



Digital Preservation and Adaptive Reuse of Barood Khana within Lahore Fort

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Abstract: The research is an attempt to develop three dimensional scaled wire-frame model using Total Station as an integrated approach towards digital preservation of historic monuments and heritage sites, with a particular focus on a significant historic monument, Barood Khana located in the Lahore Fort. In the historical context of Lahore, there is a dire need for the application of digital technologies for the safeguarding of architectural and urban built heritage in terms of documentation, data archiving and preparation of conservation plans. The research focuses on the documentation and recording of Barood Khana, using total station with electronic distance measurement (EDM) technique for the development of scaled wire-frame three dimensional model. With the application of advanced techniques in 3D modeling and digital reconstruction, this study aims to capture architectural details of Barood Khana with high level of precision and accuracy. The development of wire-frame model involves site surveys including pictorial and visual surveys and documentation using total station for identifying structure's dimensions, architectural details and spatial relationship within its context. This digital representation of Barood Khana gives a detailed insight into damages and deteriorations, contributing to the preservation efforts. It serves as a technical tool for researchers, conservation experts and other stakeholders for sharing of data, minimizing chances of errors and achieving quality of work.

Keywords: Scaled wire-frame model, Total Station, Digital Techniques, Barood Khana, Electronic Distance Measurement

1. Introduction

In recent years, the importance of preserving and documenting Lahore's cultural heritage has become increasingly evident. Rapid urbanization and modernization pose significant challenges to the conservation of these monuments, highlighting the need for innovative approaches to heritage management (Liang et al., 2023). The preservation of cultural heritage in Lahore, Pakistan, is of utmost importance, particularly concerning its historic core (Mughal, 2011). This study focuses on creating a scaled wire-frame model of Barood Khana, a significant monument within Lahore's historical fabric. Employing advanced 3D modeling techniques, archival research, and on-site surveys, this research aims to accurately capture the essence of Barood Khana. The wire-frame model serves as a digital representation, providing insights into the monument's architectural intricacies and historical context (Tania Qureshi, 2023).

Lahore, the cultural heart of Pakistan, boasts a rich tapestry of historical monuments that bear witness to the city's illustrious past (Ali, 1990). Among these treasures, Barood Khana stands as a testament to Lahore's architectural splendor and cultural heritage. Nestled within the historic core of the city, Barood Khana holds a special significance, serving as a symbol of Lahore's storied history. This study focuses on the development of a scaled wire-frame model of Barood Khana, offering a novel means of documentation and preservation. By leveraging advanced techniques in 3D modeling and digital reconstruction, this research endeavors to create a

detailed representation of the monument, capturing its architectural intricacies and historical significance (Muhammad, 2009).

By meticulously detailing the monument's dimensions, ornamentation, and spatial relationships, the wire-frame model offers a comprehensive understanding of Barood Khana. Moreover, it explores potential applications in heritage conservation and education, facilitating informed decision-making and fostering appreciation for Lahore's cultural heritage. This endeavor contributes to the broader efforts of preserving Lahore's historic core and underscores the significance of Barood Khana within the city's cultural landscape (Tania Qureshi, 2018).

Through a multidisciplinary approach that combines archival research, site surveys, and digital modeling, this study seeks to unravel the layers of history encapsulated within Barood Khana. By meticulously reconstructing the monument in digital space, we aim to provide scholars, conservationists, and policymakers with a valuable tool for understanding and safeguarding Lahore's cultural heritage. Furthermore, this research explores the broader implications of the wire-frame model, including its potential applications in heritage conservation, education, and public outreach. By fostering a deeper appreciation for Barood Khana and its place within Lahore's historic core, we hope to inspire future generations to cherish and protect the city's cultural legacy.

In essence, the development of a scaled wire-frame model of Barood Khana represents not only a technical achievement but also a testament to the enduring significance of Lahore's architectural heritage. Through this endeavor, we reaffirm our commitment to preserving the past for the benefit of future generations.

1.1 Statement of the Research Problem

The Barood Khana within Lahore Fort possesses significant historical and architectural importance, yet lacks a detailed, accurate, and accessible representation through modern digital technologies. The absence of a comprehensive model hinders scholarly research, conservation efforts, and public engagement with this cultural heritage site. Traditional documentation methods are time-consuming and prone to inaccuracies, while existing digital models often lack the required level of detail or precision (Bullock & Richard E. Warren, 1998). During the preparation of Master Conservation Plan 2016 by the Walled City Lahore Authority, Fort and Badshahi Mosque has been assigned a number 1B in the proposed list of zones of special value (WCLA, 2016).

Therefore, this study aims to address these challenges by developing a scaled wire-frame model of the Barood Khana using advanced surveying techniques, specifically Total Station technology. This model will provide a detailed and accurate representation of the structure, aiding in preservation efforts, historical research, and public education. Additionally, it will serve as a valuable resource for architects, archaeologists, historians, and other stakeholders involved in the conservation and management of Lahore Fort.

1.2 Objectives of the Research

- To conduct a comprehensive review of existing literature on heritage documentation, digital modeling techniques, and the historical significance of Barood Khana within the context of Lahore Fort and the broader cultural landscape of Lahore.
- To conduct on-site surveys of Barood Khana using Total Station equipment to obtain accurate measurements of the monument's dimensions, architectural features, and spatial relationships within the Lahore Fort complex.
- To develop a scaled wire-frame model of Barood Khana using the point cloud data as a reference, employing advanced digital modeling software to recreate the monument in digital space.
- To validate the accuracy and fidelity of the wire-frame model through comparative analysis with historical records, architectural drawings, and other forms of documentation available for Barood Khana.
- To document the wire-frame model of Barood Khana, including detailed descriptions of architectural elements, historical context, and preservation needs, to facilitate its use in heritage conservation efforts, educational initiatives, and public outreach programs.

By achieving these objectives, this research aims to contribute to the broader goals of preserving Lahore's cultural heritage by providing a comprehensive and accurate digital representation of Barood Khana, enriching our understanding of its historical significance and architectural legacy.

1.3 Significance of the Study

The significance of developing a scaled wire-frame model of Barood Khana using Total Station surveying technology within the Lahore Fort complex encompasses several dimensions, including heritage preservation, research advancement, and public engagement. The study holds importance for various stakeholders and contributes to the broader goals of safeguarding Lahore's cultural heritage. Barood Khana is a vital part of Lahore's cultural heritage, representing a tangible link to the city's rich history. The development of a detailed

wire-frame model using Total Station technology enables accurate documentation of the monument's architectural features, spatial relationships, and preservation needs. This data can inform conservation efforts, aid in the identification of restoration priorities, and ensure the long-term preservation of Barood Khana for future generations.

The study advances research in the fields of heritage documentation, digital modeling, and architectural history. By integrating traditional surveying methods with advanced digital techniques, the research demonstrates a novel approach to capturing and analyzing complex architectural structures. The wire-frame model serves as a valuable research tool, facilitating in-depth analysis of Barood Khana's architectural evolution, cultural significance, and historical context.

2. Literature Review

Lahore, Pakistan, including its Fort stands as a vibrant testament to the region's rich cultural heritage, with its historic core serving as a repository of architectural marvels. A serious effort for the conservation of Lahore Fort was initiated by the authorities during last two decades (Iftikhar, 2019). Within this context, the preservation and documentation of significant monuments have garnered increasing attention from scholars, conservationists, and policymakers alike (UNESCO, 2011). This literature review explores existing research related to heritage conservation, digital modeling techniques, and the historical significance of Barood Khana within Lahore's urban fabric.

Studies in heritage conservation underscore the importance of safeguarding cultural heritage sites as repositories of collective memory and identity (Hassani et al., 2015). In the context of Lahore, rapid urbanization and encroachment pose significant threats to the city's historic core, necessitating proactive measures to protect its architectural heritage. Efforts to document and preserve Lahore's monuments have therefore become imperative in ensuring their survival for future generations (Rafiq, 2010).

Digital modeling techniques offer innovative solutions to the challenges of heritage preservation, providing researchers with tools to create detailed reconstructions of historical sites (Leon et al., 2020). In recent years, advancements in 3D modeling software and digital imaging technology have enabled scholars to produce highly accurate representations of cultural heritage sites, facilitating conservation efforts and enhancing public engagement (Haddad, 2011).

Barood Khana, situated in Lahore's historic core, holds particular significance as a tangible link to the city's past. The monument's architectural features and historical context provide valuable insights into Lahore's socio-cultural development over the centuries. As one of the few surviving examples of Mughal-era architecture in Lahore, Barood Khana represents a focal point for heritage conservation efforts and scholarly inquiry.

By synthesizing existing research on heritage conservation, digital modeling techniques, and the historical significance of Barood Khana, this literature review sets the stage for the subsequent phases of the study. Through the development of a scaled wire-frame model, this research aims to contribute to the ongoing discourse surrounding Lahore's cultural heritage while providing a tangible tool for conservation and education initiatives.

2.1 Scaled Wire-frame 3D Model

A scaled wire-frame 3D model of Barood Khana, situated within the Lahore Fort complex, has provided a detailed representation of the monument's structural framework. This wire-frame model accurately captured the monument's architectural features, dimensions, and spatial relationships, serving as a valuable tool for documentation, analysis, and preservation efforts. In the wire-frame model, the structural elements of Barood Khana, such as its walls, roof, and openings represented as interconnected lines and vertices, forming a skeletal framework of the monument. This simplified representation would highlight the overall form and geometry of Barood Khana while allowing for detailed examination of its architectural elements.

The wire-frame model developed using advanced 3D modeling software, incorporating data obtained from on-site surveys, archival research, and digital imaging techniques. Precise measurements and dimensions collected during the surveying process ensured the accuracy of the wire-frame model, enabling it to closely resemble the physical structure (Remondino & Menna, 2008).

Key features of the scaled wire-frame 3D model of Barood Khana may include:

Structural Elements represented walls, roof, ceiling and other architectural elements forming the basic framework of Barood Khana. Spatial Relationships depicted spatial arrangement and layout of the monument within the Lahore Fort complex, including its orientation and proximity to other structures. Proportions and Scale has been observed in accurate scaling of the wire-frame model to reflect the dimensions and proportions of Barood Khana relative to its surroundings such as Almigiri gate and Mussaman (octagonal) darwaza. User-friendly interface allowing for interactive exploration of the wire-frame model, enabling users to navigate around and examine different aspects of the monument.

Compatibility: Compatibility with various digital platforms and devices, facilitating accessibility and dissemination of the wire-frame model for research, educational, and public outreach purposes. Overall, the scaled wire-frame 3D model of Barood Khana has served as a valuable resource for researchers, conservationists, educators, and the general public, providing insights into the architectural heritage and historical significance of Lahore's cultural landscape (Archaeology Department Punjab, 2017).

Digital technology offers numerous applications for digital documentation, especially in the context of heritage preservation and architectural documentation. Total Station surveying technology combines electronic theodolites with distance measurement instruments to capture precise measurements of points on a structure or terrain. Total Station surveys are commonly used for documenting architectural features, land contours, and archaeological sites (Remondino & Menna, 2008).

By leveraging these digital technologies for digital documentation, researchers, conservationists, and heritage professionals can create accurate, detailed, and accessible records of cultural heritage sites, contributing to their preservation, research, and public engagement efforts.

3. Research Methodology

The development of a scaled wire-frame model of Barood Khana necessitates a methodological approach that combines rigorous data collection, advanced digital modeling techniques, and historical analysis. This section outlines the research methodology adopted to achieve the objectives of the study.

3.1 Archival Research

The first phase of the research involves comprehensive archival research to gather historical data, architectural drawings, and photographs of Barood Khana. Primary and secondary sources, including historical records, scholarly articles, and archival photographs, are consulted to understand the monument's architectural evolution and historical context.

3.2 Site Survey

Conducting on-site surveys is crucial for capturing accurate data and dimensions of Barood Khana. A team of researchers visits the monument to document its current condition, measure dimensions, and photograph architectural details. High-resolution photographs and precise measurements are obtained using surveying equipment to ensure the fidelity of the wire-frame model.

3.3 Digital Modeling

Advanced 3D modeling software is utilized to create the wire-frame model of Barood Khana. The data collected from archival research and site surveys serve as the basis for modeling the monument in digital space. Techniques such as photogrammetry may be employed to generate detailed textures and surface reconstructions, enhancing the model's realism.

3.4 Scaling and Dimensioning

Accurate scaling of the wire-frame model is essential to ensure its fidelity to the original monument. Historical records and measurements obtained from the site survey are used to scale the digital model accurately. Special attention is paid to dimensions, proportions, and architectural details to capture the essence of Barood Khana.

3.5 Documentation and Analysis

Once the wire-frame model is finalized, it is thoroughly documented, including detailed descriptions of architectural elements, historical significance, and restoration needs. Comparative analysis with existing historical data and archival photographs is conducted to assess the model's accuracy and identify areas for improvement.

By employing a systematic research methodology encompassing archival research, site surveys and digital modeling processes, this study aims to develop a comprehensive and accurate wire-frame model of Barood Khana. This model serves as a valuable tool for documenting, preserving, and understanding Lahore's cultural heritage for future generations.

4 Case Study: Barood Khana

4.1 Location and Context

Presently the Barood khana is a single story building located at western side of Lahore Fort near Alamgiri gate and Musammam Darwaza. Barood Khana was built in 1857 during the British period in the southwestern corner of the Lahore Fort for the storing of ammunition and gunpower and termed as Barood Khana (house of ammunition). During the magnificent and monumental buildings, this monument is standing with its beauty and

simplicity. This Barood Khana also symbolizes the early modern age that was unfolding in the Western world. The spirit of the Renaissance, Reformation, and Scientific Revolution, spanning the 16th to 19th centuries, propelled Western society forward with great leaps in history (Tania Qureshi, 2018).



Figure 1: Location map of Barood Khana, Lahore Fort (source: mapbox - modified by the authors)

The main access to Barood Khana is from the Tarmac road which starts from the Shah Burj gate of the Fort complex. According to the historians, vehicular access was introduced during the British period for the transportation of the British army and their weapons.

4.2 Historical Background

In 1887 the Barrod Khana is built during British era, for the purpose of storing gun powders. The Barood Khana is the special formation of British era and best known historic part with in Lahore fort. This building was built like cottage, thus it was ventilated. In this building British had been storing the gun powders for” Thoradar Bandoog” (long gun) and for all kinds of armory. Two rooms i.e. at north and south ends were constructed and made part of the building. The purpose of these rooms were to ensure the security of all the barood stored in the building.



Figure 2: View of Barrod Khana from Alamgiri Gate (Source WCLA)

During the British period, Lahore Fort was occupied by the East India Company and significant modifications were made to adjust the British army. The British army settled in the southern end of the Fort and constructed this structure for the safeguarding of gunpowder, making a lot of changes in the other parts of the fort complex (Khalid, 2021).

4.3 Current Function of the Monument

After the conservation, the monument is being utilized for the official meetings and academic seminars after a minimal payment by the groups of researchers, academicians and conservation experts. According to the web page of WCLA, 25 + 5 persons can attend an event inside the Barood Khana.



Figure 2: Image showing view of an event in Barood Khana after conservation (Source: WCLA webpage)

4.4 Architectural Details

The arsenal depot or Barood khana is a rectangular structure with a groin vault design from inside and outside and very simple in its form considering the function. The other buildings of the Victorian period, designed are presenting love of designs for art and architecture, giving respect to previous historic structures such as Aitchison college, Mayo School of art, Railway Station etc.(Bryant, 2020). This specific shape for designed for the storage of the gunpowder, to control the temperature. The other structures in the premises has been ruined and now, they are part of fort's landscape. The rooms on the north and south end were constructed for the safety of the gunpowder as there is no entrance on the east and west walls.

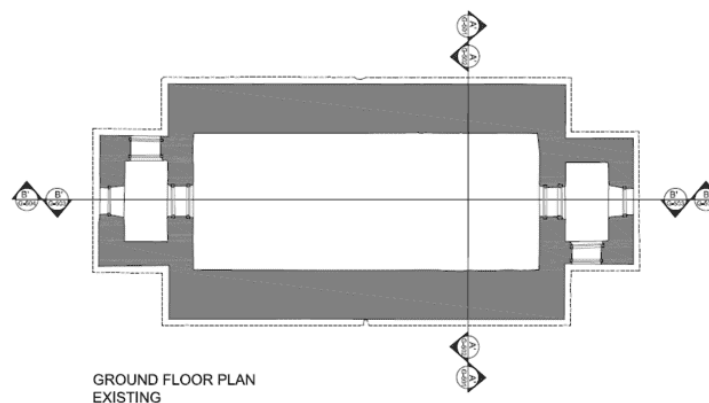


Figure 3: Ground Floor plan of Barood Khana (Source : WCLA)

The ceiling structure is vaulted for temperature control due to the heat dissipating from the gunpowder. There were two issues in terms of temperature control and security.

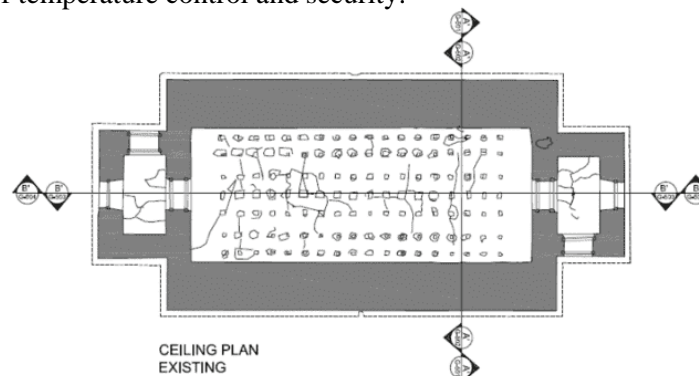


Figure 4: Ceiling Plan of Barood Khana (Source: WCLA)

The structure is plain due to its function but it is part of historic context and witness of human activities of the past. There is no direct entrance into the main hall, however, entrance to main hall id through the rooms adjacent to main hall.

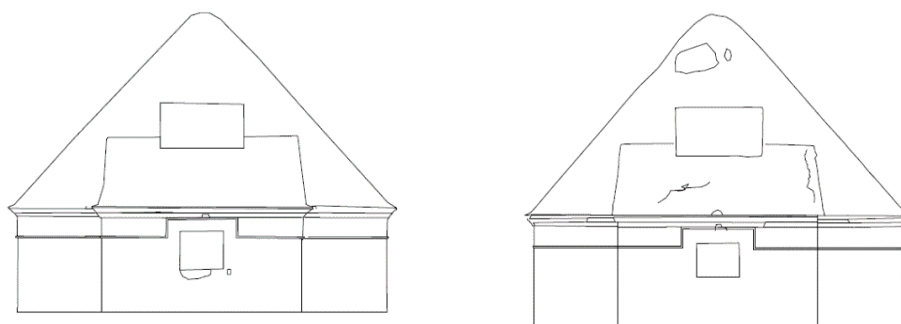


Figure 5: North Side Elevation (Left) South Side Elevation (Right) (Source: WCLA)

The north and south elevations are with plain structures. There are doors in the small rooms attached with the main hall.

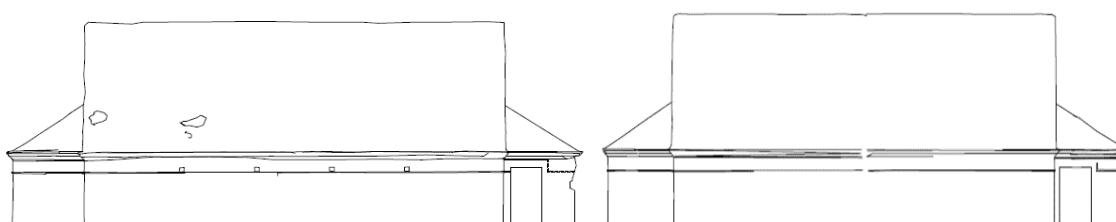


Figure 6: West Side Elevation (Left) East Side Elevation (Right) (Source: WCLA)

The section BB' showing thickness of the walls and interior towards the openings towards small rooms and cracks in the walls.

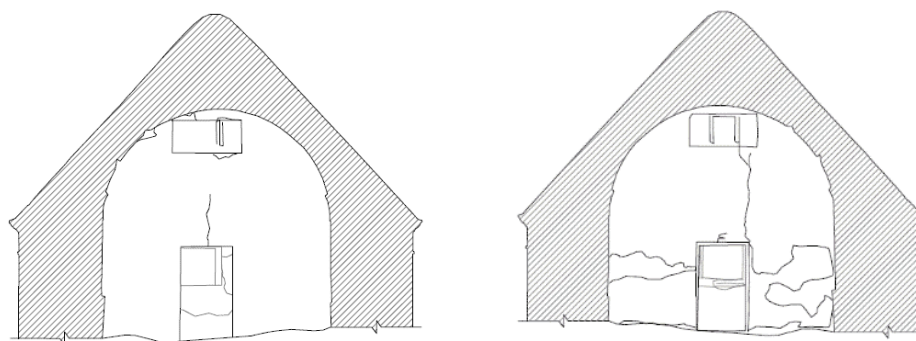


Figure 7: Section AA' looking North (Left), Section AA' looking South (Right) (Source: WCLA)

The section AA' showing the longitudinal inner dimensions and damages in the walls of the main hall and adjacent rooms.

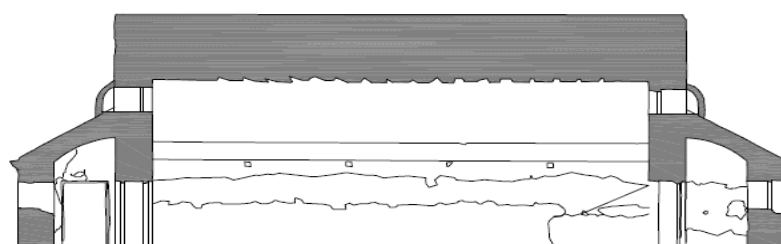


Figure 8: Section BB' looking East (Source: WCLA)

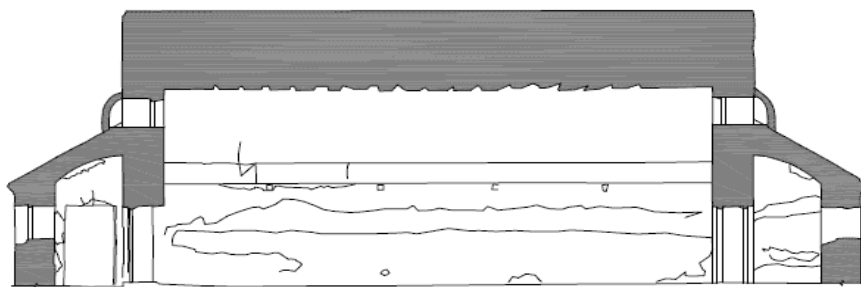


Figure 9: section BB' looking West (Source: WCLA)

4.5 Status of the Monument before Conservation

The structure of the Barood Khana has built with the brick masonry and lime mortars in British era. The presence of vegetation or landscaping around the building was the cause of seepage of rain water. Consequently, loosen the soil underneath and causing the cracks in building. It has been observed that the entire structure on the Barood Khana was suffering from severe threat and damages. During visual inspection the majority of damages found in the form of cracks, bulging in plaster, missing or dismantled brick masonry, missing cornices, damages in wooden doors and ventilators, blackish surface, graffiti internal side and biological growth around structure. Considering the fact venerability of the structure, it is important for the stability and prolonging of the structure all threats and damages to the structure both at macro and micro scale should be addressed and encountered before transferring the structure in to worsen condition. The doors and windows totally injured because of aging factor, termites, others woodworms and would not give proper attention to the building in the past. The remains of the historic flooring, pattern and renders are in dilapidated condition need to be rectified by following given



standards of conservation.

Figure 10: Damaged Plaster, Cracks in building, damaged brick masonry and decayed wood (Source: WCLA)

4.6 Threat to Exterior and Interior Renders and Finishes

The Barood Khana almost all structural and architectural elements are significantly affected by environmental factors such as direct rain water, which increase the damaging effects of humidity on the surface. A bulk of renders from wall and ceiling has already been lost completely while some of them are intact. Most of the damages to the interior and exterior spaces are due to neglect, lack of maintenance and management of the site. The majority of the threats to the interior elements are directly related with the natural and manmade causes and the best part of the threats to exterior around the structure is affected by biological growth and atmosphere pollution. Moreover, the vegetation or landscape around the structure is the cause of seepage of rainwater. The drainage of the area is not proper and hence percolation of water may reduce the load carrying capacity of the soil underneath. There is a threat that loss of strength of soil due to rain water percolation may result in differential settlement of the structure. Therefore proper drainage system is essential.



Figure 11: Image showing the context of Barood Khana full of debris before conservation (Source: WCLA)

4.6.1 Damage Masonry

- Brick masonry damaged internal side as well as outer side of the building structure.
- Damage masonry should not be replaced or reconstructed if it can repair as it will lose its value.
- Cleaning of masonry should only be done after carrying out tests, which should be observed over a sufficient period of time. Sand blasting or other abrasive method should not be used for the cleaning of masonry.
- No re pointing or any other repair work should be done with mortar of Portland cement unless it is component of the historic mortar as this can cause further damage to the historic structure.



Figure 12: Image showing structural damages such as peeling of lime pilaster and rotten bricks (Source: WCLA)

4.6.2 Damage Plaster

The plaster need to be restored to the extent possible. The main expects one needs to keep in mind are:

- Same material and composition should be used as far as possible.
- The building should be fully documented before any intervention.
- The record must not be destroyed falsified or removed.
- Any intervention must be minimum necessary.
- All the method and material must be fully documented.
- Any proposed intervention should be reversible.
- Every work should be harmonious in tone, texture, and size and less noticeable than original at the same time.
- Should not be carried out by untrained or inexperienced conservator.
- The new the restored portions are not considered original.
- The cause of absence of plaster portions, which are restored, should be evident and care should be taken so that, efflorescence, dampness in plaster all need to be tackled on a case-by-case basis.

- Outlet for the rain water is not properly fixed in its location as a result, wall renders are severely effected by the rain water.
- To avoid surface destruction, a proper rain water outlet should be placed.

4.6.3 Cracks in Building

- The cracks need to be tackled on a case-by-case basis depending on the type and the nature of the crack. Ideally, the cracks need to be monitored over a period of time to ascertain its nature. The cracks need to be classified as to whether they are structural or any other.
- Depending on the nature of the crack, their growth pattern and the damage caused, the solution required would vary.
- Minor cracks on internal and external side of structure have been observed, this need to be rectified and it is also essential that the causes should also be identified in priority.

4.6.4 Damaged Flooring

The damaged flooring of the barood khana needs to be repaired where required. At the southern entrance of the building, the floor has been damaged due to percolation of water. Floor inside the building seems to be fine. However, minor damages can be repaired.



Figure 13: Image showing damage floors (Source: WCLA)

4.7 Significance and State of Conservation

The Barood Khana is the special formation of British era and best known historic part with in Lahore fort. The monument is a witness of the incomparable use of spaces, valued formation and application of geometric proportions during the well-known era of British. It is completely a sole combination of history, culture and architecture. The previous conservation schemes for the Lahore fort, the Barood khana could not get the required attention as a result this marvelous monument lost its historic function, and diluted architectural appearance. The walled city Lahore authority (WCLA) has acknowledged the importance of the monument and decided for its proper conservation and rehabilitation. In this regard, visual inspections were made by the conservation team, existing drawings has been prepared.



Figure 14: Image working environment with Total Station (Source: WCLA)

5. Development of a Scaled Wire-Frame Model

Barood Khana, located in the historic core of Lahore, Pakistan, stands as a testament to the city's rich cultural heritage and architectural legacy. This case study focuses on the development of a scaled wire-frame model of Barood Khana, employing advanced digital modeling techniques and historical research to create an accurate representation of this significant monument. The total station is a surveying tool for the measurement of distances and angles with the help of software TheoLT, installed in Laptop attached with Total station through cables.

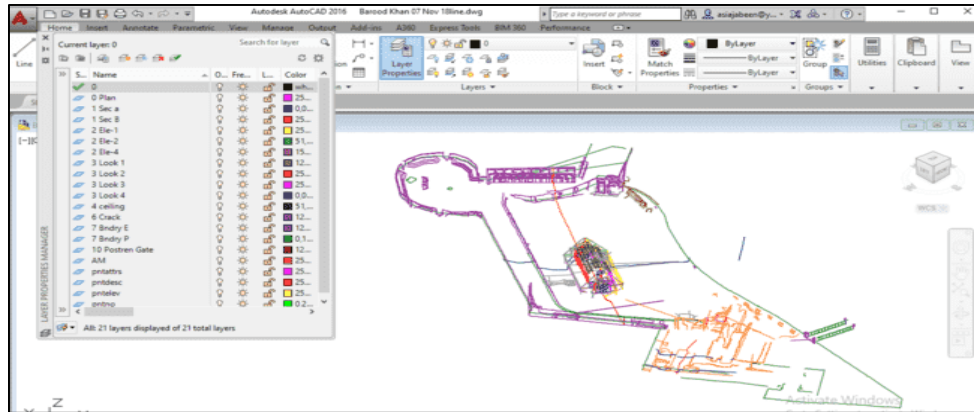


Figure 15: Barood Khana with its context, the work is in the form of layers (Source: WCLA)

There are total 21 layers, assigned different properties for various architectural and structural elements. The outcome of the whole is the digital documentation of Barood Khana using total station as a surveying tool. The 3D model is in the form of scaled wire-frame model. The layer assigned to plan and perspective with the identification of cracks in structure has been shown in the figure below. Although the methodology has been implemented decades back but continued till the introduction of terrestrial Laser scanner, accommodating the ornamentation of the heritage sites.

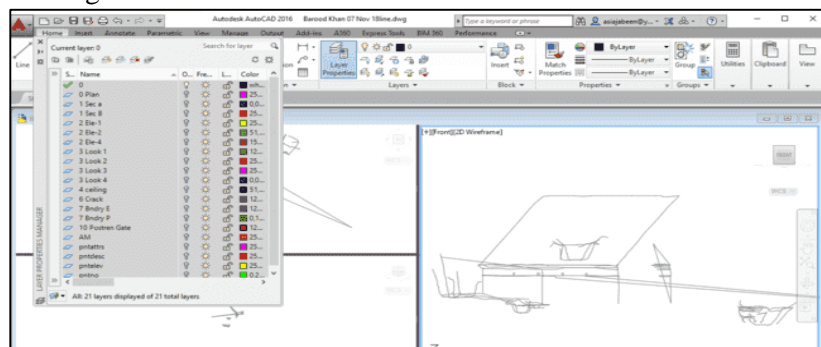


Figure 16: Image showing layer of roof structure (Source: WCLA modified by authors)

The images of the floor plan and perspective is showing various layers in terms of ceiling of vault structure and cracks, differentiated with various colors.

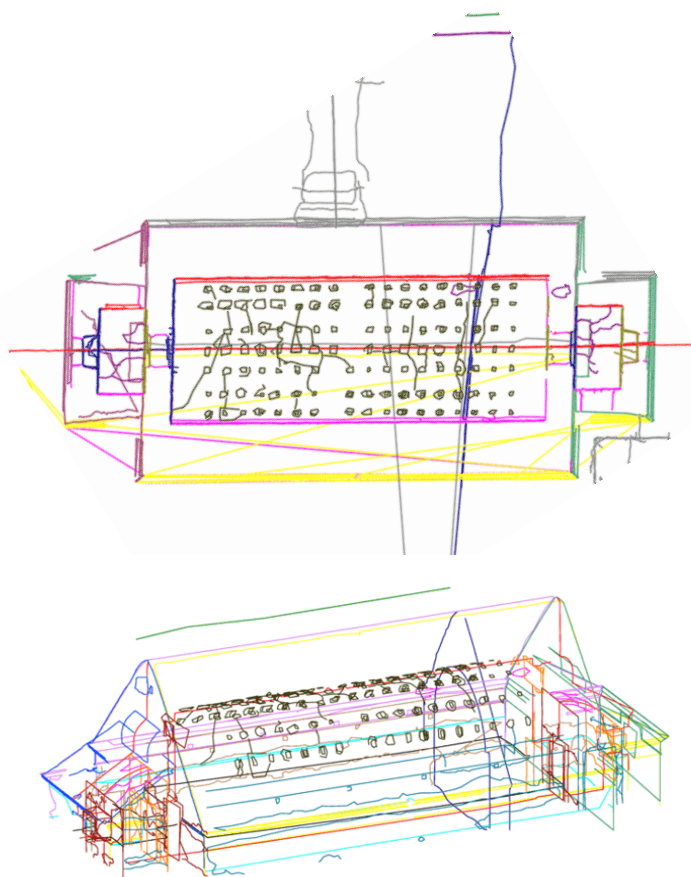


Figure 17: Image showing layer of floor plan and 3D model (Source: WCLA modified by authors)

Through this Scaled wire-frame model, accurate measurement can be drawn in terms of damages.

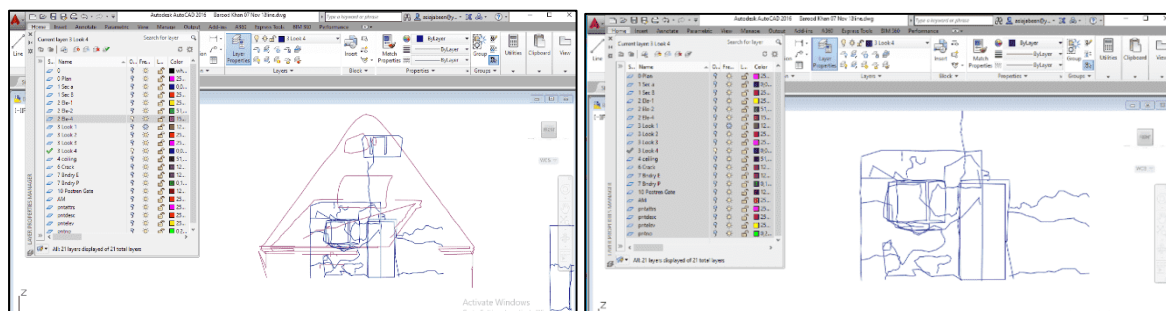


Figure 18: Image showing damages in north and south elevations

The development of a scaled wire-frame model of Barood Khana represents a significant contribution to the documentation and preservation of Lahore's cultural heritage. This case study demonstrates the effectiveness of combining historical research with digital modeling techniques to create accurate representations of significant monuments. The wire-frame model serves as a valuable tool for understanding, preserving, and promoting awareness of Lahore's architectural legacy for future generations.

6. Recommendations

The Walled City Lahore Authority (WCLA) took the charge of Lahore fort in 2023 (Hassan Naqvi, 2023). Barood Khana was built by the British. The Lahore Fort describes complete history from Mughal era to British era. Barood Khana shows the presence of British in sub-continent. However, this building was ignored for conservation works and was kept hide or importance of the building was not explored to the tourists visiting Lahore Fort. Building possess historic importance and therefore it is imperative to conserve this building and explore for the local as well as foreign tourists.

Now a day, humen are working to protect their heritage from further destructions and deteriorations. Several kinds of applications are applied for conservation and restoration works. Due to these applications they had

conserved/recovered much of the heritage worldwide. Conservationists from all parts of the world are doing their best to preserve the cultural heritage of the ancient civilizations. Same work was also applied in Pakistan to preserve our cultural heritage (Din, 2018). There are many monuments in Pakistan especially in Lahore built by the Mughals; Lahore fort, Shalimar Garden, Begum Shahi Masjid, Badshahi Mosque, Masjid Wazir Khan, Shahi Hamam, Sunehri Gold Masjid, 13 Gates, Temple etc. are the important monuments in Lahore. Many historic residential buildings are also present within Walled City of Lahore which reflects the complete history from Mughals time to British. British have also built couple of building in Lahore and in royal fort built the one of marvelous building which is known as Barood Khana and after partition as well.

We need to give more attention to historic buildings like Barood Khana for its preservation. Conservation of façade, floor, roof, window, door and other part of the Barood Khana need to be done so that the historic buildings may be retained in its original condition by using same material used in ancient time. After the completion of conservation works at Barood Khana, it will attract more tourists at Lahore Fort. The manpower to be used in such historically important monument should be experienced like ustads, craftman etc. wherever needed.

References

- Ali, R. H. (1990). Urban Conservation in Pakistan: a Case Study of the Walled City of Lahore. In *Architectural and Urban Conservation in the Islamic World* (Vol. 1, pp. 74–88).
- Archaeology Department Punjab. (2017). Report on State of Conservation of World Heritage Property Lahore Fort & Shalimar Gardens. *Government of Punjab*.
- Bryant, J. (2020). Colonial Architecture in Lahore: J. L. Kipling and the ‘Indo-saracenic’ Styles. *South Asian Studies*, 36(1), 61–71. <https://doi.org/10.1080/02666030.2020.1721111>
- Bullock, M. L., & Richard E. Warren. (1998). Electronic Total Station Speeds Survey Operations. *Hewlett-Packard Journal*.
- Din, N. U. (2018). CUNY Academic Works Shadows of Empire : The Mughal and British Colonial Heritage of Lahore. *City University of New York (CUNY)*.
- Haddad, N. A. (2011). From ground surveying to 3D laser scanner: A review of techniques used for spatial documentation of historic sites. *Journal of King Saud University - Engineering Sciences*, 23(2), 109–118. <https://doi.org/10.1016/j.jksues.2011.03.001>
- Hassan Naqvi. (2023). WCLA Gets Control Of Historic Sites Including Lahore Fort, Shalimar Gardens. *Friday Times*. <https://thefridaytimes.com/15-May-2023/wcla-gets-control-of-historic-sites-including-lahore-fort-shalimar-gardens>
- Hassani, F., Studies, W. H., Process, C., Technology, D., & Heritage, C. (2015). *Documenting of Cultural Heritage Techniques, Potentials and Constraints*. <https://doi.org/10.5194/isprsarchives-XL-5-W7-207-2015>
- Iftikhar, R. (2019). Lahore Fort- a Mughal Monument on the Verge of Decline. *Journal of the Research Society of Pakistan Volume*, 56(1), 27–40.
- Khalid, A. (2021). Conservation Challenges and Emerging Trends of Digital Preservation for UNESCO Architectural Heritage, Pakistan. *Conservation*, 2(1), 26–37. <https://doi.org/10.3390/conservation2010003>
- Leon, I., Pérez, J. J., & Senderos, M. (2020). Advanced techniques for fast and accurate heritage digitisation in multiple case studies. *Sustainability (Switzerland)*, 12(15). <https://doi.org/10.3390/su12156068>
- Liang, W., Ahmad, Y., & Mohidin, H. H. B. (2023). The development of the concept of architectural heritage conservation and its inspiration. *Built Heritage*, 7(1). <https://doi.org/10.1186/s43238-023-00103-2>
- Mughal, M. R. (2011). Heritage management and conservation in Pakistan: the British legacy and current perspective. *Pakistan Heritage*, 3, 119–134.
- Muhammad, S. (2009). Introducing EDM Survey for Recording Vernacular Heritage and Sites in Pakistan. *22nd CIPA Symposium*.
- Rafiq, M. (2010). *Heritage Preservation in Pakistan*. 1–27.
- Remondino, F., & Menna, F. (2008). Image-based surface measurement for close-range heritage documentation. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 37.
- Tania Qureshi. (2018). barood-khana an arsenal depot of british era. *Daily Times*. <https://dailytimes.com.pk/267199/barood-khana-an-arsenal-depot-of-british-era/>
- Tania Qureshi. (2023, July 23). Barood Khana: Unveiling the Resplendent structure in Lahore fort. *Daily Times*. <https://dailytimes.com.pk/1117808/barood-khana-unveiling-the-resplendent-structure-in-lahore-fort/>