IABSE Conference – *Structural Engineering: Providing Solutions to Global Challenges*
September 23-25 2015, Geneva, Switzerland

Analysing Concrete Structures - Advances in Material Modelling with Practical Applications

Steve Rhodes, Philip Icke, Paul Lyons

LUSAS, Kingston-Upon-Thames, UK

Contact: steve.rhodes@lusas.com

Abstract

Numerical models for concrete have been in development for more than three decades. The advances in recent years, along with the arrival of powerful computers on the desks of consulting engineers, mean that this technology can now be regarded as a practical tool for use in industry, rather than only a research tool.

A simple example is used to demonstrate the use of a modern concrete material model with different idealisation approaches, 2D and 3D, allowing comparison to hand methods such as member resistances to EN1992-1-1.

Keywords: concrete, nonlinear, buildings, bridges, finite elements

1 Introduction

To ensure that the structures we build are safe, we use verification processes, generally relying on mathematical models.

The development of Finite Element (FE) analysis software has made a huge range of mathematical models practically available to engineers. However, the analysis of a structure rightly starts with the same consideration now as it did when manual calculation methods were the only option: the modelling approach selected must be one which adequately describes the behaviour of the structure in question.

Moreover, an efficient analysis will represent the true behaviour of the structure to a level of accuracy which is *justified* by the purpose of the analysis.

For new structures, conservative approaches are often acceptable. For existing structures, such conservatism could lead to unnecessary disruption and wasted resources. Consequently advanced analysis approaches – which better represent the real behaviour of structures – are more often justified, as we seek to maintain and upgrade our aging infrastructure.

For safety critical structures, such as nuclear installations, Liquid Natural Gas (LNG) tanks and the like, conservative approaches may be used alongside more advanced analysis approaches in an effort to ensure that aspects of the structural behaviour have not been overlooked.

It is in this context that we consider the use of advanced concrete material modelling with FE.

2 Idealisation of RC structures

2.1 Linear vs. nonlinear analysis

For reinforced concrete (RC) structures, linear elastic analysis is widely used even though RC is generally cracked and therefore has a significantly lower stiffness than that which would be assessed using the gross section and the elastic modulus from a Code of Practice. Overlooking such nonlinear behaviour is often acceptable bearing in mind the purpose of the analysis – to determine a

https://doi.org/10.2749/222137815818358367