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Case Study for Repair Methodology of Old Industrial Structure Made of Brick Masonry

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Abstract

Repair of old brick masonry structure is a big challenge for civil engineesr. Absence of original drawing, non availability of compatible matrials makes it very difficult to repair this type of structures. In west Bengal lots of old industrial structures are still are in use, but their health condition is nery poor in nature. One of the old industrial structure of Cheviot Jute Mill, Budge Budge situated near Kolkata is badly damaged and the structure was repaired sucessfully. Repair methodology is found to be very effectiveto extend service life of the structure.

I. INTRODUCTION

In Indian sub-continent lots of British Era structure is still in use. Due to long age (some structures are more than 100 years old) and very hot and humid weather loading, those structures are in very poor condition. Most of structures along gangetic West Bengal are constructed with brick masonry. Roof are constructed with either steel truss with metallic sheet or made with jack arch type.

Cheviot Jute Mill situated at Budge Budge, an industrial city on the left bank of river Ganga at downstream of Kolkata City. Almost all the structure of Cheviot Jute Mill was constructed during British Era and their age is more the 75 years old.

All structures are constructed with brick masonry. Joining mortars are consists of lime and surki (crushed brick). Roofs are constructed with either jack arch or steel truss roof.

Structures are well maintained. Moderate level of distress is noticed. Some structures have shown some distress.

II. CHALLENGES FOR MAINTENANCE AND REPAIR OF OLD STRUCTURES

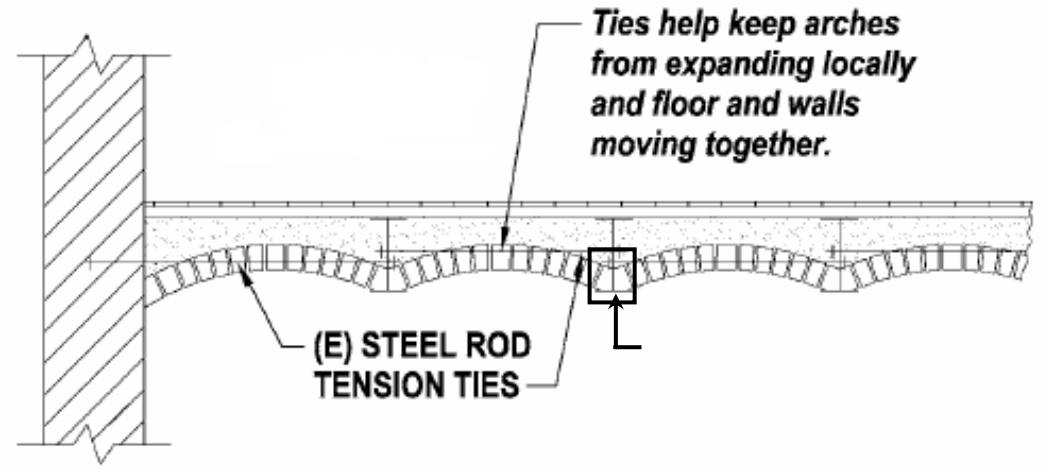
Maintenance and repairs of those old masonry structures is very challenging for following reasons.

- Joining mortars of clay brick masonry made with lime and surki (crushed brick). Availability of lime and surki is very troublesome, which make repair works very challenging in present day.
- Corrosion of steel members are very common problem. Some time loss of considerable amount of steel section is noticed in steel structure due to corrosion is noticed. Strengthening of old steel section is a challenging technique as mineralogical composition of old steel is different with respect to present quality, so it becomes very difficult to strengthen old steel structural member with present structural steel.
- Most challenging part of repair of old brick masonry structure is to seal or repair of cracked zone. As old masonry structure is made with very low strength mortar, sealing of cracks is to be done with very sensible way.

Generally pressure scouting is not a very good solution for sealing of cracks / voids as they may damage. The existing structure sealing / repainting of cracks / distress in brick masonry is to be done with stainless steel bar sometime found to be a good solution.

III. DESCRIPTION OF TURNING SHED

This Turning Shop is a very old structure. External wall is constructed with brick masonry wall. Roof is constructed with jack arch and steel joist. Some part of roof is constructed with slab (Jack Arch) made of lime concrete supported over steel joist. Some part of roof is constructed with metal steel roof. Main steel joist is supporting the both type roof structure. Lime concrete slab portion is typical jack arch type construction. End of jack arch is supported over steel joist. From visual observation, dislocation of brick works at steel joist support area was noticed. Delamination of cover/ chunk at soffit level of Jack arch was also noticed. It was also reported during visit that some chunk of lime concrete delaminated and fell on the working place.



SKETCH I: SKETCH SHOWING CROSS SECTIONAL VIEW OF JACK ARCH

IV. TYPE OF DISTRESS AND MAPPING

Based on the investigations carried out at Turning Shed structures of the plant, the following can be proposed.

- It may also be concluded by the nature of crack near support area, these cracks are generated due to corrosion of steel joist.
- Corrosion of steel joist near Jack arch support is noticed. Supporting area of steel joist is encapsulated by brick structure of jack arch, so it is wise not to disturb that support area. Disturbance of support area of steel joist is not advisable as that may disturbed overall stability of jack arch.
- Repair work is to be done externally without disturbing stability of Jack arch.
- Jack arch portion of roof is distressed in many places. Due to long service life, geometric deformation of roof arch is noticed. Loss of mortar from bottom surface of the arch is also noticed.

V. PROPOSED REPAIR METHODOLOGY

Following methodology may be adopted to restore the structure.

- Exposed steel joist has shown moderate level of corrosion. Those exposed steel members are to be painted with anti-corrosive coating system after removal of corrosion.
- Some horizontal cracks are noticed on the supporting brick masonry wall. Those cracks are to be sealed with cementitious grout and PMM (single part).
- As some chunks of lime mortar / plaster is falling into the workspace area. To arrest this unsafe phenomenon following repair methodology may be adopted
- Strengthening scheme of Jack Arch portion
- To counter permanent geometric deformation of arch following strengthening technique is adopted.
- At first loose mortar is eliminated by gentle manual chipping. Sound dust free substrate is exposed manually.
- Re pointing of mortar line is done with Polymer Modified Mortar.
- After pointing of mortar area plastering of soffit level of Jack arch to achieve smooth surface and to ensure a proper geometry of arch.
- Steel angle (ISA 50 506) is to be bent to match profile of soffit level of Jack arch as per Sketch-II.
- Steel angle is supported and welded with bottom level steel joist so that steel angle should touch bottom portion of jack arch. This strengthening technique will not allow Jack arch to further deform in downward direction.

PLATE 1 : VIEW OF JACK ARCH MADE WITH BRICK MASONRY AT TURNING SHED. STEEL SECTION IS TO BE WELDED AS PER SKETCH.

PLATE 2 : VIEW OF CORRODED STEEL JOIST.

PLATE 3 : MODERATE CORROSION AT STEEL JOIST.

PLATE 4 : DE-LAMINATION OF CHUNK.

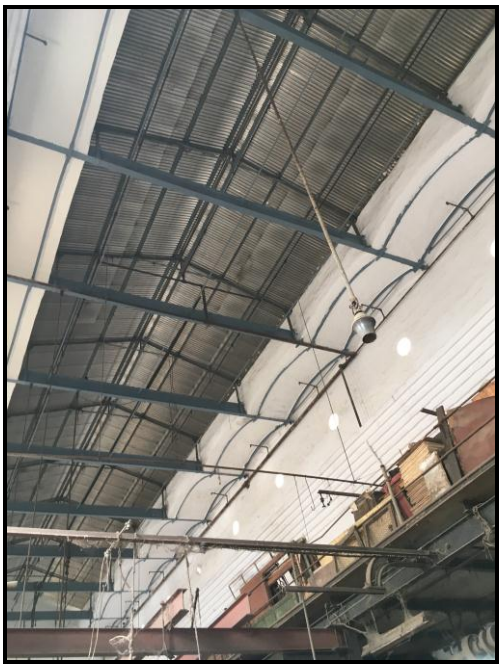
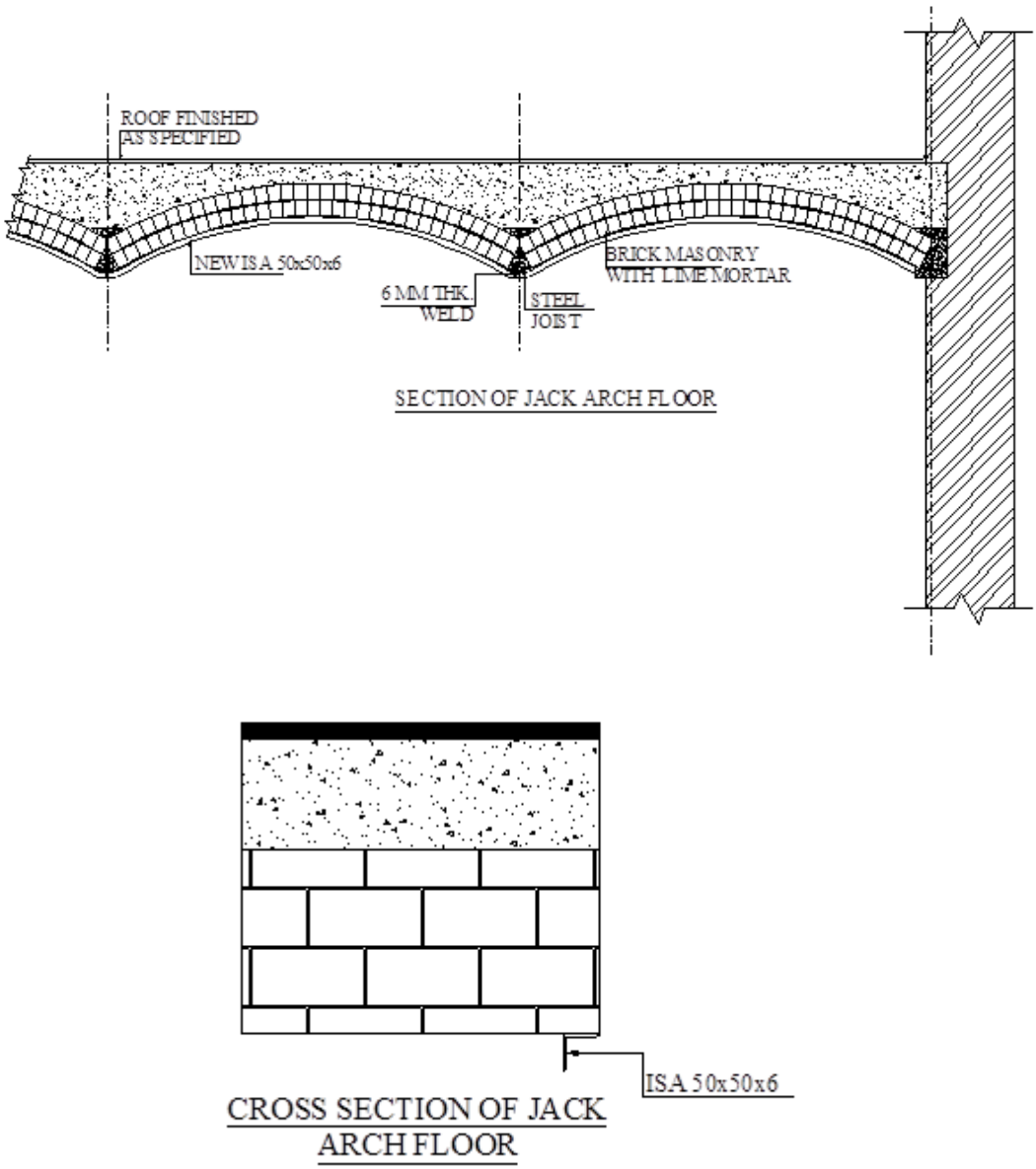


PLATE 5 : PHOTOGRAPH SHOWING CONDITION OF ROOF STRUCTURE AFTER REPAIR.

PLATE 6 : PHOTOGRAPH SHOWING STRENGTHENING OF JACK ARCH AT SOFFIT LEVEL BY ISA 50X50X6



SKETCH II: SKETCH SHOWING CROSS SECTIONAL VIEW OF JACK ARCH STRENGTHENING SCHEME WITH ISA 50X50X6

VI. CONCLUSION

After execution of repair works, site has been inspected thoroughly to investigate performance of the structure after repair. All corroded surface of steel joist have been painted with anti corrosive paint and Jack arch portion is strengthened with steel frame form bottom. No further cracks and seepage marks are noticed at the soffit level of Jack arch. Overall performance of the structure after repair found to be satisfactory.

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