AN EXPERIMENTAL STUDY OF STRUCTURAL PARAMETERS IN BRICK MASONRY BLOCK USING FIBER REINFORCED POLYMER

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ABSTRACT

The Brick Masonry structures are more susceptible to earthquakes and their unstable assessment remains a challenge. This study shows improvement in compressive strength and displacement in brick masonry under unstable loading, and to work out their safety. The focus in this research is to find out strength of the brick masonry blocks using fiber reinforced polymer (FRP) materials throughout unstable impact and without using FRP. The masonry blocks plastered with fiber reinforced polymer (FRP), tested above the load carrying capability & stability, throughout unstable impact in comparison to the unreinforced brick masonry block. Thus the load carrying capability is considerably improved in the FRP plastered brick masonry. A comparison is also done between English Bond & Rat trap bond type of brick masonry.

1. INTRODUCTION

Test may be used for the laboratory analysis to research the various factors touching bond strength & additionally for derivation style values for the masonry standards. Unreinforced masonry structures are the foremost vulnerable throughout an earthquake. Unremarkably they’re designed for vertical masses and since masonry has adequate compressive strength, the structures behave well as long because the masses are vertical. Once such a Masonry structure is subjected to lateral mechanical phenomenon masses throughout an earthquake, that develops shear and flexural stresses. The strength of masonry below these conditions typically depends on the bond between brick and mortar. In this research English bond and Rat trap bond are taken in to consideration. Cement Mortar which is used in the ratio of 1:3. A masonry wall can even bear in plane shear stresses if the mechanical performance forces are within the plane of the wall. Shear failure within the variety of diagonal cracks is discovered, However, harmful collapses occur once the wall experiences out of plane flexure. Fiber reinforced polymer is a composite material made of a polymer matrix reinforced with fiber. A polymer is manufactured by poly-condensation, polymerization or poly-addition. The FRPs advantage also includes negligible specific weight, corrosion immunity, and high lastingness.

1.1 BENEFITS (ADVANTAGES)

- The Fibre Masonry walls provide additional protection against impact of projectiles, like rubble from strong winds like tornadoes or hurricanes.
- The Fibre Masonry structures have inbuilt compressive strength & it improves with lime-mortar will have structure life of over five hundred years as compared to thirty to one hundred for steel structures or Ferro-concrete.
- The Strength to weight ratio of fibre masonry structure is more than conventional masonry structure.

1.2 DISADVANTAGES

- The fibre masonry wall surface degrades in extreme weather conditions.
- The fibre masonry structure are bit expensive due to higher price of fibers.
- The Fibre Masonry is not capable of taking heavy loads if used in foundation but they only resist the cracking.

2. GENERAL MODES OF FAILURE IN UNREINFORCED MASONRY BUILDING

Recent earth quakes have greatly contributed in raising the notice of unstable hazard attributed to unreinforced masonry buildings. Varieties of the common failure modes are of un-reinforced masonry building are discovered and these are often classified below the subsequent.
Unreinforced masonry buildings are most liable to flexural out of plane failure. Out of Plane failure affects the gravity load carrying capability of the unreinforced masonry wall [5]. Parapet situated at the highest of the building act as cantilever parts that are subjected to the best amplification of the bottom motion, and consequently at risk of flexural failure.

2.5 COMBINED IN PLANE AND OUT OF PLANE IMPACT

Earthquake forces are bi-face in nature, and therefore every unreinforced masonry component is affected in each in plane and out of plane direction. As in plane shear cracking happens, some triangular cantilever wedges are made, whose out of plane strength is considerably weaker than that of original un-cracked panel [9]. These are vulnerable to out of set up failure. Pounding against adjacent structure can even have an effect on this combined failure mode.

2.6 DIAPHRAGM CONNECTED FAILURE

Flexible floor diaphragms behave as deep beams spanning between unreinforced masonry walls, the in plane rotation of the diaphragm’s finish will induce harm at the wall’s corner. In long slender building thanks to bending within the long direction the in plane shear forces cannot be transmitted over the little length of wall the diaphragm can instead notice its support by pushing on the unreinforced masonry walls within the crosswise direction.

2.7 BEHAVIOUR OR MASONRY WALL BELOW SEISMIC LOADING

The un-reinforced masonry building is brittle in nature and has lower resistance to earthquake shaking. The makes the unreinforced masonry building additional vulnerable throughout earthquake. Most of the human fatalities occurred throughout earthquake established this. Once the bottom motion is imparted to the building, the wall that’s parallel to the bottom motion is termed shear wall and wall that’s perpendicular to the bottom motion is termed cross wall. The Shear wall subjected to each in plane shear stresses and in plane bending stresses. In plane shear stresses cause typical X-type of cracking close to the gap in shear wall and additionally slippy failure in shear wall. In plane bending stresses within the wall cause crushing of toe and separation of cross wall from shear wall at junction. Stress concentration takes place close to the gap that's why shear wall with openings is additional vulnerable throughout earthquake. Throughout earthquake cross wall behaves sort of a plate i.e. bending on the length and on the peak of the wall. Failure of cross wall ends up in harmful failure of building. The Ground vibration throughout earthquake cause an inertia forces at the locations of mass within the building. These forces travel through roof and walls to the inspiration. The most stress is on making certain that these forces reach the bottom while not inflicting major harm or collapse to the structure. Of three elements of masonry building (foundation wall and roof), walls are most liable to harm caused by the horizontal forces thanks to earthquake. Wall topples down simply, if pushed the horizontally at the highest in an exceedingly direction perpendicular to
its plane. The bottom shakes at the same time within the vertical and two horizontal directions throughout earthquake. Horizontal vibrations are the foremost damaging to traditional masonry building. All the walls aren’t tied along sort of a box, wall loaded in their weak direction tend to topple. To make sure sensible unstable performance, all walls should be joined properly to adjacent walls. During this method, walls loaded in weak direction will benefit of the great lateral resistance which offered by the walls loaded in sturdy direction [11]. Further, walls additionally ought to be tied at roof level, header level, sill level and footstall level to preserve their overall integrity. Brick masonry buildings are liable to ground motions, due to its low tensile and shear strength heavy mass and low ductility (plasticity) In the case of earthquake, it’s potential to neutralize their damage by applying basic engineering and coming up with principles that are cheap and not on the far side the abilities of most building industries. This statement is especially relevant for construction of straightforward masonry building.

### 2.8 ENGLISH BOND PLAIN

<table>
<thead>
<tr>
<th>No. of specimen</th>
<th>Maximum load (KN)</th>
<th>Displacement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>138.57</td>
<td>5.58</td>
</tr>
<tr>
<td>2.</td>
<td>138.69</td>
<td>5.52</td>
</tr>
<tr>
<td>3.</td>
<td>138.58</td>
<td>5.49</td>
</tr>
</tbody>
</table>

#### Table 1: - English Bond Plain

![Figure 3: brick masonry block testing](image)

![Figure 4: English Bond Plain Graph](image)

#### 2.9 RAT TRAP BOND PLAIN

<table>
<thead>
<tr>
<th>No. of specimen</th>
<th>Maximum load (KN)</th>
<th>Displacement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>131.04</td>
<td>1.65</td>
</tr>
</tbody>
</table>

#### Table 2: - Rat Trap Bond Plain

![Figure 5: Rat Trap Bond Graph](image)

![Figure 6: English Bond With FRP Graph](image)

#### 2.10 English Bond with FRP

<table>
<thead>
<tr>
<th>No. of specimen</th>
<th>Maximum load (KN)</th>
<th>Displacement (mm)</th>
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</thead>
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<td>19.66</td>
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<tr>
<td>2.</td>
<td>211.13</td>
<td>19.06</td>
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<tr>
<td>3.</td>
<td>211.55</td>
<td>19.15</td>
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</tbody>
</table>

#### Table 3: - English Bond With FRP

#### 2.11 RAT TRAP BOND WITH FRP

<table>
<thead>
<tr>
<th>No. of specimen</th>
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</tr>
</tbody>
</table>

#### Table 4: - Rat Trap Bond with FRP
2.12 SPECIMEN SIZE

A. FOR COMPRESSION TEST SPECIMEN SIZE

Length = 400mm
Breadth = 220mm
Height = 450mm

B. FOR FLEXURAL TEST SPECIMEN

Length = 450mm
Breadth = 220mm
Height = 400mm

3. CONCLUSION AND FUTURE WORK

Strength analysis is very important aspect in the field of construction and particularly due to progression of engineering techniques being involved in the construction practices.

As we can see the results from the table 4.1.4 named English bond with FRP and table 4.2 named English bondplain, we can conclude that displacement is improved using English bond with FRP technique. Similarly Rat trap bond using FRP technique is better than conventional one.

After conducting tests English bond with FRP and conventional bond we derived to a conclusion that Rat trap bond shows better compressive and flexural behavior in comparison with conventional bond. As we know mortar has good compressive strength it also exhibits enough strength in tensile state when we put for the flexural test. Rat trap can be used for construction but should be avoided generally for high rise buildings when compared to conventional bond. Rat trap bond can be implemented for dwellings of low rise. However application of different composite materials also enhances the life of masonry structures and it can also be used for retrofitting of the buildings as it play an important part during the earthquakes showing good sustainable behavior towards the lateral movement of the structure avoiding sudden collapse of the structures.

REFERENCES


[9] Rajkumar dubal1, Gole Neha2, Patil g. r3, Sandip vasanwala4, Chetan modhera5,” application of performance based seismic design method to reinforced concrete moment resistant frame with vertical geometric irregularity with soft storey ,” volume-03, issue-12

[10] Prof. J.w.b. stark,” where structural steel and concrete meet.”


