Canadian Sheet Steel Building Institute

Sheet Steel Facts 29

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Installation Guidelines for Steel Deck Shear Diaphragms

Steel deck shear diaphragms are used extensively as a component in the lateral force resisting system in buildings, and have been for many years. As an aid to structural engineers the CSSBI published its first steel deck diaphragm design guide in 1972 and the third edition was published in 2006. With the adoption of the 2005 National Building Code of Canada seismic loads in many areas of the country have increased significantly requiring the steel deck to accommodate very high shear diaphragm forces. It is important to consider the limits of how steel deck can be used on a job site in a safe manner while still achieving a design advantage. Towards this end, there are several factors regarding deck installation which should not be overlooked by the structural engineer when doing calculations to achieve the desired diaphragm requirements.

The placement of steel deck bundles is almost always accomplished by hoisting with a crane or other mechanical apparatus. The weight or length of individual sheets at this stage is generally of no issue. However, once the bundles are landed they are then broken open, spread and secured to the structure using physical manpower. The installation is usually completed using three man crews. Two workers will drag and spread the deck sheets with the third worker securing them in place. The total weight of the deck is important when considering the use of heavier gauges to achieve a greater diaphragm capacity, particularly for the 3" (76mm) deck. Listed in Table 1 are the weights of some common deck types in typical lengths.

The option of using shorter deck sheets to minimize the handling weight is not always the answer with respect to a safe installation. Most deck specifications qualify that the deck should be installed in such a manner that the deck sheet will cover three structural spans as a minimum. Deck should only be installed in one or two span conditions when made necessary by the support layout or to accommodate openings. With respect to safety, it is a fact that landing and installing deck in a three span condition is considerably safer than in a one or two span condition. Should a one or two span deck bundle not be placed directly over all of the supporting steel members, it could become dangerously unbalanced and topple from the structure. The optimal formula is one that finds the correct balance between sheet weight and length.

The last factor to consider for the practical installation of the steel deck pertains to fastening and side lap attachment. In many applications the steel deck is welded directly to the structural members using puddle welds. This is advantageous since it achieves good diaphragm action due to the shear strength of the welds. The number of the welds can also be increased to further augment the shear diaphgram capacity. The effectiveness of puddle welds at locations where the deck sheets overlap may require special procedures to ensure the proper weld penetration. Other types of fasteners such as self-drilling screws or powder-actuated pins are also viable methods of attachment and can provide some structural advantages over puddle welds.

1-1/2" deep deck, 36" coverage, 6" rib spacing				
Thickness (in)	0.030	0.048	0.060	0.075
Weight (psf)	1.761	2.083	2.732	3.385
Weight of a 20' sheet length (lbs)	106	125	164	203
3" deep deck, 24" coverage, 6" rib spacing				
Thickness (in)	0.030	0.048	0.060	0.075
Weight (psf)	2.537	3.007	3.992	4.864
Weight of a 30' sheet length (lbs)	152	180	240	292
3" deep deck, 32" coverage, 8" rib spacing				
Thickness (in)	0.030	0.048	0.060	0.075
Weight (psf)	2.229	2.642	3.445	4.271
Weight of a 30' sheet length (lbs)	178	211	276	342

Table 1: Weights of Various Deck Types

Diaphragm design tables like CSSBI B13-06, *Design of Steel Deck Diaphragms* or tables published by the steel deck manufacturer are available for a variety of fastener types and configurations.

A practical problem for fastening a steel deck diaphragm often lies in the joining of deck sheets to each other along the side lap. The two side lap types illustrated in Figure 1 are the most common and require different types of connections. The male/female side lap (hook and square) is practical for lighter deck sections (22 and 20 gauges) and a button punch connection can be made with a hand crimping tool (as illustrated in the photograph in Figure 2). However, it is recommended that 18 gauge (or heavier) deck be installed with a nesting side lap (cladding lap) using screws to stitch the joint since it is impractical to mechanically crimp the heavier gauges. Stitch screwing the side laps can be done in all deck thicknesses and makes a significantly stronger connection than the button punches. It is worth noting that the use of deck with a nesting side lap (cladding lap) can be a more costly installation due to the extra time involved in laying out and aligning the sheets.

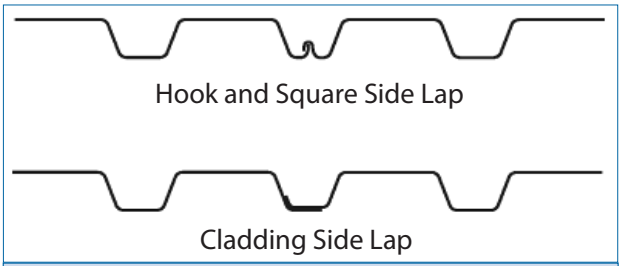

Figure 1: Side Lap Types

The CSSBI diaphragm design tables also provide values based on the seam welding of the male/female side laps. This procedure is not recommended unless absolutely necessary, and only in smaller quantities, since the side lap design does not lend itself to a quality seam welding. Also, it is not possible to properly seam weld light gauge deck sheets at the side lap in a timely and efficient manner. Attempting this type of weld will generally result in a poor quality joint or a blow through condition. It may not be realistic to expect results with seam welds that would provide the desired shear diaphragm capacity.

It is hoped that knowing more about the safe handling and installation of steel decking will help structural engineerings achieve their goals while recognizing that the advantages need to be weighed against extra cost and safety issues. It is a case of theory tempered by practically.

Figure 2: Button Punch Side Lap (Hand Crimping)

For More Information

For more information on sheet steel building products, or to order any CSSBI publications, contact the CSSBI at the address shown below or visit the web site at www.cssbi.ca.