Renovation and Reconstruction of Historical Buildings in Order to Improve Strength with Longibility: A case study of old Dhaka Central Jail

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

Department of Civil Engineering

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147/I, Green Road, Dhaka-1215, Bangladesh

Section:18B

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Dedicated

to

“Our beloved parents”

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ABSTRACT

A proper systematic approach to the restoration of historic buildings is crucial in the preservation of heritage buildings. This paper presents the unity between the restoration of a historic building and sustainability. The aim of the research is to establish an effective method for the restoration of historic buildings and their reuse and sustainable renovation in terms of energy efficiency, in accordance with modern needs and conservation requirements while maintaining the authentic appearance.

Conservation Methodology is a brief appraisal of the history and development of a building or site, with an emphasis on assessing and **understanding the significance of that place.** The assessment of the site is based on site visits with photographic survey, basic documentary research, and a brief analysis of the surrounding arca's character and history. This assessment of significance is then used to identify any vulnerabilities within the site, as well as discussing any possible future opportunities.

A combination of scientific and cultural knowledge and experience is indispensable for the study of cultural heritage buildings. The purpose of all studies, research and interventions is to safeguard the cultural and historical value of the building as a whole and structural engineering provides scientific support necessary to obtain this result. The evaluation of a building frequently requires a holistic approach considering the building as a whole rather than just the assessment of individual elements. The investigation of the structure requires an interdisciplinary approach that goes beyond simple technical considerations because historical research can discover phenomena involving structural behavior while historical questions may be answered by considering structural behavior. Knowledge of the structure requires information on its conception, on its constructional techniques, on the processes of decay and damage, on changes that have been made and finally on its present state.

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CHAPTER 1
INTRODUCTION

1.1 General

Cultural Heritage is more than just a petrified memory of the past that has a particular significance in the life of the nation, it is also an active resource for the future. Reusing and valorizing it changes the way we think about preservation. Since many of the listed buildings have outstanding landscape or picturesque values, it is essential that nothing is carried out that might impair these qualities. Although precious cultural heritage resources are reusable, they are neither renewable nor replaceable. This means that all interventions to modify buildings must involve minimal disturbance to both the buildings themselves and to their wider context. [1]

Historic buildings and their remains, which belong to the monumental heritage of a society, should be protected from further deterioration, restored and adapted to modern requirements and modern social changes. [2]

Architectural heritage and historic buildings are primarily influenced by the bioclimatic design principles, specific resilient architectural structure and strategic design choice of durable construction materials, as well as by characteristic free land space and greenery they are surrounded with. Their sustainability is verified by their endurance and durability measured by hundreds and thousands of years [3, 4]. All the construction materials and any planned interventions should be in harmony with the authentic appearance and integrity of the building. The building should meet the space requirements of the new functions [5].

Before research is done, it is essential to know about its historical significance. There are some reasons why we select the Old Dhaka central jail.

1.2.1 HISTORICAL SIGNIFICANCE OF OLD DHAKA CENTRAL JAIL.

Fig 1.1: Historical Significance of Old Dhaka Central Jail

The Central Jail bears a legacy more than 400 years old with history and context of Old Dhaka which proves that many important structures and architectures flourished all over the Old Dhaka throughout this timeline. Prior to 1608, before the arrival of Mughals (Mughal Fort) [6] the Jail area was used as Afghan Fort ruled by the governors descending from the Delhi Sultanate. From 1608-1768 during Mughal Period Nawab Ibrahim Kha built there a fort that was demolished by earthquake. Afterward, Islam Kha rebuilt the fort in 1638. There was a palace, a court and a mint (takshal) inside the fort where the maximum important public services were carried out. Around 1702, a market named 'Padshahi Bazaar' (presently Chawk bazaar) was built on the south corner of the fort by Nawab Murshid Kuli Khan. The city expanded around the 'Padshahi Bazaar' and some connecting roads were built around the market and Bakshi bazaar', 'Dewan bazaar', 'Pilkhana',' Mahut-Tuli areas and people started to live and work in those areas. The central business district (CBD) was formed around the 'Chawk bazaar' and the Jail area was known as Badshahi Fort.

1.2.2 JAIL TIMELINE OF FATHER OF THE NATION-3053 DAYS OF JAIL LIFE (1938-1948-1949-1952-1955-1959-1962-1964-1964-1966-1968-1969-1971)

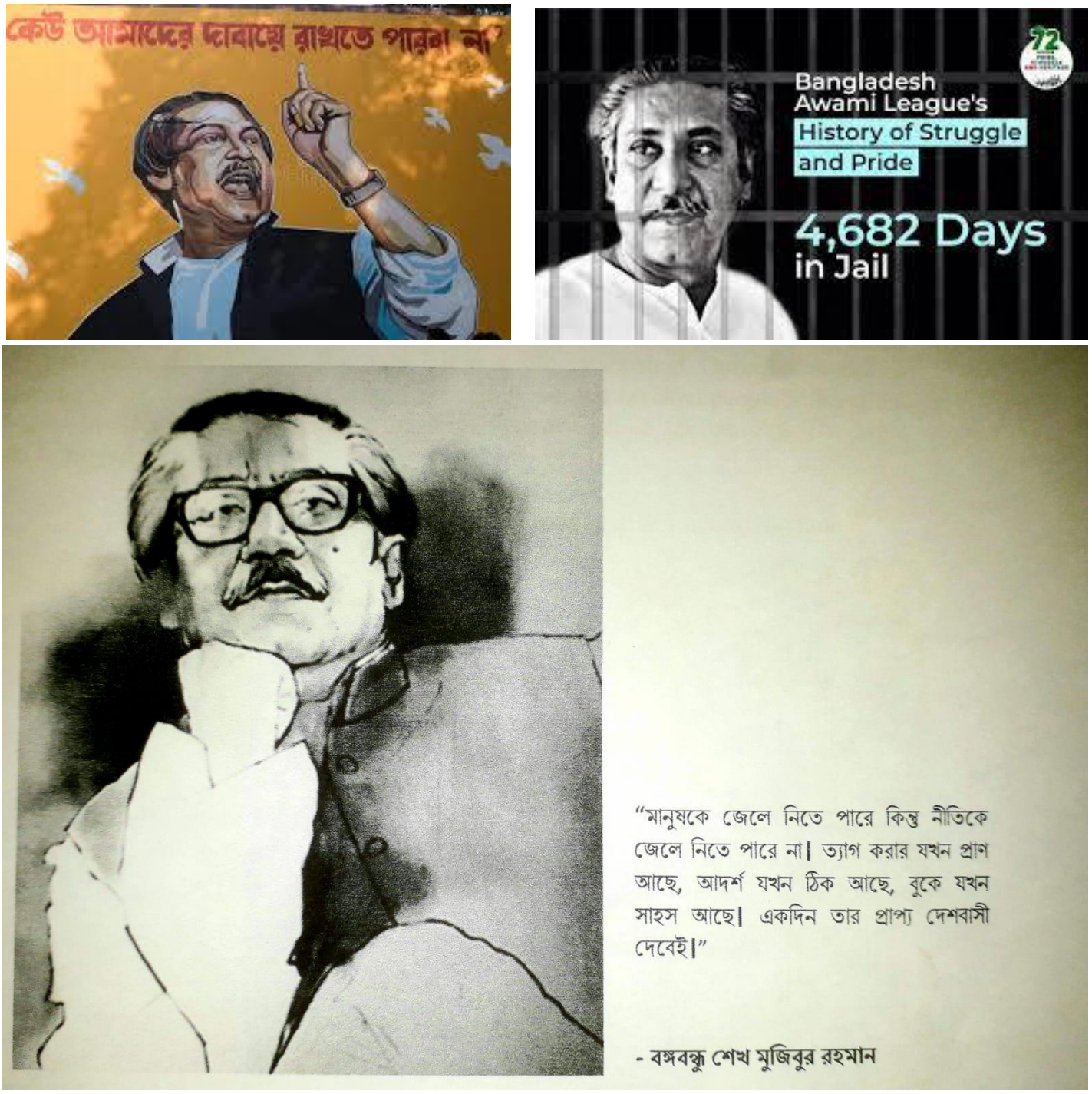


Fig 1.2: Jail Timeline of Father of The Nation-3053 Days of Jail Life

Bangabandhu Sheikh Mujibur Rahman was imprisoned in various occasion from 1948- 1969. Although within these various occasions, from 1966 to 1969 he was imprisoned for the longest time, almost 3 years in this Old Dhaka Central Jail.

Bangaldesh's National Four Leaders - former Vice-President Syed Nazrul Islam, former Prime Minister of Bangladesh, Tajuddin Ahmed and Captain Mansur Ali, and former Home Minister AHM Quamruzzaman were killed in this premise in 1975. [7, 8 and 9]

The historical and political significance this site makes this a potential museum of jail-life history. Keeping in mind the political and historical significance, conservation of important historical buildings has been considered as a major design element. All the historically significant building will be conserved and will be adaptively reused commemorating 228 years of Jail Life, conveying the historic memory nationwide.

According to Historians, 1545- The Afghan Fort (old fort) was built in the period of Sher Shah Shuri, an Afghan ruler. (Ref- Nana rong er Dhaka; P-82, Kajal Ghosh) [10] Later, Islam Khan rebuilt the fort in 1638. There was a palace, a court and a mint inside the fort. The maximum important public services were carried out there. In the tenure stated above, there was a mental asylum in the fort also. Up to 1772 in Mughal Dynasty, the fort was used solely as a mint. Around in 1810, the inhabitants of Old Dhaka had a movement against the impose of holding tax at the Fort Area. During Sepoy Mutiny in 1857, the Rebel Soldiers were the first to be disarmed by the English Soldiers. Later, During East-India Company Dynasty, the Fort was transformed into a Jail in 19th Century. At the same time Aligarh, Rajshahi Jail was also established. During Anti-British Movement, many activists were held at this prison. In 1948, Along with Sheikh Mujibur Rahman, some other leaders were held at Central jail that invoked people to burst out against the Ruling party. In 1966, Sheikh Mujib was again got prisoned and started the 6-term Movement that intrigued a mass involvement across the country. The Mass Movement in 1969, to free Sheikh Mujib from the central jail, a huge crowd was gathered outside the jail area.

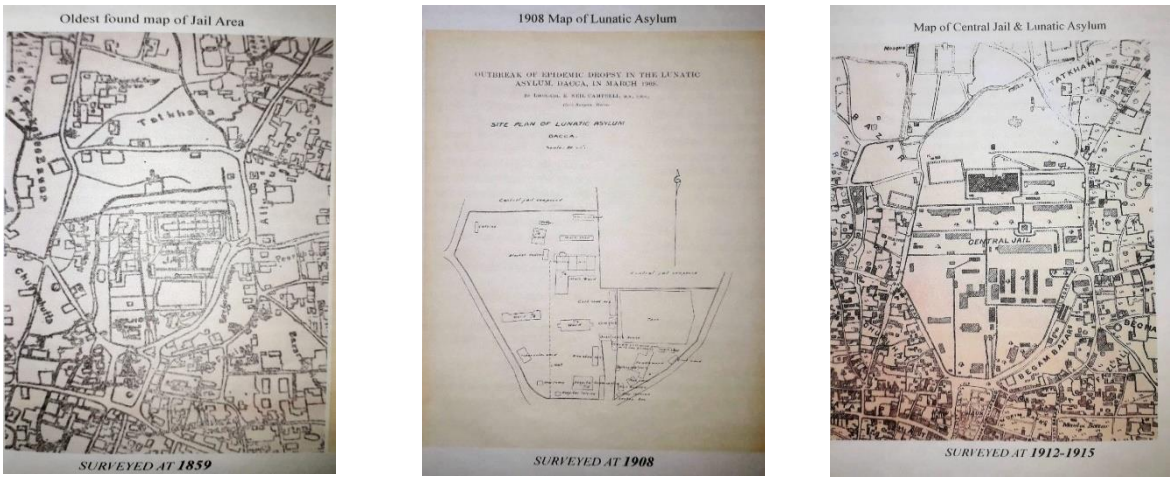


Fig 1.3: Historical Map of old Central Jail

Objective:

The main objectives of this study are to;

i. Restoration of building or its part, without affecting the load-bearing constructions, facade of the building or engineering communications of general use.

ii. Repair (overhaul) of the construction or its part with the aim to restore the building or its part by replacing the worn-out load-bearing elements or structures.

iii. Renovation of existing buildings is a logical path forward in order to extend their useable lifespan, improve living and working conditions, and lower operational energy costs.

CHAPTER 2
Literature Review

An Afghan fort, turned into a Mughal Stronghold and then a treasury; with the passage of time the site became the Dhaka Central jail at the central location of old Dhaka. In the course of history, the morphology of this specific area has been significant. But when the functionality of this site is evolving and changing, it was, it is and it will be the heart of the oldest city part of Dhaka. Despite the rapid urbanization, the essence of the place survived but the jail remained as a sealed part within it. The change has now begun and it has been for the betterment of the area. The Dhaka central jail has now been relocated to Keraniganj. When relocated, the jail left behind a large space with lots of potentials. The place will come in hand with endless possibilities, and with that come endless complexities. Any misconduct with the changed functionality of the place will severely damage the essence Old Dhaka.

Apart from all these, the objective was to identify the consultant who can develop and implement The Project in close cooperation with Prisons Directorate, Security Services Division, Ministry of Home Affairs, and Government of the People's Republic of Bangladesh. A total of 99 consultancy firms registered for the competition. A jury panel was formed including experts and stakeholders of various sectors for the judgment

This open design Competition was scrutinized by the renowned jurors in a four-day long jury session. Among 36 submitted design proposals under various criteria the respected jury selected a proposal to match with the sensitivity and magnitude of the project requirement. Finally, the best suitable designs were selected as the first prize and second prize winning entry and all the designs were exhibited in a week-long exhibition at Bangladesh Shilpakala Academy starting from 30 October, 2017.

Upon the completion of the project the site surrounding old Dhaka can be relieved of some major urban problems. The redevelopment place can become important in every aspect- socio-cultural, infrastructural and historical. It can contribute greatly in national and international context by upholding our heritage and history to the global community and create a strong and positive image of our beloved Dhaka city to the World. Somewhere in between the broad-brush of urban planning the specifics of architectural intervention, this project will contribute to create a responsive environment for Old Dhaka.

2.1 TYPES OF CONSERVATION METHODOLOGY

Historic Preservation is the "preservation and repair of archaeological, historical, and cultural sites and artifacts"[11]. When dealing with building conservation, there are four primary types of treatment, or ways in which a property can be managed. Each one has their own objectives and limitations [12].

Preservation "places a high premium on the retention of all historic fabric through conservation, maintenance and repair"[13]. In other words, all the materials added to a building over its lifetime are retained and work is only completed when it is essential to prevent deterioration of the site.

→ Maintenance & Repair existing historic materials.
→ Retention of Form as the property has evolved over time.

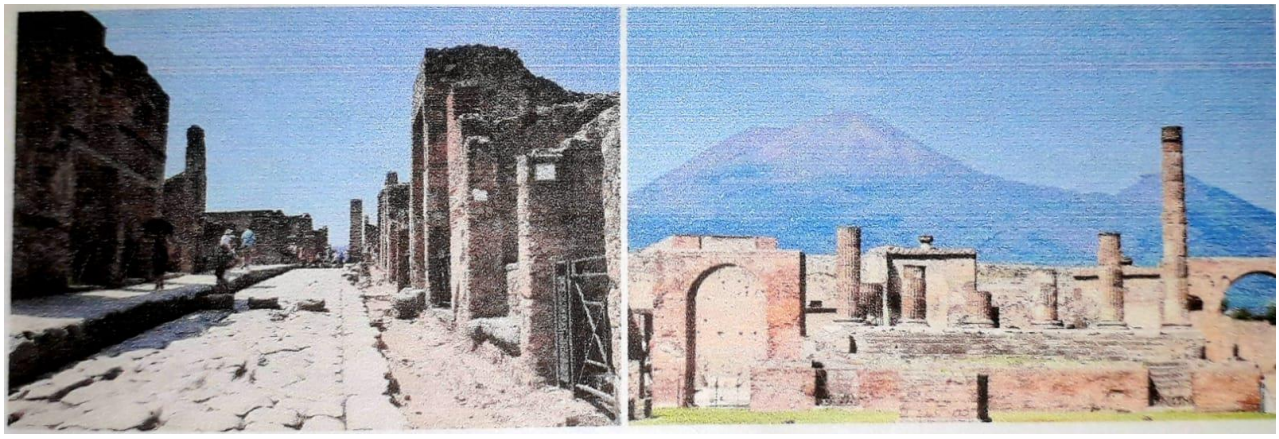


Fig 2.1: Ancient Roman City Pompeii, Italy

Rehabilitation is a more lenient standard of preservation because it assumes the building is so deteriorated that it needs repair to prevent further damage. It focuses on maintaining the materials, features, and spatial relationships that give a building historic character and allows for additions or alterations to be made that do not destroy the integrity of the property [14].

→ Alter or add a historic property to meet continuing or changing users.
→ Retain Historic Character the identity is not forgotten as adaption proceeds.

Fig 2.2: Nagaur Fort, Rajasthan, India

Restoration like preservation, it works to maintain as much of the original material as possible. However, the focus of restoration is to present the property at a specific point in history. As result repairs and recreations of certain elements or fixtures are completed and anything which postdates the intended period is documented and removed. The extent of a restoration is limited by the existing structure or proof of pre-existing features that were previously modified. Designs that were never executed cannot be included [15].

→ Depiction of a Particular Period restore in it purest/original form.
→ Removing Evidence/Traces - Traces of other periods are removed to restore the building to its rightful period of existence.

Fig 2.3: Castell de la Tossa, Spain.

Reconstruction the most substantial type of treatment, it allows for the recreation of a former sites, landscape, or objects that no longer exists using all new materials. It is limited to aspects of a historic building that are essential for understanding and must be completed on documentary and physical evidence. Unlike the other treatments, a reconstruction must be labeled as a "contemporary re-creation" as it has historical foundations but is new in construction [16].

→ Recreation - re-creates vanished or non-surviving portions
→ Interpretive aesthetically interpreted with new materials

Figure 2.4: Neues Museum, Museum Island, Berlin, 1993-2009

2.2 TERMS & REFERENCES USED IN CONSERVATION METHODOLOGY

Historic Preservation (US), Heritage Preservation or Heritage Conservation (UK) is an endeavor that socks to preserve, conserve and protect buildings, objects, landscapes or other artifacts of historical significance. It is a philosophical concept that became popular in the twentieth century, which maintains that cities as products of centuries development should be obligated to protect their patrimonial legacy. The term refers specifically to the preservation of the built environment, and not to preservation of, for example, primeval forests or wilderness.

CHAPTER 3

Methodology

3.1 The following analyses and activities were conducted in this research:

- On-site observation—the subject of preservation was determined on the basis of the analysis and evaluation of historic buildings;

- Designing and defining criteria for constructive protection based on a preliminary on-site analysis and choosing the type of work that needs to be undertaken in order to restore a facility that has been permanently used for almost a century;

- Analyses of the building materials used in the construction of the historic building;

- Restoration of the building in accordance with the conservation requirements: retaining the authentic elements of the structure (facade walls, roof structure) as well as the authentic appearance of the building;

- Restoration of the historic building and retention of the original appearance, preserving the visual appearance of facade bricks walls and stone details, as well as the interior aspects, in terms of maintaining the existing frescoes on the interior walls and meeting modern principles and requirements of building physics;

- Project preparation for the restoration of a historic building, along with checking the possibility of improving the already restored buildings by applying individual interventions in order to improve energy e_ciency and energy saving;

- All interventions on historic buildings, aimed at restoring and improving energy e_ciency, are reversible processes and can be done in accordance with the conservation requirements;

- Analysis and evaluation of the achieved results by applying various proposed restoration models for the purpose of energy refurbishment, along with permanent use and preservation of the environment.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 STAGES OF GENERAL CONSERVATION WORKS AND ADAPTIVE RELSE

The redevelopment of all historically or culturally significant buildings will go through Conservation works and Adaptive reuse. The break dews of this conservation work well include the following stops. Here general steps of historic building conservation have been mentioned. Building specific adaptive will require special interior fitting according use.

STAGES OF GENERAL CONSERVATION WORKS AND ADAPTIVE REUSE

1. Documentation phase
2. Building condition assessment/conditional survey
3. Dismantling of later additions
4. Removal of angler fig, repairing of cracks
5. Detail study of structure
6. Foundation
7. Structural System
8. Floor System and Skirting
9. Condition of all Walls (de-plastering and new lime mortar-plastering, repointing)
10. Repair and Reconstruction of Ceilings
11. Mechanical and Electrical Equipment Installation
12. Repair or Installation of Fixtures (lighting, sanitary etc)
13. Roof and waterproofing
14. Gutters and downpipes
15. Water ingress rising damp (insertion of damp proof course)
16. Building Envelope
17. Windows/ Doors/ Shutters/Grills/Railings
18. Pest control
19. Waterbodies
20. Conservation of Archaeological Excavation
21. Boundary Walls

4.2 GENERAL STAGES OF CONSERVATION WORK

A. DOCUMENTATION STAGE

1. On site physical investigation, examination and assessment, evaluation of current condition.

2. Gather historical material that has been produced on the heritage place and identify existing listing.

B. CONDITIONAL SURVEY

1. Create a set of measured drawings for the buildings/structures if unavailable. These drawings should be of a high standard for use in interpretative displays. On the drawings.

- Make the different periods of construction.
- Record the condition of the building structure/asset is various possible format before any physical intervention, during the process & after compiction of the intervention.

C. RESEARCH & ANALYSIS

1. Research and gather information from various sources like library, archive, museums, literatures, govt publications like gazettes about the project history and background to enrich the historical significance of the project.

2. Develop a plan for the treatment (stabilization, conservation and restoration)

3. Provide a conservation action plan including a dilapidation schedule, for the building's structures, clearly illustrated by drawings and/or photographs, to identify the repairs needed:

- Prioritize items for conservation work.
- Provide sufficient work specification, so a competent builder can cost the works required as agreed with the client.

4.3 SOME STAGES DESCRIPTION

Architectural Features Detail Documentation Survey face

Floor & Paved Surface

Existing paved tile will be replaced with brushed concrete surface.

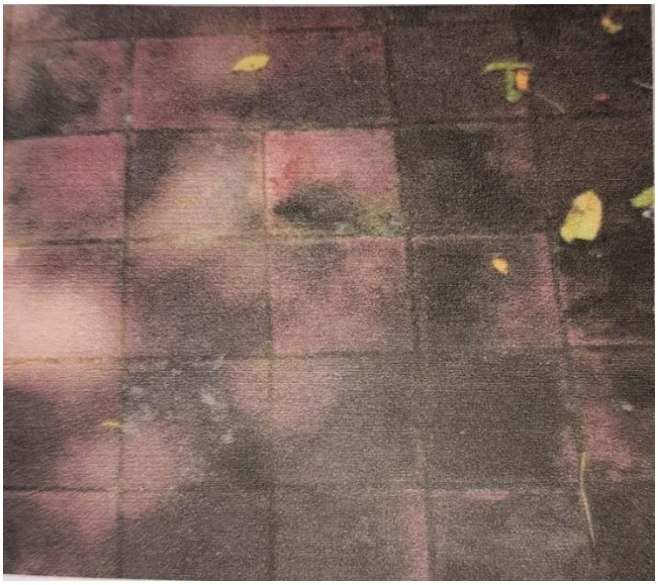


Fig 4.1: Pavement of Bangabandhu Kara Smriti Museum Premise

A perfect sample of the then paved surface of jail area made of lime plaster and stone having a mild reddish tone.

This material will be conserved and will work as a sample for other paved surfaces in the whole project.

Fig 4.2: Pavement Beside Workshop 01

Evidence of lime plaster and lime mortar joint in brick inside Padma. 1-Joist or steel has been used in lintel.

Similar wall could be found in Meghna, Kara Hospital & Surma. This portion will work as a sample for other parts where materials has been used to construct wall

Fig 4.3: Inside Wall of Padma

4.3.1 ARCHAEOLOGICAL EXCAVATION AREAS

The old Dhaka central jail has a history of more than 400 years, from Pre-sultanate period. It was named as afghan fort. The British demolished several parts of it and made it Dhaka jail. The trace can be restored only through proper archaeological excavation.

Fig 4.4: Archaeological Excavation Areas

4.3.2 MOISTURE CONTENT MEASUREMENT

For brick walls in historic buildings, the consequence of long-term moisture, usually combined with excessive salinity, is the severe and extensive destruction of wall components At die beginning of the restoration works of such objects, specialized tests of the moisture content should be first executed. If the moisture content in walls exceeds the permissible level, it is necessary to undertake measures for its reduction in the conditional survey, present of moisture in the form of dampness is present in several buildings this is due to rain penetration, drainage issues, damp from the land.

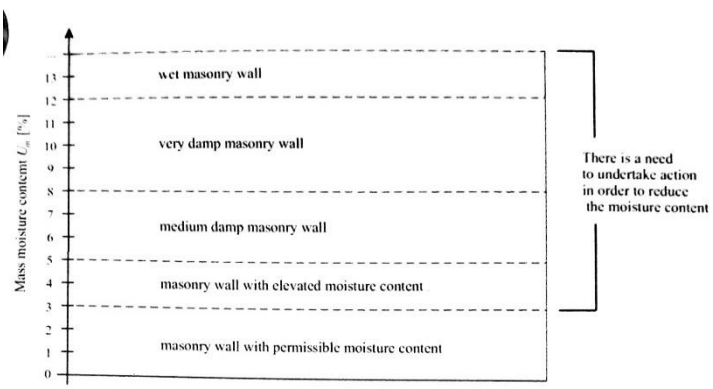
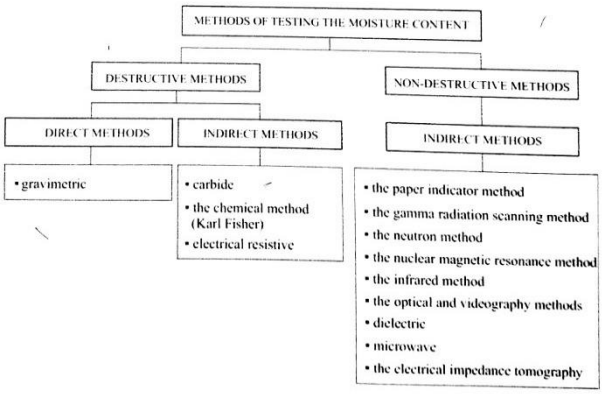


Figure: Classification of the moisture content of brick walls



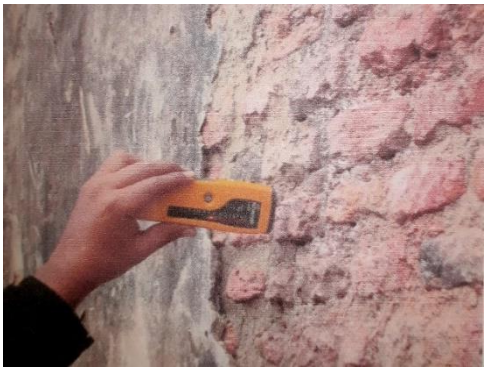


Fig 4.5: Methods of Testing Moisture Content of Bricks Wall

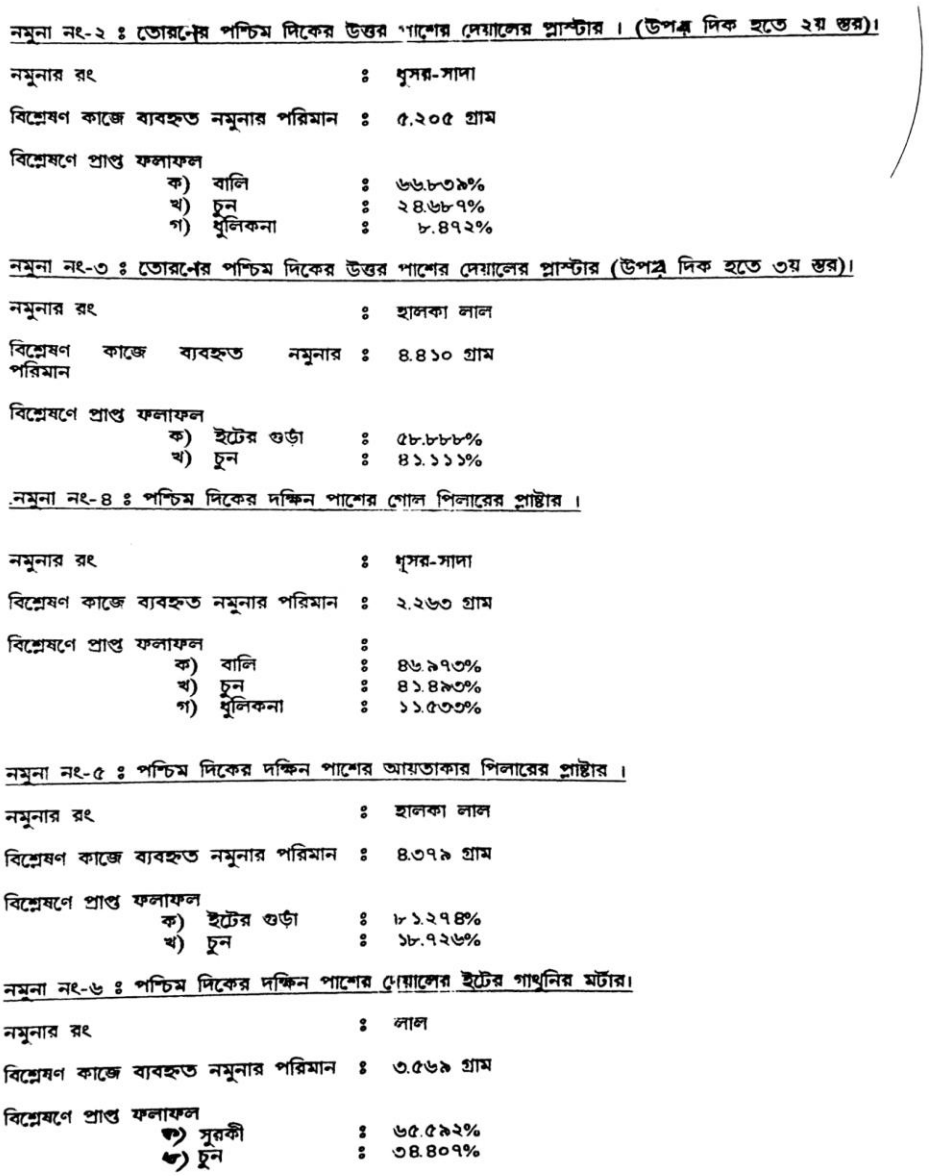
4.3.3 SALINITY MEASUREMENT AND CONTROL

For brick walls in historic buildings, the consequence of long-term moisture, usually combined with excessive salinity, is the severe and extensive destruction of wall components At die beginning of the restoration works of such objects, specialized tests of the moisture content should be first executed. If the moisture content in walls exceeds the permissible level, it is necessary to undertake measures for its reduction in the conditional survey, present of moisture in the form of dampness is present in several buildings this is due to rain penetration, drainage issues, damp from the land.

Figure 4.6: Salt crystallization in different areas in Old Dhaka Central Jail Compound.

4.3.4 Chemical Analysis of Salinity

A chemical-physical and mechanical analysis of bricks and mortars of old historic buildings shall be carried out, in order to characterize the basic material properties and the relevant decay. This latter is correlated to the quality of the materials. The kind of damage is clearly related to moisture transport within the wall: the moisture source can be found as rainwater penetration, rising damp. The main processes, leading to a decrease of the various properties, are salt crystallization and sulphuration.



নমুনা নং-২ ঃ তোরণের পশ্চিম দিকের উত্তর পাশের দেয়ালের প্লাস্টার । (উপর দিক হতে ২য় স্তর)।

নমুনার রং	ঃ	ধূসর-সাদা
বিশ্লেষণ কাজে ব্যবহৃত নমুনার পরিমান	ঃ	৫.২০৫ গ্রাম
বিশ্লেষণে প্রাপ্ত ফলাফল		
ক) বালি	ঃ	৬৬.৮৩৯%
খ) চুন	ঃ	২৪.৬৮৭%
গ) ধুলিকনা	ঃ	৮.৪৭২%

নমুনা নং-৩ ঃ তোরণের পশ্চিম দিকের উত্তর পাশের দেয়ালের প্লাস্টার (উপর দিক হতে ৩য় স্তর)।

নমুনার রং	ঃ	হালকা লাল
বিশ্লেষণ কাজে ব্যবহৃত নমুনার পরিমান	ঃ	৪.৪১০ গ্রাম
বিশ্লেষণে প্রাপ্ত ফলাফল		
ক) ইটের গুড়া	ঃ	৫৮.৮৮৮%
খ) চুন	ঃ	৪১.১১১%

নমুনা নং-৪ ঃ পশ্চিম দিকের দক্ষিন পাশের গোল পিলারের প্লাষ্টার ।

নমুনার রং	ঃ	ধূসর-সাদা
বিশ্লেষণ কাজে ব্যবহৃত নমুনার পরিমান	ঃ	২.২৬৩ গ্রাম
বিশ্লেষণে প্রাপ্ত ফলাফল	ঃ	
ক) বালি	ঃ	৪৬.৯৭৩%
খ) চুন	ঃ	৪১.৪৯৩%
গ) ধুলিকনা	ঃ	১১.৫৩৩%

নমুনা নং-৫ ঃ পশ্চিম দিকের দক্ষিন পাশের আয়তাকার পিলারের প্লাষ্টার ।

নমুনার রং	ঃ	হালকা লাল
বিশ্লেষণ কাজে ব্যবহৃত নমুনার পরিমান	ঃ	৪.৩৭৯ গ্রাম
বিশ্লেষণে প্রাপ্ত ফলাফল		
ক) ইটের গুড়া	ঃ	৮১.২৭৪%
খ) চুন	ঃ	১৮.৭২৬%

নমুনা নং-৬ ঃ পশ্চিম দিকের দক্ষিন পাশের দেয়ালের ইটের গাথুনির মর্টার।

নমুনার রং	ঃ	লাল
বিশ্লেষণ কাজে ব্যবহৃত নমুনার পরিমান	ঃ	৩.৫৬৯ গ্রাম
বিশ্লেষণে প্রাপ্ত ফলাফল		
ক) সুরকী	ঃ	৬৫.৫৯২%
খ) চুন	ঃ	৩৪.৪০৭%

Fig 4.7: Chemical Analysis Result

4.3.5 STRUCTURE DISTRESS MANAGEMENT:

In course of time, with ageing, distress would appear in structures as a natural phenomenon. This natural metamorphosis is due to natural wear and tear. Moreover, in the present days, the structures are in extreme aggressive environment. The old structures which were constructed in non-aggressive environment and without any special preventive measure are now very badly affected due to gradual deterioration of the environment around them.

4.3.6 SLAB STRENGTH ANALYSIS: BRICK LAYING/SAND BAG TEST

Fig 4.8: Slab Strength Analysis: Brick Laying/Sand Bag Test

4.3.7 BRICK STRENGTH ANALYSIS PRISM TEST & BUNDLE TEST

It is a laboratory test to calculate the compressive strength of a masonry prism. The prism can be obtained from site or can manufactured in lab as a representative modal of site. It used to check that whether the masonry is providing sufficient strength or not.

Fig 4.9: Brick Strength Analysis Prism Test & Bundle Test

4.3.8 IDENTIFY DAMAGED BRICKS

Thick work is damaged, it might not be just blighting buildings appearance: it could also be letting more moisture penetrate the er or outer walls or even compromising the wall's structural integrity.

Fig 10: Damaged Bricks

4.3.9 IDENTIFY FAILED OR UNSUITABLE POINTING

The brickwork might have been pointed in a manner that has led to the wall inadvertently picking up damage. For example, modern cement mortar instead of traditional lime mortar - has been used for pointing. The more modern mortar could trap moisture and so prevent it escaping via the mortar joints. This, in turn, would force the moisture to emerge on the brick faces, abere it could be frozen and then lead the brick surfaces to crumble.

Fig 11: Unsuitable Pointing

4.3.10 IDENTIFY EFFLORESCENCE

It refers to white deposits that form on brickwork due to water including dissolved salts rising to the surface. Efflorescence does at typically damage the brickwork from a practical point of view. However, it is unsightly and if the way that the brickwork has been assembled is causing efflorescence, then replacing that brickwork might be the best solution.

Fig12: Efflorescence

4.3.11 IDENTIFY DAMP

Decaying timber flooring or crumbling plaster can indicate damp. Alternatively, it might be penetrating damp, which can happen if water shifts from a high part of your home to another part further down. An especially common cause of penetrating damp is inadequate pointing to the brickwork. Such pointing can let water leak into the wall.

Fig 13: Damp

4.3.12 IDENTIFY REHABILITATION OF DAMPED PLASTER

- Remove the damped/ distressed plaster
- Rake out the joint mortar - clean this exposed surface properly and repack using seal coat after layer.

Fig 14: Damped Plaster

4.3.13 IDENTIFY REHABILITATION OF SPALLED OF CONCRETE ROOF SLAB/LINTEL BEAM

- Support the roof/beam properly and effectively.
- Remove all loose concrete and expose the reinforcement.
- Clean the surface through sand blasting/water jetting or at least use steel wire brush.
- Clean the reinforcement and provide additional reinforcing bars as per requirement. New and old steel reinforcement shall be coated with anti corrosive paint.
- Fix the grouting nozzle and rebuild the area using polymer mortar layer. Proper compaction shall be ensured.
- Pressure grout after 36 hours and finish the surface with polymer modified mortar.

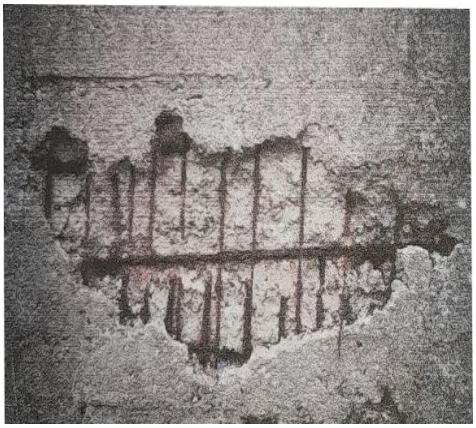


Fig 15: Rehabilitation of Spalled of Concrete

4.3.14 IDENTIFY OF HONEYCOMBED CONCRETE

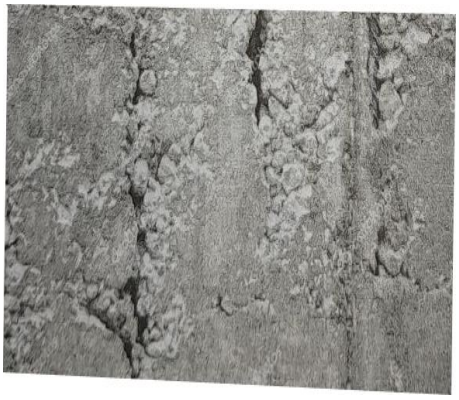


Fig 16: Honeycombed Concrete

4.3.15 IDENTIFY OF DECAYED BRICKS IN WALL

Brick walls are typically durable. It can withstand severe weather and other abuse for years. But they are not impervious to erosion. Brick and mortar expands and contracts as moisture enters and evaporates Over time, the natural expansion and contraction of the brick caused by water infiltration causes erosion or crumbling of the mortar.

Fig 17: Decayed Bricks in Wall

4.3.16 IDENTIFYING PALLING EFFECTS OF BRICKS

Spalling is when brick masonry begins to deteriorate to the point chunks of brick are falling from the structure. Spalling starts off as small cracks that grow into bigger cracks until the entire surface deteriorates it's a indication that the surrounding bricks will do the same.

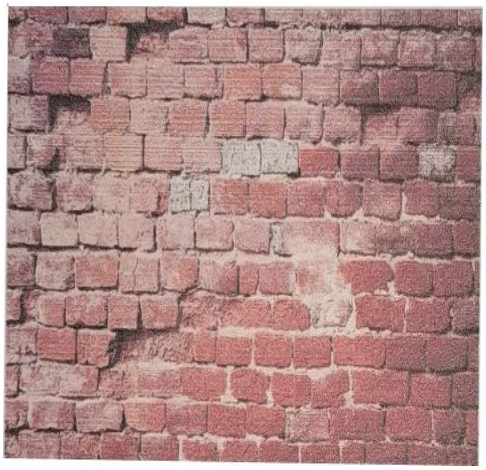


Fig 18: Palling Effects of Bricks

4.3.17 IDENTIFYING THE CRACKS

In old building there are lot of cracks.

Fig 19: Cracks in Brick Wall

4.3.18 IDENTIFYING PATCHING

Eroding bricks can be repaired by patching over the old mortar without removing, the crumbling sections. This process is called tack pointing. But it is not a long-term repair for eroding brick walls. Tuck-pointing eroded joints provides a weak bond between old and new mortar layers.

Fig 20: Patching in brick wall

4.3.19 IDENTIFYING THE DAMAGE

Damaged joints need to be dug out at least as deep as they are wide. The loose mortar needs to be removed by sliding a grout saw between the horizontal joints and digting out the crumbling sections to a depth of at least a 3/4 inch.

Fig 21: Damage in Brick Wall

4.3.20 IDENTIFY DAMAGED BRICKS:

Bricks that have spalled tend to make the penetration of moisture more likely, look unsightly and may have structural implications for the wall. There are a number of options available to rectify the problem.

Fig 22: Damaged Bricks

4.4 CONSERVATION WORK PROCEDURE WHICH IS USED IN THIS SITE:

Work Site: Old Dhaka Central Jail.

Govt. Project Name: Conservation of Old Dhaka Central Jail History, Historical Buildings & Development of Surroundings Area.

Conservation Work & Adaptive Reuse

1. Safety yard Precautionary Measures
2. Removal of Strangler Fig Plants
3. Cleaning Lichen/Algae Growth
4. Demolition of Later Additions
5. Dismantling Works
4. De-Plastering
7. De-Pointing
8. Desalination-Removal of Harmful Salts
9. Damp Proofing Works
10, Repairing the Cracks
11. Floor System and Skirting
12. Brickworks
13. Preparation of Lime Surki Mortar
14. Re-Pointing
15. Lime Plaster
16. Lime Wash
17. Lime Concrete
18. Lime Terracing
19. Roof Reconstruction and Preservation Works
20. Repair and Reconstruction of Ceilings
21. Reconstruction of Doors and Windows

4.4.1 SAFETY AND PRECAUTIONARY MEASURES

1.1 Effort to be taken by the concern authority to protect the historic structures and its elements, fabric etc. from possible damage due to fall of material, accidental damage caused by the workmen, etc. by adequately covering such areas with appropriate material and as instructed by the concern authority.

1.2 Preservation of original fabric shall be given priority over new work. Masons undertaking the conservation works must appreciate that the new work they are undertaking secondary in importance to surviving original fabric.

1.3 Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the historic surfaces of the buildings and other structures.

In such cases, constant's written approval to be obtained mentioning about the means of ensuring safety to the historic surfaces. [18]

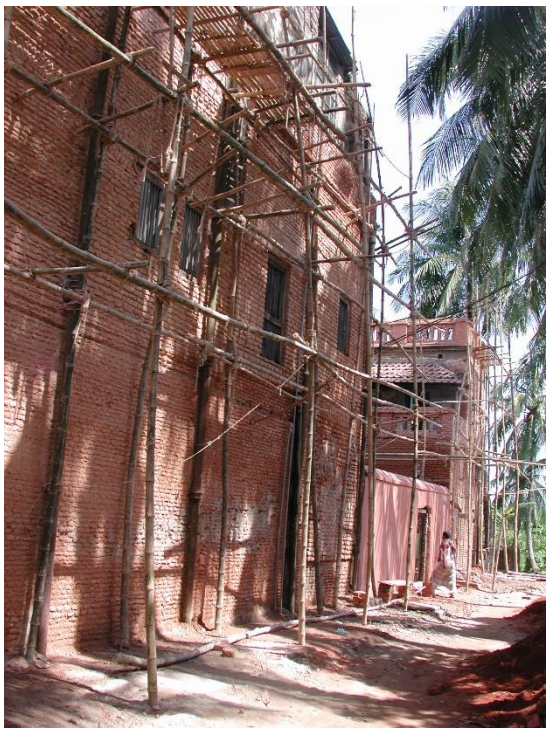


Fig 4.23: Reference Picture of ongoing conservation At Panam Nagar (2020)

4.4.2 REMOVAL OF STRANGLER FIG PLANTS OR TREES

2.1 All surfaces around the banyan tree needs to be de-plastered

2.2 If the root is of a reasonable size, drill holes into the stumps 80mm deep and fill the approved herbicide solution. Soak acid free paper pulp in a solution of ammonium carbonate (GPR) 5% - 8% / Sodium Arcenite, mixed with distilled water and cover the affected areas.

2.3 Wrap/ cover the area with polythene and keep it for about 4-5 days.

2.4 Remove the polythene cover and spray the solution given under 1.0 using a hand spray to wet the dried paper pulp and wrap/ cover the area again with

Fig 4.24: Strangler Fig Plants or Trees in Building

4.4.3 CLEANING LICHEN/ALGAE GROWTH

Fig 4.25: Existing Wall Condition

Fig 4.26: Reference Image of Wall after Cleaning Lichen/Algae Growth.

1. The work to be handled by a conservator with a background and experience in chemical Conservation.
2. Soak acid free paper pulp in a solution of ammonium carbonate (GPR) 5% - 8%, mixed with distilled water and cover the affected areas.
3. Wrap/ cover the area with polythene and keep it for about 4 - 5 days.
4. Remove the polythene cover and spray the solution given under 1.0 using a hand spray to wet the dried paper pulp and wrap/ cover the area again with polythene and keep it for about another 4-5 days.
5. Remove the polythene cover and the paper pulp.

TREATMENT OF WALLS WITH A BIOCIDE

1. Walls shall be treated with a slow-release copper biocide with a pH of 7 or above - the contractor shall propose the product to be used for the approval of the consultant.
2. Provide complete protection against breakage, staining and weather damage (mainly due to sun and rain) by temporary cover, but with adequate ventilation.

4.4.4 DEMOLITION OF LATER ADDITIONS

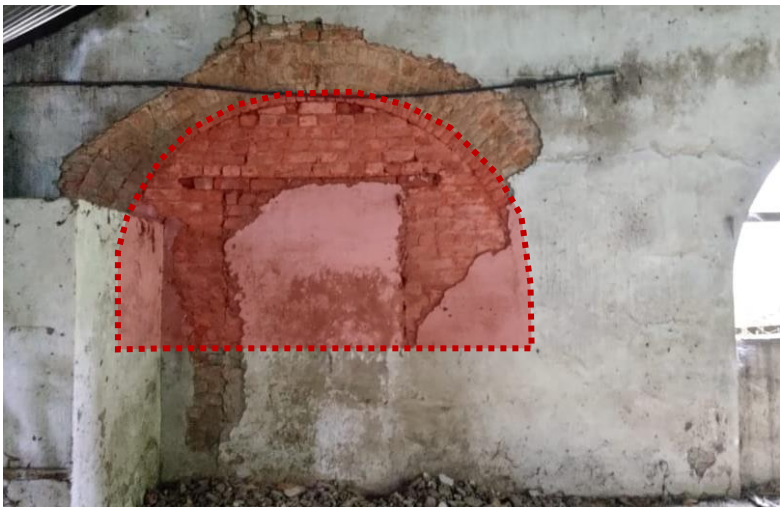


Fig 4.27: Arched opening revitalization from CC06

Fig 4.28: Arched opening revitalization from CP05

4.4.5 DISMANTLING WORME

To restore the original condition of its construction period.

4.4.6 DE-PLASTERING

During the last restoration work occurred in Jail, lime plasters used in all internal and external surfaces are mostly removed and re-plastered with cement mortars. The use of cement mortars as plaster is widely recognized as being detrimental to old buildings as they can drastically alter the way in which a wall handles water and water vapors. Cement mortars tend to trap water which will lead towards dampness, and mortars may ultimately fail, often causing damage to the surrounding masonry in the process. So all cement plasters should be removed form CC 05, CC-06, CC-07, CD-25, CD-26.

However, De-plastering shows all the defects and cracks in the walls to come up with intervention plan. Lime and Surki are the main ingredients used in the construction system in the Jail Compound.

Fig 4.29: De-Plastering

4.4.7 DE-POINTING

De-pointing-Removal of Damaged Brick Face and Joint carefully. After the de-plastering, Cement mortar will be removed. The joints on the exposed surface shall be carefully racked with soft stick or pointing key to a depth of about 8mm, or at least twice the width of the joint.

Fig 4.30: De-Pointing

4.4.8 DESALINATION-REMOVAL OF HARMFUL SALTS

Desalination work procedure

1. The plaques or molded bricks to be removed for destination shall be agreed with the consultant.
2. A detail drawing shall be prepared showing the inception of the plaques/molded bricks to be re- moved so that they can be correctly replaced following treatment.
3. The plaques/molded bricks shall be placed in a clean container filled with distilled or deionized.
4. Immersion should be continued over 10 days, with the water being changed 5 times during that period.
5. At the conclusion of the process, any sediment that may have accumulate on surfaces during desalination should be removed with a small amount of clean distilled/deionized water.
6. The plaque/molded brick should be placed to dry in a position and at an angle which allows water.

Fig 4.31: Reference Picture of Conservation project

4.4.9 DAMP PROOFING WORKS:

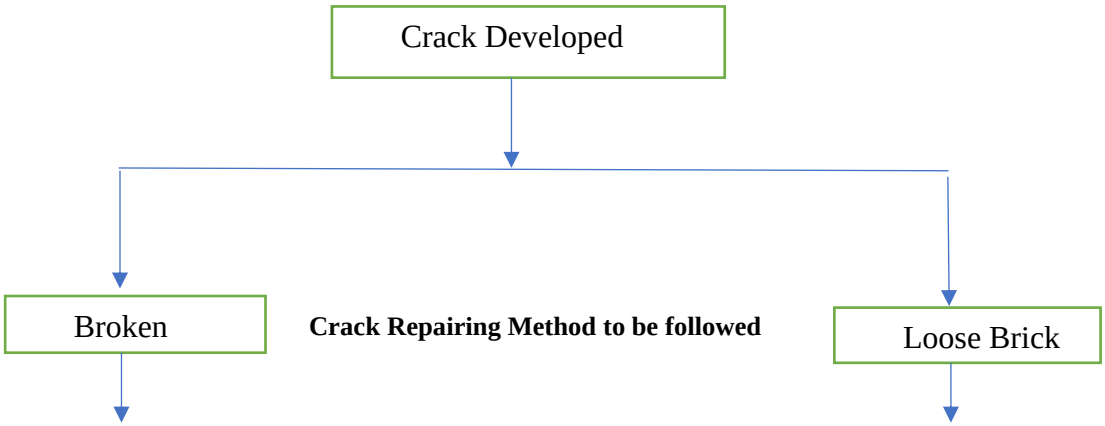
01. Tamarind solution (1 kg tamarind with 10 ltr water for 150sft surface)
02. D-Salt, SBR & Foam-Lub

Fig 4.32: Damp Proofing Works

CHEMICAL SOLUTION:

- A colorless, breathable, water-repellent treatment for brick.
- Carefully selected silanes and siloxanes which line the pores of the masonry to form a water-repellent silicone matrix.
- Resistant to UV light and other forms of degradation, resulting in a life expectancy of 20-30 years.

4.4.10 REPAIRING THE CRACKS



01: Replacing broken with same size brick

02: Strengthening the broken part with Metal Bracing (Blacksmith's Workshop)

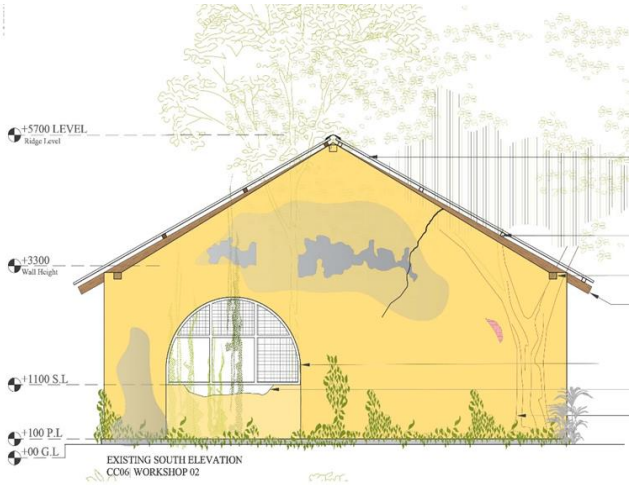
03: Stitching of the same brick with new mortar.

04: Dismantling the loose part after strengthening lower part with scaffolding, then stitching of the same brick with new mortar.

Strengthening the broken part with metal bracing

Replacing broken Brick with same size brick

Fig 4.33: Repairing the Cracks



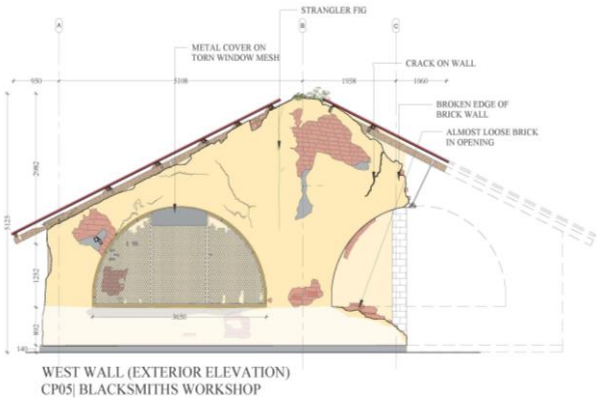


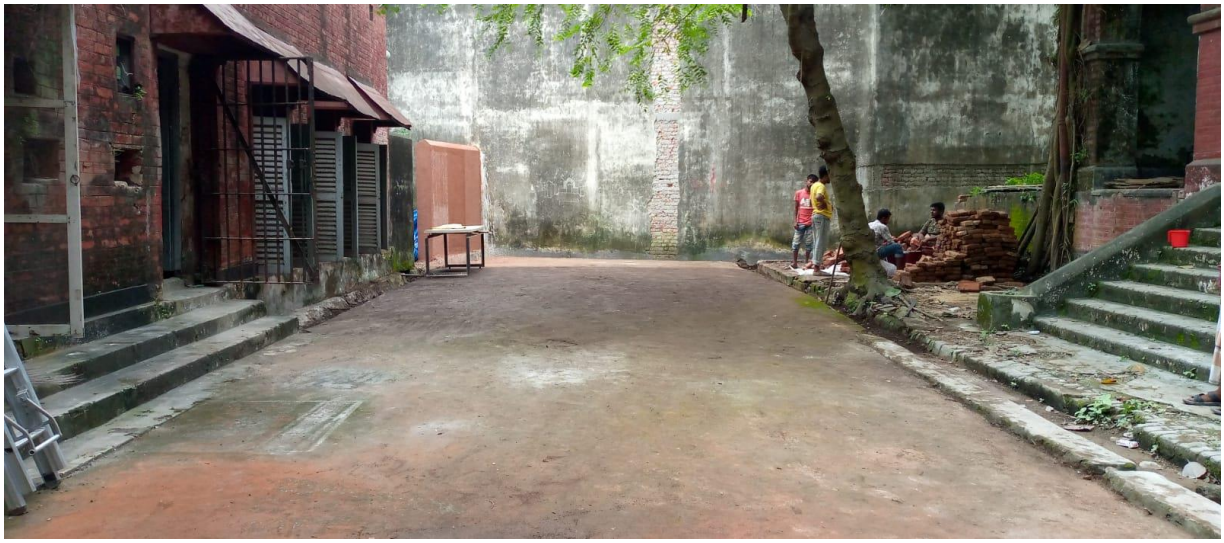
Fig 4.34: Repairing the cracks with field condition and repair system.

4.4.11 FLOOR SYSTEM AND SKIRTING

This should be as usual floor we use in buildings.

4.4.12 RECLAIMED BRICK WORKS

1.New Wall Site Preparation



2.New Wall use of Reclaimed Bricks

Fig 4.35: Reclaimed Brick Works

4.4.13 PREPARATION OF LIME SURKI MORTAR

Mortar Materials

1. Lime shall not contain more than 5 percent of foreign impurities; it shall dissolve in soft water when this is added in sufficient quantity. Stone lime may be used. Lime shall first be staked for 48 hours then strained through a sieve of 64 meshes to the square Inch.
2. Surki shall be made only from well burnt but not vitrified brickbats of class one or two. Surki made from under-burnt bricks shall not be used and shall be perfectly, free from admixture of dust, sand or any other particles and shall be ground to fineness.
3. Sand shall have fineness modulus 1.6 plus/minus 0.10. It shall be free from salts Injurious organic and inorganic impurities.
4. Water shall be clean and free from oils, acids, alkalis or other injurious materials.

For wall thickness 250mm – 500mm, Lime: Brick dust = 1: 2 Slaked Lime(Source: Sylhet Lime)

For core area (not external wall), Lime: Brick dust = 1 : 3

Binder: Brown Sugar Molasses (Chitagur)

For 1 cft (12-15 kg) of Lime, 1 tbsp (12/15 gm) of Brown Sugar is enough to ensure desired bonding.

Fig 4.36: Preparation of Lime Surki Mortar

4.4.14 RE-POINTING

STEP 1: Removal of the mortar needs to be done carefully, and at no time should the tool remove any of the masonry unit. Special care needs to be taken for short vertical joints or very thin joints to avoid damage to the masonry. The joint needs to have mortar removed to a depth of 3/8" minimum, or three times the width of the joint, whichever is greater.

STEP 2: The cut-out joint must be squared off and cleaned out; not be left with a V or U configuration; and have no dust or unsound mortar present. Rinse out the joints to remove dust.

STEP 3: Sand, cement, and water needs to be mixed to a consistency of peanut butter. Quantities need to be carefully measured to ensure consistent appearance. Ideally, it should be mixed in a mechanical mixer for best workability.

STEP 4: nce the joint is moist, without standing water, the mortar needs compacting in ¼" layers, or "lifts," into the joint. Then the mortar is kept within the joint and avoid any smears or droppings on the masonry units. Once the mortar is "thumbprint hard," tool the joint to match the existing profile.

STEP 5: Control the mortar shrinkage. When repointing historic buildings, it is critical to control the mortar shrinkage. Part of the solution is to ensure the aggregates are well gradated, with the largest granules no larger than 30 percent of the mortar joint.

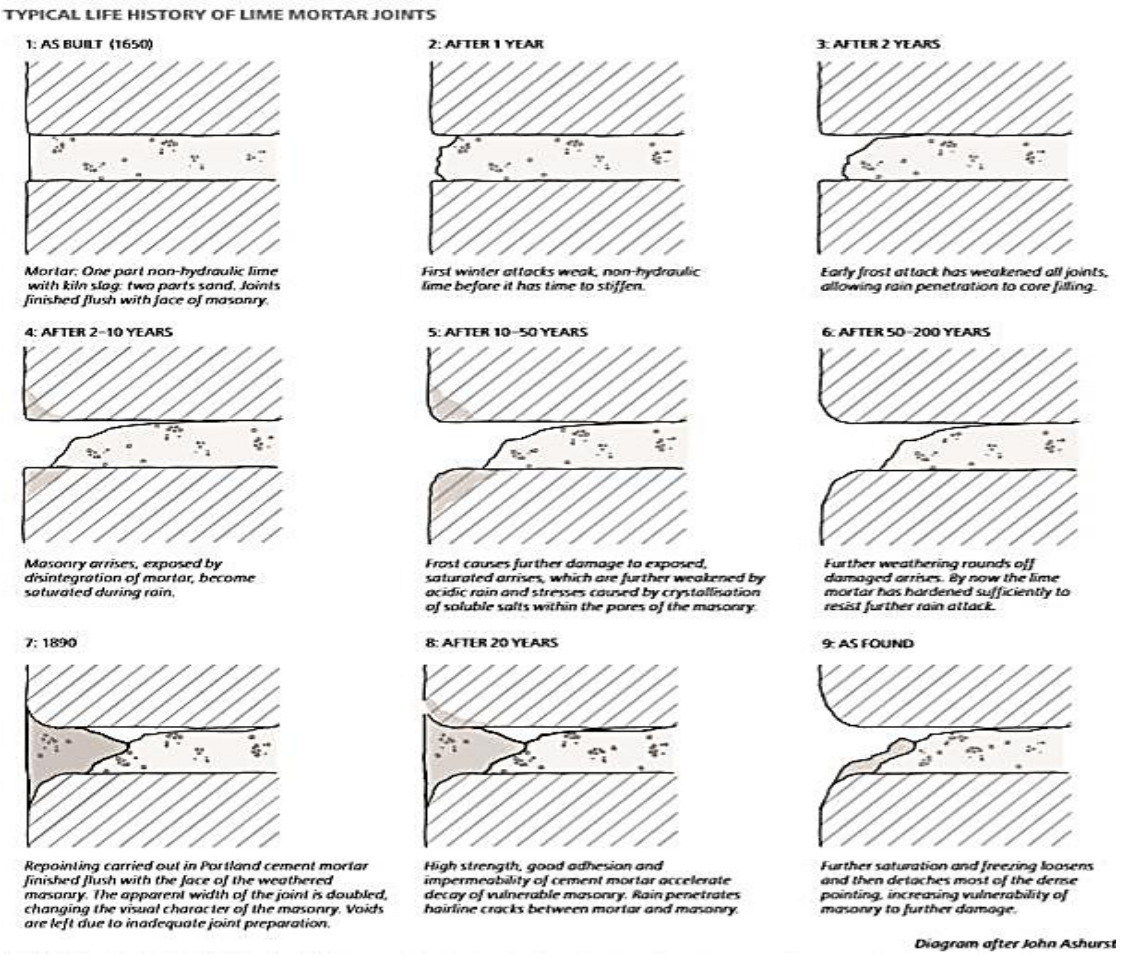


Fig 4.37: Re-pointing

Fig 4.38: Repointing Tools

Fig 4.39: Process of Rope Pointing

Fig 4.40: Process of Recessed Pointing (Maintaining the Old Brick Wall)

4.4.15 LIME PLASTER

1. Spreading water to clean the surface and chemical to prevent bio-deterioration. Using lime water over the wet surface as the binder for lime plaster. Then mortar has been placed in small portions.
2. Spread the mortar through the wall with wooden derby. After spreading the mortar, the wall has been kept to dry for 6 hours.
3. Using hammer to compact the surface and to remove the air bubble among the surface. Finishing with clean like lime mortar, using steel trowel for smooth surface finish.

Material and Its Mixing

For wall thickness 250mm – 500mm, Lime: Brick dust = 1: 2 Slaked Lime (Source: Sylhet Lime)
For core area (not external wall), Lime: Brick dust = 1: 3
Binder: Brown Sugar Molasses (Chitagur)
For 1 cft (12-15 kg) of Lime, 1 tbsp (12/15 gm) of Brown Sugar is enough to ensure desired bonding.

(a) 1-3: Mixing of dry Lime + Brick Dust, where ratio is, Lime: Brick Dust = 1: 2

(b) 4-6: Water was then added gradually and mixed using a shovel. The water was free from clay and other impurities. All the mixing has been done manually.

(c) 7-9: For small construction, hand mixing has been used. Mixture has been kept in shade for further use.

Fig 4.41: Material and Its Mixing

Lime Surki Plaster_Process

1. Spreading water to clean the surface and chemical to prevent bio-deterioration.
2. Using lime water over the wet surface as the binder for lime plaster.
3. Then mortar has been placed in small portions.


4. Spread the mortar through the wall with wooden darby . After spreading the mortar, the wall has been kept to dry for 6 hours.
5. Using hammer to compact the surface and to remove the air bubble among the surface.


6. Using hammer to compact the surface and to remove the air bubble among the surface.


7. Using hammer to compact the surface and to remove the air bubble among the surface.

8. Finishing with clean like lime mortar, using steel trowel for smooth surface finish.

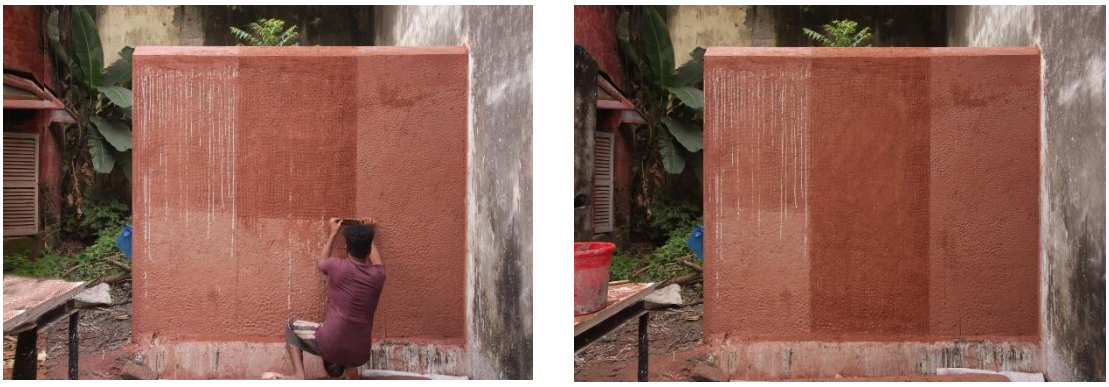


Fig 4.42: Lime Surki Plaster Process

Lime Sand Plaster Preparation

Fig 4.43: Lime Sand Plaster Preparation

Process

1. Spreading water and Chemical for prevention against bio deterioration .
2. enhance the quantity of moisture by using lime water
3. Lime sand mortar placed on the wall in small portion
4. Spread over the wall for uniform distribution by wooden Darby .
5. Finished with lime wash .

Fig 4.44: Lime Mortar Process

4.4.16 LIME WASH

1. Materials

1. Lime putty made of slacked lime.
2. Binder (as instructed by the consultant such natural glue, egg white, Portland cement, salt, soap, milk, flour and soil.)
3. Robin Blue (only if instructed by the consultant)
4. Color pigments (only if instructed by the consultant).
5. Water The surface to receive chalk wash shall be thoroughly cleaned down with clean water and free form all foreign matters. Defects shall be repaired accordingly. It shall be rubbed with sandpaper

2. ADDITIVES

Additives traditionally used include **natural glue, egg white, Portland cement, salt, soap, milk, flour and soil**. Whitewash is sometimes **colored with earths** to achieve colors spanning the range of broken white, cream, yellow, and a range of browns. **Salt is often added to prevent mold**.

3. MIXING

3.1. Lime putty to be diluted in water

3.2. It shall be mixed and stirred until attains the consistency of thin cream.

3.3. When sufficiently mixed, it shall be strained into a separate container through coarse cloth.

3.4. Binder shall be added to the proportions instructed by the consultant and dissolved in the stained wash.

3.5. A small quantity of formalin to be added to the mix, to prevent the growth of algae on the lime wash.

3.6. Color pigments or Robin blue dissolved in water shall then be added according to consultant's instructions. It shall be stirred sufficiently to ensure uniform mixing. It will then be ready for used.

4. SURFACE PREPARATION

4.1. The surface to receive chalk wash shall be thoroughly cleaned down with clean water and free form all foreign matters. Defects shall be repaired accordingly. It shall be rubbed with sandpaper.

5. APPLICATION

5.1. Lime wash shall be laid on surfaces in two coats over a priming coat. It shall be laid vertically and horizontally alternately. The final coat shall be applied vertically.

5.2. Each coat shall be perfectly dry before the succeeding one is laid over it.

5.3. In case of colored lime wash, priming coat shall be white

Fig 4.45: Lime Washing Work

4.4.17 LIME CONCRETE

Brick Aggregates (khoa): Brick Dust (surki): Lime 7:2:2, Brick Aggregates (khoa) size 20 mm downgraded 1st class brick, Brick Dust (surki) good quality second class brick for Foundation Bases, Load bearing walls, Pavements, flooring etc.

Fig 4.46: Lime Concrete Mixing

4.4.18 LIME TERRACING

Lime Terracing Average 100 mm thick Finished lime terracing with 20 mm downgraded good quality second class brick chips (khoa) Surki from good quality second class bricks and minimum lime content 500 kg per 2.83 cubic meter Stone lime brought at site, not being powdered in open air and to be slaked in presence of Engineer-in-charge and to be measured in volume three days after slaking for using in the mix) in the pro- portion 7:2:2 (brick chips: surki: lime)

Including preparation of the mix on the ground by melding a suitable platform under proper polythene cover, cutting the mix twice dally with limewater (1:10) at least for 7 days until the mix attain Desirable consistency Laying the mix in proper slope, beating the same with standard koppa' (weighing more than 2kg) for minimum not 7 days to gain maximum consolidation, making ghoondy and neat finishing with Time Surki mortar (1:2) and curing for 21 days providing polythene cover after each day work and cleaning etc. complete in all respect accepted by the concern authority.

Fig 4.47: Lime Terracing

4.4.19 ROOF CONSTRUCTION AND PRESERVATION WORKS.

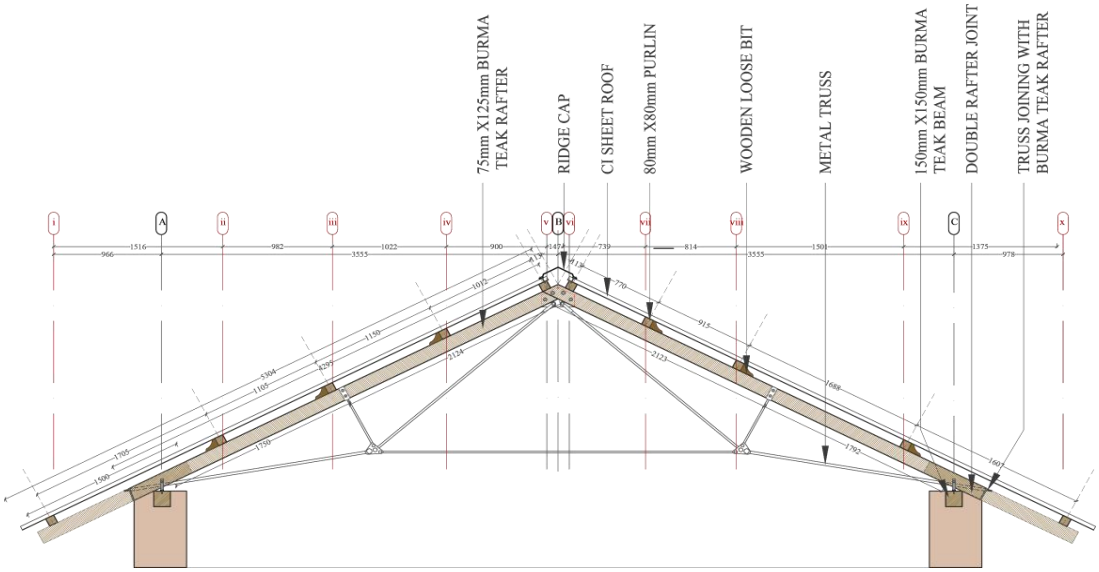


Fig 4.48: Drawing of Rafter- purlin Joint Detail of CC-05

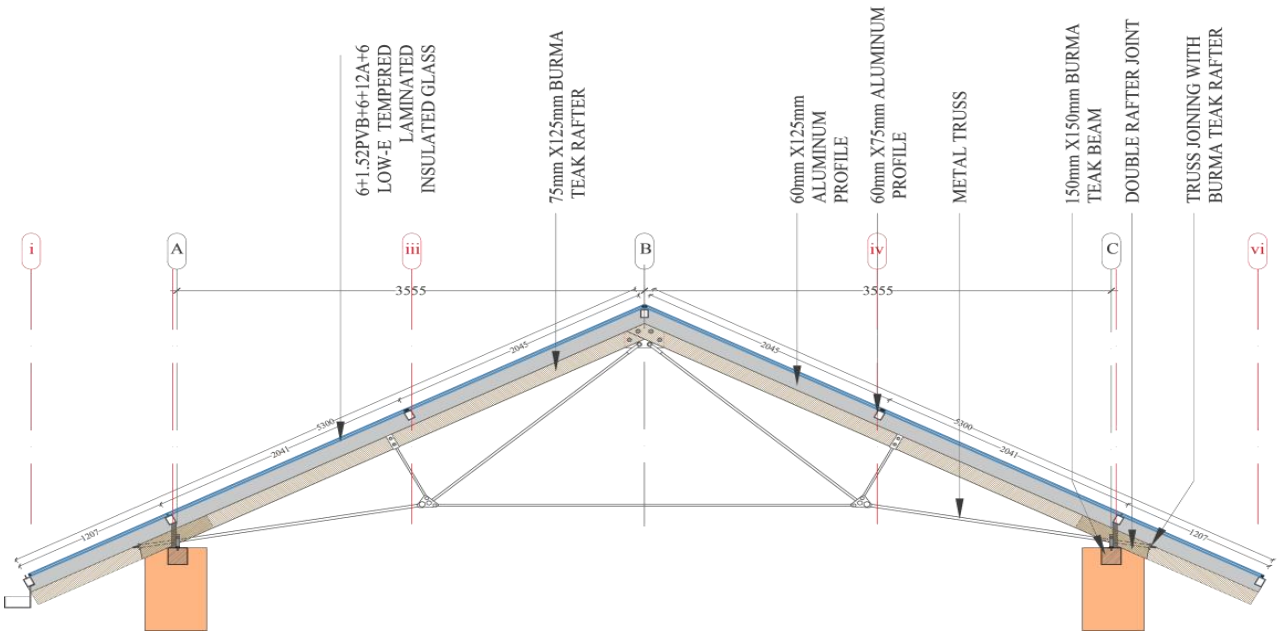


Fig 4.49: Drawing of Aluminum Profile Joint Detail of CC-05

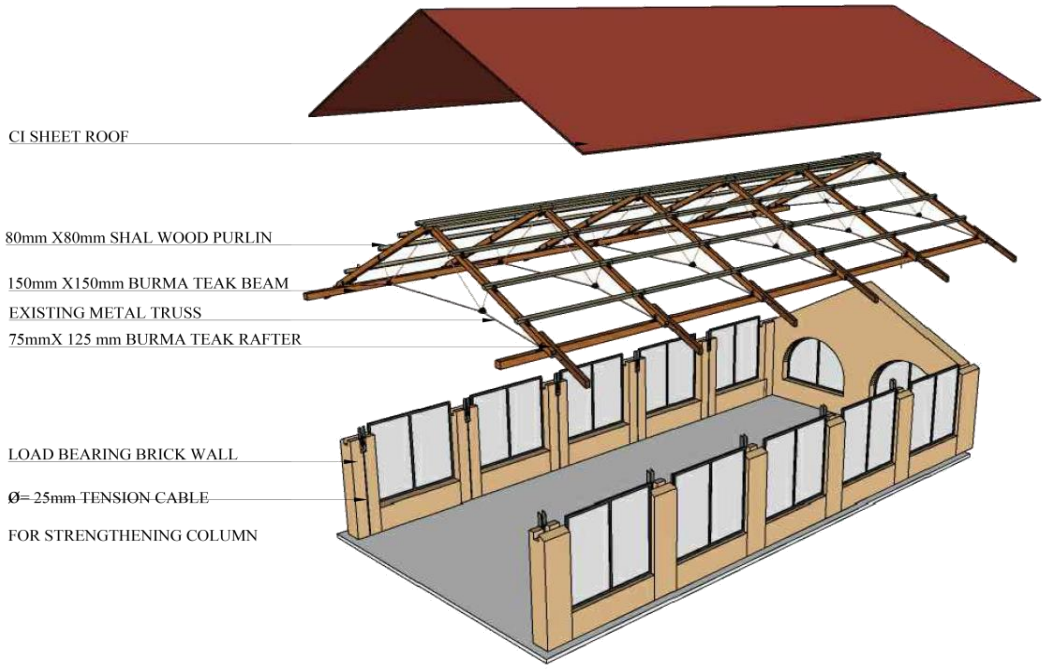


Fig 4.50: Exploded Axonometric View of Roof Detail for CC-05

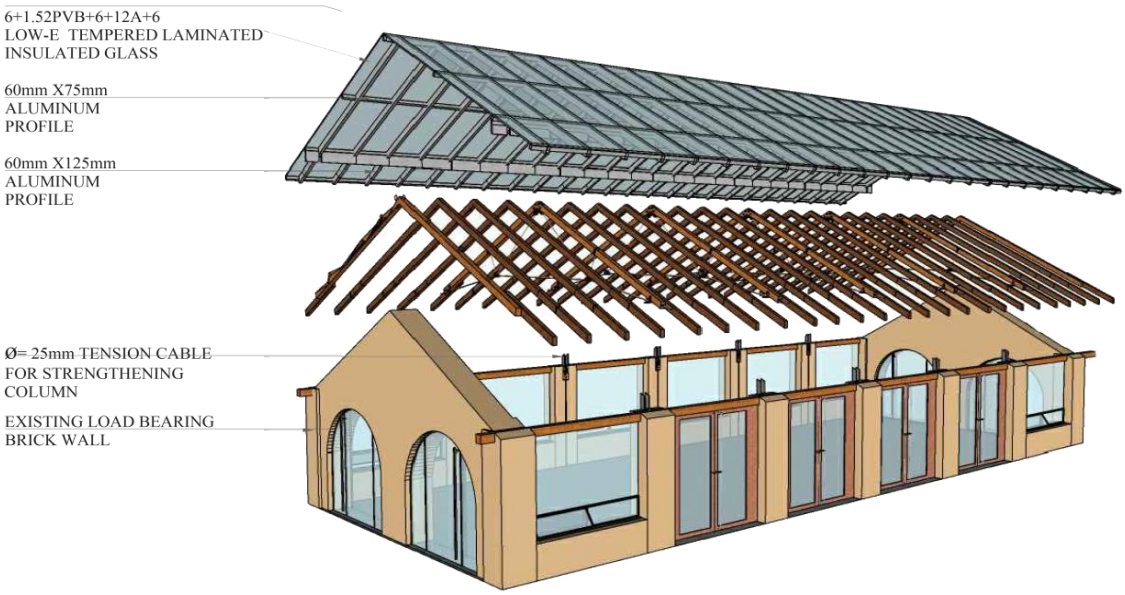


Fig 4.51: Exploded Axonometric View of Roof Detail for CC-05

4.4.20 REPAIR AND RECONSTRUCTION OF CEILINGS.

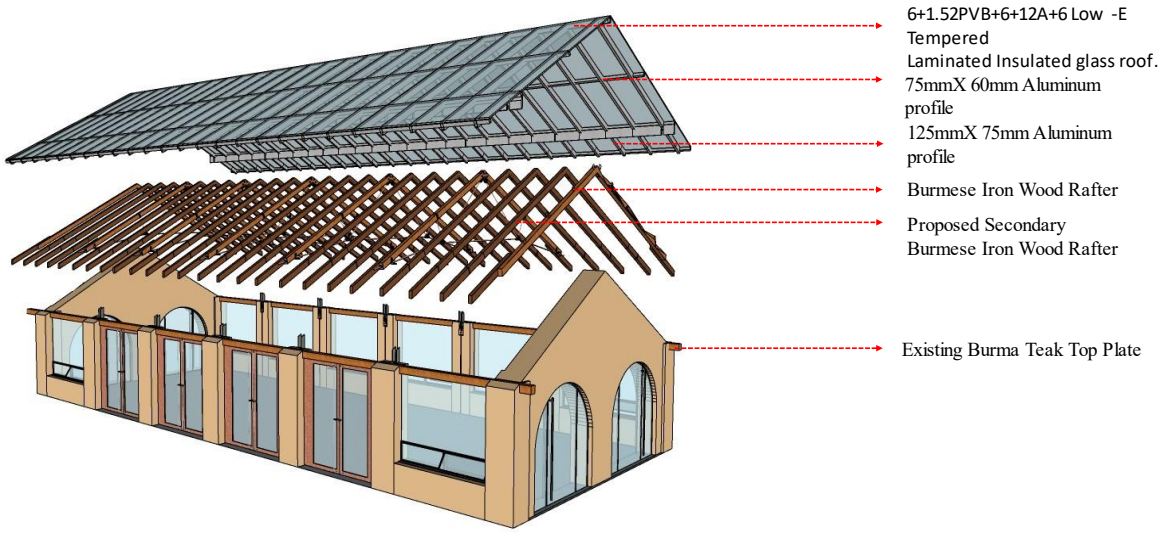


Fig: Workshop CC 05 , CC 06, CC 07

Fig 4.52: Repair and Reconstruction of Ceilings

4.4.21 RECONSTRUCTION OF DOORS AND WINDOWS.

- Preservation
- Reconstruction_ Doors and windows will be reconstructed as the number of openings has been increased in a greater extent.
- New Intervention_ CC-06 windows from middle part will be replaced with glass doors.

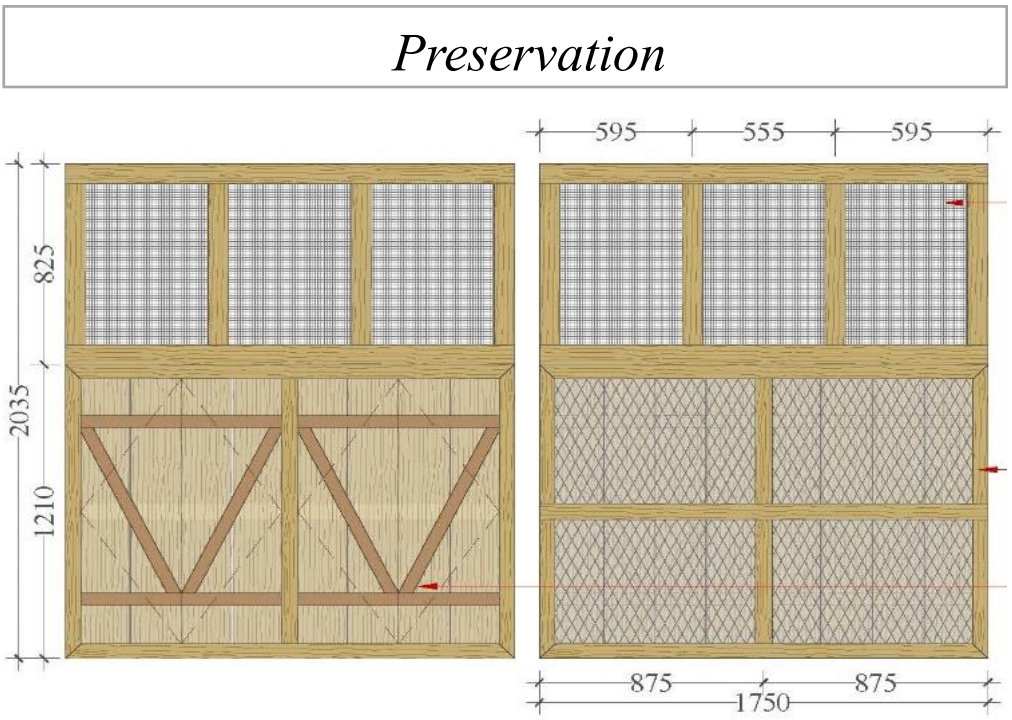


Fig 4.53: Drawing of Existing Window Condition_CC06

Reconstruction

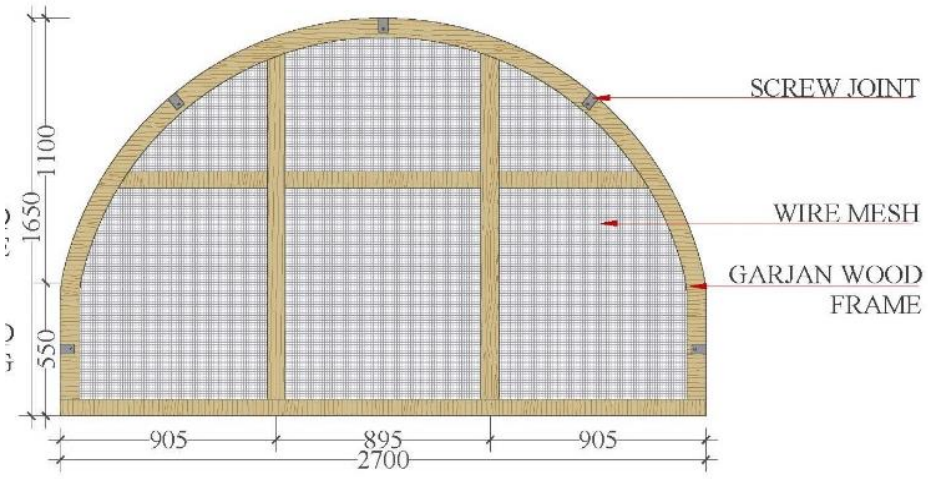


Fig 4.54: Existing Window Condition of CP-05

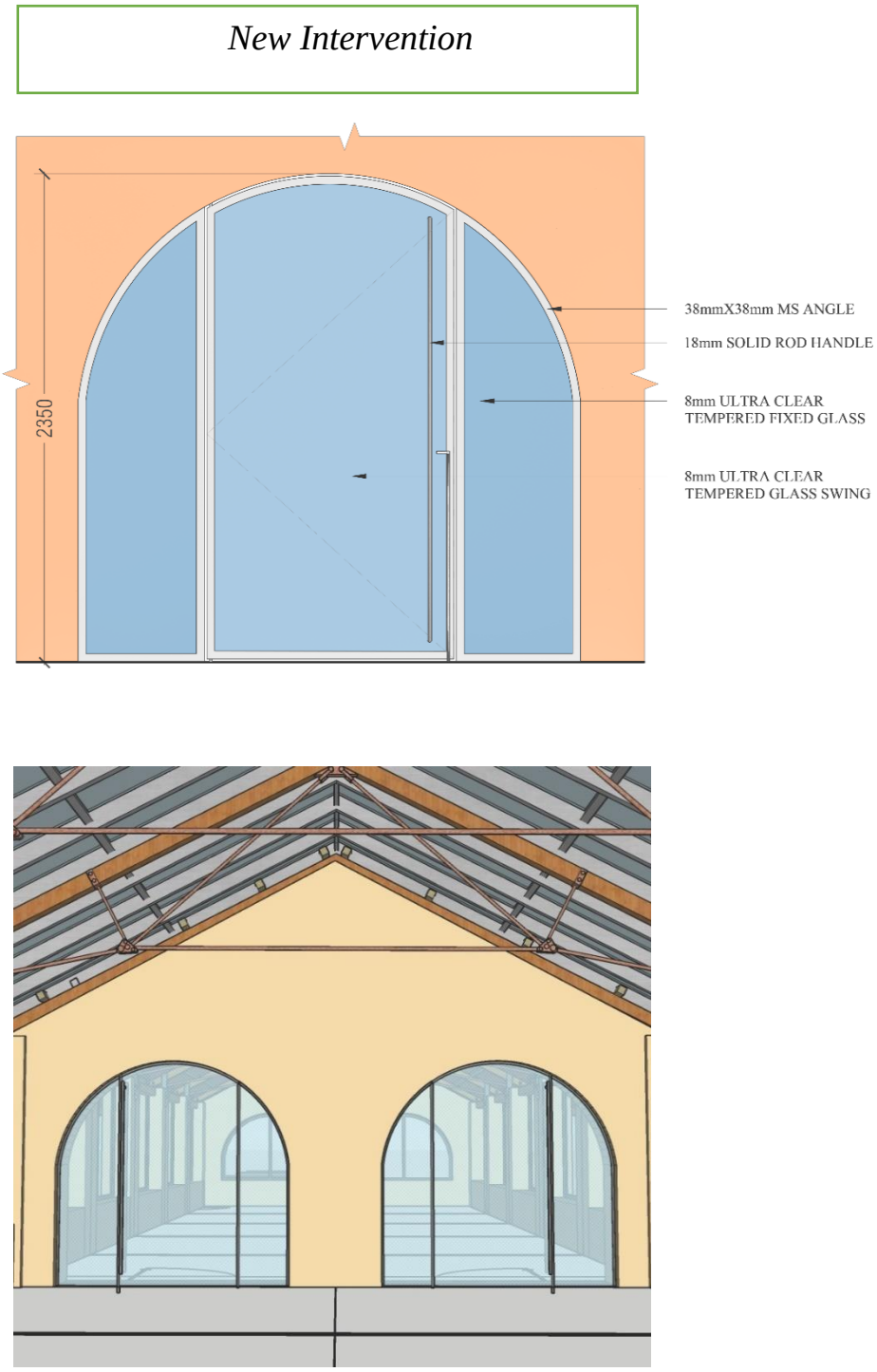


Fig 4.55: Proposed Window Condition of CC-05

4.5 DISCUSSION

Restoration

Restoration is vital to our future. However, there are multiple challenges associated with it. Job site variations, non-standard design, lack of experience, and lengthy construction schedule are to name a few.

In case you are planning to undertake building restoration, here are a few tips to ensure that you are well on your way to protect your community's historical, cultural, and architectural heritage.

- Carry out an environmental site assessment to ascertain hazardous materials used in the structure
- Create a financial plan and secure funding sources
- Make sure that the building can support modern amenities
- Maintain the building's character
- While incorporating new elements, try and retain the original as much as possible
- Pay heed to building codes and regulations
- Obtain prior approval for changes in the exteriors
- Go through the guidelines for repair, restoration, and seismic strengthening of buildings

Seek expert guidance, wherever required.

Renovation

Historic buildings do age, exposing the need for repairs or renovations. When a building has gone unused, has weather damage, or fallen into disrepair, these common problems make renovations more challenging. Here are just a few repair items we face with older commercial buildings:

- **Leaks:** Leaks are a typical issue that requires rapid intervention to avoid further damage, especially if the leak is coming from the ceiling or roof. Roofs need frequent inspections to make minor leaks part of regular maintenance instead of an emergency repair. If consistent issues are present, it may be time to get a roof sealed or even replaced.
- **Costs:** Older buildings can also come with high costs for maintenance, outdated systems, and insufficient energy usage.
- **Cracks:** Cracking may seem like a small problem, but it can indicate a significant underlying issue with a sense of urgency to address. Cracks in the foundation may even be a warning sign of structural concerns. At HR Construction, we can examine any cracks, patch them, and ensure the building is structurally sound.
- **Security problems:** Older buildings can be more at risk for breaches. To prevent or address security issues, we can implement measures like installing high-quality locks and camera systems.

- **Electrical faults:** Electrical malfunctions, frequent power outages, and dead outlets can be hallmarks of extensive electrical damage. Addressing electrical faults as quickly as possible is essential to prevent further inconveniences. While changing the lightbulbs may resolve some of the issues, other problems might require a complete electrical overhaul.
- **Poor ventilation:** Another common problem with older commercial buildings is poor ventilation. This issue can be challenging to correct, but HR Construction has the tools and experience to add materials that can improve airflow in your commercial property.
- **Excess moisture:** Excess moisture can come from leaks, water damage, humidity, and even improper temperature control. Keeping damage from excess moisture under control is essential to avoid impacting the structure.

  We find out the problem and try get recovered from it. All work is supervised by our teacher and we done the wok successfully.

Reconstruction

When a building has gone unused, has weather damage, or fallen into disrepair, these common problems make renovations more challenging.

As the maximum building were more than 100 years older, so when we observed those buildings, we find some problem and we try to recover it. As the work were challenging, we done the work successfully under supervised by our teacher.

CHAPTER 5
CONCLUSION

5.1 Conclusions:

These standards of ethics have been rigorously observed in this conservation work-

(1) The existing condition of the building have been recorded and documented before any intervention.

(2) Historic evidences have been preserved with proper care without any falsification, all the additive members are distinguishable from the original fabric.

(3) All kind of interventions have been governed for structural stability and longevity and the requirements of adoptive uses.

(4) All methods and materials used during treatment must be fully documented.

5.2 Limitation and Recommendations for Future Works:

Limitation:

This is a short scale research work due to limitation of time and resources. Large scale of research is needed with changing various parameters for having more accurate conservation method. More research works about conservation can be established more easier process.

Recommendations:

- Large scale research work can be changing oldest conservation system.
- When many works done by various process then it should be complete low cost.
- If more research work done in future, it should be easy to establish fixed process for conservation system and it helps to increase building strength.

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