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Abstract

Checking IFC with MVD Rules in Infrastructure: Case Study†

Štefan Jaud [1,*] and Sergej Muhič [2]

[1] Jaud IT, Moorenweis, Germany; stefan.jaud@outlook.com
[2] Sergej Muhič IT Consulting, Griesstätt, Germany; sergej.muhic@pm.me
* Corresponding author
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Building information modelling (BIM) is getting increasingly used in practice as a method of consistent and continuous usage of digital information in design, construction and operation of buildings [1]. During recent years, the infrastructure sector of the architecture, engineering and construction (AEC) domain has been introduced to the established workflows, processes, and data models previously only focusing on the building sector [2, 4]. This contribution showcases a typical workflow as applied to a bridge model, i.e., the quality checking and quality assurance (QA/QC) of digital information delivered during the design phase. We present the QA/QC process, report lessons learned, and conclude with an outlook.

A very important aspect of any information flow is ensuring received data's compliance with predefined requirements (see Figure 1). In the world of BIM, the Exchange Information Requirements (EIR) lists all necessary information to be delivered at handover, i.e., every element with its attributes, attribute types as well as constraints to values in attributes. The information author produces a BIM execution plan (BIM) which details the EIR as applied to the project considering the software solutions employed. The model is submitted in an agreed format, e.g., a vendor-neutral, non-proprietary data format Industry Foundation Classes (IFC) [3]. Checking rules shall be derived from the BEP and encoded using the open data format mvdXML. The rules are used for automatic model checking of the delivered data from the BIM modelling process. Identified issues shall be reported back to the modeler using the BIM collaboration format (BIM) data format.

We showcase the QA/QC process on a bridge model from Sweden. The requirements were defined before the design commenced and shared with the design firm. For example, the EIR requires the length of an edge beam *Längd (kantbalk)* to be provided for the asset management system used by the agency. The BEP foresees this information to be provided within an IFC dataset, attached with a property set to an *IfcBeam* element. The property set shall be named *ePset_BaTManKantbalkOccurence* and the property *K35: Längd (kantbalk)*.

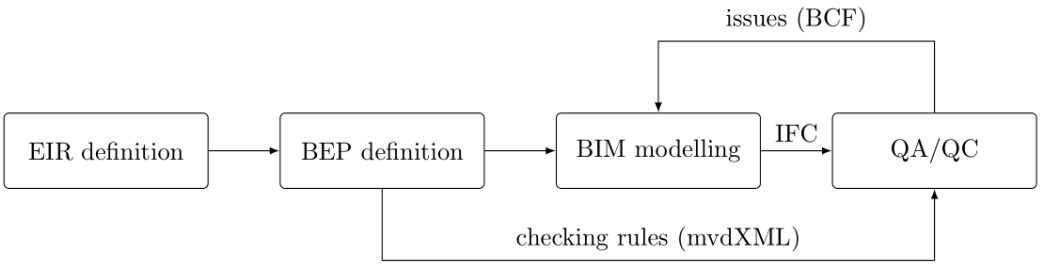

Figure 1: Conceptual workflow of information with QA/QC in AEC domain.

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<TemplateRule
 ↪  Parameters="Set[Value]='ePset_BaTManKantbalkOccurence' AND
 ↪  PropertyName[Value]='K35: L&#xE4;ngd (kantbalk)' AND
 ↪  Value[Exists]=TRUE AND Value[Type]='IFCLENGTHMEASURE'"/>
```

Figure 2: The checking rule encoded in mvdXML.

The corresponding checking rule in the mvdXML is presented in Figure 2. Next to correct naming of the property set and the property, it checks that the type of the property's value is a length measure. The model submitted to the stakeholder has been checked against the requirement with the following result: out of 15 beams in the delivered dataset, 13 pass and 2 fail the described check, since they don't have the specific property set attached.

The example and the checking rules were prepared in the current official IFC4 version of the standard [3]. The scope of this version is building related with limited support for the infrastructure domain. Thus, many modelling decisions in BEP were suboptimal, frequently knowingly misusing an established concept or an IFC entity. The spatial container for the whole bridge was chosen to be *IfcBuilding* and showcases a work-around for the lack of better alternatives, whereas other such as the railing of the bridge modelled as an *IfcRailing* demonstrates good practice. Additionally, many elements had to be modelled using the placeholder entity *IfcBuildingElementProxy* and classified using less than ideal concepts, e.g., properties for objects defined in this project.

The IFC standard has been expanded over the course of the past years to provide better support for infrastructure specifics [4]. The authors call for its fast adoption in the industry to ensure semantically rich exchanges with little-to-none work-arounds needed. This can provide a sound basis for QA/QC in the infrastructure domain of the AEC industry.

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