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Legacy report on the 1997 *Uniform Building Code*™

DIVISION: 03—CONCRETE

Section: 03405—Concrete Design

DESIGN OF FIRE-RESISTIVE CONSTRUCTION FOR PRECAST AND PRESTRESSED CONCRETE

PRECAST/PRESTRESSED CONCRETE INSTITUTE
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1.0 SUBJECT

Design of Fire-resistive Construction for Precast and Prestressed Concrete.

2.0 DESCRIPTION

2.1 General:

The design of fire-resistive construction for prestressed concrete utilizes known strength-temperature relationships of concrete and steel. With this information, and the specified furnace temperatures in UBC Standard 7-1 for various fire-resistive ratings, the reduced ultimate strengths of the concrete and reinforcement can be predicted. The ultimate strengths at the elevated temperatures are determined by methods consistent with Chapter 19 of the 1997 *Uniform Building Code*™ (UBC), except that all load and capacity reduction factors are unity, which is consistent with the conditions of acceptance of a tested fire-resistive assembly in which the structural members need only support a load that results in maximum design stresses for the concrete and steel at a normal temperature range. The ultimate structural capacity of the member at the elevated temperature consistent with the required fire-resistive rating is computed to determine if it is greater than the design condition. The temperatures of the reinforcement and concrete at a specified external temperature consider the thickness and type of aggregate used, configuration of the structural component and variations of concrete cover over tendons. The effect of surface application of fire-resistive coatings is considered in this report but recognition is limited to specific products covered in other evaluation reports that reference the PCI fire-resistive procedure.

The design of fire-resistive construction requires the use of the PCI manual "Design for Fire Resistance of Precast Prestressed Concrete," 1989, a copy of which must be submitted to the building official when a fire-resistive design under this report is submitted for approval. The procedures described in this report and the PCI manual comply with Section 703.1 of the UBC as alternates to Tables 7-A, 7-B and 7-C.

The fire-resistive design procedure is applicable to the following:

2.1.1 Concrete Beams and Slabs: Concrete beams and slabs under restrained and unrestrained conditions with consideration of continuity, if present. In continuous beams, the ultimate positive moment capacity is subject to a higher reduction than the ultimate negative moment capacity because of the location of tension reinforcement near the bottom of the structural member. The negative moment reinforcement ratio must be limited so that the reinforcement index does not exceed 0.30 before and after the temperature-strength reduction is considered. This is to prevent compression failure in the negative moment region. At least 20 percent of the negative moment reinforcement must be extended through the continuous member. Restrained beams and slabs are designed on the concept that the reinforcement at the elevated temperatures has a yield strength equal to the thrust created by the thermal restraint. Temperature rise on the unexposed face of a concrete floor or roof is considered on the basis of equivalent thickness and type of aggregate used.

2.1.2 Precast Wall Panels: The design procedure covers solid and hollow concrete wall panels, including ribbed panels, utilizing various types of aggregates. The design procedures consider bearing and nonbearing conditions.

3.0 EVIDENCE SUBMITTED

Manual for "Design for Fire Resistance of Precast Prestressed Concrete," 1989; report of fire tests; and research bulletins.

4.0 FINDINGS

That the fire-resistive design procedure for prestressed horizontal components and concrete walls complies with the 1997 *Uniform Building Code*™, subject to the following conditions:

4.1 A copy of the second edition of the Precast/Prestressed Concrete Institute manual entitled "Design for Fire Resistance of Precast Prestressed Concrete," 1989, is submitted with each project on which details of fire-resistive construction are based on this reference manual.

4.2 Calculations concerning fire-resistive construction are in full compliance with the design manual and are submitted to and approved by the building official prior to construction.

This report is subject to re-examination in two years.

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