

Attachment of Sheet Metal Curbs to the Building

Attachment of a sheet metal curb to a roof structure involves intimate knowledge of the type of roof being used, the slope of the roof, the location of the curb on the roof, and the orientation of the curb with respect to the roof structure and slope. We, at Kinetics Noise Control, usually do not have access to all of the information necessary to completely specify the connection between the curb and the roof structure. Having said all of that, this document will provide some of the requisite guidelines for attaching a sheet metal curb to a roof structure.

General Comments

We will begin by making some general comments on attaching sheet metal curbs to roofs made of different materials.

- 1.) The attachment fasteners at the foot of the sheet metal curb are assumed to be loaded primarily in shear.
- 2.) If uplift forces are present they must be carried directly to the roof by the KSCV Seismic & Wind Vertical Restraint Kits at each corner of the equipment.
- 3.) ***The local attachment between the roof and the building structure must have a capacity greater than or equal to the loads transferred from the sheet curb foot and the KSCV kits to the roof!***
- 4.) The minimum number of fasteners per curb side will be three regardless of the fastener type or size. There will be one fastener approximately at each end of the curb side, and one approximately at the middle.
- 5.) The actual positions of the fasteners are approximate to account for vertical curb wall reinforcements, troughs in metal decking, etc.
- 6.) ***Support beneath the sheet metal curb side wall must be continuous around the entire perimeter to maintain the full horizontal seismic, and/or wind load rating. If the curb side wall is required to span significant distances, it will be placed in bending, and thus suffer a large reduction in the horizontal load-carrying capacity!***
- 7.) Sheet metal curbs may be allowed to span the valleys in metal roof decking. However, if vertical reinforcements are required for the curb side walls, the reinforcements ***must not*** be located above a valley in the metal roof decking, or the valley must be spanned with a support for the reinforcement as discussed in a later paragraph.

Attachment to Metal Decking

The sheet metal curb foot may be fastened to metal decking using sheet metal screws of sufficient size and quantity to carry the required loads, see Figure 6.2.4-1. Kinetics Noise Control requires that the screws be no smaller than No. 10 and that they have a washer-

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type head. The washer-type head helps reduce the incidence of pull-through. The analysis provided by Kinetics Noise Control is based on a flat roof, and will give a recommended number of No. 10 or No. 12 sheet metal screws per side, and the maximum allowable spacing for each screw size. The sheet metal screws must be long enough so that their threads can be fully engaged at the maximum screw diameter to generate full screw strength. Since the foot of the curb must be continuously supported, 14 gage sheet steel may be used to bridge the valleys in the metal roof decking to support the foot of the curb as shown in the view in Figure 6.2.4-1.

As shown in Figure 6.2.4-2, the curb may also be fastened to the metal deck with through bolts and nuts. Standard steel washers should be used under the nuts and bolt heads to prevent pull-through. It is good practice to insert the bolts as shown in Figure 6.2.4-2, and to use double nuts. This will help to maintain the integrity of the joint over time. The analysis by Kinetics Noise Control specifies the number of ¼-20 UNC SAE Grade 2 bolts to use per each curb side, and the maximum allowable spacing for use on a flat roof.

Curb installations have been made by welding the curb foot to the metal decking. The strength of these welds is dependent on the type of welder being used, the procedure being followed, and the actual materials involved in the weld joint. There are too many unknowns for Kinetics Noise Control to specify the number and size of the welds required to attach a curb to a metal roof deck. However, if the shear strength of the welds used is equivalent to the shear strength of the fasteners indicated by Kinetics Noise Control, the weld attachment will be adequate. It is up to the Design Professional of Record to specify the number and size of the welds required to attach the curb to the metal deck once the details of the welding process and materials are known.

When vertical reinforcements are used the reinforcement must not lie over top of an unsupported portion of the curb foot. This would occur if the foot of the curb was spanning a valley in the metal roof decking. A bridge that is tied into the adjacent portions of the decking must be created beneath the vertical reinforcement. Figure 6.2.4-3 shows one way this may be accomplished. It is important that at least two screws attach the bridge to the deck on both the inside and the outside of the curb side wall.

Attachment to Structural Steel

Kinetics Noise Control requires that sheet metal curbs be attached to structural steel with through bolts and nuts with washers beneath the bolt heads and nuts, as shown in Figure 6.2.4-4. Again it is good practice to insert the bolts as shown, and to use double nuts. Certain structural shapes will require the use of square beveled structural washers. For a flat roof the analysis provided by Kinetics Noise Control will indicate the proper number of ¼-20 UNC SAE Grade 2 bolts per curb side and the maximum allowable spacing. Note that the curb side wall is fully supported by the structural members.

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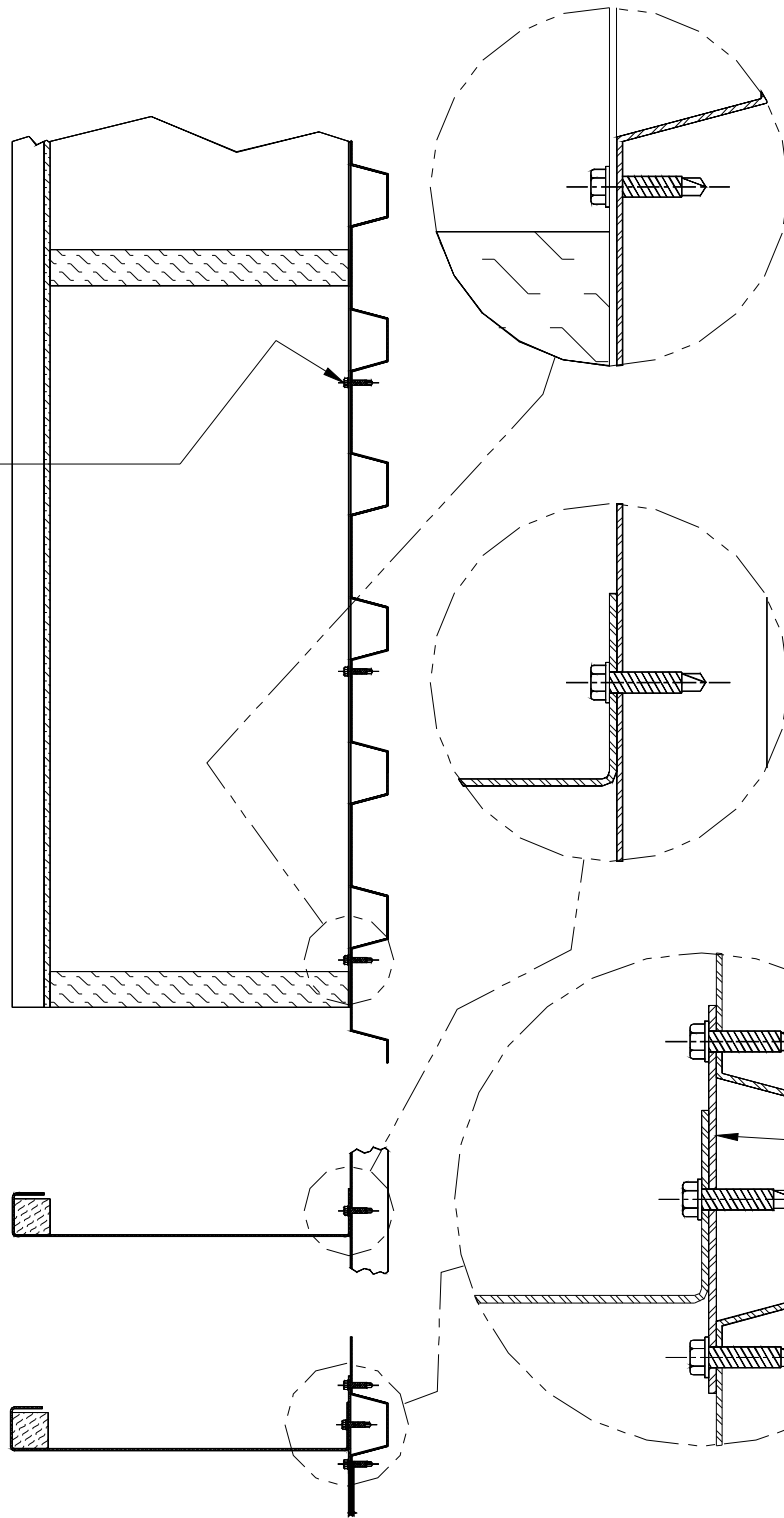
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No. 12 OR No. 10 SHEET METAL SCREWS TO ATTACH CURB TO METAL DECK, NUMBER & SPACING SPEC'D BY KINETICS.



TWO (2) No. 12 OR No. 10 SHEET METAL SCREWS PER FASTENER LOCATION, BY OTHERS.

14 GA. STEEL SHEET, BY OTHERS, TO BRIDGE METAL ROOF DECK VALLEY.

Figure 6.2.4-1. Attachment to Metal Decking Using Sheet Metal Screws.

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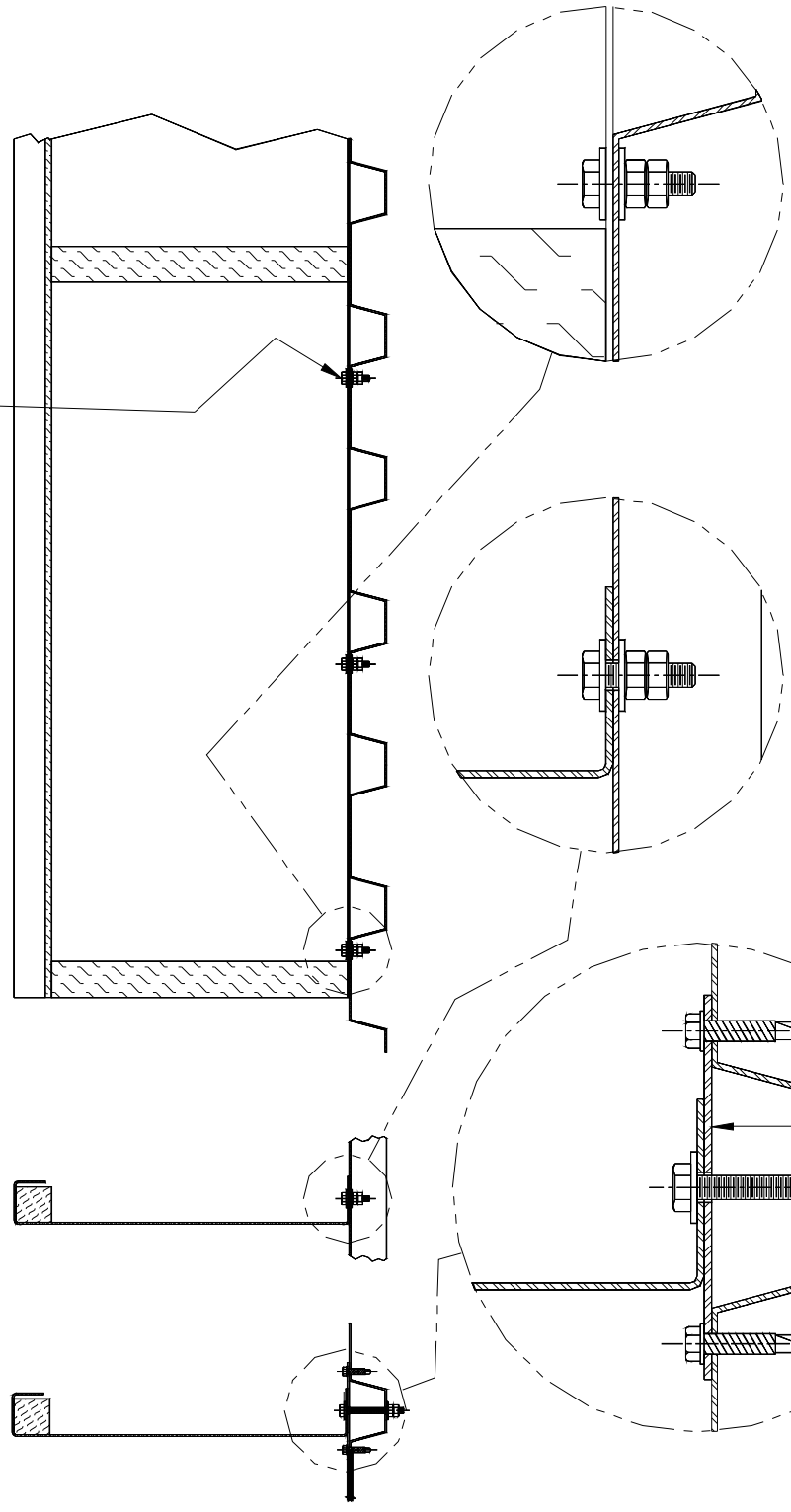
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1/4-20 UNC SAE GRADE 2 BOLTS, NUTS & WASHERS TO ATTACH CURB TO METAL DECK, NUMBER & SPACING SPEC'D BY KINETICS.



TWO (2) No. 12 OR No. 10 SHEET METAL SCREWS PER FASTENER LOCATION, BY OTHERS.

14 GA. STEEL SHEET, BY OTHERS, TO BRIDGE METAL ROOF DECK VALLEY.

Figure 6.2.4-2. Attachment to Metal Decking Using Through Bolts.

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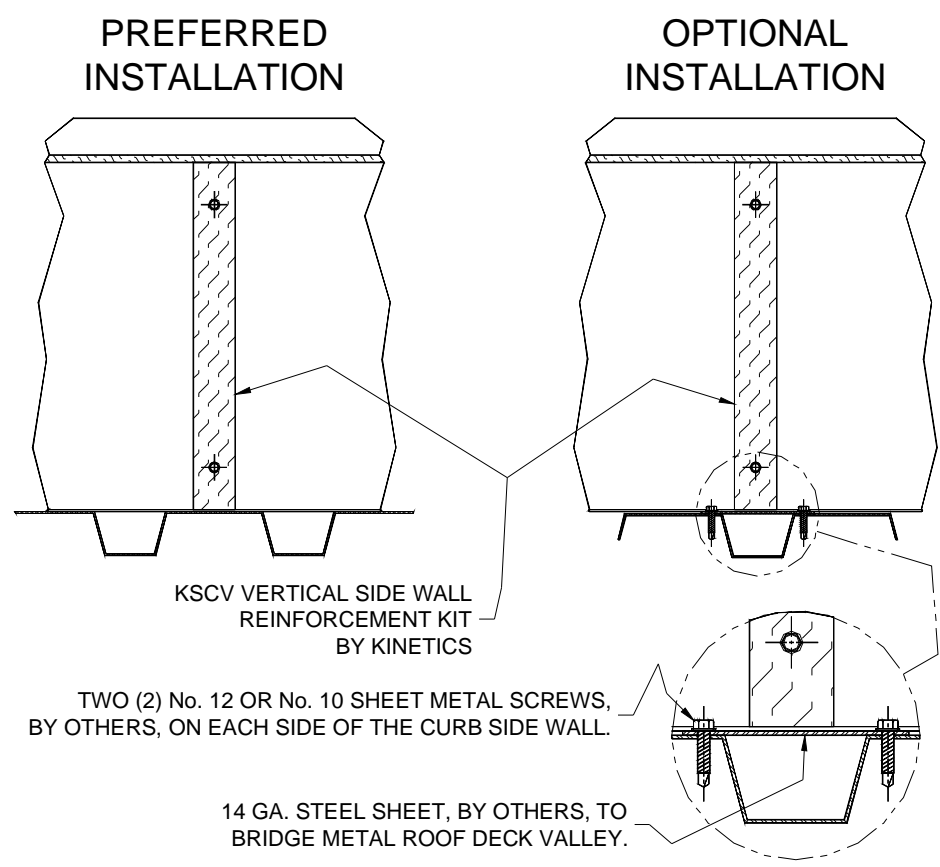


Figure 6.2.4-3. Vertical Reinforcement Placement for Metal Decking.

Curbs have been attached to structural steel by welding. As before, Kinetics Noise Control will not make any recommendations concerning the weld size and number. It will be up to the Design Professional of Record to specify the number of welds and their size. However, the welds must be of sufficient size and number to have a capacity greater than or equal to the number of ¼-20 UNC SAE Grade 2 bolts specified by Kinetics Noise Control for the application in question.

Attachment to Concrete

In order to attach a curb to a concrete deck, the concrete must have a minimum compressive strength of 3,000 psi and be steel reinforced. Figure 6.2.4-5 shows a typical concrete roof installation. The analysis provided by Kinetics Noise Control will indicate the proper number of ¼" concrete wedge-type anchors per side and the maximum allowable spacing. The ¼" wedge-type anchors require an embedment depth of 2" and a minimum distance to any edge of the concrete of 3³/₈". Double nuts are not necessary for this installation due to the wedging action of the anchor when properly tightened.

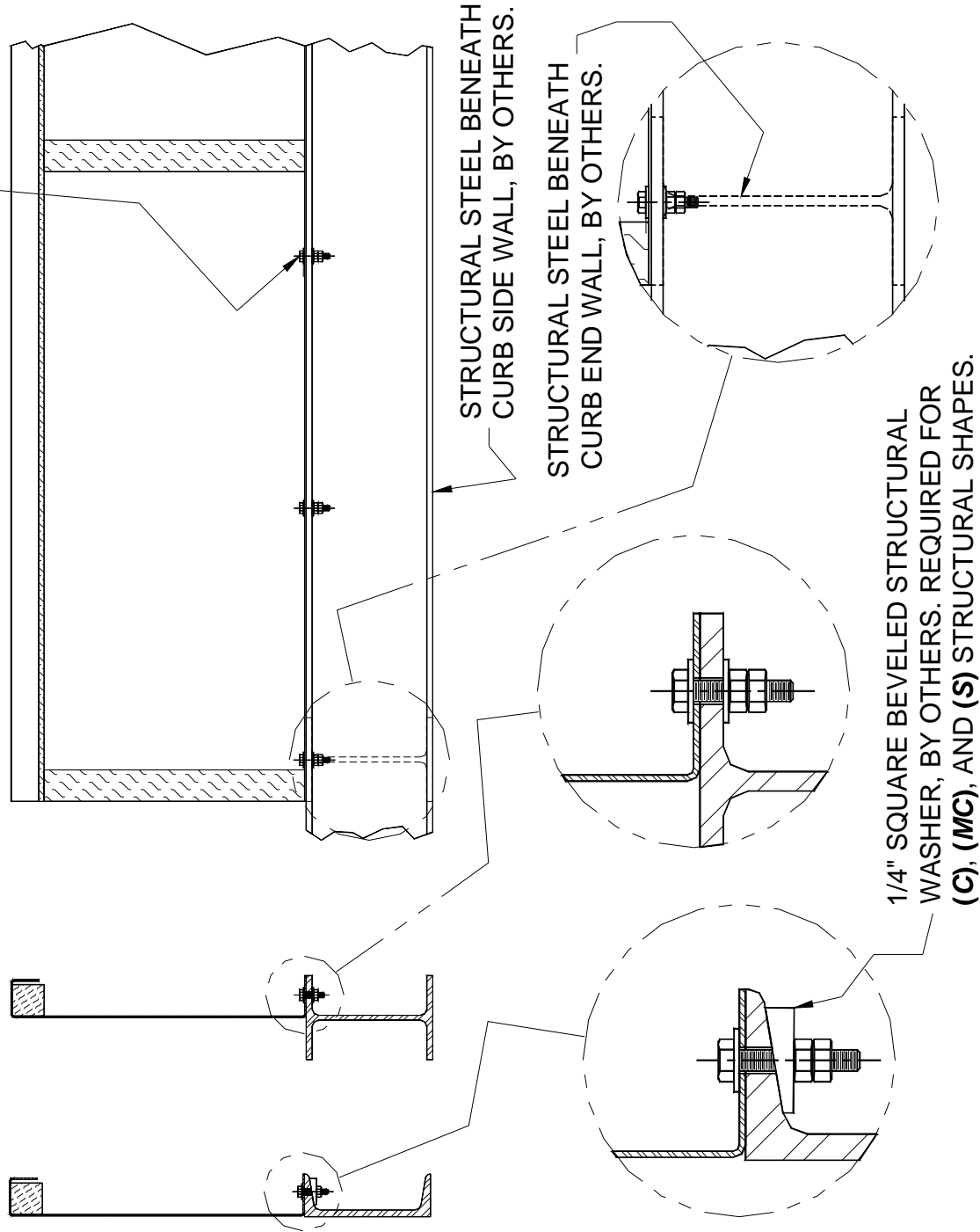
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1/4-20 UNC SAE GRADE 2 BOLTS, NUTS, & WASHERS TO ATTACH CURB TO STRUCTURAL STEEL, NUMBER & SPACING SPEC'D BY KINETICS.



1/4" SQUARE BEVELED STRUCTURAL WASHER, BY OTHERS. REQUIRED FOR (C), (MC), AND (S) STRUCTURAL SHAPES.

Figure 6.2.4-4 Attachment to Structural Steel Using Through Bolts.

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1/4 X 3-1/4 WEDGE-TYPE CONCRETE ANCHORS WITH NUTS & WASHERS TO ATTACH CURB TO A CONCRETE ROOF DECK, NUMBER AND SPACING SPEC'D BY KINETICS.

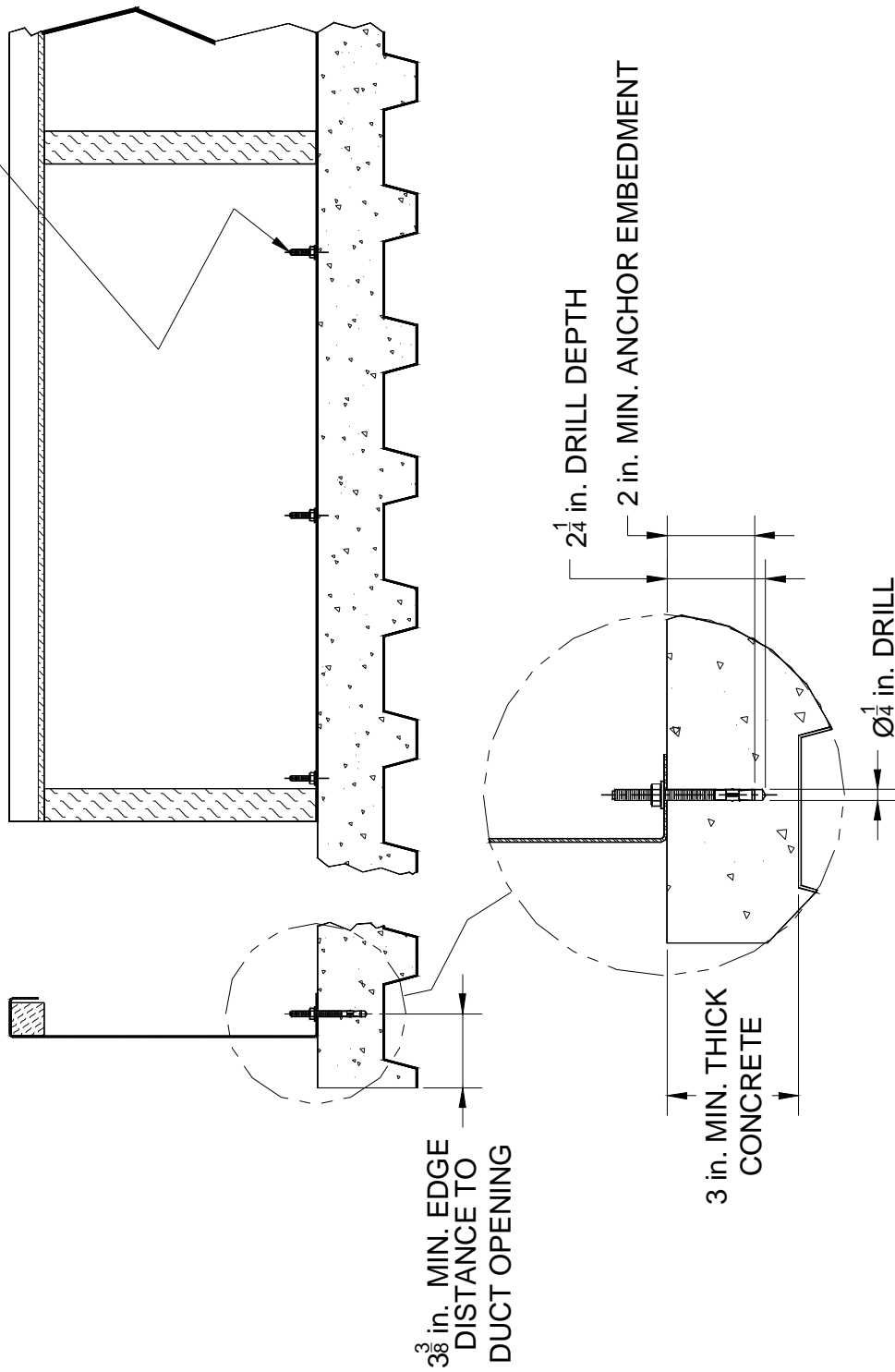


Figure 6.2.4-5 Attachment to Concrete Using Wedge-Type Anchors.

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In order to maintain the full capacity of the ¼” wedge-type anchors, the spacing between adjacent anchors must be no less than 4”. In addition, the deck must be thick enough to provide a minimum of 1” cover beneath the bottom of the hole for the ¼” wedge anchor.

Attachment to Wood

In general, wood is a highly variable structural material in terms of its strength and uniformity. The strength of a piece of wood depends very strongly on its grain structure and direction, as well as its species, moisture content, and growing conditions. The in situ strength of the wood can change over time as its moisture content increases or decreases relative to the surrounding environment. Wood is also susceptible to strength reductions due to aging and insect infestations. Also, plywood decking and “glulam” structural components may be delaminated over time through exposure to harsh environments, and thus lose their integrity.

Wherever possible, Kinetics Noise Control recommends that attachments be made to wood using through bolts, nuts, washers, and “fish-plates” against the wood side of the bolt joint. This arrangement is depicted in Figure 6.2.4-6. The bolts should be inserted as shown and retained with double nuts. The minimum recommended “fish-plate” size and material is ¼” X 3” X 3” ASTM A36 steel. The “fish-plate” distributes the compressive load from the nut, and prevents crushing of the wood fibers. The “fish-plate” is to be provided by others.

There may be some cases where the use of lag screws may be most appropriate. Two examples of this type of installation are also detailed in Figure 6.2.4-6. Note, in both of the cases shown, the required embedment for the lag screw is into the structural timber. The embedment for the lag screw is measured to where the tapered point begins. Care must be taken to maintain the proper edge and end distances in the structural timbers for the lag screws in order to develop their full capacity. Pilot holes of the proper diameter must be drilled slightly beyond the required embedment for the lag screws to prevent splitting of the structural timbers. Do not allow the pilot holes to go clear through the structural timber. Note that the curb side wall is fully supported by the structural timbers.

Attachment to Sloped Roofs

Sloped roofs present an interesting problem for the attachment of sheet metal curbs. The ideal sheet metal curb for a sloped roof would be one where the sheet metal was cut and bent to accommodate the slope. This would keep the equipment level, and still allow the curb to be attached to the roof directly using the fasteners as recommended by Kinetics Noise Control. However, frequently standard curbs of uniform height are ordered and applied to sloped roofs. Blocking is placed under the foot of the curb to level the curb. Depending on the slope of the roof, the height of the blocking could be considerable. This presents serious problems when attempting to create a competent connection between the curb and the roof.

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1/4-10 LAG SCREWS & WASHERS OR 1/4-20 UNC SAE GRADE 2 BOLTS, NUTS, WASHERS, & 1/4 in. X 3 in. X 3 in. "FISH-PLATES" TO ATTACH CURB TO STRUCTURAL STEEL, NUMBER & SPACING SPEC'D BY KINETICS.

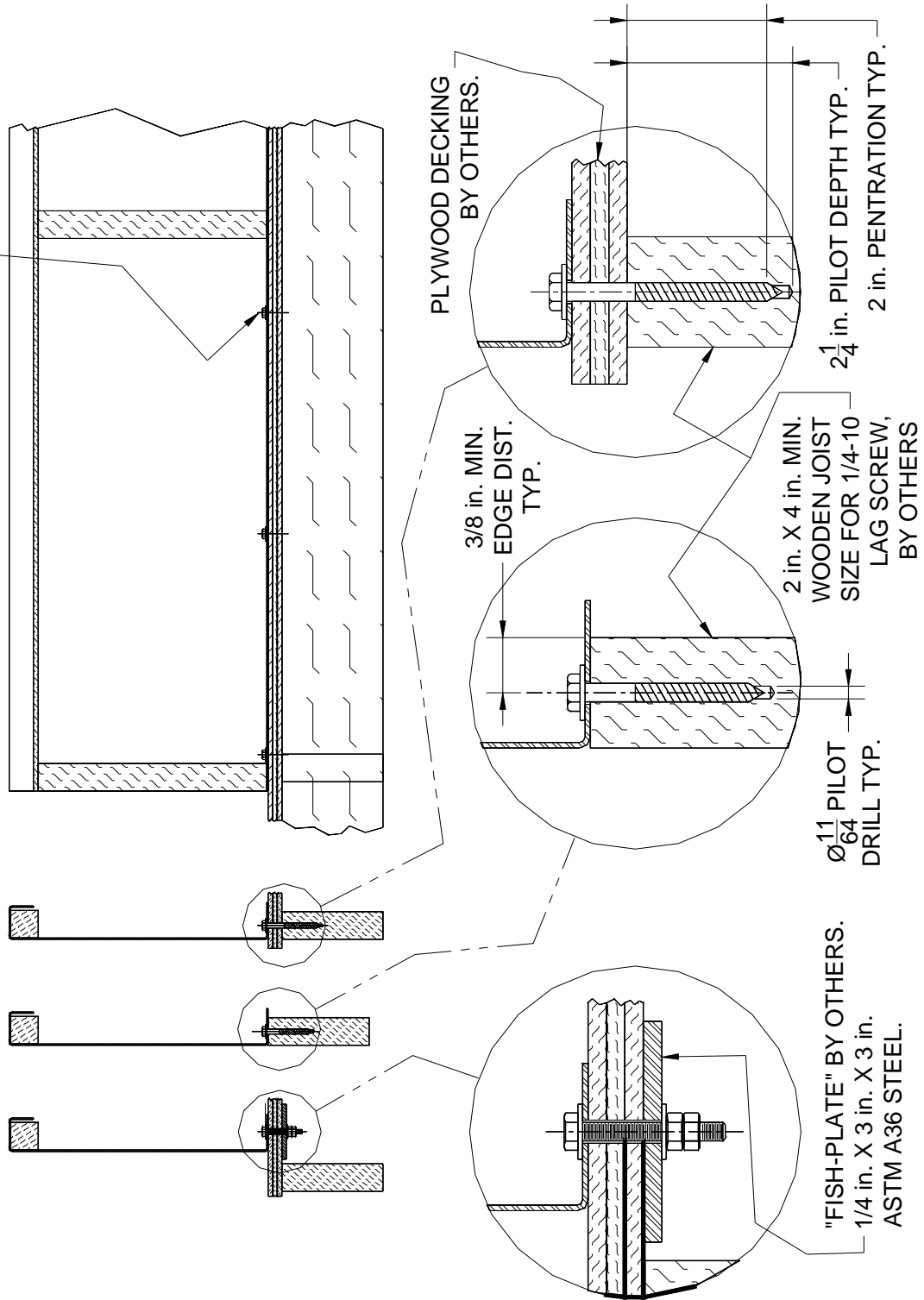


Figure 6.2.4-6 Attachment to Wood Using Through Bolts & Lag Screws.

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The blocking for a seismically rated sheet metal roof curb must continuously support the curb side walls. This is required to prevent bending in the side walls which would drastically reduce the curb's ability to carry horizontal seismic and/or wind loads. A possible roof curb arrangement on a sloped roof is shown in Figure 6.2.4-7. The blocking is cut in such a way that it provides full and continuous support for the curb side walls.

The attachment hardware passes through the blocking. This ensures that the blocking will remain in position beneath the curb side wall. The holes through the blocking for the attachment hardware should be tight against the hardware. It would be best if the attachment hardware had to be "tapped" into place. A close fit with the attachment hardware will reduce the bending stress to near zero, and keep the hardware in shear.

When the height of the blocking exceeds (3) three inches, the attachment hardware that provides the most flexibility is ¼-20 UNC SAE Grade 2 All-Thread. Use double nuts and washers on each end of the All-Thread. Where the height of the blocking is not excessive, the attachment hardware discussed in the previous paragraphs may be used as long as it passes through the blocking with minimal clearance.

Figure 6.2.4-8 provides a detail to handle situations where the blocking on two adjacent sides meets at a corner. To help maintain the integrity of the attachments, it is necessary that the corners of the blocking be reinforced inside and out with field-fabricated sheet metal angles. The angles must be attached to the curb with sheet metal screws as shown. The threads of the screws must fully engage the sheet metal of both angles to develop the full capacity of the screws. The minimum number of screws recommended per leg is (3) three, (4) four screws per leg are shown. There will be corners where the blocking is short enough so that corner bracket is not needed. It is only necessary to install the corner brackets when the blocking exceeds (2) two inches in height.

Conclusion

This section has taken a quick and very general look at the attachment of sheet metal curbs to roof structures. There will be many situations that are not specifically addressed by this document, which is not intended to be all encompassing. The drawings and descriptions are intended to provide general guidelines to help the Design Professional of Record, and the contractor with the installation of a curb.

The use of mounting hardware larger than ¼-20 UNC should be avoided. The use of a larger number of smaller fasteners will provide a better load distribution along the foot of the curb than a small number of larger fasteners. The key to using sheet metal curbs in seismic applications is to distribute the loads entering the curb from the equipment and exiting the curb to the equipment as evenly as possible.

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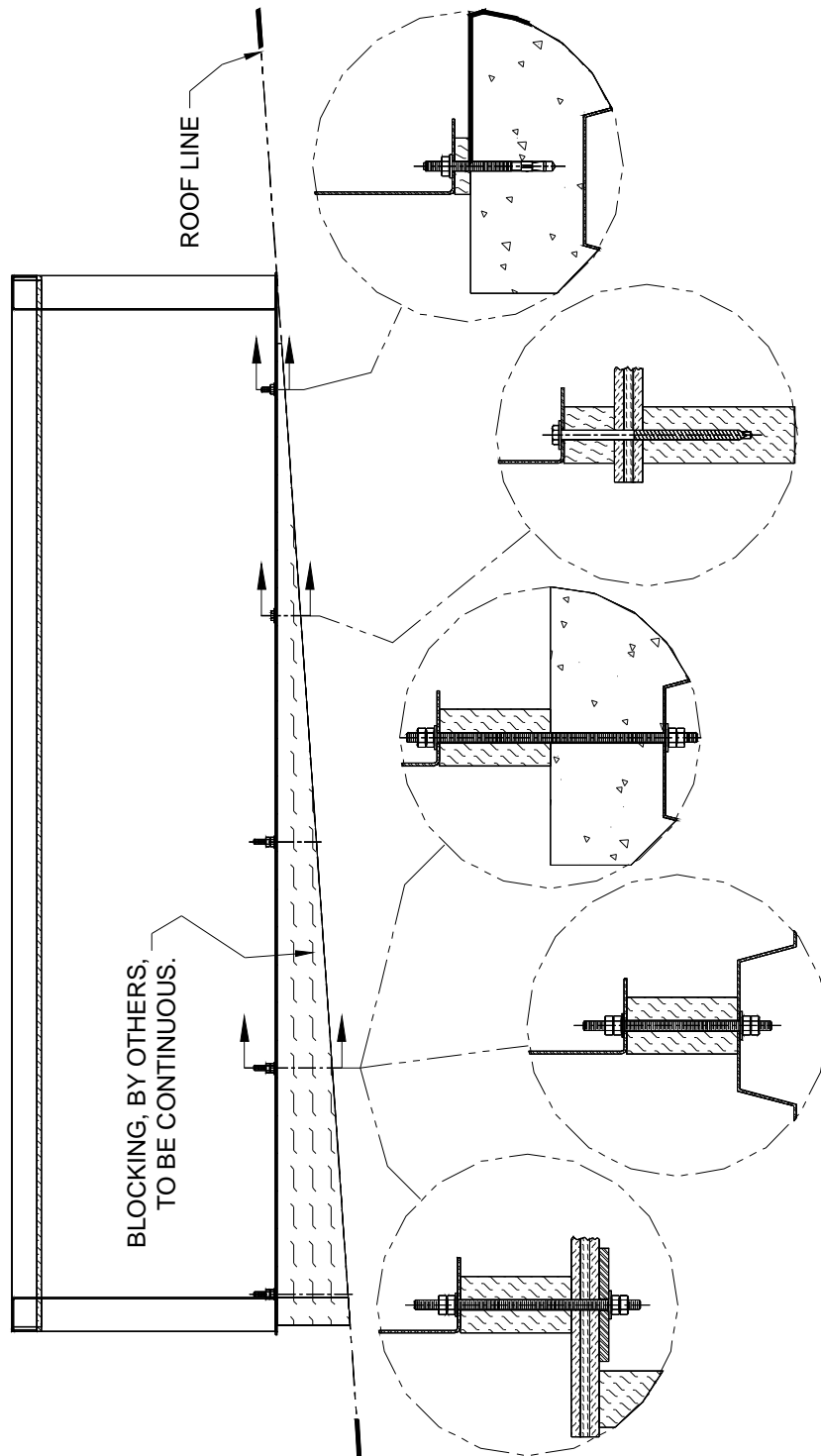


Figure 6.2.4-7 Blocking & Attachment for a Sloped Roof.

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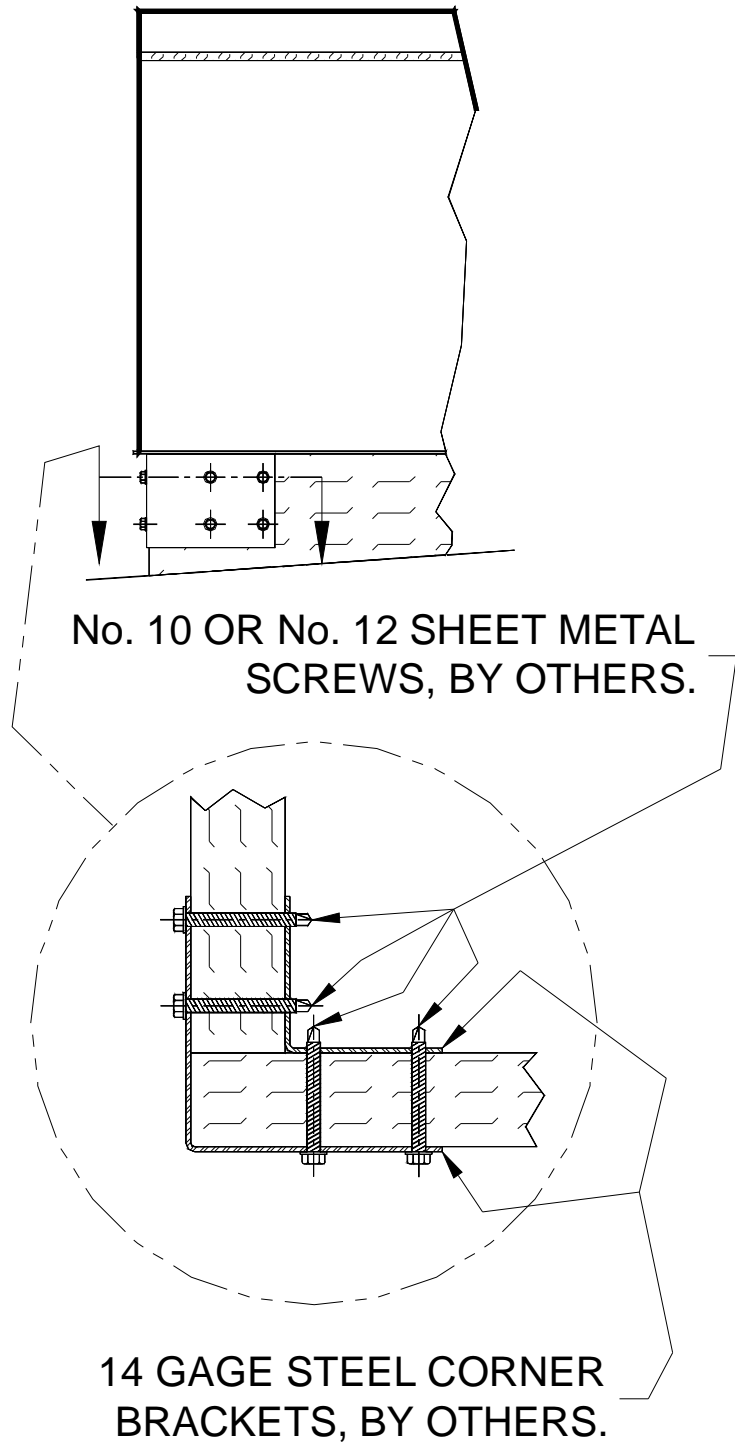


Figure 6.2.4-8 Curb Blocking Corner Detail.

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