



BIM: Design Embedded Simulation of Road Bridges

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Abstract

The application of Building Information Modeling is rapidly increasing worldwide. As a consequence 3D-CAD models are available in early project phases which give a well representation of the 3D-geometry ready to use for other purposes such as simulations. Why not use them for the preliminary design of the structure like it is done in other industries for many years? The terminus for this kind of simulation was here established as “design embedded simulation”.

This contribution picks up the idea of design embedded simulation for the structural preliminary design of road bridges. It was worked out within a research and development project at the Cologne University of Applied Sciences in collaboration with a structural engineering company, Schüßler-Plan.

A new methodology for design embedded FEM of road bridges is presented which includes three major steps:

- An enrichment of the spatially double curved, object based CAD model for FEM simulations by geometrical and statical constraints.
- The Finite Element Simulation of the enriched 3D-Model using tetrahedron-elements with a quadratic form function for linear elastic stress analysis.
- The application of integration- and design-objects to derive global internal forces for a nonlinear design, according to standard design codes for R/C.

To investigate and prove the concept it was applied to case studies of pre-stressed concrete road bridges to compare the design results (stresses, internal forces, design, effort) to regular simplified FEM.

Keywords: BIM, FEA, Design Embedded Simulation, Isogeometric Simulation, Bridge Structural Design