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New Materials and Techniques for the Repair and Restoration of the Heritage Structure

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Abstract: *Thousands of years have passed since heritage structures were built, and they are frequently the most durable and well-known emblems of past civilizations. They are national symbols with cultural and historical significance, their condition being critical they need to be preserved. Each heritage structure has its different features, artistic finishes, and unique conservation issues requiring creative solutions. Pollution, aging action, fire, catastrophic events such as seismic, floods, tsunamis, cyclones, soil and structure interaction (soil settlement, etc.), faults in construction, and many other factors contribute to the deterioration ofstructures. This will be a major setback for the country, as heritage structures are significant landmarks. It is vitalto select the appropriate material for rehabilitation basedon the appearance of the parent construction. The new material should work well with the structure's existing materials. With the use of a case study of the restoration of the Bombay high court, this paper focuses on such challenges and corrective strategies to address them whilemaintaining the cultural integrity of the structure.*

Keywords: Heritage Structure; Rehabilitation;Restoration; Preservation; Conservation.

I. INTRODUCTION

India has a Very rich historical background that can be seen in various things: buildings, forts, temples, landscapes, and historical objects. Many of these were built during the Golden Age of Indian Civilization, many hundred years ago.All heritage buildings have their unique historical significance. Their character-defining elements that are responsible for their inheritance values vary by structure. Asthese are national symbols with historical and cultural significance, they must be preserved. Heritage structures that are not actively in use deteriorate quickly, whereas heritage structures that are currently in use have a better chance of being restored. An ancient, broken, dilapidated, ordefunct building is not considered a loss by the profession. Instead, see it as a chance to create a work of art that is even better than the original. First and foremost, the Grade of the building should be considered when restoring any heritage property or monument. The rehabilitation program should be prepared with the authorization of the Heritage Conservation Committee, depending on the structure's grade. Engineers should also be aware of the materials that are accessible on the market. Engineers should choose appropriate materials and techniques for the restoration of the monument so that itsvisual appearance is preserved. The properties of the old and new materials should be compatible. All of thecircumstances for using the new materials must be appropriate.

As these monuments are deteriorating for a variety of causes, it is essential torestore them before they fail. But, careneeds to be taken to ensure that the monument's appearance is not altered. . To do this, the material and technique to be employed must be carefully chosen. A balance between management, technology, and economics should also be maintained.

An investigation of the structure should be conducted before beginning the restoration. It's a challenging process to properly assess the structure. The physical, chemical and mechanical qualities of the stones and mortars and all other elements used in the structure are determined throughout the assessment, providing insight into the original building's construction procedures, architectural forms, and materials. Using this knowledge, one should be able to choose a compatible rehabilitation material.

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1.1 Restoration

Restoration is the process of accurately disclosing the state of a historic structure as it appeared in the past and recovering it using various methods while maintaining the building's heritage value. This is a very responsible job in terms of preventing dangerous structural failure due to degradation and deterioration. The success of the restoration rests entirely on delivering innovation in the sector and keeping up with current trends. For old structures that are showing indications of decay, restoration is strongly suggested to prevent people's lives from being destroyed.

II. NECESSITY OF RESTORATION

Heritage structures have cultural and historical Significance. Pollution, weathering action, fire, natural calamities such as earthquakes, floods, tsunamis, cyclones, soil and structure interaction (soil settlement, etc.), faults in construction, and many other factors contribute to the deterioration of these structures. This will be a huge loss for the country, as heritage structures are the country's emblems.

The need for the structural restoration of heritage buildings is usually prompted by the following factors:

- A storm or an earthquake are examples of naturaldisasters.
- Contact materials' corrosive action
- Uncontrolled vegetation growth
- Natural degradation as a result of growing older
- Cracks form as a result of vibrations from driving cars, changes in land usage, plant growth, avian threats, and support settling
- Dampness in cracks and fissures is known asseepage

III. OBJECTIVE OF PAPER

- To study the problems associated with theheritage structures.
- To study the materials and techniques usedto restore and repair heritage structures.

IV. LITERATURE

The study of building materials use principles in the restoration of architectural and town-planning heritage monuments is the focus of this article. The basic features of the materials, as well as their classification and application specialization, are listed. The most essential role of the material in the construction of the architectural image of the object was proven as a result of the analysis. The material should be examined not only in terms of technical features but also in terms of architectural and artistic characteristics, according to the researchers. The emphasis is on object authenticity, which entails an understanding of the thing andthe functional aspects of the materials employed fornamentation. It was mentioned that the materials should bechosen based on the previous stage. [1]

Restoration of architectural formation elements includesattempting to determine the most efficient approach of placing a historic architectural artist in his work. The goal ofthis essay is to establish a foundation for the repair of architectural formation elements. It is primarily an intellectual effort on the part of the restorer to determine the ideal manner for the artist and the ancient architect to work together. The restoration procedure can be performed as fullyas feasible by determining the objective of this work and analyzing the original accessible techniques during the production period. The study is focused on restoring trust in traditional building repair procedures such as consolidation and reconstruction. The traditional method is an effective way to return a structure to its original state, especially now that all technology tools for reporting and documenting are available. Extending the use of previously unapplied materials and techniques is not required. In this regard, the study was able to offer answers, ideas, and procedures that assisted in the preservation and restoration of architectural components. The study also highlighted the need of tying thephysical and plastic components of archaeological elements together. [2]

Using the tombs of Nakodar as a case study, this researchattempts to highlight the prevalent faults and issues encountered in old constructions, as well as the ways used inthe past to conduct conservation while maintaining the cultural integrity of the structure. The degradation of the structure has been discovered to be caused by several inherent and external factors. As a result, this article aims to make the job of a conservation architect easier by providing the necessary information for the conservation and restoration of a historic landmark, as well as a methodical way to deal with these

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challenges. [3]

This paper discusses the need for fort rehabilitation as well as fort restoration approaches. We must acquire sound conservation methods, especially for heritage structures, to prevent deterioration and extend the life and basic functions of these buildings to future generations to pass on what is currently defined as being of cultural relevance today. Heritage structures were built in the past and have significant historical, architectural, spiritual, social, political,and economic significance. In the same way, heritage buildings are extremely useful and informative in terms of a society's socio-cultural, socio-political, socio-economic, and even technological activities. We must prevent fort deterioration and employ unique fort restoration techniques. [4]

In this paper, a quick overview of traditional repair techniques is provided, as well as the approach to specific repair techniques. The promise of modern technologies is highlighted in this paper. Chemicals and admixtures are usedto create a philosophy. The use of novel compounds is quite important. Well-explained for various building components to mitigate the negative consequences of Wetness, for example. The strategy used in this study involves specific repair techniques utilizing Grouting, waterproofing, protective coatings, and chemical applications that require particular product materials. The topic of adhesives is discussed. Testing and guidelines for evaluating the structure under consideration technique for inquiry, site preparation requirements, cleaning systems, and rectification there are descriptions of the measures. Executions of Special Techniques for non-structural repairs and Special repair workis also provided for structural problems that require a management approach. Will undoubtedly aid in improving the performance of civil engineering projects of a similar nature. There is a lot of repair and maintenance work that needs to be done. [5]

V. METHODOLOGY

- Collection and study of literature and researchpaper related to restoration of the heritage structure
- Selection of heritage structure/study area
- Data collection Selection of plans Digital photography
- Identifying damages and problems
- Study problems occurred in the structure
- Study techniques and materials used as aremedial measures

VI. CASE STUDY

The restoration of the Bombay High Court's main building was looked into to gain a better knowledge of how conventional restoration work is done in India. The Bombay High Court is a Social Monument and a Heritage Structure ofGrade II-A. The structure of the Bombay High Court has beenpreserved. After 150 years, it is still standing. The building has a beautiful north-facing double-steeple roof and magnificent Venetian balconies, all of which are surrounded by lancet-arched passages. It is made of the same dark basalt,interrupted by soft Pounder stone and heightened in parts with red sandstone and buffed basalt, making it easier to merge with the current foundation of the High Court. Chippedfloors, dangling brass drops, missing cast-iron rails, leaking ceilings, corroded sculpted figures, and clogged gargoyles have all survived to tell the story of the destruction.

BOMBAY HIGH COURT

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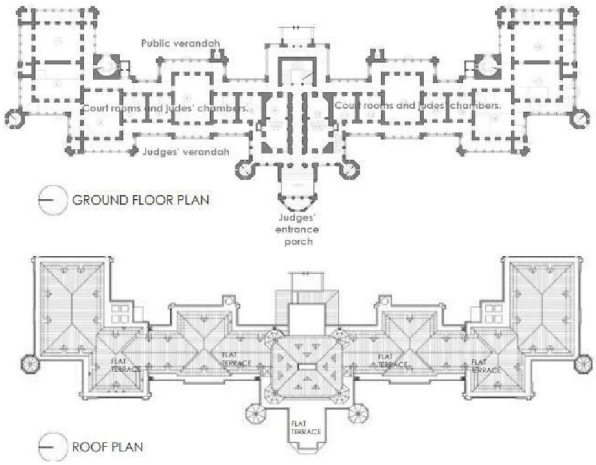

Fig.1. Plan of Bombay High Court

The restoration work of the structure is given below:

6.1 Stonewall Restoration

Problem-the walls had no major structural difficulties other than a few cracks. Helifix, a specific stitching technique in which long helical bars were put in grooves produced across the cracks at regular intervals, was used to restore them. For this, a specialized team was deployed.

Some Images of the Roofs before and afterRestoration

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6.2 Roof Restoration

Problem- The roof has undergone extensive seepagethrough the timber structural parts and into the load-bearing stone walls, generating fractures, moisture, leaking, water puddles, and structural strain in several locations.

The roof was restored by removing and deconstructing the existing Mangalore tiles, waterproofing layers, teak wood boards, rafters, and purlins, and replacing them with new components made of well-seasoned Burma teak wood that matched the original. Salvaged members were utilized whenever possible. After the boarding and battens were restored, waterproofing layers of dungaree cloth, bitumen, and specially profiled G.I. sheets were applied. Before installing the Mangalore tiles, a final layer of horizontal battens was installed above the G.I sheeting.

6.3 Façade Restoration Works

Problem - The exquisite decorations of the facade were dark, stained, and chipped unattractive due to years of pollution, dust accumulation, and natural weathering. Some of them were also producing slight leakage into the walls' inner surfaces Water and surfactants were used to clean the continuousbasalt façade surfaces without destroying the stone. Specialized techniques including sand and copper blasting were used in places with severe facade damage and thick layers of dust. After washing the façade, the stone masonry joints were meticulously re-pointed with lime mortar.

Some Images of Restored Exterior Facades of the Building

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6.4 Structural Restoration of verandahs

Problem- The verandah floor slabs, which run west and east, have suffered considerable damage over the years as a result of the constant and very heavy monsoons.

Fixing additional 8mm thick M.S plates over each rafter increased the load-bearing capability of the rafters. R.C.C. slabs were to be cast over the teak wood boarding that had been installed over the rafters. The ends of the rafters were covered with a layer of Black Japan and polythene sheets before being buried in the walls during the restoration. The boarding was also bitumen coated to lessen the impact of moisture exposure on the wooden sections, extending the life of all members.

Terrace Waterproofing

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6.5 Terrace Waterproofing

Multiple layers of waterproofing had to be dismantled to restore the flat terraces, the damaged rafters had to be replaced, and the boarding had to be repaired over it. After that, a layer of brickbat Coba and reinforced bitumen tar felt was applied to avoid any water seepage. It was finished witha cement mortar layer combined with waterproofing chemicals after the requisite slopes were provided

6.6 Finishing Works of Verandahs

Tiles were to be used to finish the slabs after they had been cast and securely fixed. Cement tiles were used to recreate a historical pattern existing within the building. The tiles were to be polished seven times with different grades of polishing stones once they were fixed, and the final buffing layer was to be done using special chemicals.

V. CONCLUSION

The restoration of the Bombay High Court brought an almost infinite number of problems in all areas to the frontline. According to historical efforts at restoration heritage buildings, they must be preserved as close to their original state as feasible. Engineers should choose appropriate materials and techniques for the restoration of the monument so that its visual appearance is preserved. All conditions of using the new materials and techniques should be suitable.

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