Reinforced Concrete Predimensioning to Enhance Optimization

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Summary

Due to the nature of the material, reinforced concrete elements normally need a complex computation process to find efficient sections. Recommendations of some main codes face the problem by offering very simple non-transparent all purpose predimensioning criteria. This paper demonstrates how transparency and accuracy are not in contradiction with simple predimensioning methods. This opens the possibility to make it easier to reach optimization of reinforced concrete elements.

Keywords: Reinforced concrete; predimensioning; optimization; span-to-depth ratio; beams; slabs.

1. Introduction

Reinforced concrete flexural elements are far from easy to optimize. Unlike timber or steel beams, efficient reinforced concrete members can only be found by iterating. This mainly has two reasons: on the one hand, concrete has a high weight-to-elastic-modulus ratio, such that self-weight of the structural element is not negligible when compared to superimposed loads; on the other hand, concrete has a low ratio of tension-strength-to-compression-strength, such that under flexural actions elements undergo cracking, leading to variable section properties along their main axis. This causes difficulties in estimating the modulus of inertia of the several cross sections, and thus of the whole member.

As a consequence, designing efficient reinforced concrete elements is done by a relatively long process. First, a certain height of the element is chosen to enable strength check and find the amount of reinforcement required. Then, deflection is computed to see if it matches allowable values. These two steps must be repeated until the desired efficient result is reached. The longer the iteration sequence is, the better the optimization. Alternatively, the most accurate is the first step in the sequence the shorter the iteration may be to get a good optimization.

2. Recent trends in predimensioning

2.1 Codes recommendations and everyday practice

At present, the most usual practice consists in:

a) Predimensioning the height of the section using simple predimensioning criteria such as *L/constant* 'based on prior experience' given by codes (ACI [1], EC [2]).

b) Checking if deflection in bigger than allowed, based on calculation, sometimes using FEM software.

c) If the computed deflection is larger than the allowed value, the height is increased until the deflection criterion is satisfied.

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