Table 1

| The supplement | Pozzolanic activity, mg$Ca(OH)_2$per 1 g of additive |
|---|---|
| Calcined bauxite | 534 |
| Micro silica | 427 |
| Blast furnace slag | 300 |
| Ash | 875 |
| Metakaolin | 1000 |

Pozzolanic activity of some mineral additives [2]

Based on the above, we believe that using ash production waste in place of a part of cement, compatible with a superplasticizer in concrete composition, is relevant.

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## POST-WAR RECONSTRUCTION OF HISTORICAL BUILDINGS BY MEANS OF HISTORIC BUILDING INFORMATION MODELLING

War catalyses the development of new, pragmatic strategies aimed at protecting the nation and its citizens from the ravages of war. Many of these innovative solutions will take shape during the renovation phase. It is already worth thinking about the Ukrainian programme of rebuilding after the war, considering all the previous plans for the implementation of sustainable development principles in Ukraine. The basis of this transformation is the principle of post-war reconstruction: "to rebuild better than it was".

Historic buildings should be considered as an integral component of the sociocultural entity, encompassing the values and communities that reside in or use them, in addition to the architectural structure consisting of physical elements such as walls, floors, ceilings, windows, doors, and stairs. These buildings undergo transformations influenced by user actions and conservation efforts. [1]

The objective of reconstruction is to establish a systematic approach for digitally maintaining and managing historical dwellings. The technique presented in this paper focuses on constructing parametric models that offer modelling benefits, allowing for convenient updates to the Historic Building Information Modelling (HBIM). By swiftly converting various data into a real-time information platform and a robust decision-support system, HBIM significantly enhances the efficiency and accuracy of the reconstruction process. One of the key advantages is its ability to synchronise detailed data regarding building materials and their associated environmental impacts. This synchronisation of data within HBIM empowers stakeholders to conduct thorough environmental analyses. It provides a holistic understanding of the ecological footprint associated with various building materials and products. Consequently, informed decisions can be made during the selection of building materials, considering both historical authenticity and environmental sustainability. [2]

Previous methods that incorporated images for digitising historic buildings typically required on-site image capture, which was followed by intricate processes before commencing HBIM development. In contrast, the method outlined in this paper focuses on selecting a suitable image that requires minimal processing to develop the HBIM for the facade of historic buildings. The proposed method encompasses three phases: initiation, modelling, and validation phases, each is essential for developing HBIM (Fig. 1).

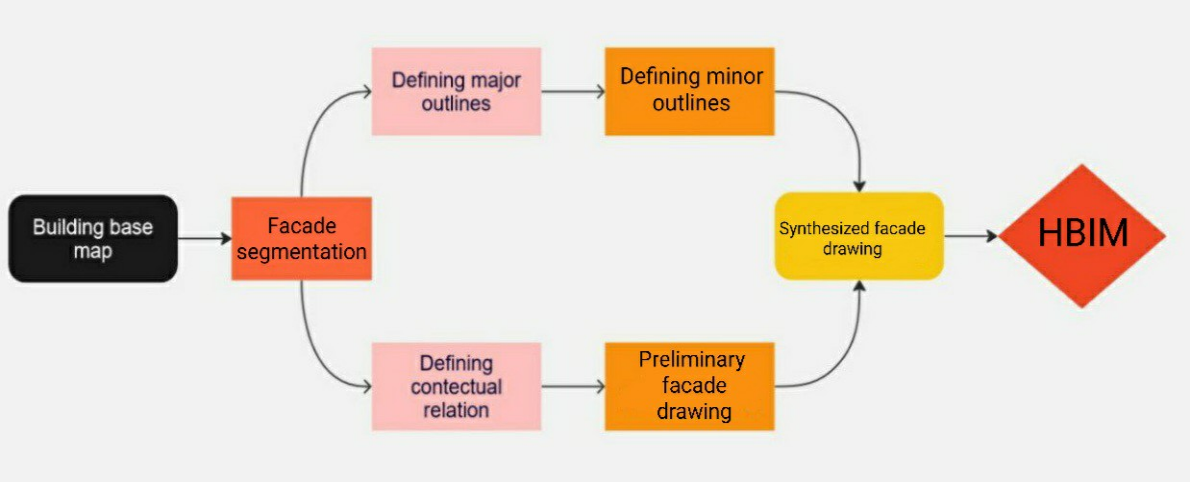


Fig. 1. Methodology of HBIM development, my own research based on [3].

HBIM promotes a data-driven and environmentally conscious approach, thus, its applications contribute to a more responsible and forward-thinking methodology in post-war reconstruction. The careful selection of materials, mindful of both historical and environmental implications, not only preserves the historical building, but also promotes sustainable practices, synchronising with modern environmental standards and concerns. BIM tools allow designers to explore different design options at the initial stages of a project and quickly transfer design data to energy and simulation modelling tools for verification and analysis. This efficiency and speed are invaluable for ensuring a project meets performance and sustainability criteria. HBIM tools enable owners to acquire a holistic visual depiction of their construction projects throughout different phases of renovation. These tools provide real-time insight into the development process. These models are used to coordinate complex renovations of historic buildings, determine material quantities, and identify possible inconsistencies between equipment. [4] The result of a successful historic building renovation project includes improvements in many aspects, including design efficiency, resource management, and project coordination.

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## MODERN TECHNOLOGIES IN BRIDGE RENOVATION

The renovation of bridges has been significantly influenced by modern technologies, leading to safer, more durable, and longer-lasting structures. Here are some key advancements in bridge renovation technology:

Safety and Durability Enhancements. Civil engineers have focused on improving safety by making bridges more resilient to fire, earthquakes, and high winds. They are also exploring how technology can help monitor new bridges and maintain those already in place. [1]

Many new bridges now have sensors that collect data on their structural behavior and condition, allowing for continuous monitoring and maintenance to extend their design life beyond the previous average of about 50 years. [1]

Use of Advanced Materials and Construction Techniques. The Industrial Revolution brought about the use of industrially produced iron, which paved the way for the development of modern bridges using materials such as steel and reinforced and prestressed concrete. [2]

Innovative new construction materials and advanced construction methods, tools, and software are now available for bridge engineers, enabling more accurate models and detailed analyses of bridges [3].

Intelligent Technology and Information Systems. Intelligent technology based on information technology provides a new opportunity for innovation in bridge engineering, focusing on construction efficiency, management effectiveness, and long-term service [4].

Building Information Modeling (BIM) pairs architects with engineers and construction professionals, allowing for more efficient communication and collaboration throughout the stages of construction. BIM enables engineers and designers to create 3D models that include a wealth of data, from the physical characteristics of a bridge to its functional features [5].

Advanced Construction Methods. Advanced Bridge Construction (ABC) methods, such as building the new structure alongside the old one or underneath it, are being employed, with heavy lifting equipment that can handle more weight and is more compact, facilitating the renovation process [6].

These advancements in technology have not only enhanced the safety and durability of bridges but have also improved the efficiency and effectiveness of bridge renovation projects, ultimately contributing to the development of more resilient and long-lasting bridge structures.

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