Development and Application of an Intelligent Masonry Modulation in BIM Tools: Literature Review

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Abstract : The heritage building information modelling (HBIM) of the historical masonry buildings has expanded lately to meet the urgent needs for conservation and structural analysis. The masonry structures are unique features for ancient building architectures worldwide that have special cultural, spiritual, and historical significance. However, there is a research gap regarding the reliability of the HBIM modeling process of these structures. The HBIM modeling process of the masonry structures faces significant challenges due to the inherent complexity and uniqueness of their structural systems. Most of these processes are based on tracing the point clouds and rarely follow documents, archival records, or direct observation. The results of these techniques are highly abstracted models where the accuracy does not exceed LOD 200. The masonry assemblages, especially curved elements such as arches, vaults, and domes, are generally modeled with standard BIM components or in-place models, and the brick textures are graphically input. Hence, future investigation is necessary to establish a methodology to generate automatically parametric masonry components. These components are developed algorithmically according to mathematical and geometric accuracy and the validity of the survey data. The main aim of this paper is to provide a comprehensive review of the state of the art of the existing researches and papers that have been conducted on the HBIM modeling of the masonry structural elements and the latest approaches to achieve parametric models that have both the visual fidelity and high geometric accuracy. The paper reviewed more than 800 articles, proceedings papers, and book chapters focused on "HBIM and Masonry" keywords from 2017 to 2021. The studies were downloaded from well-known, trusted bibliographic databases such as Web of Science, Scopus, Dimensions, and Lens. As a starting point, a scientometric analysis was carried out using VOSViewer software. This software extracts the main keywords in these studies to retrieve the relevant works. It also calculates the strength of the relationships between these keywords. Subsequently, an in-depth qualitative review followed the studies with the highest frequency of occurrence and the strongest links with the topic, according to the VOSViewer's results. The qualitative review focused on the latest approaches and the future suggestions proposed in these researches. The findings of this paper can serve as a valuable reference for researchers, and BIM specialists, to make more accurate and reliable HBIM models for historic masonry buildings.

Keywords : HBIM, masonry, structure, modeling, automatic, approach, parametric