

Composite Attachment of Grid Reinforced Concrete Bridge Decks

Design

Article C9.4.1 in the 2014 Seventh Edition of AASHTO LRFD Bridge Design Specifications states, “Composite action is recommended to enhance stiffness and economy of structures.” That general recommendation is applied specifically to Grid Reinforced Concrete Decks in Article 9.8.2.3.1: “[Fully] Filled and partially filled grids shall be attached to supporting components by welding or shear studs to transfer shear between the two surfaces.” Similar language is provided for Unfilled Grid Decks Composite with Reinforced Concrete Slabs (Exodermic® decks) in Article 9.8.2.4.1: “Composite action between the grid deck and the supporting components should be ensured by mechanical shear connectors.” The best current practice is for deck attachment via headed shear studs as shown in the commentary of those two articles.

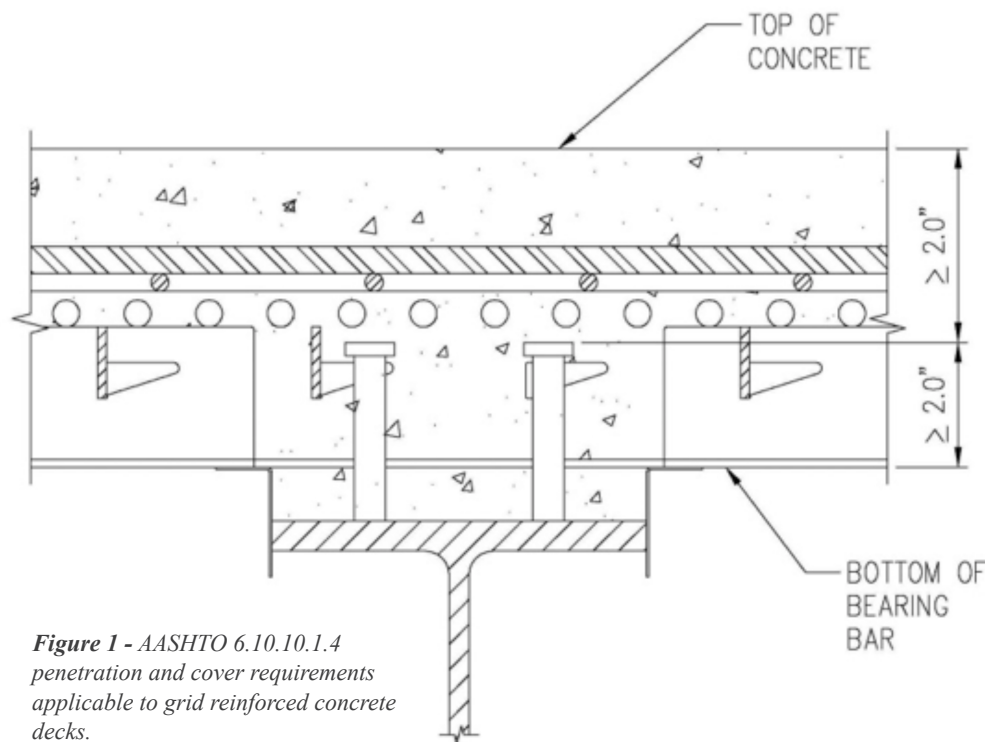


Figure 1 - AASHTO 6.10.10.1.4 penetration and cover requirements applicable to grid reinforced concrete decks.

By nature of attachment with headed shear studs, all grid reinforced concrete decks offer a certain degree of composite behavior with the supporting steel. At a minimum, at least one 3/4" diameter headed stud at 8 to 12 inch spacing along the supporting element, located between main bearing bars for any grid reinforced concrete deck is recommended. If the design is composite, the diameter and number of shear studs required must be calculated. (See **BGFMA TechLine #8** and **TechLine #10** for grid steel contribution methods for composite girder design.) Code provisions covering design of shear connectors is contained in Article 6.10.10. Spacing of the headed studs should coincide with main bar spacing. In accordance with Article 6.10.10.1.4, shear connectors shall penetrate at least 2.0 inches into the concrete deck and have at least 2.0 inches of concrete cover over the tops. For grid reinforced concrete decks, the head of the stud must be at least 2.0 inches above the bottom of the grid main bearing bar. See *Figure 1*.

(continued, other side)

Construction

The use of headed shear studs eliminates the need to weld grid bars directly to bridge framing members, thus reducing concerns about the quality of field welds. On rehabilitation projects which retain existing bridge girders/stringers, achieving an improved cross slope is often a project parameter, and is greatly simplified through the use of shear studs, since grid panels need not bear directly on those supporting members. (Various deck elevation adjustment methods have been used in this situation. See **BGFMA TechLine #12, “Leveling Devices and Haunch Forms.”**)

Shear studs are attached using automated equipment. They may be welded to bridge girders either before or after grid panel placement. Welding before panel placement usually requires the Engineer’s approval and demands careful layout. If studs are placed after grid panels are erected, there is sufficient space between grid bars and/or rebar to insert the automatic welding equipment. Some more closely spaced grid designs do not allow the conventional stud bend test after they have been attached to the girders. In this situation, periodic weld equipment calibration and testing conducted on separate plates ensures weld quality. A separate welding generator is recommended to furnish power to each individual stud gun in order to assure acceptable welds. Finally, workmanship and techniques from various successful field installations of composite grid reinforced concrete bridge decks are shown in *Figures 2 thru 4*.



Figure 2 - Headed stud field installed showing desired full 360° flash prior to removal of ceramic ferrule.



Figure 3 - Headed studs installed prior to panel placement.



Figure 4 - Headed stud being field welded after panel placement.



www.bgfma.org

Bridge Grid Flooring Manufacturers Association
300 East Cherry Street
North Baltimore, OH 45872
p 877.257.5499

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