



THE USE OF BIM FOR BRIDGE DATA MANAGEMENT IN THE ITALIAN SCENE: A REVIEW WITH A PRACTICAL PERSPECTIVE

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Introduction

Bridges play a significant role in transport networks, making their maintenance crucial: this has become evident in Italy, where past collapses have revealed critical deficiencies in their maintenance (di Prisco et al., 2018, Clemente, 2020, Scattarreggia et al, 2022, Farneti et al., 2023). In this context, institutions moved to implement strategies capable of preserving and managing infrastructural heritage. With these purposes, in 2020 the Guidelines for Risk Classification and Management, Safety Assessment and Monitoring of Existing Bridges were published (MIT, 2020a, MIT, 2020b). This aims at defining a homogeneous and well-structured management system for existing civil infrastructures through a multi-level approach for the hierarchical classification of bridges and the subsequent prescriptions on the activities to be carried out. The logics of such an approach is shown simplified in Figure 1.

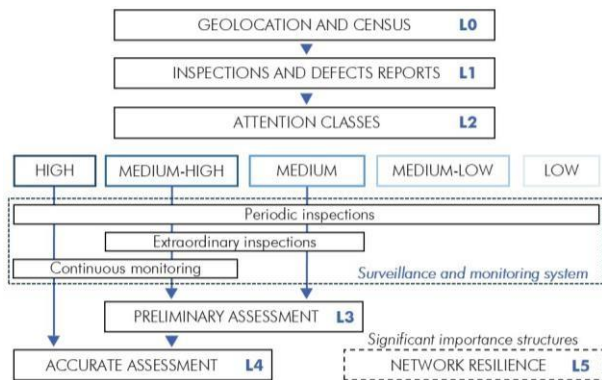


Figure 1: Guidelines multi-level approach

In this Guidelines, the Ministry suggests the use of BMS (Bridge Management Systems), even integrated with BrIMs (Bridge Information Models). For these reasons, several studies and examples of digital Guidelines implementation can be found in literature, which some of them explicitly mentioned the use of openBIMs and, in particular, the IFC (Industry Foundation Classes) format. The presence of several solutions, in addition to the advent of new features in the IFC schema for infrastructure management, requires a review of the

available approaches. For these reasons, this contribution analyses how researchers in recent years have implemented the information management required by the Guidelines within the BrIM methodology in the Italian context. From this research, three main themes have been identified: a) the Information Management for data insertion and consultation; b) the integration of the Guidelines within the BIM platforms; c) the adoption of IFC formats for data exchange.

Information management solutions

In the information management field, the analysed studies propose methods from spreadsheets to database queries (Figure 2). Some researchers used Microsoft Excel to organize information before importing it into BIM models, where data was assigned to bridge components through visual programming (Ciccone et al., 2022, Casto et al., 2023) and/or used to evaluate the bridge's structural condition through Python script (Meoni et al., 2024). Other researchers proposed the use of relational databases (RDBs), such as Microsoft Access, to manage data flow between RDB and BIM, either by extraction (Pallante et al., 2024) or direct import via a plug-in (Aglietti et al., 2023). Another mentioned solution is the use of Common Data Environments (CDEs), which are cloud platforms enabling stakeholders to centrally organise, edit and share data and models (Salzano et al., 2023, Polonia et al., 2024).

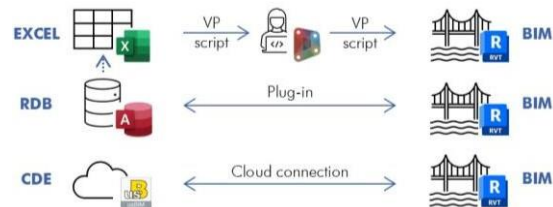


Figure 2: Approaches for data stream management

BIM modeling

In implementing Guidelines within BIM authoring platforms, most of the selected researches used Autodesk Revit for modelling and parametrising the asset (Figure 3). For 3D modeling, studies range from Scan-to-BIM (Aglietti et al., 2023, Sanseverino et al., 2024), to semi-automatic approaches through visual programming scripts

(Ciccione et al., 2022, Pallante et al., 2024), with custom families modeled as needed. Two parameterization approaches have been identified: one incorporates most of the Guidelines' data directly into the model (Ciccione et al., 2022, Casto et al., 2023), while the other selects and inserts only some data, leaving the majority accessible externally (Salzano et al., 2023, Polania et al., 2024). Both methods are usually done by creating shared parameters.

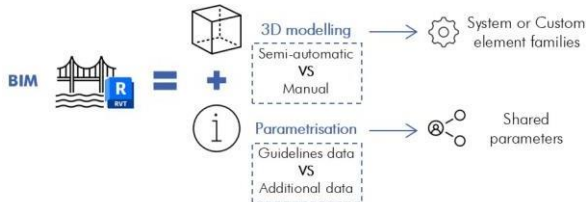


Figure 3: BIM model generation

IFC exporting

Although open formats are fundamental, only few references detail their implementation and explain common openBIM practices that are widely adopted by general users (Figure 4). By creating a predefined text file, users can export the information from Revit to IFC model, grouping it into user-defined Property Sets (PSets) and associating it to the IFC schema level defined. Once completed, according to a specific Revit IFC Export Settings the IFC models can be generated. Although not all analysed references specify the adopted IFC version, the focus is clearly on the development of the IFC4 series and its infrastructural extension, particularly IFC 4.2 and 4.3 (Ciccione et al., 2022, Polania et al., 2024, Sanseverino et al., 2024)



Figure 4: Typical IFC model generation workflow

Conclusions

Digital implementation of the Italian Guidelines for bridge defect data management is a current hot topic and several proposals can be found in literature. Different authors propose their specific workflows and features depending, mainly, on three different key points: a) data stream; b) Guidelines agreement; c) IFC adoption. From a practical perspective, it is worth making a summary and describe common features, pros and cons of the main contributors that are currently present. This work is a preliminary step for developing wider research on bridge management in the Italian context, with the aim of easiness-of-use and long-term perspective, focusing on the integration of different digital systems to create a simple workflow for the definition of a BMS in accordance with regulatory requirements and possible future implementations.

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