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SEPARATION OF PARAMETER INFLUENCE IN ENGINEERING MODELLING AND PARAMETER IDENTIFICATION – *SEPAEMPI*

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Objective

The material under consideration is a composite material consisting of high performance concrete matrix with embedded (steel) fibers. In order to make an effective model, parameters have to be identified from experiments, e.g., using inverse procedures. The two main project goals are separation of influence of the friction forces in FRC (Fiber Reinforced Concrete) and relating the 3-point bending and pull-out models for fibers (in FRC). Our parameter identification model is going to separate friction forces from plastic forces (straitening of fibers during pull-out) in bond-slip behaviour of fibers.

Numerical model

The novelty of the approach is that no linearization is performed, structure is modelled as a dynamic system described with a system of nonlinear differential equations. The presented mathematical formulation is general and allows for both displacement and force types of loading that could be freely mixed and for simultaneous use of both Kelvin and Maxwell structure elements/cells. The model is based on dynamic systems approach with the solution being a mixture of numerical procedure and symbolic representation.
Novelty of the proposed project is development of a procedure that could separate the influence of certain parameters in the model. There are methods that are already used for that purpose but are not suitable for civil engineering materials because they are based on large data sets. Here, we do not have a vast number of test results; we are going to overcome the problem by producing own experiments and procedures based on a combination of deterministic and stochastic material description.
The main difficulty in determination of parameters and loading is that in most cases they could not be directly measured, e.g., wind loads, and similar. In most cases we measure displacements, velocities or accelerations or a combination.
Special procedure has to be formulated for extraction of relevant parameters from indirect measurements, the so called "inverse procedure". The main difficulty with inverse procedure is that it is generally unstable, i.e., sensitive to errors in measurements. The new model presents a generalization of the previous model since now we are dealing with a mixture of deterministic (bending formulation) and stochastic parameters (fiber pull-out behaviour). It is a novel numerical model for steel-fiber reinforced concrete under static and dynamic loading.

Additional aspects

In addition, our model for concrete will be generalized with formulation of the forward and inverse problem for description of viscosity in asphalt mixtures. In addition, we will try to apply our novel method for formulation of an inverse model capable of exposing the dependence between various model parameters and their influence onto the total creep behaviour of concrete; this objective is supposed to be extremely difficult due to a large number of interrelated parameters (temperature, humidity, stress, etc.).