ENHANCEMENT OF SPATIAL AND PHYSICAL ELEMENTS FOR IFC-BASED BRIDGE DATA MODEL

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ABSTRACT: This study provides an enhanced data model which can represents bridge components in a 3-D model hierarchically. The bridge components were identified through careful investigation of standardized classification systems of construction information, official dictionaries, and technical documents. The identified components were classified into spatial, physical and part elements and defined as entities according to the framework of IFC (Industry Foundation Classes).

***Keywords**: Bridge Component, Data Model, Standard, Industry Foundation Classes*

The interoperability of the model data is a major concern in the BIM technology. The Industry Foundation Classes (IFC) developed by buildingSMART [1] is becoming a *de facto* and *de jure* standard supported by commercial BIM tools. However, most construction elements provided in the IFC are related to buildings rather than the other civil infrastructures including bridges, roads, and tunnels.

The French chapter of IAI (International Alliance for Interoperability) has driven development of the IFC-based bridge data model as an IFC extension project [2]. However, the IFC-based bridge data model is still lack in representing bridge elements, hierarchically.

This study proposes an enhanced data model for highway bridges. We identified bridge elements shown in open classification systems [3-4], official dictionaries [5-7], and engineering. The identified elements were categorized into spatial elements, physical elements, and group elements according to the framework of construction elements of buildings in IFC. As a next step, the categorized elements were compared with existing entities in the IFC, and we defined new entities for representing bridge elements in terms of bridge engineering.

One of major differences between the new model and previous IFC bridge model is the enrichment of spatial elements. Fig. 1 depicts a subschema for spatial elements of bridge. Two entities, 'IfcLane' and 'IfcBridgeSpan', were added for overcoming limitations of previous product data models. 'IfcLane' divides transversal spaces of roadway, and 'IfcBridgeSpan' represents a spatial container of a bridge span. In addition, we developed 'IfcCivilTransportationElement' to represent linear features of transportation networks. The transportation structures (e.g., bridge, road, tunnel) can represent this linear features because of inheritance.

Most entities provided in IFC may be able to represent some structural members of bridge. However, we considered sustainability and reusability of existing parsers in commercial software. Hence, two new elements, 'IfcTransportationElement' and 'IfcServiceFacilities-Element' were developed as generalized supertype entities for physical elements of bridge, in this study. 'IfcTransportationElement' represents physical elements sustaining structural system on the various loading conditions, and 'IfcServiceFacilitiesElement' comprised utility elements installed for ensuring serviceability of bridge and safety of the structural systems and people.

A complex type of bridge system was selected as a sample bridge to validate the enhanced data model. Fig. 2 and 3 illustrate hierarchical structures of spatial and physical elements of the sample bridge. As shown in the figures, the proposed data model provides richer context for representing spatial and physical bridge elements than previous bridge data models.

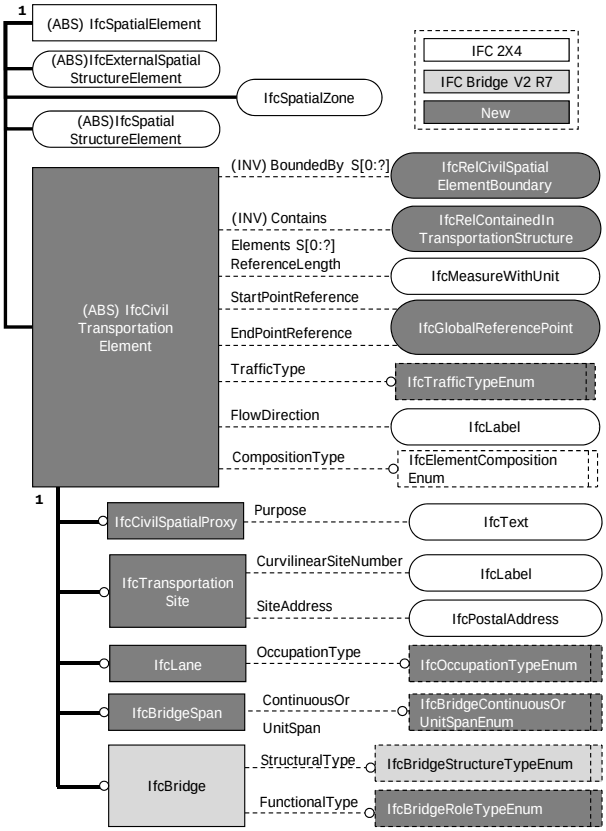

Fig. 1 Spatial elements for road bridges.

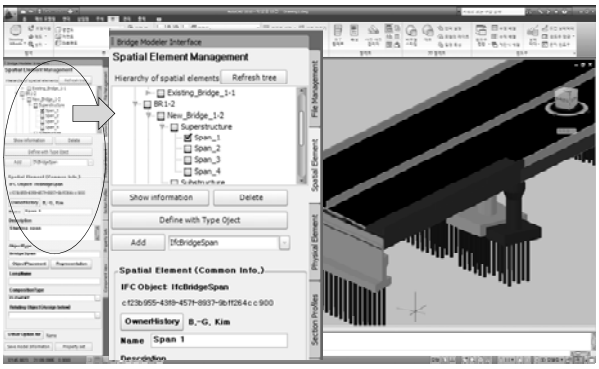

Fig. 2 Elements in the first span of new bridge section

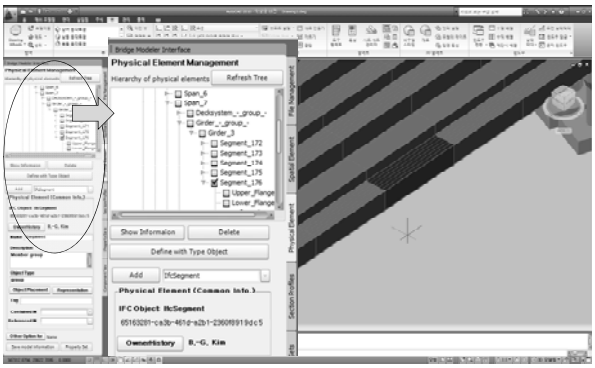

Fig 3. Part elements of a segment in a steel-box girder

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