

MECHANICAL FASTENING OF

By Paul Jokiel

MOST STEEL BUILDINGS THAT ARE CONSTRUCTED TODAY UTILIZE SHEET METAL DECKING for either their floor or roof systems. Sheet metal deck is used as a form for poured concrete floors, providing a composite or non-composite floor section.

One of the major advantages of sheet metal deck is its ability to transfer shear forces, thus acting as a lateral diaphragm. The loads applied due to wind, earthquakes or other forces are transferred through the steel roof deck diaphragm. The load moves from the windward wall to the roof deck and out to the walls parallel to the wind direction. In order to transfer the shear forces, the sheet metal deck must be attached and fastened properly to the structural supports – joists or beams. The diaphragm strength and stiffness depends on how the deck units are fastened together and how the deck is fastened to the frame.

Fastener Types

Welding is still the most common method. However, other methods are becoming more common.

Screw connections may be either self-drilling or self tapping types requiring a pre-drilled hole for installation. Most commonly No. 12 and No. 14 screws are used to attach deck to structural steel or bar joist. The smaller sizes such as No. 8 or No. 10 screws are used for sidelap connections. Where welding is not recommended, particularly for thin metal sheets (22-gauge), screws are the fasteners of choice for the stitch connections. The shear strength is dependent on the screw diameter and the yield strength of the connected sheets.

Power driven fasteners can be installed using either pneumatic

or powder actuated tools. The fastening principle is the same for both methods. A piston is accelerated towards the fastener, driving the pin into the steel. Thus the steel around the fastener is displaced. The resulting displaced steel flows around the steel shank of the fastener holding it by friction. The fastener shank should be knurled to achieve higher holding values due to additional mechanical interlocking. Due to the high energy released during the driving process, a fusion of the zinc coating of the fastener and the base steel occurs, also contributing to the holding power. Thus, a power driven fastener is held by a combination of friction, mechanical interlocking and fusion.

Most fasteners used for attaching metal deck are equipped with an additional washer or top hat. The washer serves several purposes: First it stabilizes and guides the fastener within the tool, so that it remains straight while being driven, and second, the washers main purpose is to clamp the sheet material to the base steel.

The driving force necessary can be controlled by the power level of the tool and should be adjusted to the individual application. The necessary power depends mainly on the sheet metal deck gage and the thickness and hardness of the structural base material. The tools used today have been improved regarding reliability, capacity and operator comfort. Pneumatic tools with magazines of 20 pins as well as fully automated stand-up tools are available today enabling the operator to work faster with a higher capacity and better ergonomics.

Mechanical fasteners have been tested extensively and proven to achieve adequate holding values so that they compare with welding as an alternative fastening method to attach sheet

metal deck to the steel frame. The SDI Diaphragm Design Manual contains several tables of design shear values for a variety of fasteners. These tables indicate that when identical stitch fasteners are used, all the design shear values are similar, indicating that the allowable strength of an individual power driven fastener is comparable to that of a 5/8" puddle weld. The high consistency of mechanical fastening is expressed by a decreased safety factor compared to welding.

Each fastening system has advantages and disadvantages for the designer and the steel contractor to consider. Mechanical fastening is regarded as an equal alternative to welding, although the decision has to be made at each project individually. Before submitting a change request to the engineer the contractor should base his decision on factors such as:

- Type of deck
- Deck sizes
- The deck appearance
- Job site size
- Weather working conditions.

Jokiel is the Market Manager — Sheet Metal at Hilti in Tulsa, OK.

For More Information

"How to Fasten Steel Deck," by Richard Heagler and Larry D. Luttrell, *Modern Steel Construction*, 1/1998 p. 14-19.

"Designing Roof and Floor

Diaphragms," by Larry D. Luttrell, *Modern Steel Construction*, March 1996 p. 58-65.

"SDI Diaphragm Design Manual," 2nd Edition, Steel Deck Institute (1987)