

Deflection Calculation of RC Beams: Finite Element Software Versus Design Code Methods

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Summary

The paper investigates accuracy of deflection predictions made by the finite element package ATENA and design code methods ACI and EC2. Deflections have been calculated for a large number of experimental reinforced concrete beams reported by three investigators. Statistical parameters have been established for each of the technique at different load levels, separately for the beams with small and moderate reinforcement ratio.

1 Introduction

Civil engineers for analysis of reinforced concrete structures can choose between traditional design code methods and numerical techniques. Although design code methods ensure safe design, they do not reveal the actual stress-strain state of cracked structures and often lack physical interpretation. Numerical methods which were rapidly progressing within last decades are based on universal principles and can include all possible effects such as material nonlinearities, concrete cracking, creep and shrinkage, reinforcement slip, etc, being responsible for complexity of this material. In order to choose a particular calculation method, engineers should be aware of accuracy of different techniques.

This paper investigates accuracy of deflection predictions made by the finite element package ATENA and the design code methods ACI and EC2. Deflections have been calculated for a large number of experimental reinforced concrete beams reported by three investigators. Statistical parameters have been established for each of the technique at different load levels, separately for the beams with small and moderate reinforcement ratio.

2 Deflection calculation methods of design codes

In this section, two design code deflection calculation techniques, i.e. the ACI (ACI Committee 318 1989) and the EC2 (ENV 1992-1-1 1992) methods are briefly described.

2.1 Deflection analysis by ACI method

The curvature of a reinforced concrete member is determined by the classical expression $\kappa = M/E_s I$ where $E_s I$ is the flexural stiffness. Constant modulus of elasticity of concrete, E_c , was offered for all loading stages, but moment of inertia, I , is varying (Brimson 1977). Thus, for the elastic stage, I_e is written as for the gross concrete section ignoring reinforcement and for the load corresponding to the steel yielding I_c is calculated as for the cracked section. For loading points between the concrete cracking and yielding of the steel, the following equation was derived to express the transition from I_e to I_c , that was observed in experimental data (Brimson 1977):

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Proceedings of the International Conference on Eco-friendly Fibers and Polymeric Materials Sanjay Mavinkere Rangappa, Sathish Kumar Palaniappan, Suchart Siengchin, 2024-11-26 This proceedings book contains papers presented at the International Conference on Eco friendly Fibers and Polymeric Materials LSPM23 held on EFPM 2024 19 20 February Bangkok Thailand The papers in this book are presented by academics and industrial practitioners showcasing the latest technological advancements and applications of environmentally friendly polymeric materials with an emphasis on the production of bio based fibers and polymers are greatly enlarging its range of applications in different industrial sectors including automobiles sports architecture design and many others The content of this book appeals to academia and industrial researchers from the fields of polymer chemistry physics and materials science

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Reinforced-concrete Slab-column Structures Andrzej Ajdukiewicz, Włodzimierz Starosolski, 1990 This book presents a review of the whole field of flat plates and slab column structures also known as beamless structures encompassing their analysis design and detailed construction from both the theoretical and practical aspects Methods of analysis and design for slabs and entire slab column structures are compared and assessed both for elastic and post elastic phases with recommendations for practical use The review and comparison of the techniques of design for joints between slabs and columns together with test results presents the reader with a choice of applications The outline of international construction solutions used in monolithic prefabricated structures including lift slab structures includes examples of real buildings and provides a wealth of information for designers An integral part of the book consists of tables and nomograms for the direct calculation of bending moments deflections and support reactions in slabs locally supported

Deformation of Concrete Structures Dan E. Branson, 1976 *Transactions of the American Society of Civil Engineers* American Society of Civil Engineers, 2006 Vols 29 30 contain papers of the International Engineering Congress Chicago 1893 v 54 pts A F papers of the International Engineering Congress St Louis 1904

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