AVERAGE PRECOMPRESSION IN POST-TENSIONED MEMBERS

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The ACI-318 provisions of an average precompression in post-tensioned slabs are the means by which the code sets the requirements for a minimum amount of reinforcement in design. Other major building codes, such as European EC2, or British BS8110, do so by stipulating specific values for minimum reinforcement, as opposed to minimum precompression. The minimum reinforcement in the latter codes can be provided by prestressing steel, or a combination of prestressing steel and non-prestressed reinforcement.

In principle, a satisfactory design can be achieved for a floor slab containing only a single post-tensioned strand with adequate supplemental non-prestressed reinforcement. It is not the level of precompression that guarantees the serviceability and safety of a structure. Rather, it is the entirety of prestressing and non-prestressed reinforcement, in amount and distribution that governs the response of a post-tensioned floor system to applied loads.

The provisions for design of post-tensioned slabs in ACI 318 (Chapter 18) include a number of options that are not permitted for non-prestressed slabs. Contrary to the current trend of thought in the industry, where prestressed and non-prestressed members are viewed and designed in the same manner as “structural concrete,” ACI-318 in Chapter 18 makes a clear distinction between design of “prestressed” and “conventionally” reinforced concrete - a feature that ACI-318 is likely to phase out with time. As an example, using ACI 318 it is permissible to design a column-supported (two-way) floor slab with no bottom non-prestressed reinforcement. Also, it is permissible to design a slab with a bonded post-tensioning system having neither top nor bottom non-prestressed reinforcement. In order to insure the adequacy of design, ACI 318 imposes a minimum amount of tensioned steel to control cracking. The minimum amount of tensioned steel and its distribution are expressed in terms of average precompression. In other words, the minimum precompression accounts for other requirements of serviceability that are not spelled out in the code.

Since 2002, ACI 318 has lifted the restriction on the level of tensile stresses in service condition for beams and one-way slabs, if the likelihood of crack formation and its consequence are accounted for in design. The European code permits beams, one-way slabs and column supported (two-way) slabs to be designed in the post-cracking regime with no limitation on the minimum precompression. The provision of minimum total reinforcement in the European Code follows in effect the same concept as “minimum precompression” in ACI-318, with the difference that the former is more general.

Strictly speaking, the 125-psi (0.90 MPa) precompression stipulated in ACI 318 need not apply to beams and one-way slab systems, since in the current code there are adequate provisions for post-cracking design of these members – a design provision that is also referred to as “partial prestressing.”