Integrating HBIM for preventive conservation:

A case study of Porta Maggiore in Rome

Jiayao Jiang | China Izadora Araujo Amara | Italy

Abstract:

The advancements in technology over the last few decades have led to a proliferation of information sources, resulting in increased variety and complexity of digital data. There is a growing interest in utilizing Historic Building Information Modeling (HBIM) tools to replicate historical monuments, mainly for restoration purposes. Research often emphasizes various survey methods, the geometric accuracy of the 3D model, as well as performance assessments in the digital environment. However, there is a lack of exploration into how HBIM can be effectively employed for preventive conservation and sustainable management of built heritage. That is to say, the paradigm of prioritizing short-term solutions for conserving built heritage rather than adopting long-lasting planned conservation strategies resembles to be reflected also in digitalization initiatives.

Preventive conservation refers to the measures and actions taken to mitigate potential damage and deterioration to cultural heritage, which involves a proactive approach that aims to prevent or minimize future deterioration, rather than relying solely on reactive interventions. A key component of preventive conservation is the conservation plan, which is an operational tool that guides the implementation of effective maintenance. It encompasses elements such as time and resources management, policies, technical guidance and reports, assignments, monitoring, and assessments. These procedures highly depend on a method of documentation that can ensure the viability, efficiency, and continuity of the conservation plan. In the context of new construction, the concept of 7D Building Information Modeling (BIM) has emerged for Facility Management, which comprises the 3D model, time schedule, cost intelligence, and sustainability. Builders and project managers employ 7D BIM in the maintenance and operation of a building throughout its entire life cycle. Given that the field of HBIM is still in its early stages and currently lacks specialized tools for conservation plans, this paper aims to elucidate the potential adaptation of 7D BIM to 7D HBIM. The change of perspective towards this digital system holds promise for improving the effectiveness of conservation efforts among diverse stakeholders and ensuring the long-term preservation of cultural heritage.

This paper presents a case study of Porta Maggiore in Rome, initially constructed as a triumphal arch from the imperial period, which is a monumentalization of two aqueduct channels' arcades. Subsequently, it was incorporated into the Aurelian Walls, serving as an important gate to the city. Over time, this defensive structure and water ducts underwent various transformations, adding complexity to the creation of a comprehensive HBIM model. Based on photogrammetric surveys and point clouds, a 3D model was constructed on the HBIM platform, representing the current condition of the monument. The architectural components were classified in a manner to enable their use as a repository of the documentation produced by planned conservation. In other words, the semantic segmentation, categorization, and parametrization of the 3D elements were defined according to the management purpose. In addition, this model also facilitates the

identification of single elements or architectural systems selected by different properties, permitting information recording directly associated with required components (see Figure 1). Subsequently, a comprehensive conservation plan was formulated, encompassing technical sheets, guidelines, time schedules, and cost estimates. This plan was integrated into the HBIM platform with the aid of available Facility Management digital tools. The software employed ensures continuous updates of the plan by documenting every periodic inspection, maintenance procedure, or potential intervention in the database. Moreover, the digital platform allows for sharing of data and documents (drawings, documents, reports, photographs) among different actors. All the data produced by the conservation plan and the ongoing conservative activities are stored and become beneficial for future decisions, which avoids the fragmentation and discontinuity of information when conservation works involve multiple parties, that is often the case in the practical world. In this manner, the digital database serves a dual purpose: it not only stores records of specific interventions but also functions as a valuable resource for long-term sustainability, going beyond mere energy consumption.

This paper aims to explore the potential of HBIM as an innovative approach to managing built heritage and sharing information with building lifecycle operators. The significance of establishing criteria to evaluate the practical relevance of creating, processing, and storing 3D models and related data is emphasized. These criteria should not only focus on their application in 3D reconstruction or short-term restoration but also consider the long-term value of digitalizing cultural heritage as a means of implementing and improving preventive conservation measures. Furthermore, the purposeful utilization of 3D heritage data should serve as a valuable resource in anticipation of forthcoming societal changes. The adoption of 7D HBIM for planned conservation holds the potential to shift preservation practices by enabling data-driven renovation strategies, empowering conservation professionals to make informed decisions based on accurate and up-to-date information, and generating collaborative and sustainable management of cultural heritage.