THE APPLICATION OF MODEL UPDATING METHODS AND WAVELET TRANSFORM FOR DAMAGE DIAGNOSTICS OF COMPOSITE BEAMS

Steel-concrete composite beams are often used in public space and industrial building engineering as direct elements of composite floors. They are also used in bridge engineering and pedestrian crossings as main carrying girders. Because of the way composite elements are used special attention should be paid to the operation and the technical condition of these strategic facilities. Damage detection and structural condition assessment is the field of SHM (Structural Health Monitoring), which, through measurements and control systems is designed to notify users of any changes that may warning signs of damaged elements. Early damage detection allows users to repair the engineering construction and may extend the service life-time of the object.

In this paper the methods of model updating and discrete wavelet transform (DWT) were used for damage detection composite beams. A two-level algorithm ***U-DL*** (eng., *Damage Detection - Location*) for the detection and location of damage were developed. Damage detection included analysis of the changes in dynamic and static parameters of beams (i.a natural frequency, vibration forms, modal damping, the spectral features of the transition, deflection, stress). Damage in beams was located using discrete wavelet transform (DWT). The validation of the ***U-DL*** algorithm was conducted on discrete models of steel-concrete composite beams for three independent simulations, ie. damage to the lower belt of a steel beam, damage to the reinforced concrete slab and damage to a steel studs for the free-end and simply-supported beams. The natural frequency, mode shapes, line deflections and stresses of damaged and undamaged discrete models were analyzed.

The discrete models were developed in the convention of Finite Element Method (FEM), based on the author's original program, written in the Python programming language and computing platform Abaqus. A multi-level model updating of computational models was defined, i.e. the identification of selected parameters of computational models (***ID-IS-IT***, i.e. *Identification of Dynamic parameters - Identification of Static parameters - Identification of Damping parameters*). The model updating was based on the results of experimental studies, during which the static and dynamic parameters of steel-concrete composite beams were determined. The identification of selected parameters was carried out connecting advanced computational programs (Python, Abaqus, Matlab) in automatic optimization loops. Boundary conditions and load scheme in computational models in the analysis were like those that were applied in the experimental studies.

The results of the model updating by ***ID-IS-IT*** indicate that the results of computational models are highly consistent with the results of experimental tests. The analysis results of clearly demonstrated that the ***U-DL*** algorithm can be successfully used for damage detection and location in steel-concrete composite beams.

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