USE OF REINFORCING STEEL IN CONCRETE FILLED STEEL DECK DIAPHRAGMS

This document has been prepared by the Steel Deck Institute (SDI) as a position statement in response to inquiries made regarding the necessity of including steel reinforcing, either reinforcing bars or welded wire reinforcement, in concrete filled steel deck diaphragms.

Reference 1 reports on the testing of concrete filled steel deck diaphragms at Iowa State University. A total of 32 full-scale tests were reported, of which 6 tests were performed with both in plane (diaphragm) and gravity loading. The steel deck was attached to the supporting structure with either arc spot welds or with welded shear studs. Thirty-one tests were performed using normal weight concrete and one test was performed with lightweight concrete. All diaphragms were tested using reverse cyclic loading. **No reinforcing steel (reinforcing bars or welded wire reinforcing) was used in any test.** The results of these tests verified the design recommendations made by the SDI in the *Diaphragm Design Manual,* 2nd Edition (2) that were carried forwarded in to the *Diaphragm Design Manual,* 3rd Edition (3).

Section 5.3 of the *Diaphragm Design Manual,* 3rd Edition includes a requirement for a minimum reinforcement in the form of 6 x 6 - W1.4 x W1.4 welded wire reinforcement. This reinforcement was intended to control temperature and shrinkage effects in the concrete. The diaphragm load tables were developed without considering any potential strength increase from the steel reinforcing. Since the publication of this document, additional work has shown that properly specified fiber reinforced concrete can be used in lieu of steel reinforcing to control temperature and shrinkage effects. Section 2.4.B.6.a of the *Standard for Composite Steel Floor Deck* (Reference 4) states the following:

> "Fibers shall be permitted as a suitable alternative to the welded wire fabric specified for temperature and shrinkage reinforcement. Cold-drawn steel fibers meeting the criteria of ASTM A820, at a minimum addition rate of 25 lb/cu yd (14.8 kg/cu meter), or macro synthetic fibers "Coarse fibers" (per ASTM Subcommittee C09.42), made from virgin polyolefin, shall have an equivalent diameter between 0.4 mm (0.016 in.) and 1.25 mm (0.05 in.), having a minimum aspect ratio (length/equivalent diameter) of 50, at a minimum addition rate of 4 lb./cu yd (2.4 kg/m3 are suitable to be used as minimum temperature and shrinkage reinforcement."

When the *Diaphragm Design Manual* is updated, an option to control the temperature and shrinkage effects in the concrete with properly specified fibers will be included.

Adopted by SDI - November 2008

References

1. Easterling, W. Samuel, and Porter, Max L., "Steel-Deck-Concrete Reinforced Concrete Diaphragms I", Journal of Structural Engineering, Vol 120, No 2., February 1994.
2. Steel Deck Institute, Diaphragm Design Manual, 2nd Edition (DDM02), 1987.
3. Steel Deck Institute, Diaphragm Design Manual, 3rd Edition (DDM03), 2004.
4. Steel Deck Institute, Standard for Composite Steel Floor Deck (ANSI/SDI-C1.0)