Cite this article
Bonet J (2018)
Editorial.
Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics
171(1): 1–2, https://doi.org/10.1680/jencm.2018.171.1.1

Editorial

Engineering and Computational Mechanics

ice publishing

Editorial

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This issue of the *Engineering and Computational Mechanics* journal of the Institution of Civil Engineers (ICE) contains four articles on different aspects of nonlinear behaviour of structures. The first two contributions focus on the dynamic response of structures under blast loading and earthquake loading, respectively, while the third deals with the large deflection of circular plates and the final paper presents a comprehensive correlation study of different mechanical properties of concrete based on its compressive strength. All these topics are of interest to civil and structural engineers and regular readers of these *ICE Proceedings.*

The issue starts with an article on the important topic of Hopkinson bar experiments (Rigby *et al.*, 2018). These experiments are based on measuring the transmission of shock waves along bars. They have been used for over a century to study not just the behaviour of materials under impact and blast loads but also to determine the elastic and constitutive parameters of materials used in the construction and manufacturing industries. The experiments are based on measuring the way in which shock waves are transmitted through an elastic medium. Shock waves are travelling discontinuities in the pressure field that move at speeds higher than the speed of sound. They are created by impacting one end of the Hopkinson bar and measuring time elapsed and pressure on the other end. This type of experiment was extended by Kolsky by placing a specimen to be measured between two Hopkinson bars. The transmission and reflection of elastic waves in this arrangement can give highly useful information on the material placed in between the Hopkinson bars. In order to obtain accurate material properties, however, it is essential to be able to interpret the measured signals correctly and this is the key contribution of Rigby *et al.* (2018) in so far as they describe novel correction methodologies to account for dispersion effects.

The second paper concerns itself with the simulation of earthquake-induced ground motions to be used as input to dynamic structural simulations (Eftekhari *et al.*, 2018). In order to make predictions of the behaviour of structures in response to future earthquakes, it is critical to have a method to simulate a realistic ground motion under a possible future earthquake. This is clearly not a deterministic process as there are many sources of uncertainty involved in the actual ground motion. A widely accepted stochastic methodology to come up with a realistic motion is the finite-fault model. This is based on a number of site-dependent parameters which will vary in a random manner leading to a large number of ground motion scenarios to be considered, making the resulting analysis costly. Eftekhari *et al.* (2018) propose a prior sensibility analysis in order to identify a limited set of parameters that are of key importance for a given site and fix the rest, thus leading to a much reduced cost of analysis.

The third paper in this issue deals with the large displacement analysis of clamped circular plates (Razdolsky, 2018). This problem is governed by a fifth-order partial differential equation due to Von Karman. The differential equation is accompanied by a set of boundary conditions at the clamped edge and at the centre, making it a boundary-value problem. An elegant technique for solving boundary-value problems consists of turning them into initial-value problems by ignoring one set of boundary conditions, in this case those at the centre, and replacing them by additional guessed conditions at the other end. In this way the problem becomes an initial-value problem and can be solved using much simpler and well-established techniques to solve ordinary differential equations. Of course, with artificially guessed additional boundary conditions on the clamped edge, the necessary conditions at the centre will not be satisfied. However, a simple iteration scheme can be devised in order to improve sequentially the guessed conditions at the clamped edge until the deflection of the plate meets the requirements at the centre. Razdolsky (2018) proposes a smart way of achieving this based on ever-decreasing embedded polygons that quickly converge to the final solution.

The final paper in this issue presents an in-depth analysis of the correlation of mechanical properties of concrete with the compressive strength (Vakhshouri and Nejadi, 2018). It is known that concrete is generally described and marketed on the basis of its compressive strength. However, other mechanical properties are important in order to determine the behaviour of the structure under service or ultimate loads. For instance, the module of elasticity E will determine the deflection of the structure and the splitting tensile strength and modulus of rupture will dictate the correct amounts of reinforcement necessary. Estimating these parameters from the compressive strength of concrete is carried out in a number of different ways by international design codes using empirical relations.

Vakhshouri and Nejadi (2018) give a comprehensive review of these relationships, together with several published alternatives, and use a comprehensive set of experimental data points to reach reassuring conclusions, but also point at underestimation of several parameters such as the modulus of elasticity.

The editorial team hopes that you will find this set of papers interesting and informative as they represent the state of the art in a variety of important topics in civil engineering.

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