

Concrete structures: stresses and deformations¹

Edited by A. Ghali, R. Favre, and M. Elbadry

This book is written by world-class experts in the areas of reinforced and prestressed concrete structures and their deformational behavior. It has 14 chapters and 9 extensive appendixes. Essentially, the book can be subdivided into three areas of emphasis: (a) behavior of uncracked sections; (b) behavior of cracked sections and serviceability behavior as determined by deflection and cracking, including simplified methods of computation; and (c) deformational response of prestressed concrete structures to temperature and time-dependent effects and the design of members to account for these effects.

In the first area of emphasis, the first chapter deals with creep and shrinkage of concrete and relaxation of prestressing steel. The second chapter covers the stress-strain behavior of *uncracked* sections, including time-dependant stress and strain in composite sections, with extensive examples. The third chapter deals with prestress losses and presents approximate equations for evaluation of strains and curvatures, including calculations of displacements. Chapters four and five extensively treat the subject of evaluating internal forces in uncracked sections consecutively by the force method and the displacement method of elastic analysis, while chapter 6 presents the use of electronic computational methods and computer programs that facilitate the analytical solutions for time-dependant forces.

In the second area of emphasis, chapters seven and eight present an extensive treatment of stress and strain in *cracked* sections, the effects of creep and shrinkage on cracking behavior, with good computational examples of the deflection of two-way action slabs and plates, including numerous well-synthesized tables of computations and clear diagrams illustrating the computational procedure. The student and the practicing engineer are well served by the detailed illustrative computational examples. Chapter nine is unique in that it presents in a concise manner easy to follow procedures for simplified predictions of deflection evaluations, particularly in two-way action slabs and plates. It presents extensions

and modifications to the current American Concrete Institute (ACI) provisions on the effective moment of inertia, with numerical examples for the benefit of the structural engineering designer and analyst.

The third area of emphasis in chapters 10, 11, and 12 is a well-coordinated discussion of the effects of temperature changes on the cracking and deformational behavior of large prestressed concrete elements. The subjects of crack control and residual stresses are extensively covered. The numerical examples highlight the significance of appropriately dealing with these parameters that could be detrimental to the long-term performance of such structures, if not appropriately considered in the design process.

The book culminates with chapter 13 on an introduction to nonlinear analysis of plane frames and chapter 14 on serviceability of members reinforced with fiber-polymer reinforcement. The appendixes present valuable charts, tables, material coefficients needed in design, as well a brief description of computer programs available for use in the various areas covered in this book.

In summary, this is a well-written textbook that successfully and extensively treats the critical subject of deformational behavior and long-term performance of reinforced and prestressed concrete structures. Both students at the senior undergraduate and at the graduate levels can gain immense knowledge from the detailed treatment of the subjects enumerated in this review. It is a well-organized and comprehensive textbook that is also a needed tool by the structural engineers in their quest to control excessive stresses, deflections, and cracking that can result from failure to recognize and apply the state-of-the-art knowledge embodied in this text.

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