

Description of a Structural Health Monitoring and Control System Using Open Building Information Modeling

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Abstract : In view of structural engineering, monitoring of structural responses over time is of great importance with respect to recent developments of construction technologies. Recently, developments of advanced computing tools have enabled researcher's better execution of structural health monitoring (SHM) and control systems. In the last decade, building information modeling (BIM) has substantially enhanced the workflow of planning and operating engineering structures. Typically, building information can be stored and exchanged via model files that are based on the Industry Foundation Classes (IFC) standard. In this study a modeling approach for semantic modeling of SHM and control systems is integrated into the BIM methodology using the IFC standard. For validation of the modeling approach, a laboratory test structure, a four-story shear frame structure, is modeled using a conventional BIM software tool. An IFC schema extension is applied to describe information related to monitoring and control of a prototype SHM and control system installed on the laboratory test structure. The SHM and control system is described by a semantic model applying Unified Modeling Language (UML). Subsequently, the semantic model is mapped into the IFC schema. The test structure is composed of four aluminum slabs and plate-to-column connections are fully fixed. In the center of the top story, semi-active tuned liquid column damper (TLCD) is installed. The TLCD is used to reduce effects of structural responses in context of dynamic vibration and displacement. The wireless prototype SHM and control system is composed of wireless sensor nodes. For testing the SHM and control system, acceleration response is automatically recorded by the sensor nodes equipped with accelerometers and analyzed using embedded computing. As a result, SHM and control systems can be described within open BIM, dynamic responses and information of damages can be stored, documented, and exchanged on the formal basis of the IFC standard.

Keywords : structural health monitoring, open building information modeling, industry foundation classes, unified modeling language, semi-active tuned liquid column damper, nondestructive testing

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