMP 510-92 Metal Stairs Manual 5th Edition

Aluminum Association

A. Aluminum standards and data, latest Edition

1.7 PERFORMANCE REQUIREMENTS:

A. Alternating Tread Stair Treads: shall be capable of withstanding a single concentrated 1000 pound load without permanent deformation; or 100 pounds per square foot or 300 pounds on an area of 4 square inches without exceeding the allowable working stress of the material.

B. Alternating Tread Stair Guard and Handrail: shall be capable of withstanding a single concentrated load of 200 pounds or a uniform load of 50 pounds per linear foot applied in any direction at any point on the rail without exceeding the allowable working stress of the material.

C. Alternating Tread Stair Stringers: shall be capable of withstanding a single concentrated load of 1000 pounds at any point on the stair without permanent deformation; or a uniform live loading of 100 pounds per square foot applied in a downward direction to all tread surfaces or a 300 pound load on an area of 4 square inches without exceeding the allowable working stress of the material.

1.8 CONSTRUCTION REQUIREMENTS:

A. Cast Aluminum Treads, Landings, and Mounting Base: shall be shielded metal arc welded to a single extruded box-like stringer.

B. Tread Castings: shall have integrally cast handrail support arms which are precision machined and welded to continuous aluminum handrails.

C. Pedestrian Surfaces: shall be cast with skid resistant surfaces and all treads shall have upturned integrally cast skid barriers.

D. Riser Spacing: shall be equally spaced to within 3/16" for adjacent and to within 3/8" for any two non-adjacent risers on a stair.

E. Guards and Handrails: shall be contoured for body guidance and underarm support, and shall have inclined hand side portions for free sliding of the hands unimpeded by the handrail supports.

F. Cast Aluminum Foot Divider: shall be an integral part of the landing and shall form a support for a rubber bumper strip.

1.9 <u>DIMENSIONS:</u>

A. Alternating Tread Stair Angle: 68 degrees from horizontal as specified in the drawings.

B. Vertical Drop: the change in elevation, as shown in the drawings, between the upper finished floor surface where the top landing will be attached and the lower finished floor surface where the base of the alternating tread stair will be secured.

1.10 <u>SUBMITTALS:</u>

Dimensional Prints: shall be submitted for approval prior to fabrication.

1.11 <u>DELIVERY STORAGE AND HANDLING</u>

A. Deliver materials to the job-site in good condition and properly protected against damage to finished surfaces.
B. Store material in a location and manner to avoid damage. Do not stack components. Lay out components on firm foundation material such that bending can not occur.
C. Store metal components in a clean dry location, away from uncured concrete, cement, or masonry products, acids, oxidizers, rain water, or any other chemical or substance that might damage the material or finish.
D. Plan work and storage locations to keep on-site handling to a minimum.
E. Exercise particular care to avoid damage to material finishes or unprotected surfaces when handling.

PART 2-PRODUCTS

2.1 <u>ACCEPTABLE MANUFACTURER:</u>

A. Lapeyre Stair, Inc.
5117 Toler St.
Harahan, LA. 70123;
1-(800)-535-7631 or
1-(504)-570-6209.

B. Substitutions will not be considered.

2.2 <u>MATERIALS:</u>

A. Landings, Treads and Foot Castings: Aluminum alloy F356F

B. Guards/Handrails:
1. Aluminum Alloy 6063-T4

2. 1-1/2" Φ x 1/8" Tube

C. Central Stringer:
   1. Aluminum Alloy 6063-T52
   2. 1-3/4" x 4" x 1/8" Box Shape

D. Miscellaneous Materials:
   1. Rubber Spine: Hollow neoprene strip
   2. Bolts: Landing to Structure, ASTM A307, 1/2" diameter
   3. Nuts: ASTM A563
   4. Washers: ASTM F844

2.3 <u>FINISH:</u>

Natural Finish

2.4 <u>FABRICATION:</u>

A. General: Fabricate alternating tread aluminum stairs to conform with performance and construction requirements, and in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.

B. Fabricate gas metal arc welded and/or gas tungsten arc welded alternating tread aluminum stairs using the specified materials.

PART 3- EXECUTION:

3.1 <u>PREPARATIONS:</u>

A. Coordination: Coordinate start and installation of aluminum alternating tread stairs with all other related and adjacent work. Installation shall not start until the construction has progressed to the point that weather conditions and remaining construction operations will not damage stair installation.

B. Verification: Verify that dimensions and angle are correct and that substrate is in proper condition for alternating tread stair installation. Do not proceed with installation until all necessary corrections have been made.

3.2 <u>INSTALLATION:</u>

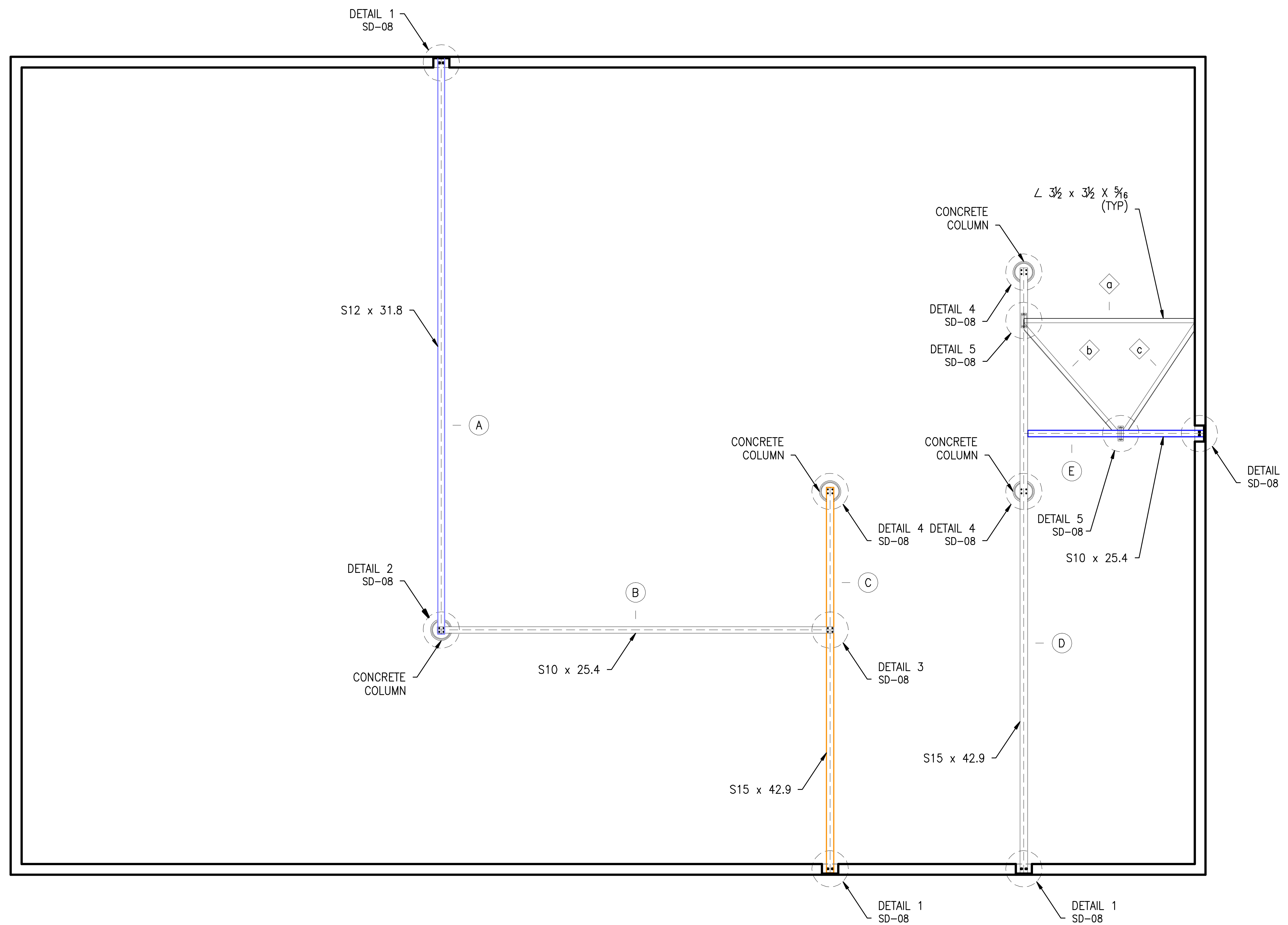
A. Prepare mounting holes.

B. Position alternating tread stair with top tread at same elevation as upper finished floor or roof surface.

C. Secure alternating tread stair with not less than 2 bolts or studs at top and with not less than 2 at bottom of stair.

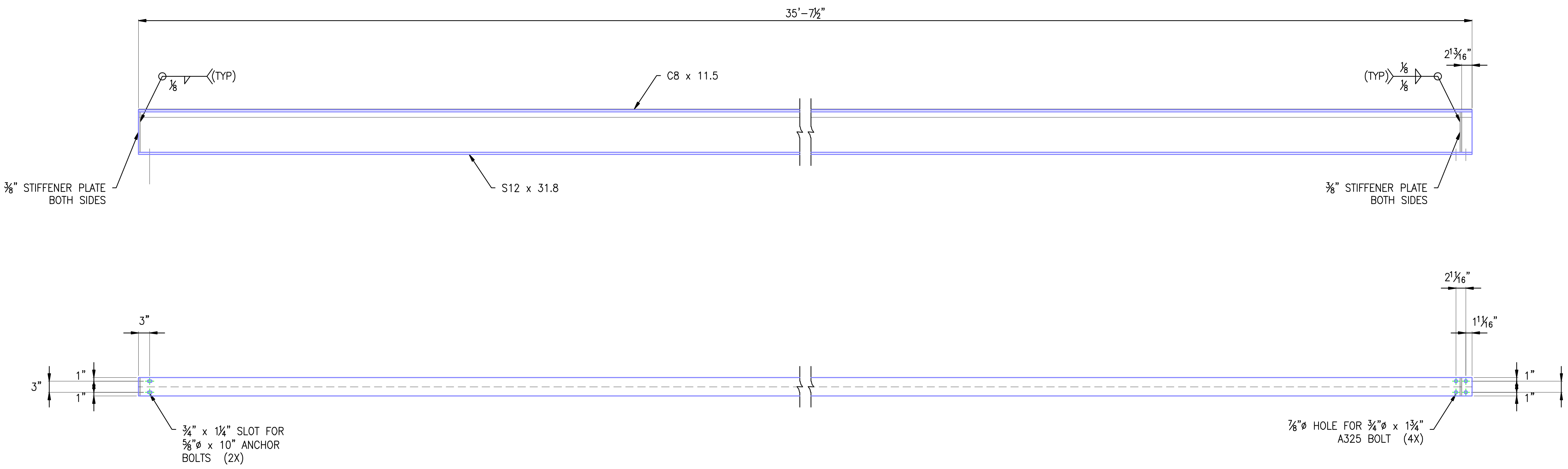
3.3 <u>CLEAN-UP:</u>

Leave work areas clean and free of debris.

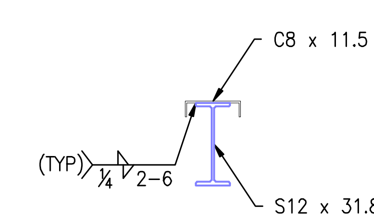


1 Beam plan

CONTRACTOR: Weaver General Construction Co. 3679 S. Huron St. Suite 404 Englewood, CO 80110 Ph: (303)789-4111 / Fx: (303)789-4310	FABRICATOR: **American Fabricators** **10290 E. 106th Ave.** **Brighton, Colorado 80601** **Ph: (303)296-6223 / Fx: (303)296-6263**	PROJECT: **Harold D Thompson WRF** TITLE: Beam Plan	Revision: 1. – – 2. – – 3. – – 4. – – 5. – –	DWG BY: **CCA** CHK BY: **EDO** DATE: **JUL 29 2011** SHEET NUMBER: **SD-01**



(A) – S12 x 31.8 CRANE BEAM



Notes:

1. S12 x 31.8 conforms to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. ¾"ø x 1¾" bolts conform to ASTM A325.
4. ¾"ø x 10" anchor bolts conform to ASTM F1554 Gr. 36.
5. Shop primed with Tnemec Series 37H–77 or equivalent.
6. Construction drawing HW–5.
7. ATTENTION ENGINEER: – WILL TROLLEY STOPS BE USED?

1 Beam -A- Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: Beam -A-

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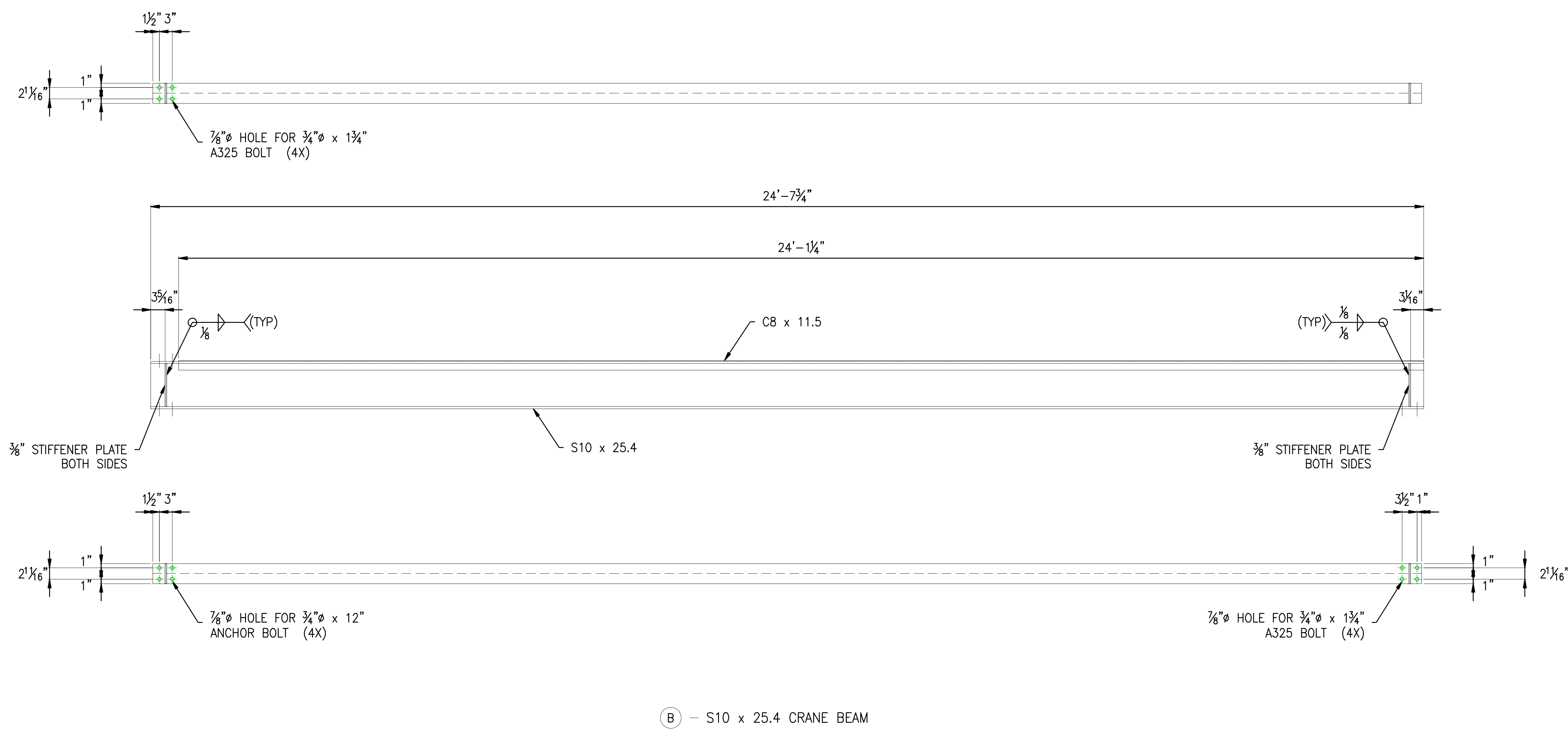
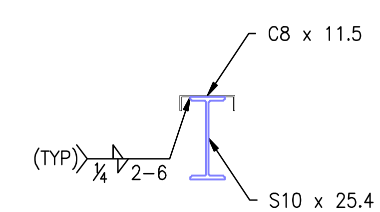
DATE: **JUL 29 2011**
SHEET NUMBER: **SD - 02**



Notes:

1. S10 x 25.4 conforms to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. ¾"ø x 1¾" bolts conform to ASTM A325.
4. ¾"ø x 12" anchor bolts conform to ASTM F1554 Gr. 36.
5. Shop primed with Tnemec Series 37H-77 or equivalent.
6. Construction drawing HW-5.
7. ATTENTION ENGINEER: – WILL TROLLEY STOPS BE USED?



1 Beam -B- Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: Harold D Thompson WRF

TITLE: Beam -B-

Revision:	
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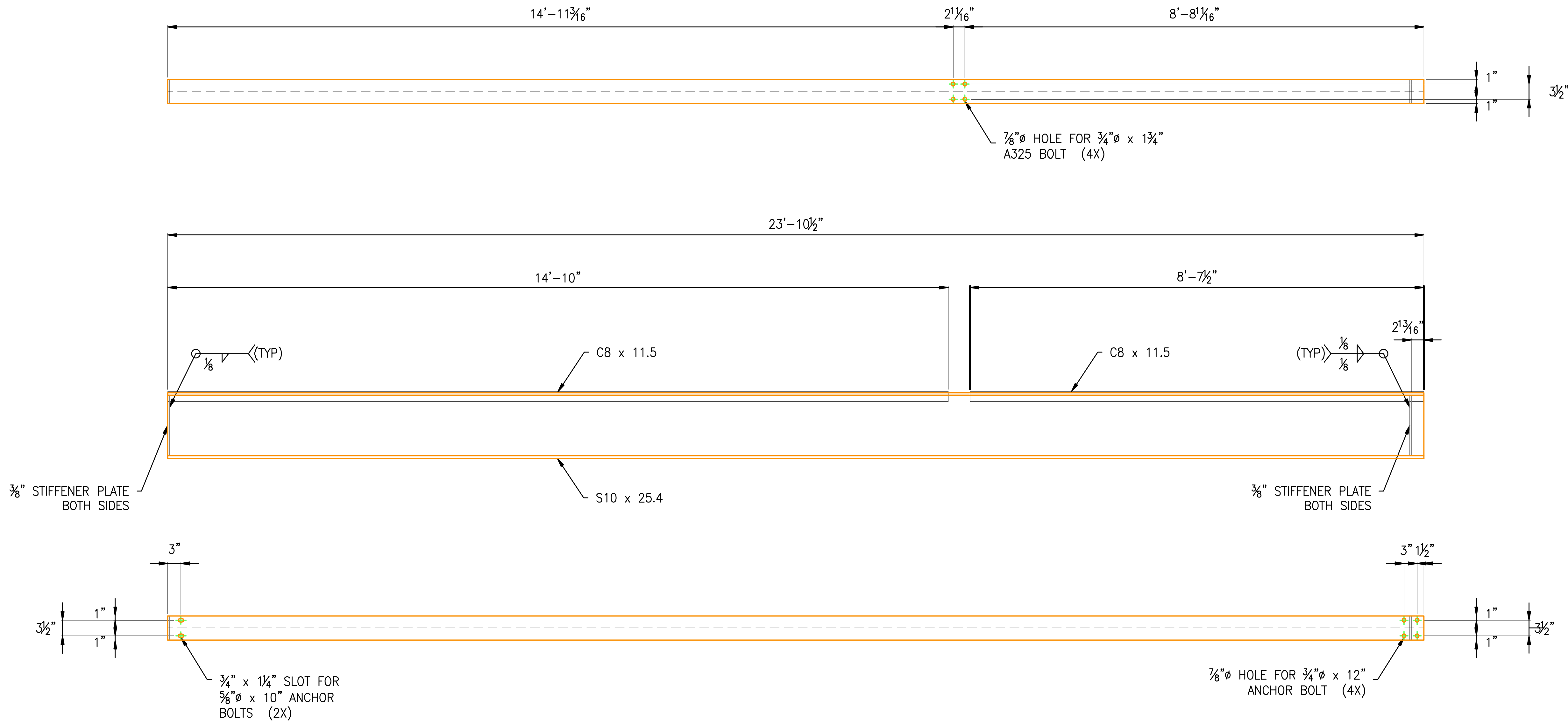
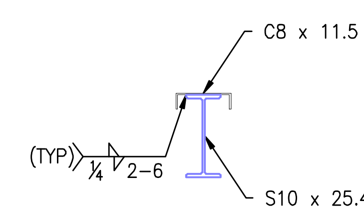
DATE: JUL 29 2011
SHEET NUMBER: SD - 03



(C) – S15 x 42.9 CRANE BEAM

Notes:

1. S15 x 42.9 conforms to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. ¾"ø x 1¾" bolts conform to ASTM A325.
4. ¾"ø x 12" anchor bolts conform to ASTM F1554 Gr. 36.
5. ¾"ø x 10" anchor bolts conform to ASTM F1554 Gr. 36.
6. Shop primed with Tnemec Series 37H–77 or equivalent.
7. Construction drawing HW–5.
8. ATTENTION ENGINEER: – WILL TROLLEY STOPS BE USED?



1 Beam -C- Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: Beam -C-

Revision:
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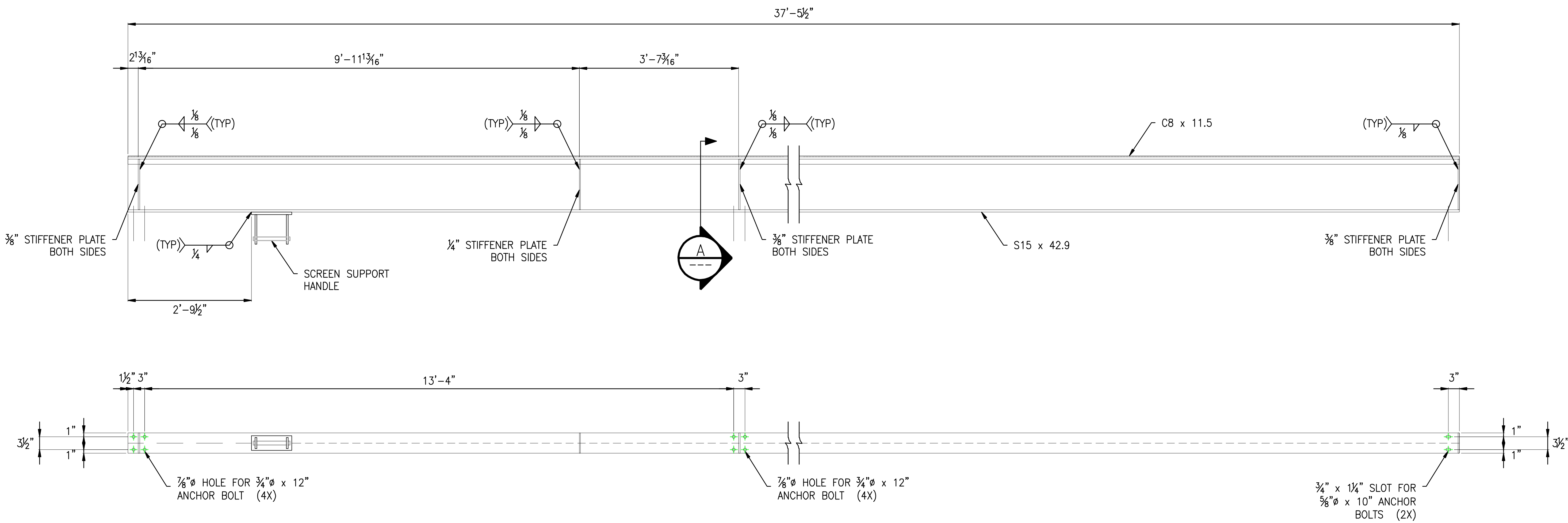
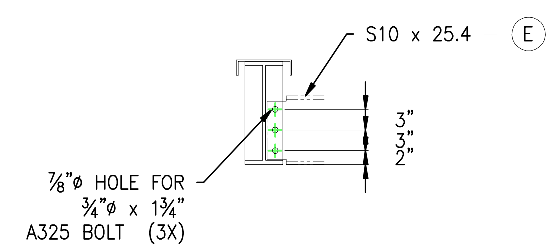
DATE: JUL 29 2011
SHEET NUMBER: **SD - 04**



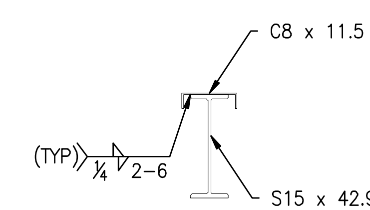
D — S15 x 42.9 CRANE BEAM

Notes:

1. S15 x 42.9 conforms to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. ¾"ø x 10" anchor bolts conform to ASTM F1554 Gr. 36.
4. ¾"ø x 1¾" bolts conform to ASTM A325.
5. Shop primed with Tnemec Series 37H-77 or equivalent.
6. Construction drawing HW-5.
7. ATTENTION ENGINEER: – WILL TROLLEY STOPS BE USED?



SECTION A



1 **Beam -D- Elevation**

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: Beam -D-

Revision:
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3. –
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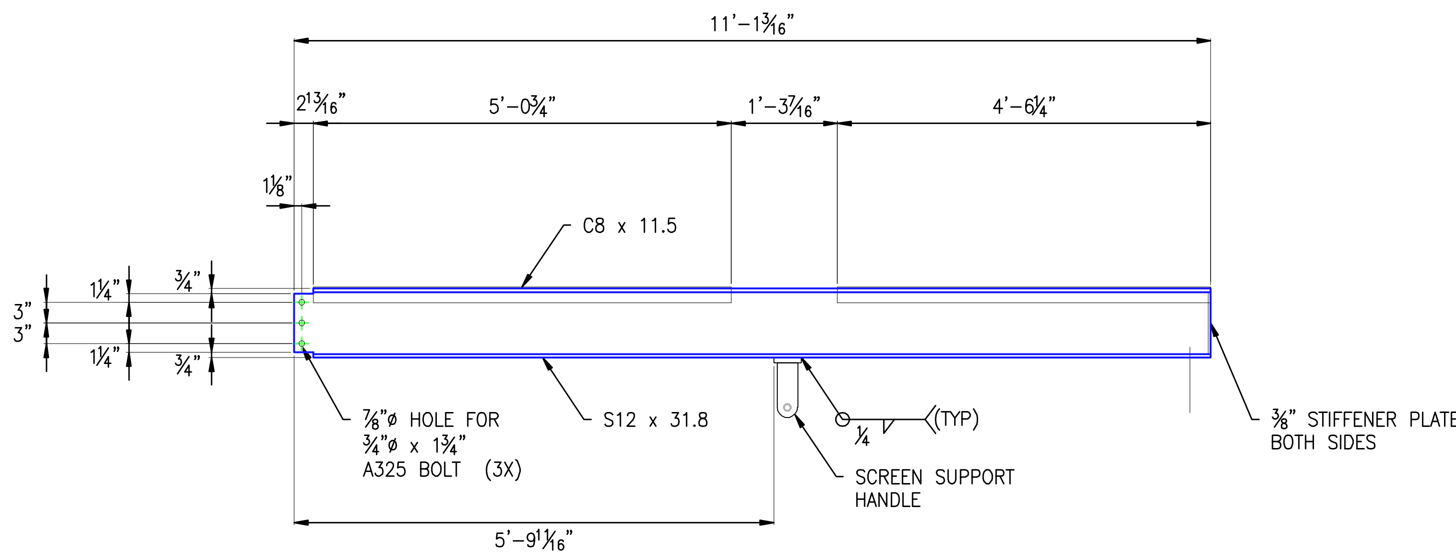
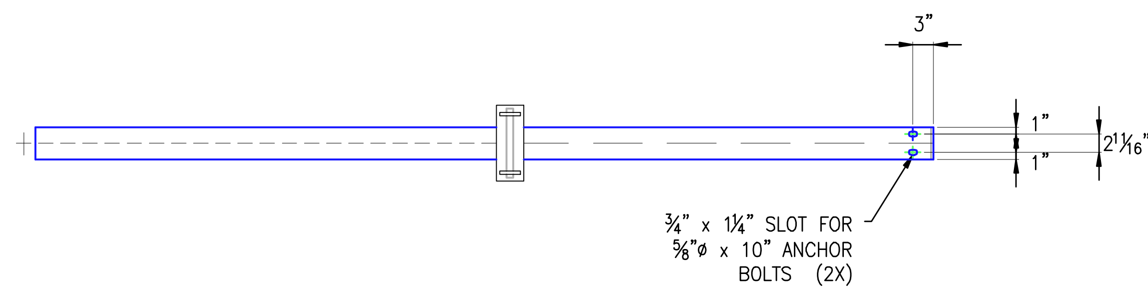
DATE: JUL 29 2011
SHEET NUMBER: **SD-05**

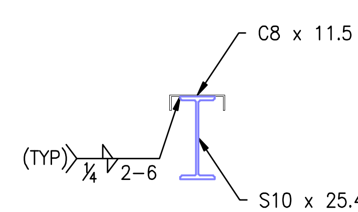




(E) – S10 x 25.4 CRANE BEAM

Notes:

1. S10 x 25.4 conforms to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. 3/4"ø x 1 3/4" bolts conform to ASTM A325.
4. 3/4"ø x 12" anchor bolts conform to ASTM F1554 Gr. 36.
5. Shop primed with Tnemec Series 37H–77 or equivalent.
6. Construction drawing HW–5.
7. ATTENTION ENGINEER: – WILL TROLLEY STOPS BE USED?



1 Beam -E- Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)298-6223 / Fx: (303)298-6263

PROJECT: Harold D Thompson WRF

TITLE: Beam -E-

Revision:	
1. –	–
2. –	–
3. –	–
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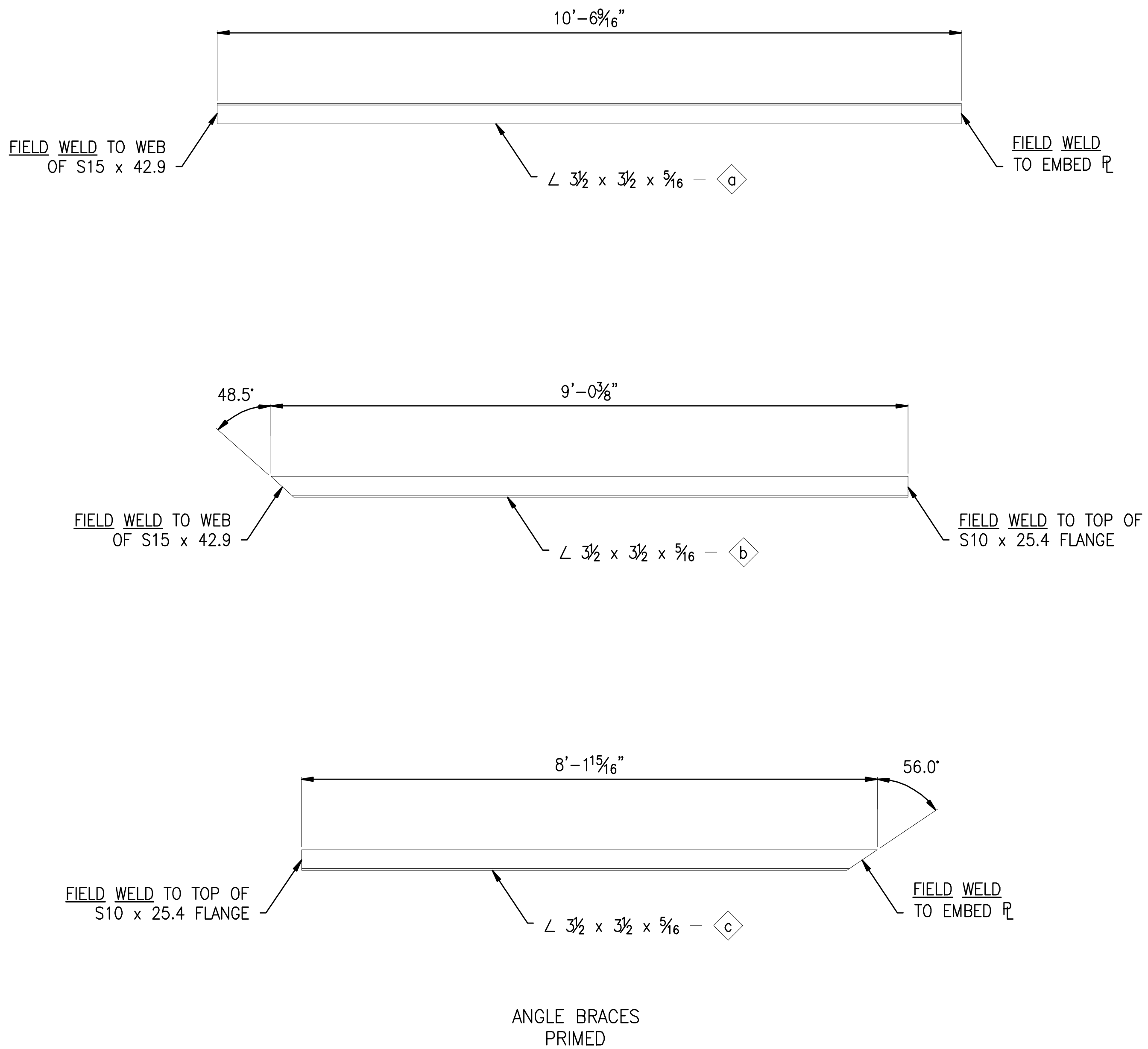
DWG BY: CCA CHK BY: EDO

DATE: JUL 29 2011

SHEET NUMBER: SD - 06

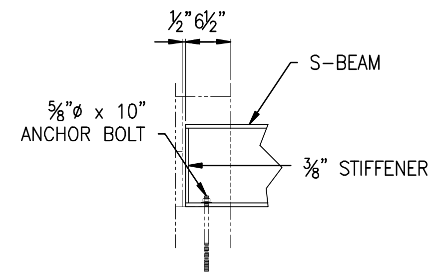


Notes:

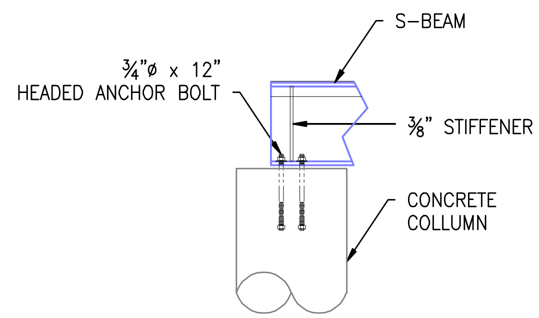
1. Angle conforms to ASTM A36 steel.
2. Shop primed with Tnemec Series 37H-77 or equivalent.
3. Construction drawing HW-5.

1 Angle Braces

CONTRACTOR:	FABRICATOR:	PROJECT: Harold D Thompson WRF	Revision:	DWG BY: CCA	CHK BY: EDO
Weaver General Construction Co. 3679 S. Huron St. Suite 404 Englewood, CO 80110 Ph: (303)789-4111 / Fx: (303)789-4310	American Fabricators 10290 E. 106th Ave. Brighton, Colorado 80601 Ph: (303)296-6223 / Fx: (303)296-6263	TITLE: Angle Braces	1. – – 2. – – 3. – – 4. – – 5. – –	DATE: JUL 29 2011 SHEET NUMBER: SD-07	



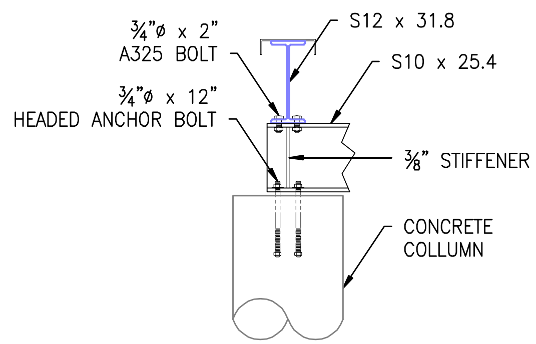
DETAIL 1



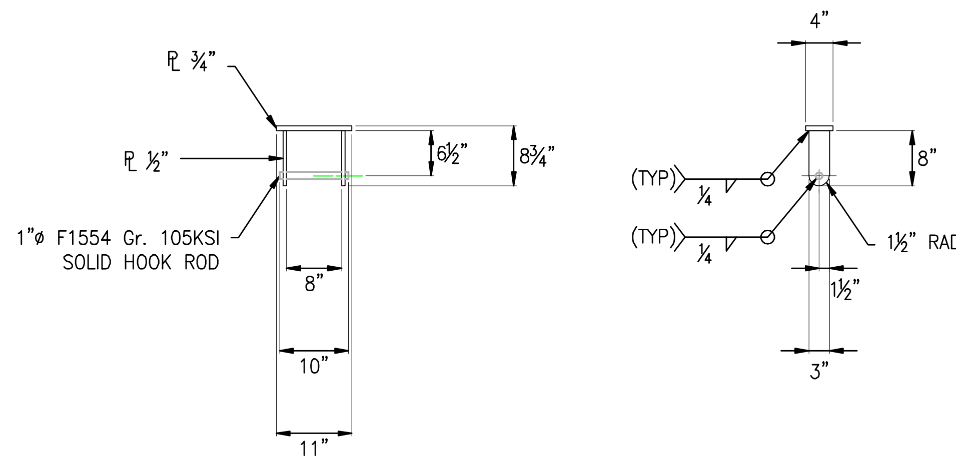
DETAIL 4

Notes:

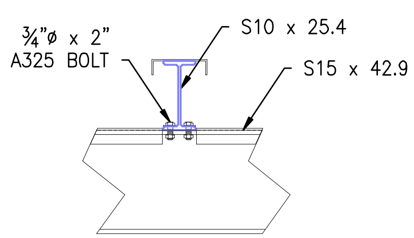
1. S–Beams conform to ASTM A572 & A992 Gr. 50 steel.
2. C8 x 11.5 conforms to ASTM A36 steel.
3. Plate conforms to ASTM A36 steel.
4. ¾"ø x 1¾" bolts conform to ASTM A325.
5. ¾"ø x 12" anchor bolts conform to ASTM F1554 Gr. 36.
6. ¾"ø x 10" anchor bolts conform to ASTM F1554 Gr. 36.
7. Shop primed with Tnemec Series 37H–77 or equivalent.



DETAIL 2



DETAIL 5
SCREEN SUPPORT HANDLE



DETAIL 3

1 S-Beam Details

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
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Ph: (303)286-6223 / Fx: (303)286-6263

PROJECT: **Harold D Thompson WRF**
TITLE: S-Beam Details

Revision:	
1. –	–
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3. –	–
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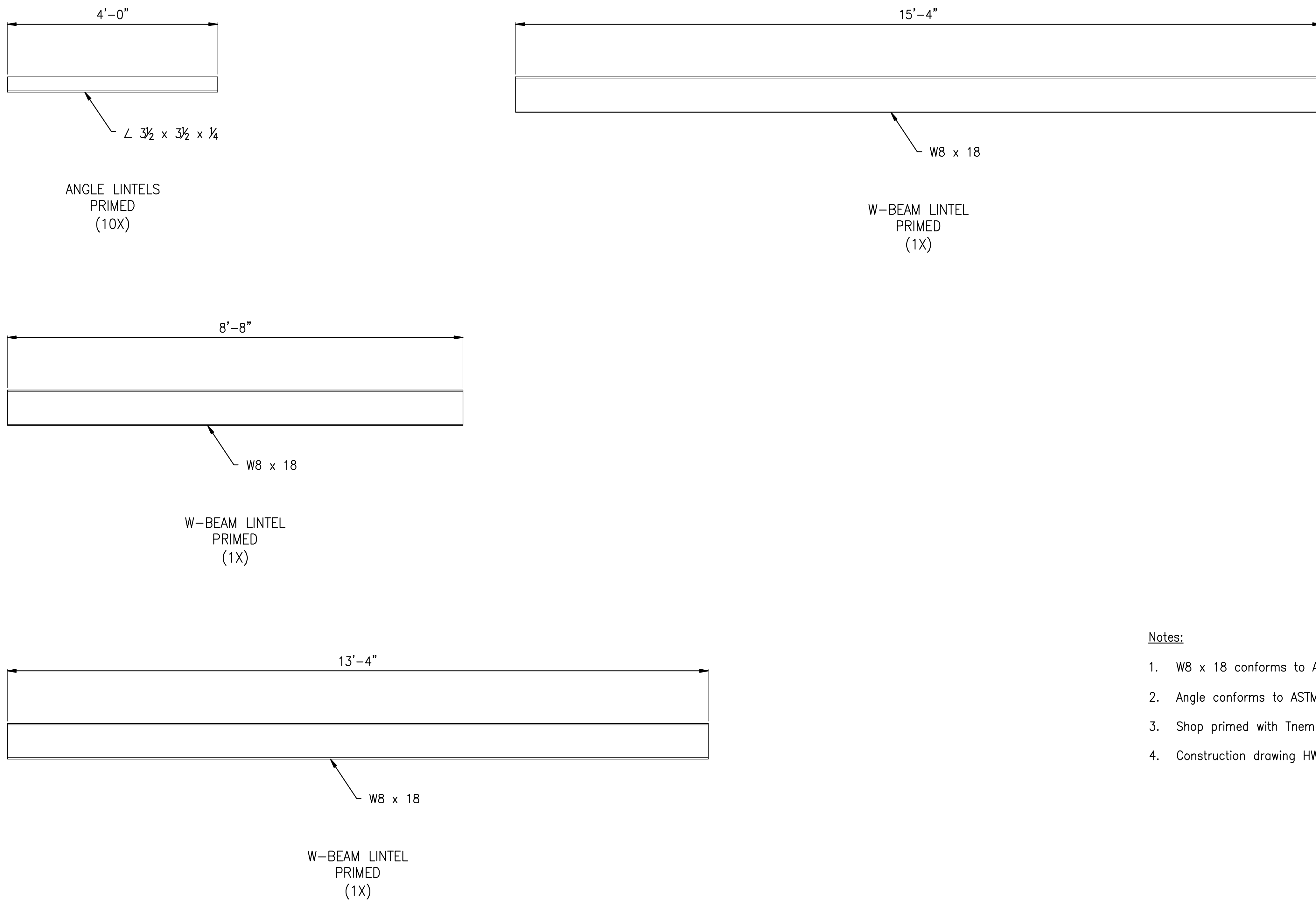
DWG BY: **CCA** CHK BY: **EDO**
DATE: **JUL 29 2011**
SHEET NUMBER: **SD - 08**

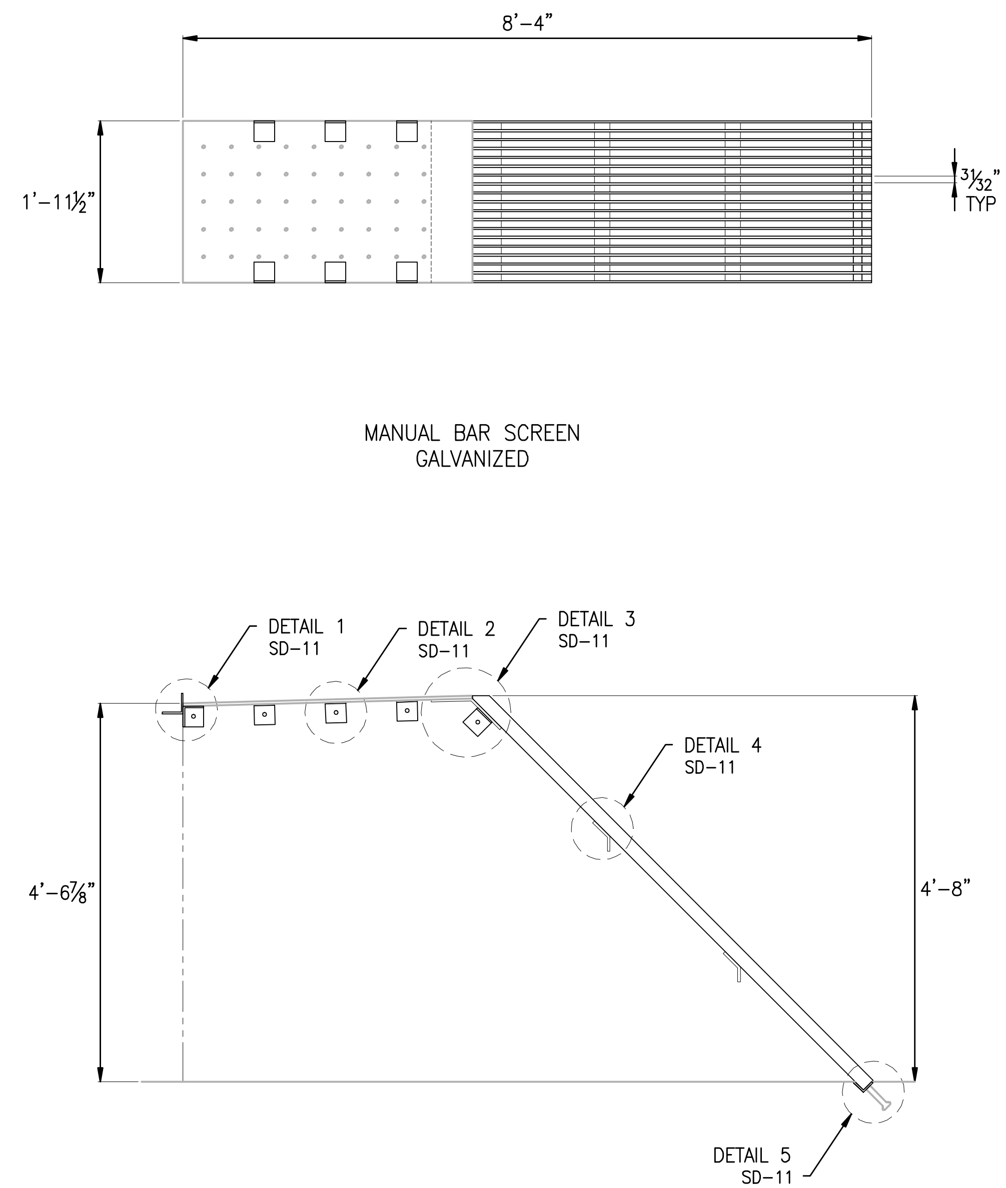


Notes:

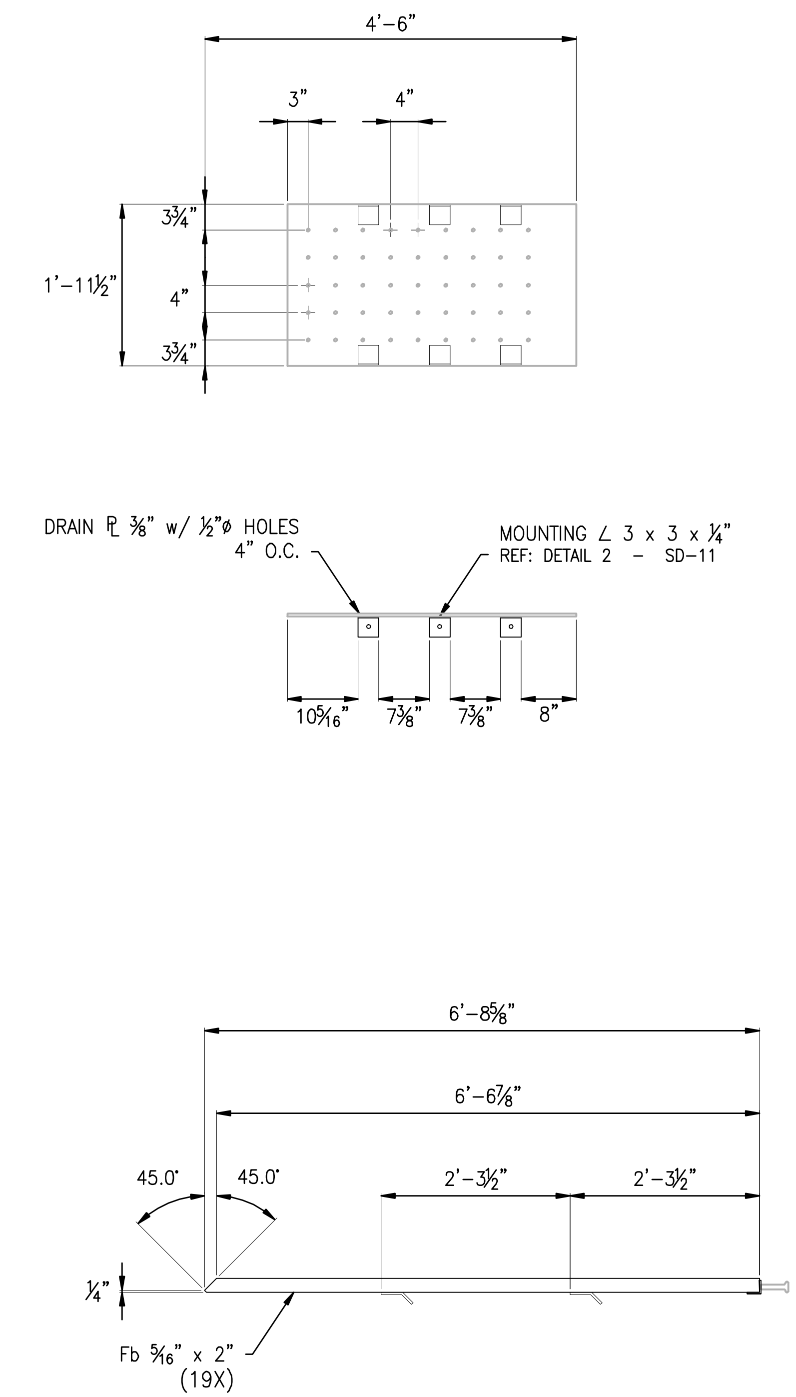
1. W8 x 18 conforms to ASTM A572 / A992 Gr. 50.
2. Angle conforms to ASTM A36 steel.
3. Shop primed with Tnemec Series 37H–77 or equivalent.
4. Construction drawing HW–11.

1 Lintel Elevation

CONTRACTOR: Weaver General Construction Co. 3679 S. Huron St. Suite 404 Englewood, CO 80110 Ph: (303)789-4111 / Fx: (303)789-4310	FABRICATOR: American Fabricators 10290 E. 106th Ave. Brighton, Colorado 80601 Ph: (303)296-6223 / Fx: (303)296-6263	PROJECT: Harold D Thompson WRF TITLE: Lintels	Revision: 1. – – 2. – – 3. – – 4. – – 5. – –	DWG BY: CCA / CHK BY: EDO DATE: JUL 29 2011 SHEET NUMBER: SD - 09



1 Lintel Elevation



2 Lintel Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT:	Harold D Thompson WRF
TITLE:	Lintels

Revision:	
1. –	–
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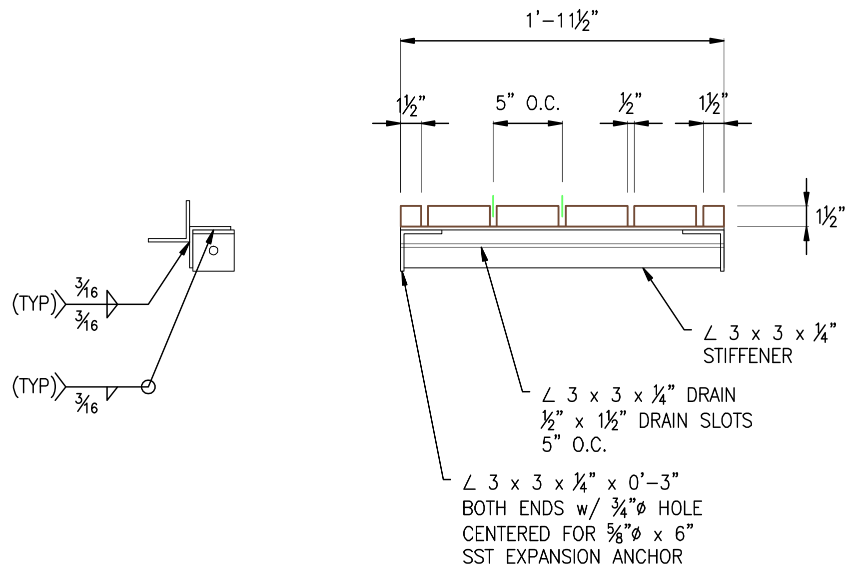
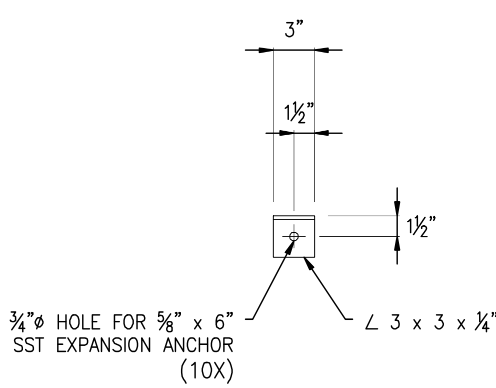
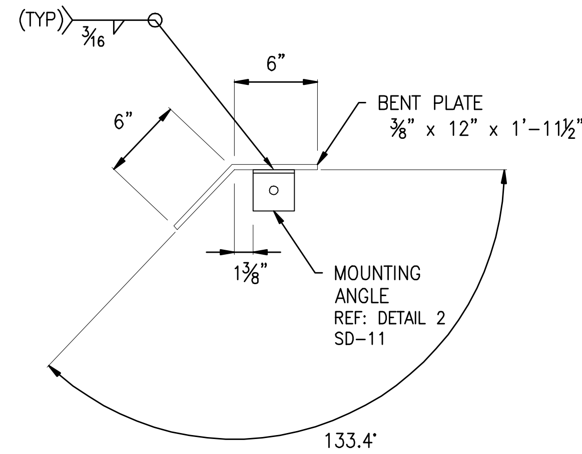
DWG BY: CCA	CHK BY: EDO
DATE: JUL 29 2011	
SHEET NUMBER: SD - 10	



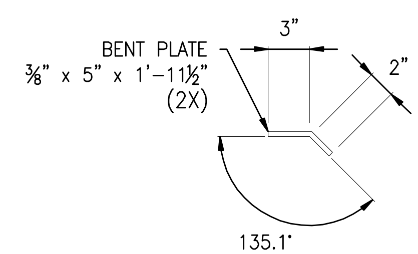
DETAIL 1



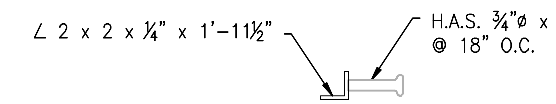
DETAIL 2



DETAIL 3



DETAIL 4



DETAIL 5

Notes:

1. Plate comforms to ASTM A36 steel.
2. Angle conforms to ASTM A36 steel.
3. Flat bar conforms to ASTM A36 steel.
4. ⅝"ø x 6" stainless steel anchors are 304.
5. Manual bar sreen to be galvanized is per AZZ Galvanizing specifications and requirements. Conforms to ASTM A123A and A123M–02.
6. Construction drawing HW–18.

1 Lintel Elevation

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
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American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: Lintels

Revision:	
1. –	–
2. –	–
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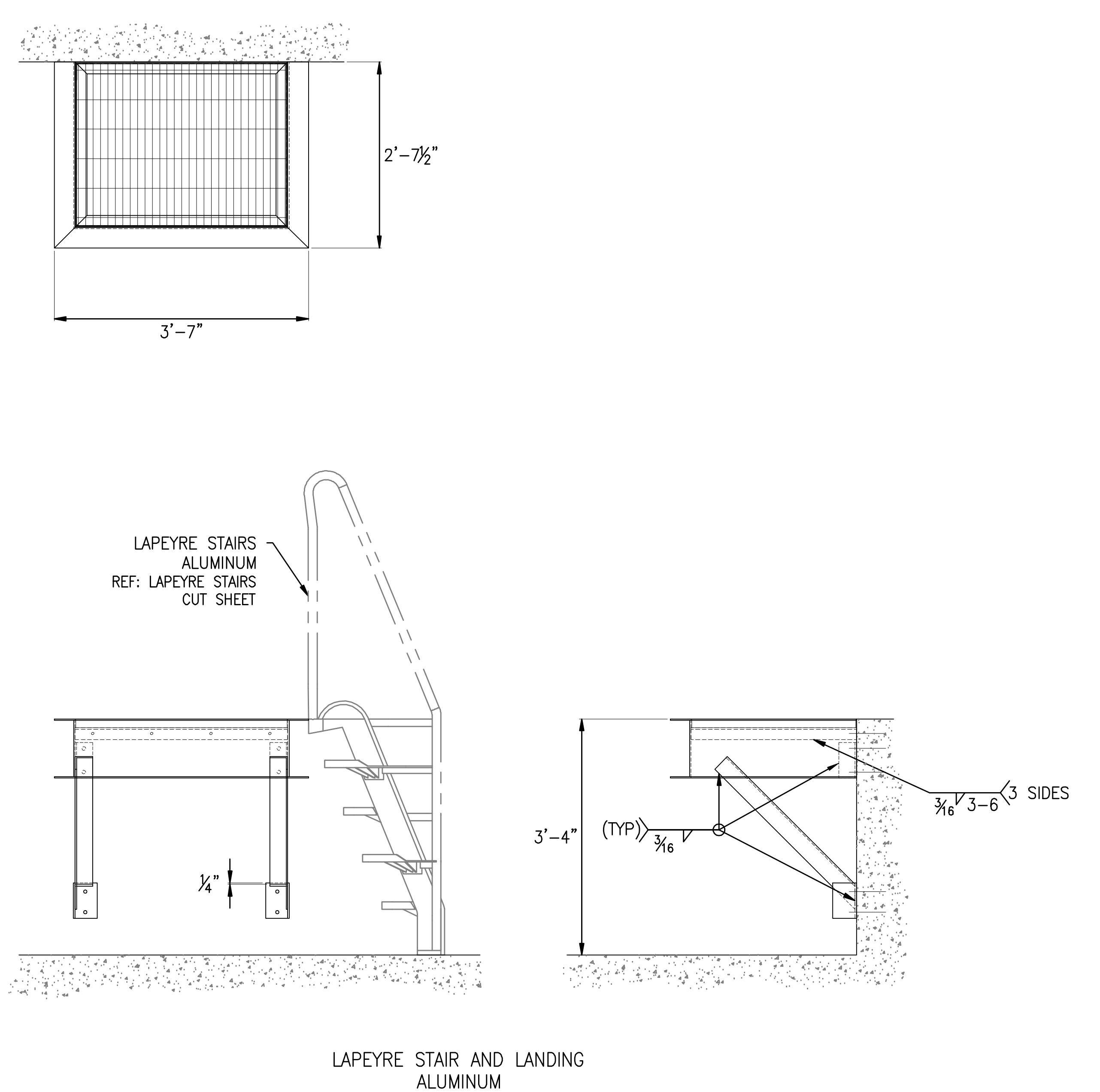
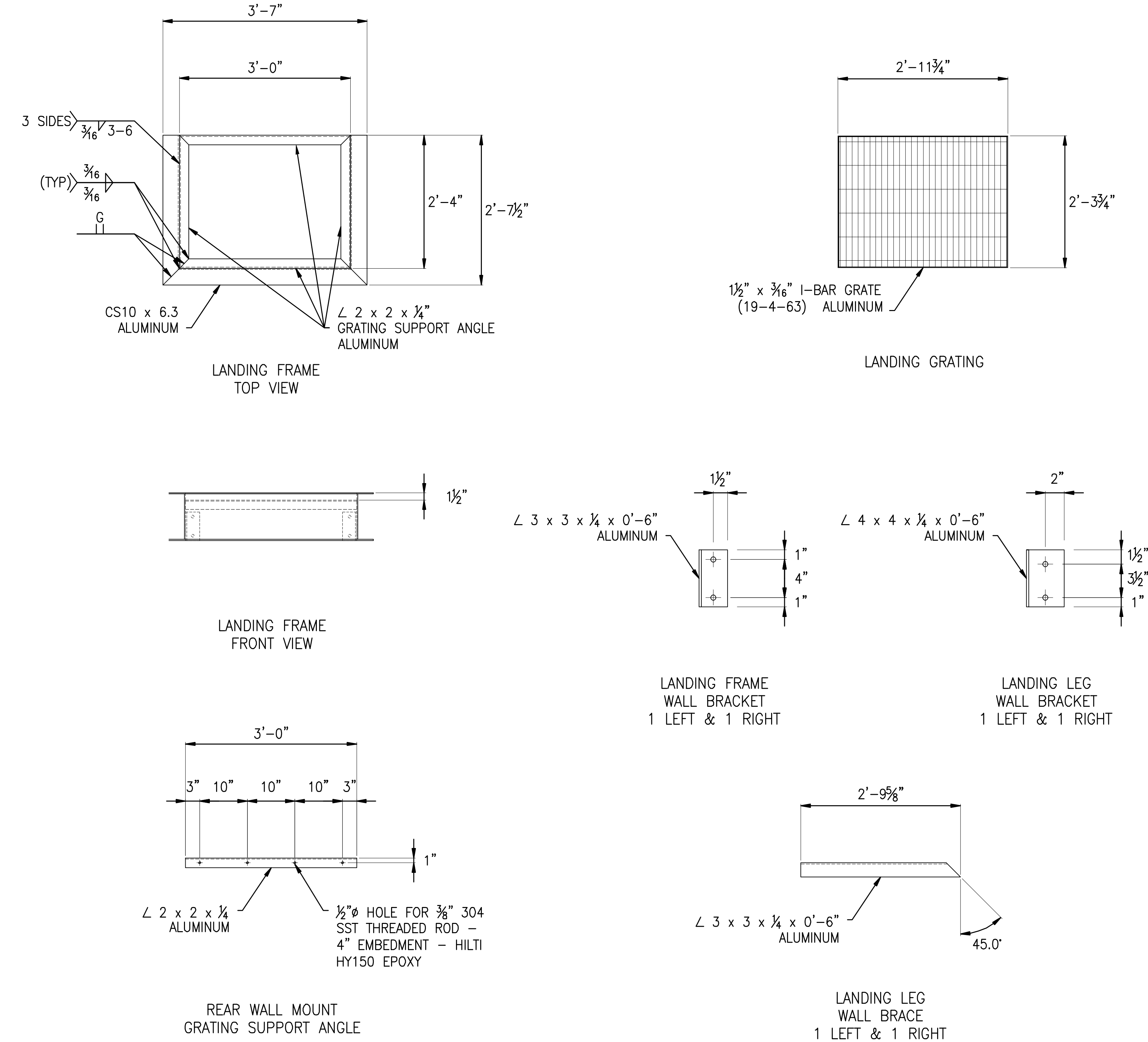
DWG BY: CCA | CHK BY: EDO
DATE: JUL 29 2011
SHEET NUMBER: **SD-11**





Notes:

1. Channel is 6061-T6 aluminum.
2. Angles are 6061-T6 aluminum.
3. Grating conforms to ASTM B-221 6063 ir 6061 aluminum.
4. ⅝"ø x 6" stainless steel threaded rod is 304.
5. Stairs ar Lapeyre - SEE CUT SHEET
6. Construction drawing HW-18.

1 Lapeyre Stairs and Landing

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**
TITLE: **Landing and Lapeyre Stairs**

Revision:	
1. –	–
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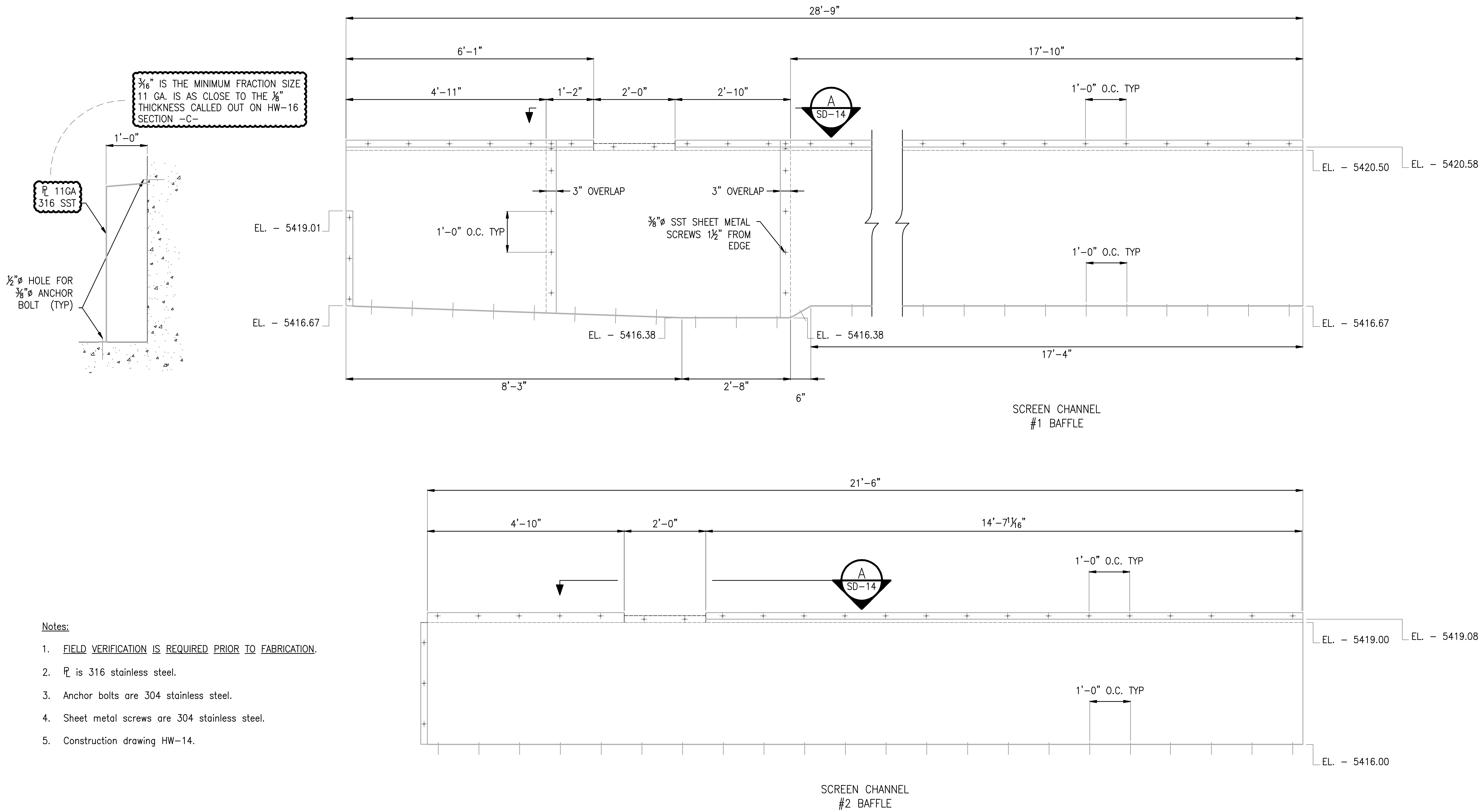
DWG BY: CCA | CHK BY: EDO
DATE: JUL 29 2011
SHEET NUMBER: **SD-12**



Notes:

1. FIELD VERIFICATION IS REQUIRED PRIOR TO FABRICATION.
2. PL is 316 stainless steel.
3. Anchor bolts are 304 stainless steel.
4. Sheet metal screws are 304 stainless steel.
5. Construction drawing HW-14.

1 Lapeyre Stairs and Landing

CONTRACTOR:
Weaver General Construction Co.
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Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: Harold D Thompson WRF

TITLE: Landing and Lapeyre Stairs

Revision:	
1. –	–
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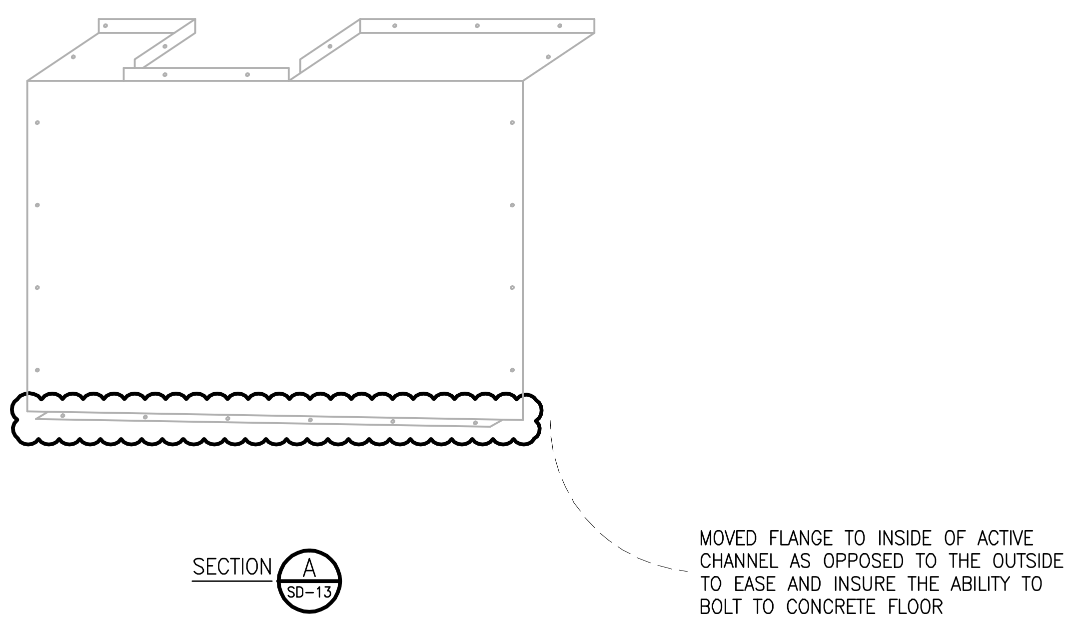
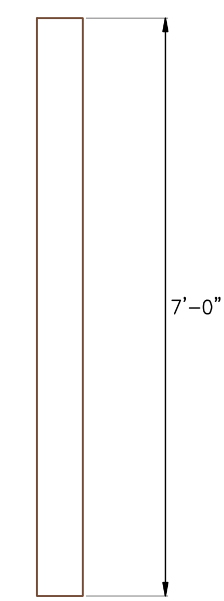
DATE: JUL 29 2011	
SHEET NUMBER: SD - 13	



1 Baffel Section



Notes:

1. Pipe conforms to ASTM A500 Gr. B steel.
2. Shop primed with Tnemec Series 37H-77 or equivalent.
3. Construction drawing HW-1 & HW-13 Details DL-3 #3.

2 Bollard

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: Harold D Thompson WRF

TITLE: Baffel Section - Bollard

Revision:	
1. –	–
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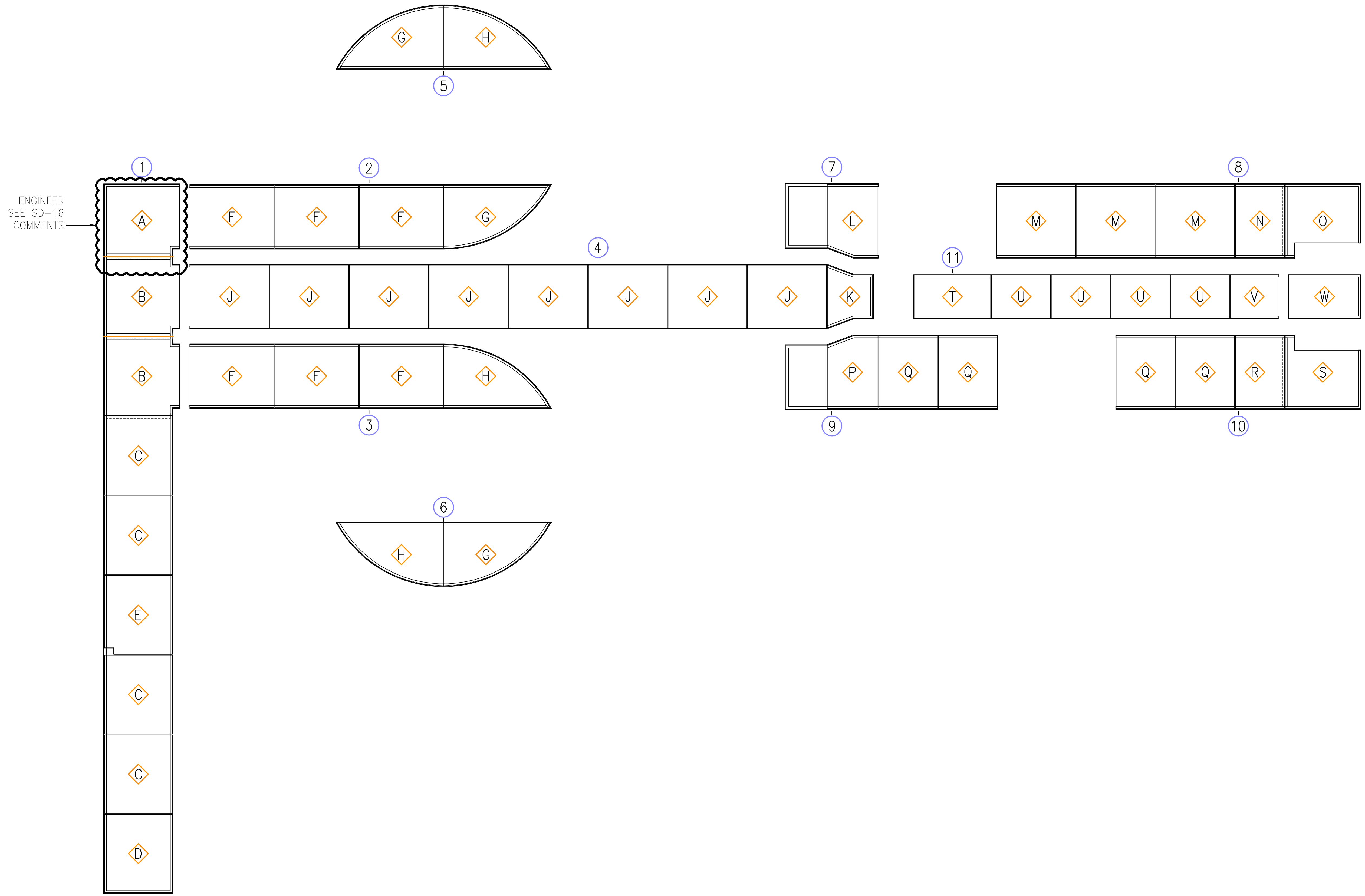
DWG BY: CCA | CHK BY: EDO

DATE: JUL 29 2011

SHEET NUMBER: SD- 14



1 **Baffel Section**

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
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Ph: (303)789-4111 / Fx: (303)789-4310

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American Fabricators
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Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: **Landing and Lapeyre Stairs**

Revision:	
1. –	–
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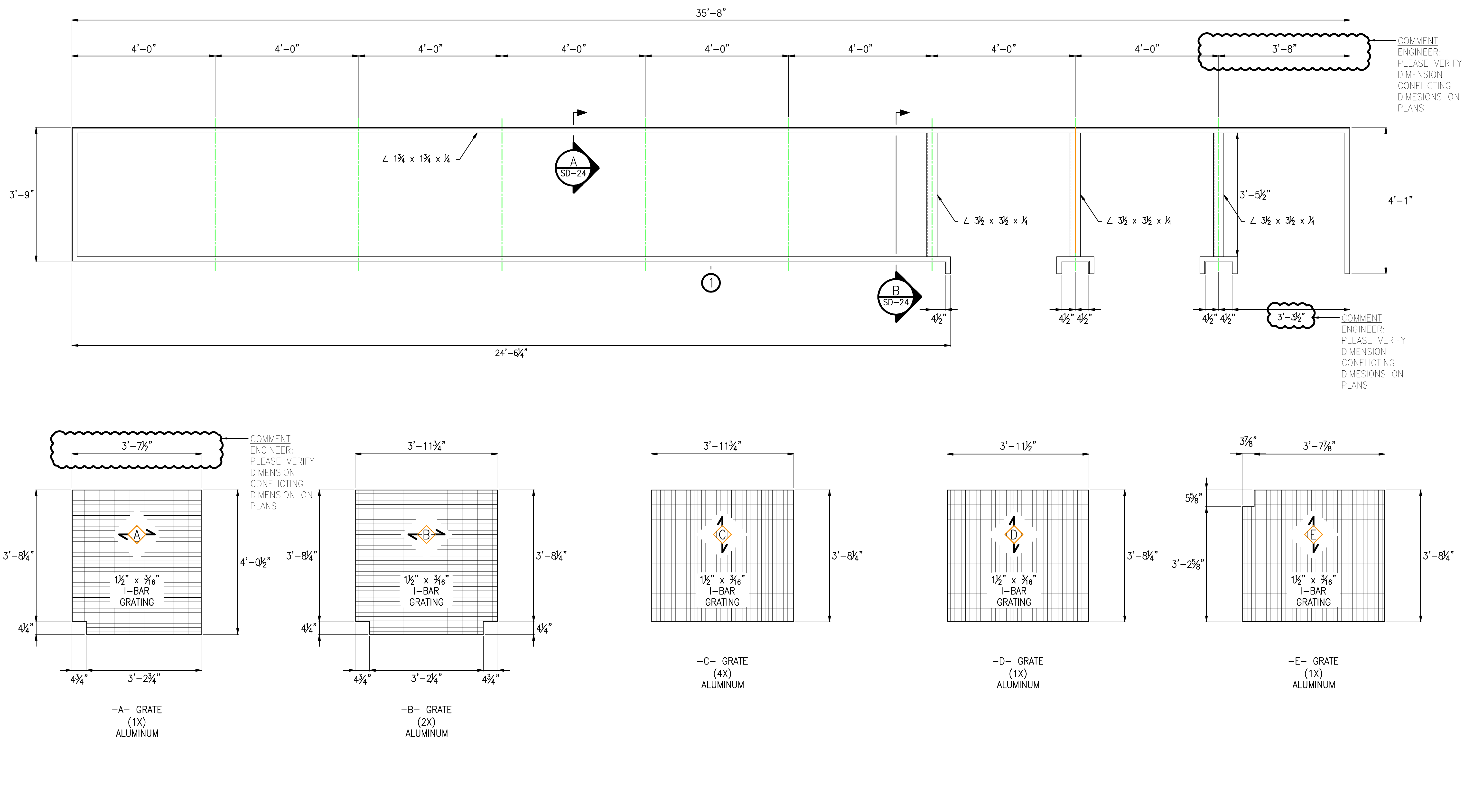
DWG BY: **CCA** CHK BY: **EDO**

DATE: **JUL 29 2011**

SHEET NUMBER: **SD - 15**



1 Embed and Grating Section 1

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)286-6223 / Fx: (303)286-6263

PROJECT: Harold D Thompson WRF

TITLE: Section 1 - Embed and Grating

Revision:	
1. –	–
2. –	–
3. –	–
4. –	–
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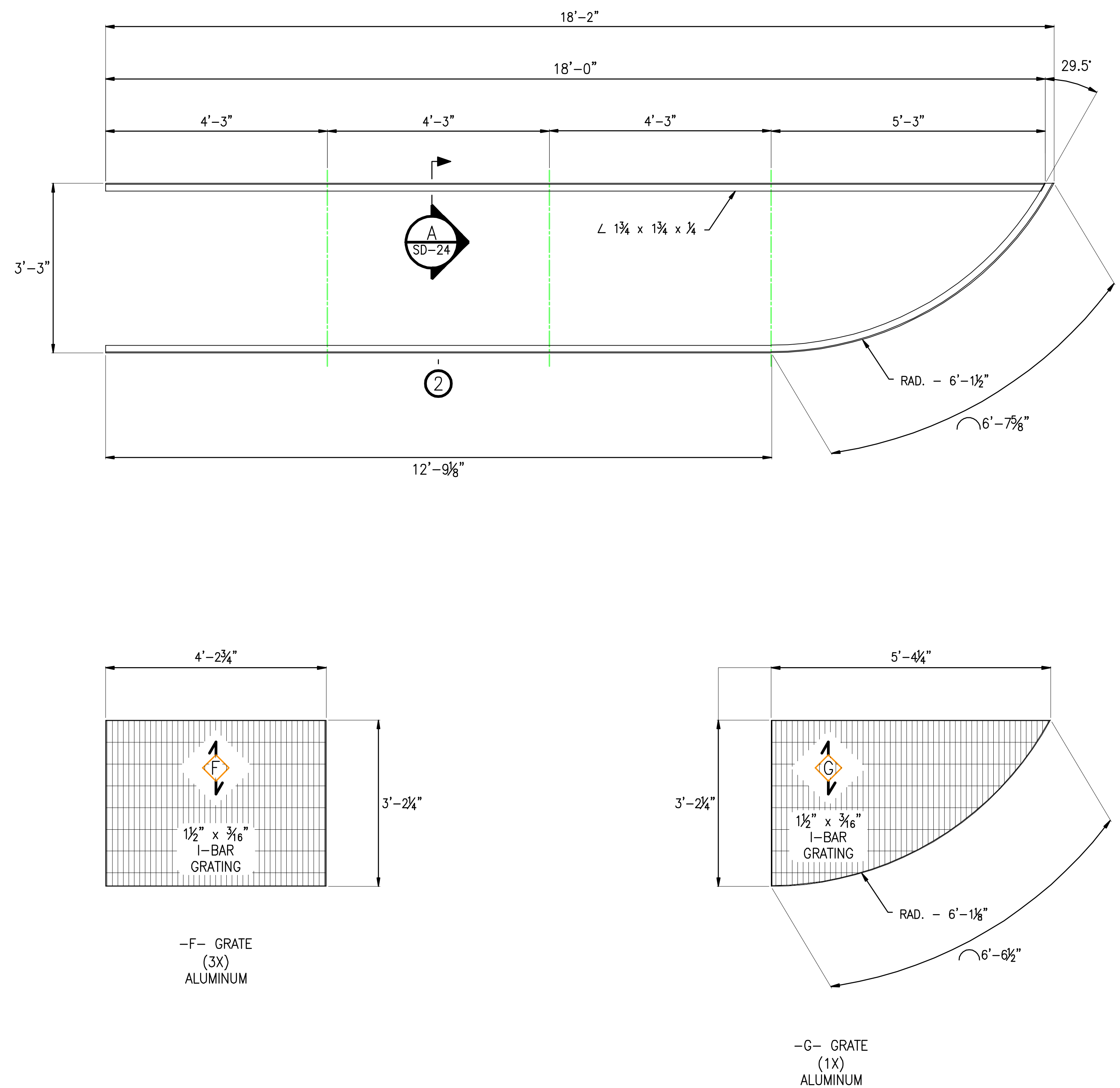
DWG BY: CCA | CHK BY: EDO

DATE: JUL 29 2011

SHEET NUMBER: SD - 16



1 Embed and Grating Section 2

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
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Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: Harold D Thompson WRF

TITLE: Section 2 - Embed and Grating

Revision:
1. –
2. –
3. –
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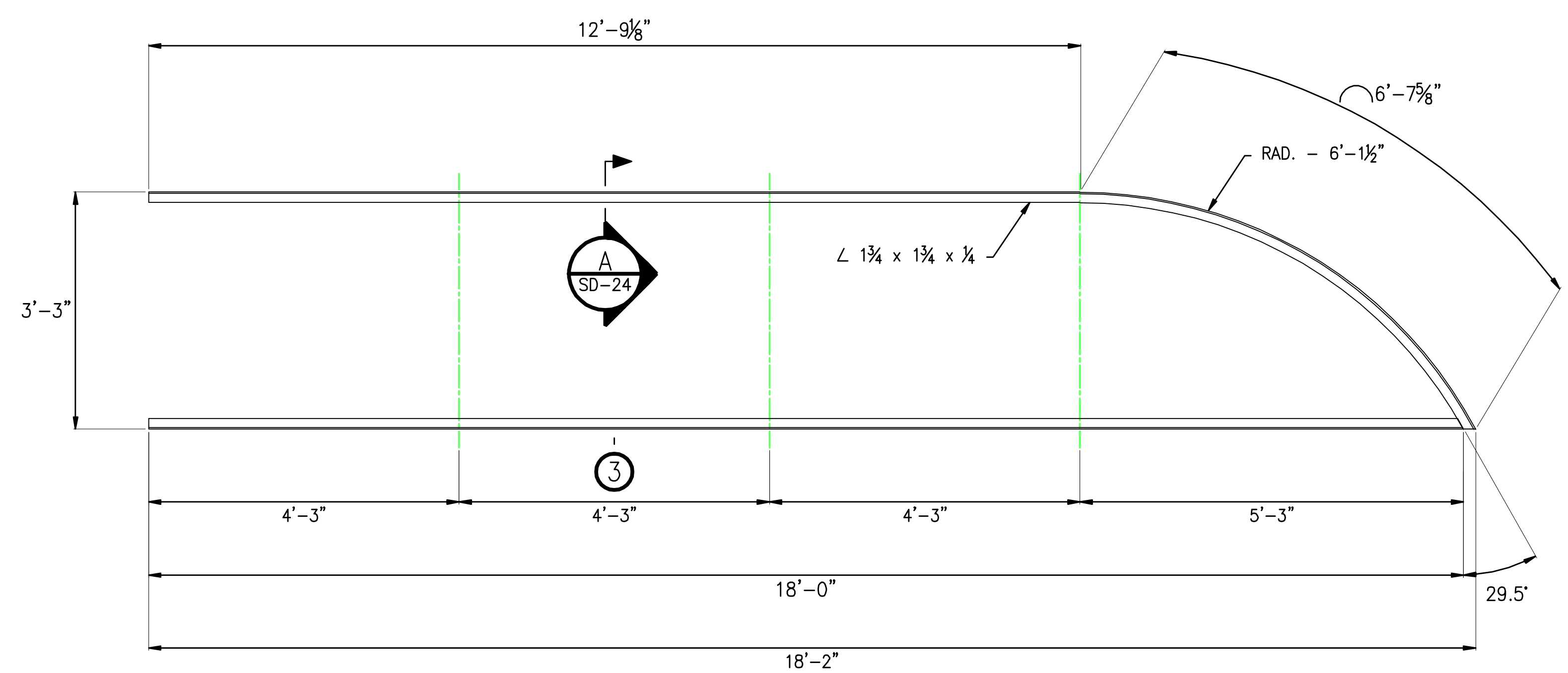
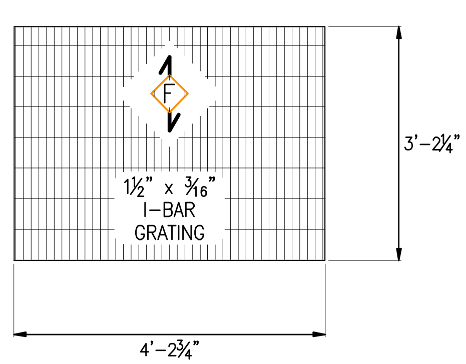
5. –

DWG BY: CCA CHK BY: EDO
DATE: JUL 29 2011
SHEET NUMBER: SD - 17





–F– GRATE
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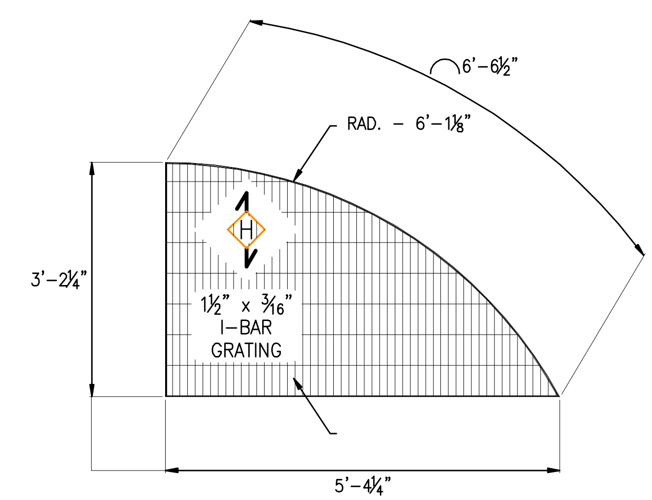
ALUMINUM



–H– GRATE
(1X)
ALUMINUM

1 **Embed and Grating Section 3**

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

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PROJECT: **Harold D Thompson WRF**

TITLE: **Section 3 - Embed and Grating**

Revision:	
1. –	–
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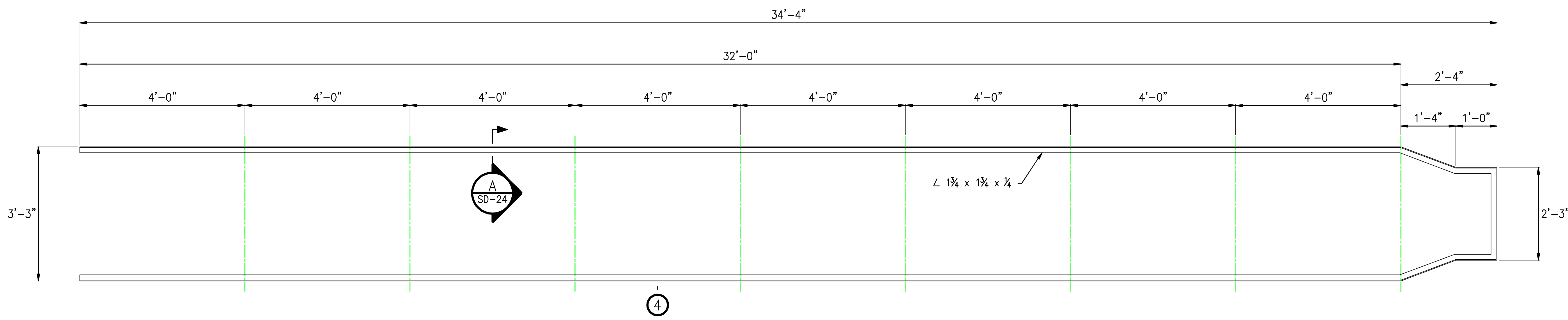
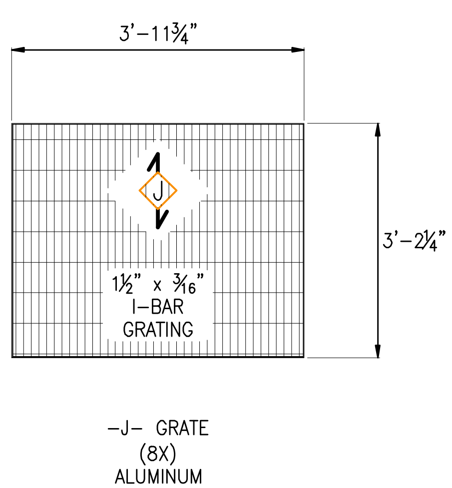
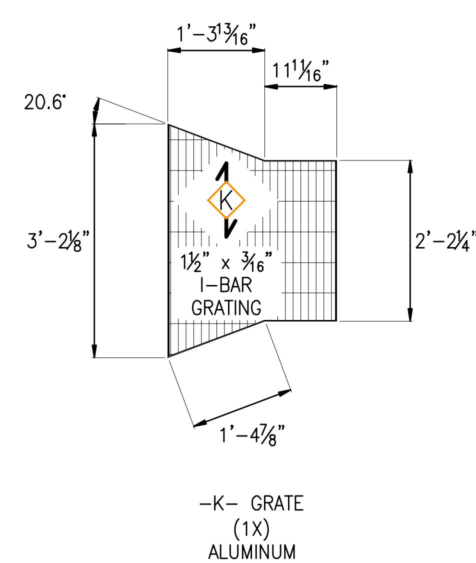
DWG BY: **CCA**	CHK BY: **EDO**
DATE: **JUL 29 2011**	
SHEET NUMBER: **SD - 18**	







1 **Embed and Grating Section 4**

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: **Harold D Thompson WRF**

TITLE: **Section 4 - Embed and Grating**

Revision:	
1. –	–
2. –	–
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4. –	–
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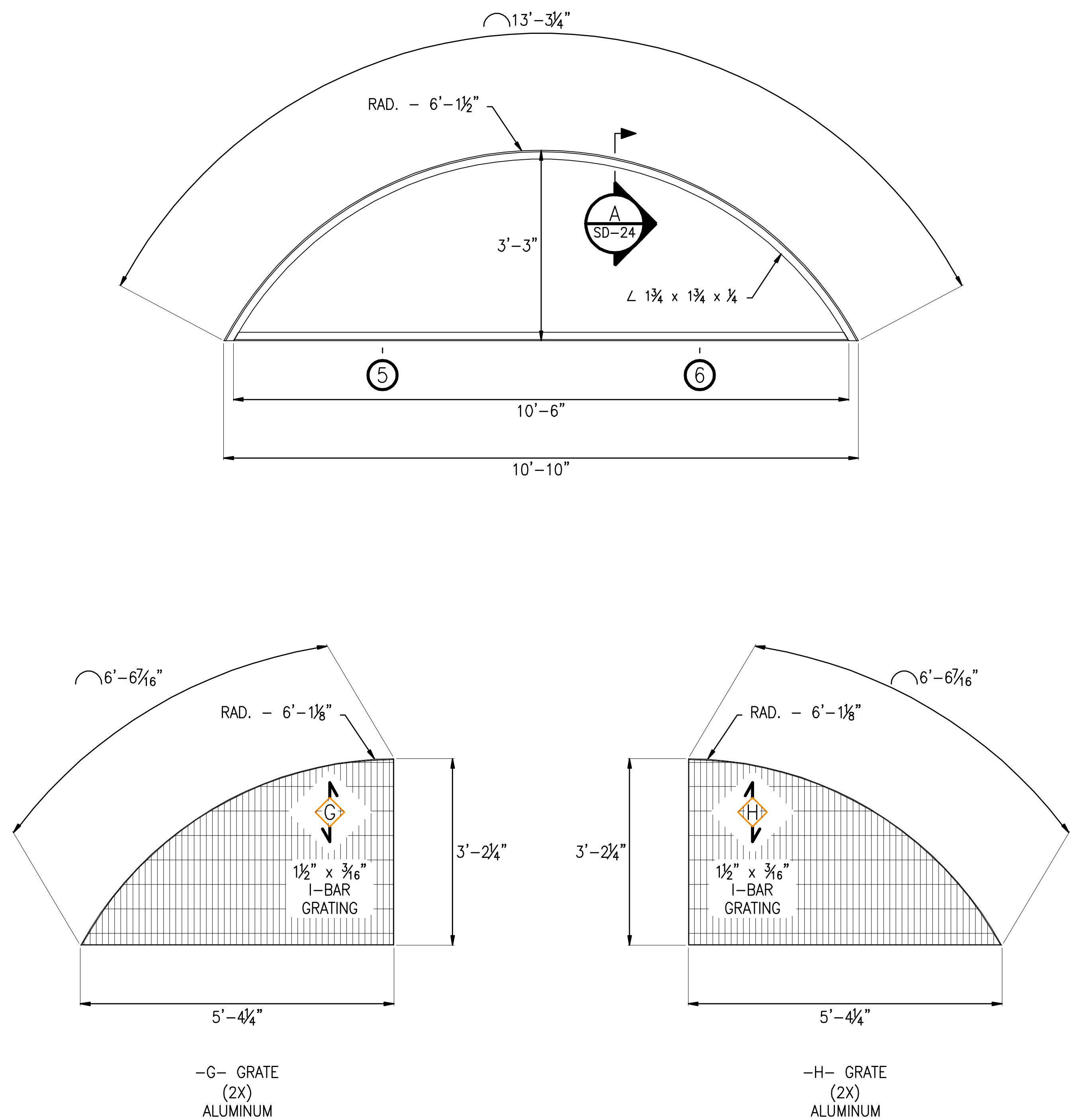
DWG BY: **CCA** CHK BY: **EDO**

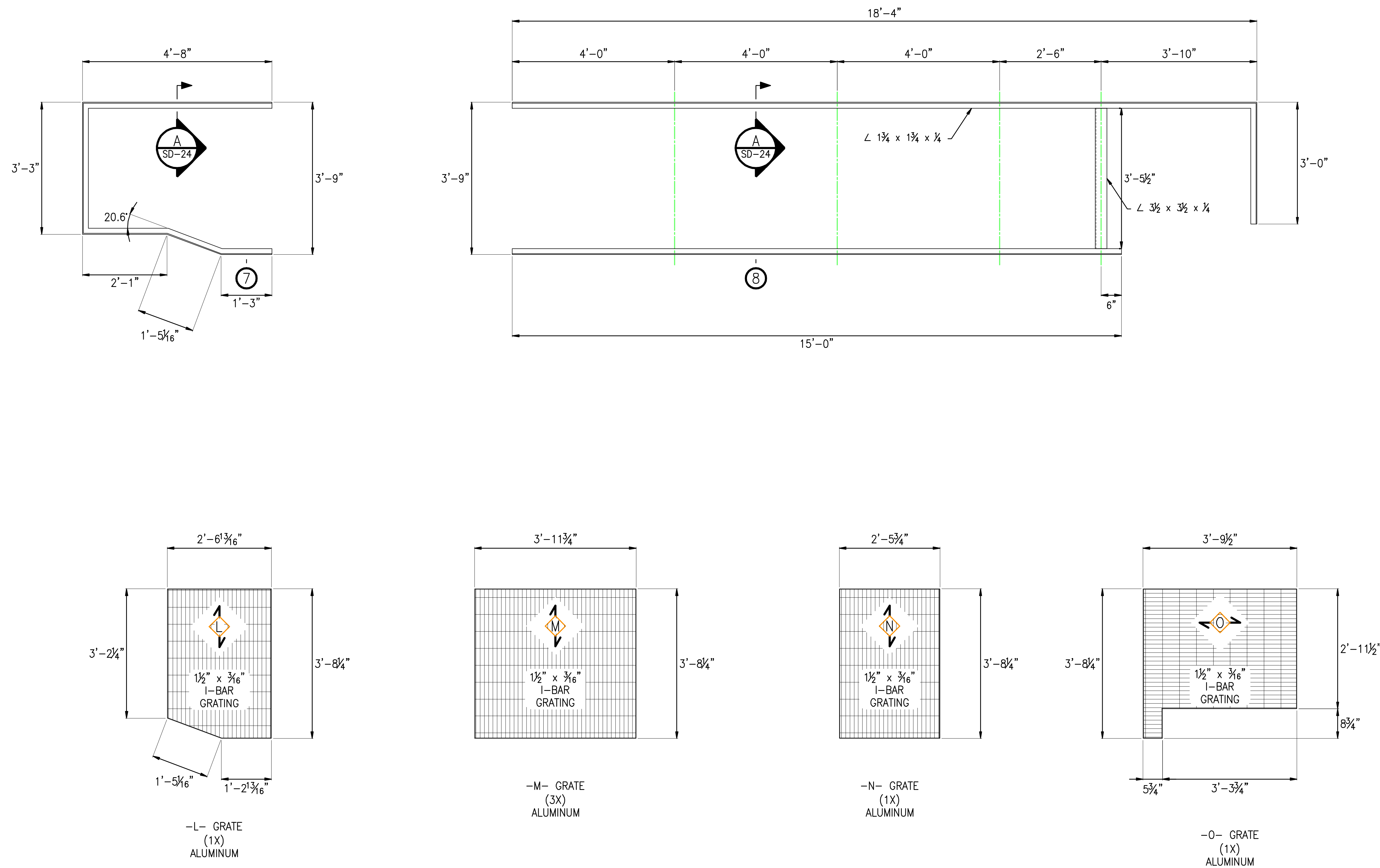
DATE: **JUL 29 2011**

SHEET NUMBER: **SD - 19**



1 Embed and Grating Sections 5 and 6

CONTRACTOR: Weaver General Construction Co. 3679 S. Huron St. Suite 404 Englewood, CO 80110 Ph: (303)789-4111 / Fx: (303)789-4310	FABRICATOR: American Fabricators 10290 E. 106th Ave. Brighton, Colorado 80601 Ph: (303)296-6223 / Fx: (303)296-6263	PROJECT: Harold D Thompson WRF TITLE: Sections 5 and 6 - Embed and Grating	Revision: 1. – – 2. – – 3. – – 4. – – 5. – –
DWG BY: CCA	CHK BY: EDO	DATE: JUL 29 2011	SHEET NUMBER: SD - 20



1 Embed and Grating Sections 7 and 8

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
American Fabricators
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Brighton, Colorado 80601
Ph: (303)286-6223 / Fx: (303)286-6263

PROJECT: Harold D Thompson WRF

TITLE: Sections 7 and 8 - Embed and Grating

Revision:
1. –
2. –
3. –
4. –
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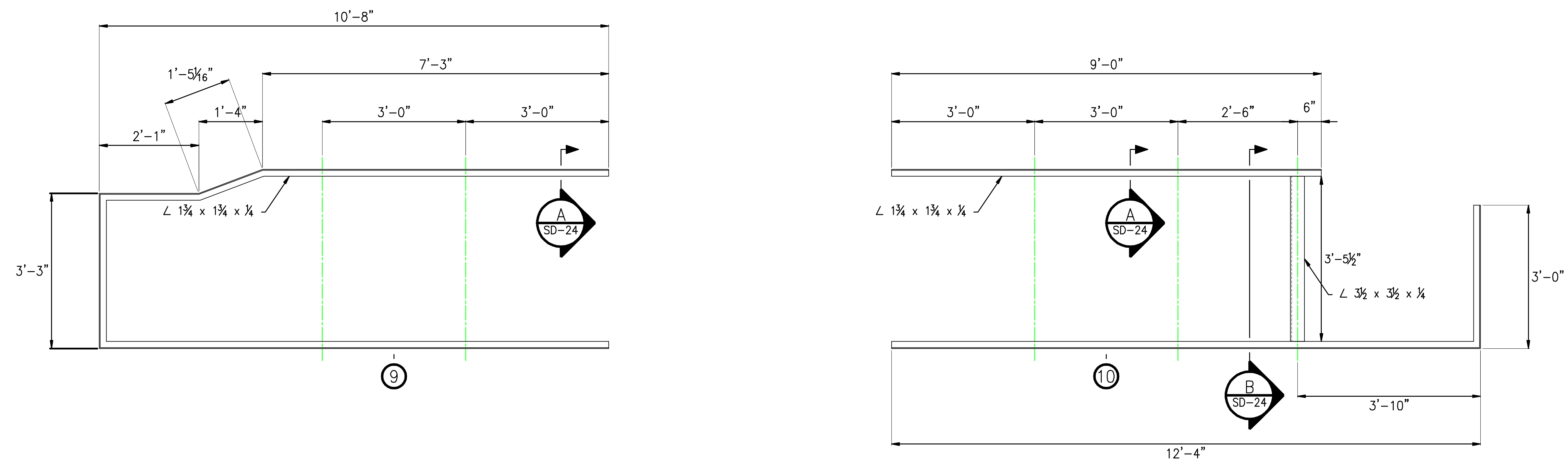
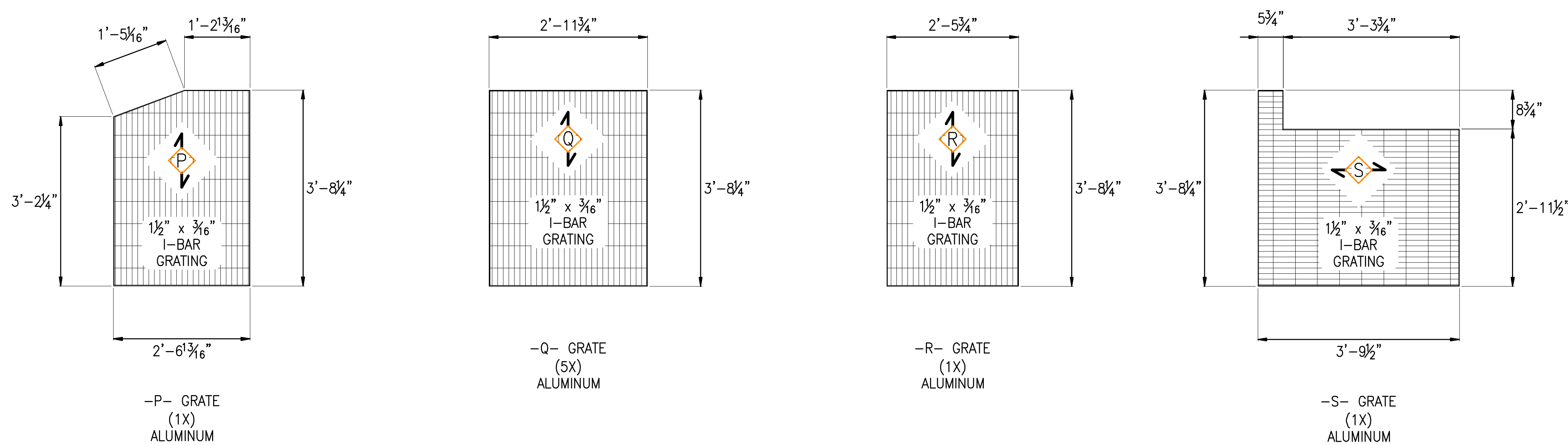
DWG BY: CCA | CHK BY: EDO

DATE: JUL 29 2011

SHEET NUMBER: SD - 21





1 Embed and Grating Sections 9 and 10

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

FABRICATOR:
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Ph: (303)296-6223 / Fx: (303)296-6263

PROJECT: Harold D Thompson WRF

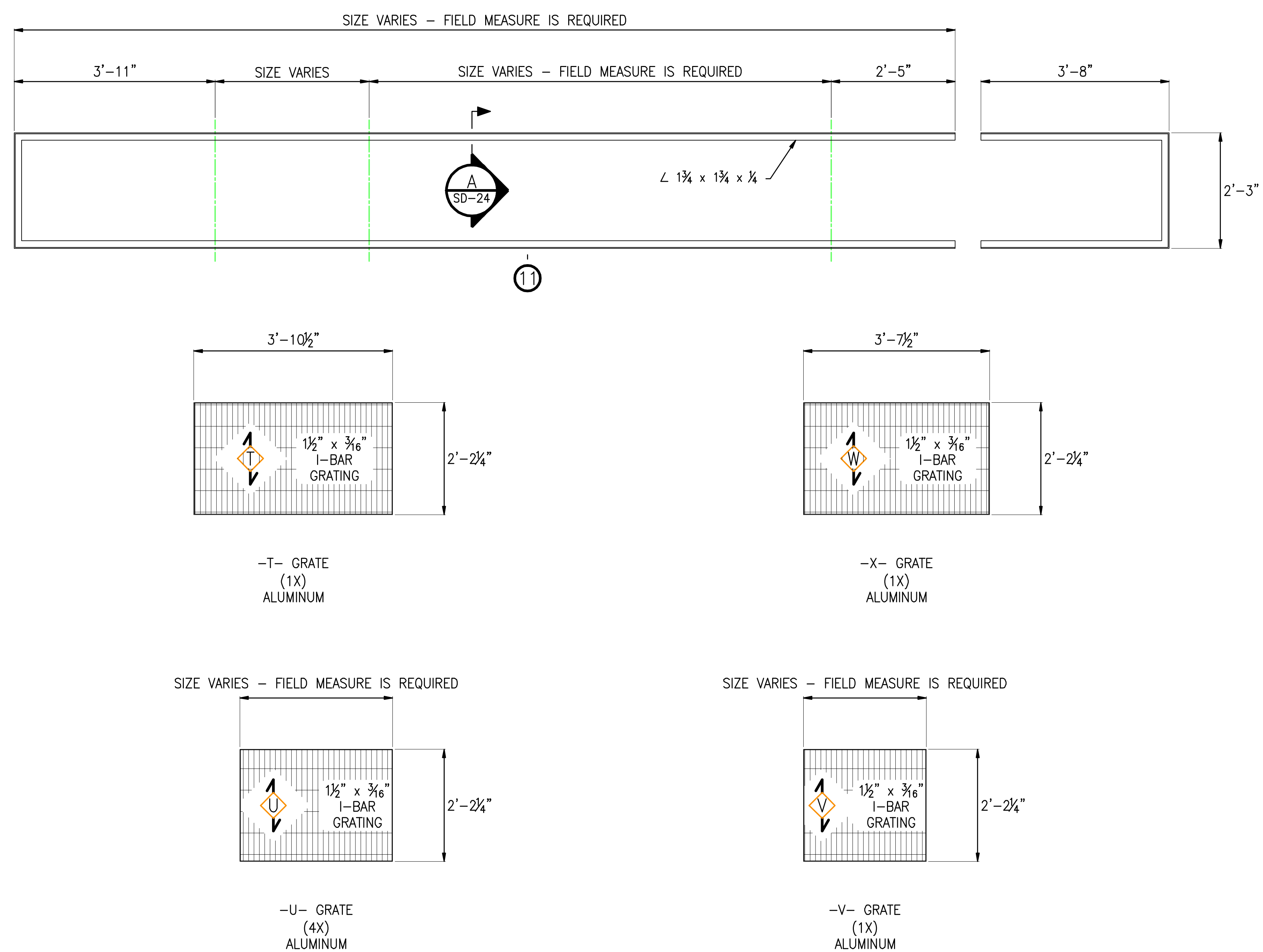
TITLE: Sections 9 and 10 - Embed and Grating

Revision:	
1. –	–
2. –	–
3. –	–
4. –	–
5. –	–

DWG BY: CCA CHK BY: EDO

DATE: JUL 29 2011

SHEET NUMBER: SD - 22



1 Embed and Grating Section 11

CONTRACTOR:
Weaver General Construction Co.
3679 S. Huron St. Suite 404
Englewood, CO 80110
Ph: (303)789-4111 / Fx: (303)789-4310

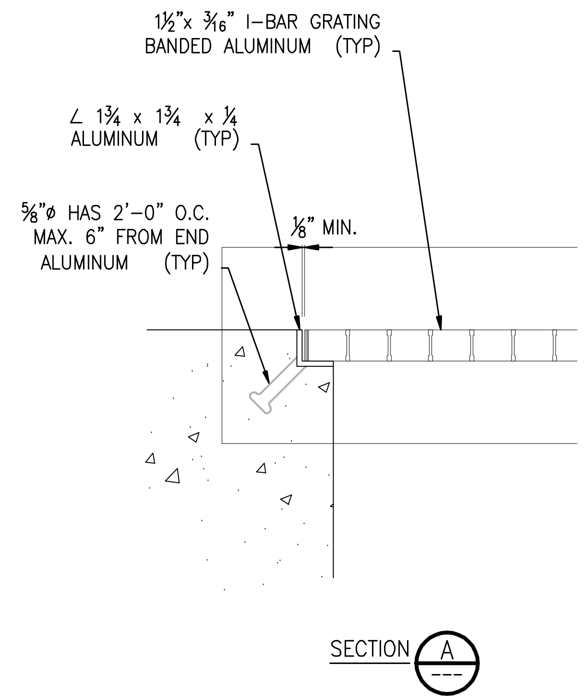
FABRICATOR:
American Fabricators
10290 E. 106th Ave.
Brighton, Colorado 80601
Ph: (303)286-6223 / Fx: (303)286-6263

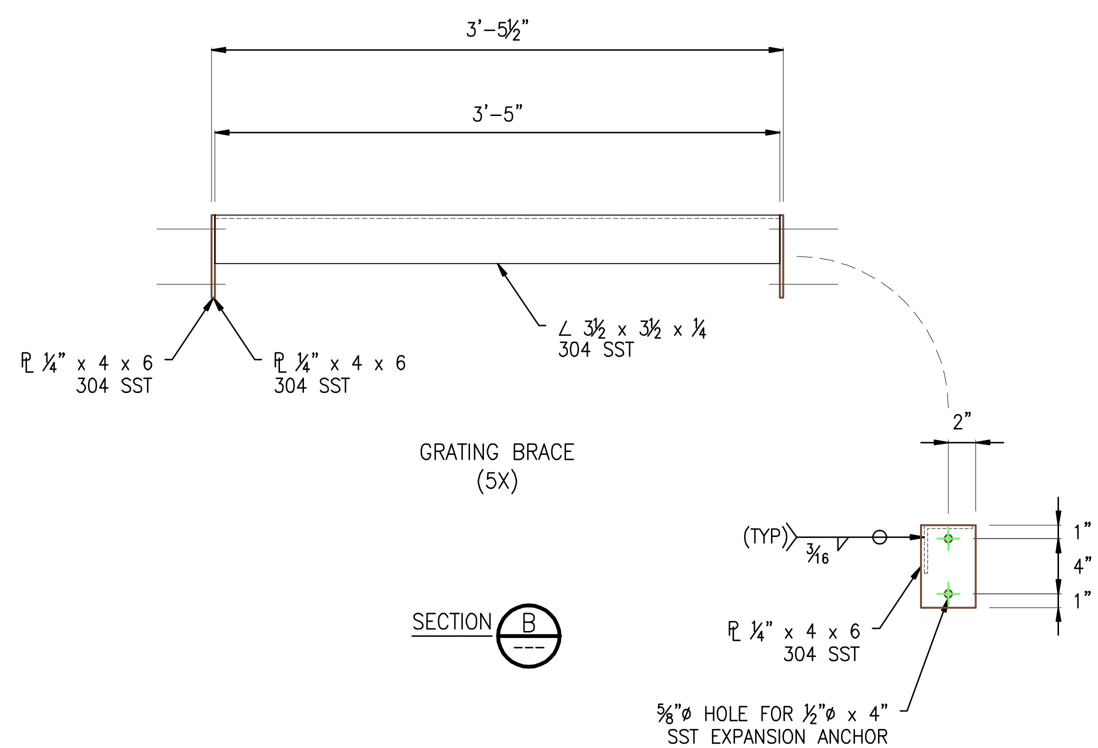
PROJECT: **Harold D Thompson WRF**

TITLE: **Section 11 - Embed and Grating**

Revision:
1. –
2. –
3. –
4. –
5. –

DWG BY: CCA CHK BY: EDO
DATE: JUL 29 2011
SHEET NUMBER: **SD - 23**





Notes:

1. Embed angle conforms to ASTM B308 – 6061–T6.
2. Grating brace angle is 316 stainless steel.
3. Plate is 316 stainless steel.
4. I–bar grating is ASTM B221 – 6063–T6.
4. Expansion anchor bolts are 316 stainless steel.
5. Construction drawing HW–19.

1 Embed Angle Section and Grating Brace Section

CONTRACTOR: **Weaver General Construction Co.** 3679 S. Huron St. Suite 404 Englewood, CO 80110 Ph: (303)789-4111 / Fx: (303)789-4310	FABRICATOR: **American Fabricators** 10290 E. 106th Ave. Brighton, Colorado 80601 Ph: (303)296-6223 / Fx: (303)296-6283	PROJECT: **Harold D Thompson WRF** TITLE: **Embed Angle and Grating Brace Sections**	Revision: 1. – – 2. – – 3. – – 4. – – 5. – –	DWG BY: CCA CHK BY: EDO DATE: JUL 29 2011 SHEET NUMBER: **SD - 24**