The possibility of using BIM for nonlinear life-cycle analysis of concrete structures

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ABSTRACT

In the recent years the issue of BIM is gaining increased attention and there is a growing number of practical applications of BIM. The basis of BIM is Industry Foundation Classes (IFC), 2013, published as International Standard ISO 16739: 2013. IFC constitute an open data format for data exchange between different types of software applications throughout the entire structural life-cycle. Authors created within the international project SE-Lab an application for data conversion to structural analysis (Structural Analysis View MVD). The structural data are converted from IFC standard to ATENA software input format, which is suitable for the nonlinear FEM analysis of concrete and reinforced concrete structures. The functionality of ATENA solution core has been extended in order to solve some of previously unsupported load types which are part of the IFC standards. Integration of the NLFEA with stochastic and degradation modeling allows to assess life-cycle reliability of civil engineering structures or structural elements.

The presented paper describes an unified approach in modeling advanced behavior of structures directly using the information from an IFC based BIM model (Figure 1). Suitable filtering tools are first applied on the BIM model to eliminate any redundant in-formation. The geometrical information as well as the information about reinforcement, material properties, loads and boundary conditions is used to automatically construct the numerical model with as little user intervention as possible. The numerical model is then used for nonlinear analyses, which can be used to evaluate various design scenarios or limit states. In the presented validation problems two design scenarios were evaluated and tested: ultimate limit state in terms of failure load and failure mechanism and service limit state of deformation, crack location and crack width.

The presented approach is part of the ongoing research and development effort of the authors in applying advanced numerical models and simulations in design and life-cycle assessment of safety critical structures.

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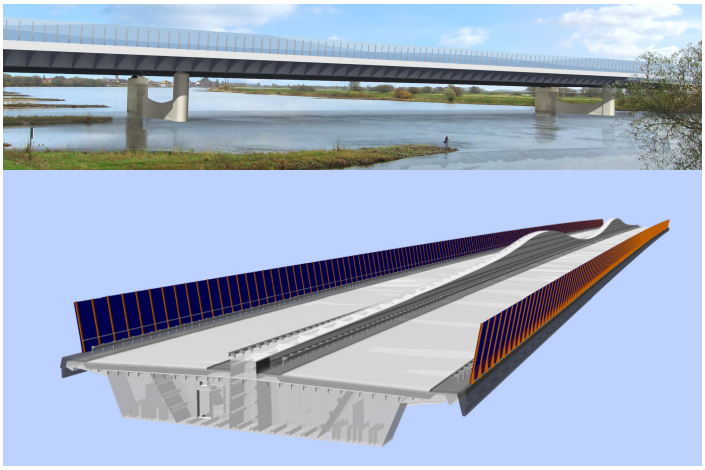

Figure 1. Visualization (top) and IFC model (bottom) of bridge Wittenberge, one of the validation problems in SE-Lab project.

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