EMI 2014; Engineering Mechanics Institute Conference

Calibration and comparison of concrete models with respect to experimental data

Jan Vorel[1], Alberto Sandini[1], Marco Marcon[1], Jovanca Smith[2], Gianluca Cusatis[2], Roman Wendner[1]

[1] Christian Doppler Laboratory LiCRoFast,
Department of Civil Engineering and Natural Hazards,
University of Natural Resources and Life Sciences, Vienna, Austria.
roman.wendner@boku.ac.at

[2] Northwestern University
Evanston, IL, USA

At the beginning of the 21st century, civil engineers more than ever face the often-contradictory demands for designing larger, safer and more durable structures at a lower cost and in shorter time. Concrete has been used for many centuries as a safe and durable building material. Two of the main advantages of concrete are its high compressive strength and that it can be cast on the construction site into a variety of shapes and sizes. Many different constitutive models have been developed to fulfill the above mentioned requirements and describe/predict the behavior and failure of concrete. The never ending challenge for engineers is to choose and set up the appropriate material model for the modeling of structures or structural elements. Therefore, the primary objective of the present research is to calibrate, validate and compare different constitutive models with respect to an extensive set of experimental data. Depending on the application and availability of data, the expected prediction quality of the available models may vary significantly. The studied material models include the microplane models M4 and M7, the damage plasticity models available in commercial (ATENA) or open source (OOFEM) finite element codes, e.g. the Grassl-Jirasek material model. Moreover, the Lattice-Discrete-Particle-Model (LDPM), implemented in the solver MARS, is utilized. We present a comparison of these models with regard to the number of input parameters, their physical meaning, the ease of calibration and their predictive capabilities by utilizing a large set of experimental data derived from specimens, cast from the same batch. All models are calibrated using three mean value nominal stress-strain curves obtained from a notched three-point bending, uniaxial compression and compression under passive confinement test. The calibrated numerical models are then used to predict the results of the remaining experiments, i.e. 3-point bending tests of 4 sizes with various notch depths, splitting tests of 5 sizes, direct tensions tests and torsion tests. These data then serve to assess the prediction quality of the models.