Restoration techniques for historic buildings using GIS

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ABSTRACT. Heritage buildings play a significant part in the history and culture of a country and serve as symbol of its diversity. Their repair is crucial to preserving life and boosting strength for future generations to understand how humans lived in earlier times. This paper aims to investigate, identify and address the structural flaws present in the structure with the use of different softwares. The use of BIM tools is done to create 3D model of the heritage structure. To use QGIS software to compile collected data and create database. Working with QGIS software to link information to mapping. QGIS software is used to keep data on both time and funds spent on repairs as well as to analyse cost and time overruns for faster analysis of the structure. To use the damaged ornamental waste of heritage structures for its reconstruction with the help of 3D printing for the use of non-invasive restoration approaches.

Keywords: Restoration, 3D Printing, QGIS.

I. INTRODUCTION

The various heritage structures hold an inevitable position in human life. The need to protect the structure grew with each small modification, giving rise to ideas like repair, restoration, retrofitting, and other similar terms. Old brick building rehabilitation or heritage structure restoration presents a unique scenario for repair. Repair increases worth Structure is valuable because it enhances beauty. Due to the emotional connection with structure maintenance, occasionally be necessary and maybe due limited space.

Every problem of dampness has its own unique cause and it leads to various defects on the structure. As causes are unique the solution to mitigate also vary due to this it needs complete and detailed study in the reference of causes and measures to put in action. All factors such as age of structure, local climate, construction techniques and ground conditions should be considered to develop an individual and specific repair programme. However, change is permanent and various firms are working to elevate this work pattern in various perspectives viz. methodology, techniques used and materials used. One of the leading company have given a new attitude to tackle issues related to repair and restoration of structures, on the same theme following methodology can be implemented to achieve the desired goal.

II. NEED FOR STUDY

Restoration of historic structures has gained significant attention in recent years especially in the most sophisticated societies throughout the world. Heritage buildings, as previously mentioned, are regarded as existing structures with substantial cultural worth; these structures might be buildings, towers, bridges, etc. They are primarily composed of masonry and wood, occasionally with steel or iron components. For instance, when new codes increase the number of activities (seismic action, traffic action, etc.) that must be taken, the competent authority may be required to act.

Heritage buildings typically require structural renovation due to one or more of the following reasons:

1. To find out whether the framework has any apparent flaws.
2. Damage following a specific incident that compromises its stability (tremor, etc.).
3. The building's use being changed to accommodate the worst circumstances.

III. OBJECTIVE

- To investigate different facets of the historic building.
- To use various BIM software to thoroughly analyse the necessary repair work on heritage structures.
- Using the mapping software QGIS to connect data to information.

IV. METHODOLOGY

This section outlines the methods used to assess the many heritage values that stakeholders, together with the architecture and crafts, have highlighted. Their research concentrated on typology assessment, identification, and criteria for recognizing material assets. The phases of the methods to coordinate and sequence the research are presented in the research organization diagram.
V. REVIT MODELLING

Users can alter entire structures, assemblies (in the project context), or single 3D shapes in the Revit work environment (in the family editor environment). Geometric models that have been imported or pre-made solid objects can both be used with modelling tools. Walls, floors, roofs, ceilings, major finishes, and even furniture constructed inside a project are examples of system families. Families and components that can be put into a project for use and were constructed using primitives (such as extrusions, sweeps, etc). The same toolset is used to create in-place families, which are built in-situ within a project, as loadable components.

VI. QGIS MODELLING

Geographic information system (GIS) software such as QGIS enables users to create, edit, and export graphical maps as well as analyze and modify geographical data. Raster, vector, and mesh layers are supported by QGIS. Feature types for vector data include point, line, and polygon features. The software can geo-reference images and supports a variety of raster image formats. Implementation of QGIS is done in stages as follows :-
1. Creating project.
3. Creating Shapefiles.
5. Digitization of data.
6. Data filling in Attribute table.
7. Running query for attribute table.
8. Attribute table result with Revit.
After creating project of the required structure, shapefiles of column, beams and slabs were created in QGIS which helps to form layers and digitize the structure. Digitisation of the structure was done to obtain query was the help of data set obtained from attribute table.
All the data collected were filled in QGIS attribute table which include types of material used, area of crack, types of crack, affected area, distress image, amount of rusticide, plaster, paint, cost of each material. After filling all the data in QGIS query builder was run to knew the repair methods of the specific element and to know the optimum cost.

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Figure 6. Queries for attribute table

VII. LIMITATION
- For users who are unfamiliar with GIS software, QGIS might be challenging.
- Some specific repair tasks, such as detailed 3D modelling or specialized heritage analysis, may require additional software or plugins.
- When collaborating with stakeholders who use different software systems, interoperability challenges can arise.

VIII. FUTURE SCOPE
- The future of QGIS can involve improved cloud-based collaboration capabilities, enabling multiple stakeholders to work together on repair projects in real-time.
- QGIS can evolve its visualization capabilities to create more compelling and informative visual representations of building conditions, repair plans, and progress reports.
- QGIS has already made progress in 3D modelling capabilities, and its future development can further enhance its ability to create and analyze detailed 3D models of buildings, this can aid in visualizing and simulating repair scenarios, analyzing structural elements, and planning restoration work.

IX. CONCLUSION
Long lifespan, lack of maintenance, unrestrained growth of plants and creepers on the structures, among other factors, can all contribute to the degeneration of a structure. Inappropriate drainage, inconsistent inspection, material deterioration, the effects of weathering, etc. Major obstacles to heritage structure restoration include current building laws and standards, respect of cultural context, conservation criteria, attainable benefit, traditional and cutting-edge approaches, etc. With the use of 3D modelling faster analysis of the structure is obtained. 3D models give stakeholders a realistic and lifelike depiction of structures so they can see the finished product or design. This facilitates decision-making by improving knowledge of the structure's spatial relationships, proportions, and aesthetics. The use of 3D models allows engineers and designers to identify and address design concerns early on, minimizing the need for expensive revisions during construction. QGIS modelling helps to create layers and identifies the distresses obtained in Revit software which can be used to save time and cost. The crucial aspect here is that all of the data needed to create the model came from a single database which helps in quicker implementation of repair plans.

REFERENCES