

Advances in serviceability and strength of normal- and high-strength concrete structures

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Summary

Serviceability and strength of concrete structures have been a topic of intense research for many years. Reported herein is the work conducted in this area, especially in the past decade, which ranges from the development of the layered finite element method and the associated theoretical studies to elaborate laboratory tests of high-strength concrete elements. In particular, serviceability studies reviewed include natural frequency, cracking and crack patterns, deflection and damping characteristics; strength investigations reviewed cover beams, slabs and walls, as well as the punching shear strength of

flat plates. A long-term on-site study of column shortening in an 80-storey residential building recently completed at Gold Coast in Southeast Queensland, Australia is also reported. In addition, a separate section discusses the serviceability studies specific for high-strength concrete structures. Summarized herein is the review of research findings published during the period spanning mainly from 1995 to 2005. Relevant formulas and analytical procedures which may assist practising engineers in the design of concrete structures are reported for completion.

Key words: axial shortening of columns; cracking and crack control; deflection; damping characteristics; punching shear strength of concrete flat plates; serviceability of high-strength concrete structures; ultimate loads of walls and slab panels

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Introduction

For a concrete structure to be considered serviceable, cracking must be controlled and deflections must be within specified limits. Also, it must not vibrate excessively. Concrete strength characteristics play a major role in each of these three aspects of the service load behaviour. Serviceability, like the strength characteristics of concrete structures, is therefore of paramount importance, especially from a design perspective.

During the past decade, various researchers have conducted a considerable amount of research in the broad area of serviceability and strength characteristics of concrete structures. These covered both reinforced and prestressed concrete structures as well as different structural elements constructed of both normal- and high-strength concrete. This paper attempts to review and present a summary of the findings from these research efforts. A significant number of papers and reports in the subject area published by different researchers are discussed

herein. A brief description is given of each of these works which were published mainly between 1995 and 2005 with some earlier ones included for completeness.

The main purpose of this paper is to acquaint the reader with the considerable body of research work and relevant findings in the topical area. The publications reviewed herein are classified and described under the following headings:

- Cracking and crack control
- Deflection
- Damping characteristics
- Axial shortening of columns in tall buildings
- Punching shear strength of concrete flat plates
- Ultimate loads of walls and slab panels

High-strength concrete (HSC) being a relatively new material, the discussion on the serviceability studies of HSC structures has been presented in a separate section.

To cover a large collection of publications in a restricted number of pages, the description of each, by

Longterm Serviceability Of Concrete Structures

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