

OPEN FORUM

PROBLEMS AND SOLUTIONS

The comments and opinions expressed herein are those of the contributing author and do not necessarily reflect official PCI policy. Some of the provided answers may have alternate solutions. Reader comments are invited.

Fire Rating for Double Tees

Q1: A double tee is to have straight multiple strands. How can the fire rating of this member be determined?

A1: There are two approaches to solving this problem, the first method being a little easier to execute than the second method.

Solution 1 — To begin with, it should be recognized that the stems of a double tee are tapered. Therefore, the first thing to do is to determine the location of the center of gravity of the strands. The best way to do this is to follow the design examples given in PCI MNL 124-89, Design for Fire Resistance of Precast Prestressed Concrete, starting on page 18.

After determining just where the center of gravity of the strands is, next calculate the thickness of the stem at that point. This then gives the available cover on each side of the strand.

Finally, go to the Uniform Building Code (UBC) [or International Building Code (IBC)], Table 7-A, Item 3-1.1 (see Table 1), to check whether there is enough cover for the desired fire rating. Note that the cover can be reduced for lightweight concrete, or by designating the member as restrained.

Solution 2 — The second approach to solving this problem is to go directly to UBC Section 704.3.3, Bonded Prestressed Concrete Tendons, starting in the second paragraph:

“For members having multiple tendons installed with variable concrete cover, the average tendon cover shall not be less than that set forth in Table 7-A, provided:

1. The clearance from each tendon to the nearest exposed surface is used to determine the average cover.
2. In no case can the clear cover for individual tendons be less than one-half of that set forth in Table 7-A. A minimum cover of $\frac{3}{4}$ in. (19.1 mm) for slabs and 1 in. (25.4 mm) for beams is required for any aggregate concrete.
3. For the purpose of establishing a fire-resistive rating, tendons having a clear covering less than that set forth in Table 7-A shall not contribute more than 50 percent of the required ultimate moment capacity for members less than 350 sq in. (0.226 m²) in cross-sectional area and 65 percent for larger members. For structural design purposes, however, tendons having a reduced cover are assumed to be fully effective.”

Q1: An existing multistory warehouse being built in

Table 1. Excerpt from Uniform Building Code, Table 7-A, Item 3-1.1.

Structural member	Insulating material	Minimum thickness of insulating material, in.			
		4 hours	3 hours	2 hours	1 hour
Bonded pretensioned reinforcement in prestressed concrete	Carbonate, lightweight, sand-lightweight and siliceous aggregate concrete - Beams or girders - Solid slabs	4	3	2-1/2	1-1/2
		4	2	1-1/2	1

Impact Factor for Hollow-Core Slabs

Denver, Colorado, is being converted to a residential occupancy, and is being required to have a satisfactory Impact Factor for the floors. The architect wants to use exposed concrete (in this case hollow-core slabs) as the walking surface without any floor covering. Is this allowable?

A1: Since the structure is located in Denver, the Impact Factor is part of “Sound Transmission Control,” Appendix to Chapter 12, found in the Uniform Building Code (UBC). Note that an Appendix is never officially a part of the Code unless a jurisdiction adopts it. In this case, Denver has adopted Appendix Chapter 12 in its entirety. In Section 1208.3, Impact Sound Insulation, a value of 50 is required.

A general approach to solving this problem is to consult the PCI Design Handbook (Fifth Edition) and particularly Chapter 9, Section 9.2, Acoustical Properties of Precast Concrete. In examining Table 9.2.1, page 9-25, we note that

the Impact Factor for a bare 8 in. (203 mm) thick hollow-core slab is 28, far short of the 50 that is required. There are several ways of reaching 50 but bare concrete is not one of them. The answer to this problem is that to increase its sound attenuating capacity, a bare hollow-core slab will need to have its thickness increased by either an overlayment or a spray from below.

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DISCUSSION NOTE

The Editors welcome discussion of reports and papers published in the PCI JOURNAL. The comments must be confined to the scope of the article being discussed. Please note that discussion of papers appearing in this issue must be received at PCI Headquarters by December 1, 2000.