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LOW COST CONFINEMENT OF MASNOARY AND PCC COLUMNS

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ABSTRACT

*Masonry structures are prone to extensive damage followed by failure and collapse whensubjected to static overloads or loads resulting from wind, earthquake and other natural or man-made events. Thus retrofit and strengthening of masonry structures, in order to furnish structuralductility and additional strength, is of primary importance .Recent earthquakes and terrorist acts have clearly demonstrated that the development ofeffective and affordable strategies for the strengthening of masonry is urgently needed. As aresponse to these challenges, fiber-reinforced polymer (FRP) composites may offertechnically viable solutions. But because of the high cost, FRP's are not often used. In this thesis an effort has been made to replace FRP with the***low cost Tin sheets of the mustard oil containers*** *for the confinement of masonry columns. Columnsbuilt with solid clay bricks, commonly found in India and many other countriesin residential & historical buildings,were tested under compression static loads and lateral loads. Square masonry columns were tested takinginto account the influence of several variables: different strengthening schemes, number of layers and aspect ratio. In this thesis an effort has also been made to strengthen the PCC Columns by the confinement of PVC pipes.*

I. INTRODUCTION

Confinement is generally applied to members in compression, with the aim of enhancing their load bearing capacity or, in case of seismic upgrading, to increase
their ductility. The confinement in seismically active regions has proven to be one of the early applications of FRP materials in infrastructure applications. Confinement may be beneficial in non-seismic zones too, where, for instance, survivability of explosive attacks is required or the axial load capacity of a column must be increased due to higher vertical loads, e.g. if new storey's have to be added to an existing building or if an existing bridge deck has to be widened. In any case, confinement with FRP may be provided by wrapping RC columns with prefabricated jackets or in situ cured sheets, in which the principal fiber direction is circumferential.

One of the main problems connected with preserving and maintenance of historic buildings and existing dwellings is the need for strengthening and retrofitting of the masonry parts of the structures. For design purposes masonry is considered as homogeneous material but in reality it shows very complex heterogeneous characteristics. Aggressive environment and some natural calamities can cause extensive damage to

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unreinforced masonry (URM) structures. Many older masonry structures currently in use were designed and constructed with little or no consideration of these aggressive factors. In addition, recent changes in seismic requirements have left many URM buildings in need of strengthening (Vanessa E.

Grillo, 2003)[1]. In many cases, these natural effects were not considered in ancient time. Since the advent of modern reinforced masonry construction, URM structures have been viewed as a significant liability when considering strengthening. Significant research has been done on strengthening masonry components and their connections resulting in strengthening methods based on traditional materials, such as steel and concrete.

II. OBJECTIVES

1. Replacement of FRP with the low cost Tin sheets of mustard oil containers for the confinement of masonry columns.
2. Effect of Tin sheets confinement on the properties of masonry columns. These properties are:

- Gravity load carrying capacity.
- Ductility.
- Rigidity.

3. Effect of PVC confinement on the same properties as described above of PCC columns.
4. Comparative study between the wrapped &unwrapped masonry columns and unconfined and confined PCC columns.

III. LITERATURE REVIEW

Within the building industry the method of strengthening using FRP was mainly given in concrete construction first. Investigations by using the method of strengthening masonry walls with fiber-reinforced polymers were first realized by Schwegler[13] : based on his results, the load bearing walls of a six story building were strengthened with carbon FRP laminates[14]. Further studies about the strengthening of masonry walls in seismic endangered zones were reported by Ehsani [15,16], Saadatmanesh [17] and Velazquez-Dimas[18]. Different types of carbon fiber and glass fiber sheets were combined with different types of matrices and the position of the sheets on the walls was varied. Laursen [19] tested carbon overlays as retrofit and repair technique to mitigate seismic strength and ductility deficiencies of masonry walls. In-plane and out of-plane tests on one story walls were carried out. The shear and flexural strength of repaired, retrofitted and original masonry walls were analyzed. Triantafillou [20] studied the strength of externally bonded laminates under out-of-plane and in-plane bending and in-plane shear, all combined with axial load.Compared to reinforced concrete, there are relatively fewer experimental studies that address the behaviour of masonry columns under combined axial load and cyclic flexure. There exist reinforced concrete masonry (RCM) columns that are part of the moment resisting system of masonry structures that are in need for seismic upgrade.

IV. FRP MATERIALS& MASONRY

4.1FRP Materials:-

Continuous fiber-reinforced materials with polymeric matrix (FRP) can be considered as composite, heterogeneous, and anisotropic materials with a prevalent linear elastic behaviorup to failure.

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Figure 3.1: Different FRP materials

They are widely used for strengthening of civil structures as the traditionaltechniques pose some disadvantage such as:

• Difficulty in manipulating heavy steel plates at the construction site

• Deterioration of the bond at the steel-concrete interface caused by the corrosionof steel

• Need for scaffolding and temporary support or loading

• Proper formation of joints due to the limited delivery lengths of the steel plates.

• It is labour intensive (Figure3.2)

• It often causes disruption of occupancy

• In many cases it provides RC elements with undesirable weight and increasedstiffness (Md. Rashadul Islam 2007)[4].

The use of FRP successfully solves the above problems. In addition, it has the goodreputation to

• Increases out-of-plane flexural strength

• Increases in-plane shear strength

• Increases stiffness at service loads

• Results in monolithic action of all units

• Converts masonry from a weak/brittle material to a strong/ductile material

•Strengthening of entire wall can be accomplished by treating only a fraction ofwall surface area

• Adds very little weight to the wall • Increases wall thickness by less than . in. (5mm) • Limited access requirements • Costs less than conventional methods • Lightweight (1/4 to 1/5 of steel), good mechanical properties, corrosion-resistant, etc.

V. MASONRY

Masonry is a composite material of bricks and mortar. When these are joint together, athird “material” appears. This “material” is the interface between brick and mortar. Thebond properties of the interface are very dependent on the properties of the brick and themortar[5]. The mechanism of developing bond is thatthe brick sucks water from the mortar leaving an area between the brick and the mortarwith other material properties than the mortar. It is believed that the bond is a crystallinezone, which develops an interlock with the rough surface of the brick. Depending on thesuction from the brick and the mortars ability to retain water the bond might be strongor weak. In general, it might be said that masonry made with high suction bricks and amortar with a low ability to retain water1 provides a weak bond. Thus, masonry madewith low suction bricks and a mortar with a reasonable ability to retain water provides astrong bond.

From this it is seen that failure of masonry in compression is a rather complex problem.This might also be said regarding deformation up to

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VI. TEST SPECIMENS

A total of 12 model masonry column specimens in two groups were prepared using clay bricks .The dimensions of bricks were 100mm width, 75mm height, and 225mm length, and were bonded together with a mortar containing cement as binder, at a cement: sand ratio equal to 1:4 and w/c ratio of 0.6. The cross-sectional area of the specimens in first group was 225mm × 225mm and for second group 350mm × 350mm .The height of model columns for both groups was 600mm.Each model column comprised bricks placed in seven rows with six bed joints in between and mortar thickness was kept 10mm in general, as shown below (Fig 4.1).

Figure 4.1 (Pictures captured in structural lab during the construction of columns)

One more group of four modelcolumns were constructed using plain cement concrete(pcc) Fig 4.2. The PCC used consists of cement: sand: aggregate ratio of 1:2:4. The two columns of this group was confined with PVC pipes of 150mm diameter.The height of the model columns of this group was 600mm for first two columns and 1800mm for the last two model columns (fig4.2).The purpose was to find out the comparative study between:

1. The un-confined masonry columns &confined masonry columns, and
2. Confined and unconfined PCC columns.

Figure 4.2 construction of pvc confined pcc columns

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In order to get the required dimensions of the tin sheets used for the confinement of the masonry columns, the sheets were joined by the spot welding in the mechanical engineering laboratory (Fig 4.3).The sheets were cold-bended with an appropriate apparatus in the mechanical engineering lab to form a square section identical to the cross-sections of the masonry columns

Figure4.4 sheet bending by the swaging machine

In the first two groups of masonry columns, two columns were unreinforced, another two columns were reinforced by wrapping the sheets of the tin in a single layer and the last two columns were reinforced by wrapping two layers of tin sheets. Wrapping of the Tin sheets took place after curing for at least 28 days in laboratory conditions. The tin was wrapped around the column horizontally (Fig 4.5).

The application of the tin sheets was a simple and rapid operation. 50 mm long screws having 4 mm diameter and plastic conical anchorage was used to fix the tin sheets on the model column. Electric driller was used to make holes for the plastic conical anchorage as shownin (Fig 4.6).

VI. TEST SETUP& INSTRUMENTS

A) Compression Test Setup:

gure 5.7 presents the test setup used for the compression test. The columns were tested under the Universal FiTesting Machine of 40 Ton capacity. The load was applied at the centre of the column by means of a 10 mm steel plate which was laid on the top of the column (fig 4.7).The purpose was to evaluate the effecton compressive strength of masonry columns and PCC columns produced by the confinement of tin sheets and PVC pipes respectively. Another important objective was to record the axial strain and find the failure mode of the masonry columns.

B) Lateral Load Test Setup:

Figure 4.8 presents the test setup used for the lateral load test. The test setup includes loading frame of 50 ton capacity, hydraulic jack and the dial gauges. The load was applied by means of a hydraulic jack and the deflections were measured with the dial gauges. The base of the columns was kept fixed with the help of steel girders and vertical restraint with a tie down was provided to prevent the overturning of column specimen. The purpose was to evaluate the effect of lateral strength and stiffness on masonry columns and PCC columns produced by the wrapping of tin sheets and PVC pipes respectively. Another important objective was to find the failure mode of the masonry columns.

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VII. EXPERIMENTAL PROGRAMME

a) For compression test

The compression test of the model columns was carried out in three groups according to the shape and size of the columns. These groups were further divided into sub-groups according to the wrapping scheme. Table 4.1 shows the experimental programme for the compression test.

Table 4.1 Experimental programme for compression test

S.NO.	SHAPE	X-section (mm)	HEIGHT (mm)	WRAPPING SCHEME	SPECIMEN NAME
GROUP 1 (MASONRY COLUMNS)					
1	square	225x225	600	unconfined	MC-A0
2	square	225x225	600	Single wrap	MC-A1
3	square	225x225	600	Double wrap	MC-A2
GROUP 2 (MASONRY COLUMNS)					
1	square	350x350	600	unconfined	MC-B0
2	square	350x350	600	Single wrap	MC-B1
3	Square	350x350	600	Double wrap	MC-B2
GROUP 3 (PCC COLUMNS)					
1	circular	150(dia.)	600	unconfined	PC-C0
2	circular	150(dia.)	600	Pvc pipe confined	PC-C1

b) For lateral load test

The experimental program for the lateral load test according to the group no., shape,size and the wrapping scheme is shown in table 4.2.

Table 4.2 Experimental program for lateral load test

S.NO.	SHAPE	X-section (mm)	HEIGHT (mm)	WRAPPING SCHEME	SPECIMEN NAME
GROUP 1 (MASONRY COLUMNS)					
1	Square	225x225	600	Unwrapped	ML-A0
2	Square	225x225	600	Single layer	ML-A1
3	Square	225x225	600	Double layer	ML-A2
GROUP 2 (MASONRY COLUMNS)					
1	Square	350x350	600	Unwrapped	ML-B0

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2	Square	350x350	600	Single layer	ML-B1
3	Square	350x350	600	Double layer	ML-B2
GROUP 3 (PCC COLUMNS)					
1	Circular	150(dia.)	1800	Unconfined	PC-L0
2	Circular	150(dia.)	1800	Pvc pipe confined	PC-L1

VIII. CONCLUSION

The behavior of masonry columns and PCC columns before and after strengthening using low cost Tin sheets and PVC pipes respectively was investigated and following conclusions are drawn:-

- Tin sheets are effective in increasing the compressive strength of masonry columns. The tin sheets improved the compressive strengths by a factor up to 1.64 and 1.69for masonry columns by the single layer wrapping and double layer wrapping respectively
- Low cost tin sheet confinement is also effective in increasing the ductility of masonry columns.
- The axial strength was improved significantly due to confinement. As expected, the effectiveness of confinement reduces with increase in cross-sectional area.
- The low cost Tin sheet confinement significantly increases the lateral strength and rigidity of masonry columns.

IX. LIST OF REFRENCES

1) Vanessa E. Grillo , 2003, ‘’ FRP/Steel strengthening of unreinforced concrete masonry piers‘’ MSc thesis, Department of Civil Engineering, University of Florida. USA.
2) John Busel, David White, (2003), ‘’CFRP & GFRP Composite Applications for InfrastructureRehabilitation and Repairs’’, Presented on behalf of Sika Corporation on NASTO 2003Conference Saratoga Springs, NY. USA.
3) Binda, L., Gatti, G., Mangano, G., Poggi, C. and Sacchi Landriani, G. 1992. ‘’The collapse ofthe Civic Tower of Pavia’’, A survey of the materials and structure, Masonry International,6(1), p. 11-20.
4) Md.rashadul islam and Farooq S. H., “Retrofitting techniques for masonry buildings damaged during 8th October earthquake”, Proceeding of The International Conference on Earthquake Engineering, Lahore, Pakistan, Sep 8-9, 2006.
5) HANSEN, L. Z. & GUDMAND-HØYER, T.: Strength effects from the initialrate of absorption on masonry, Bygningsstatiske meddelser, Vol. LXVIII, Nos 2-3, p. 35.
6) HAGSTEN, L.G.: Plasticitetsteori for murværk Del 1: Trykstyrke, Department of Structural Engineering and Materials, DTU, Series R, No. 72, 2000.
7) CAJDERT, A.: Laterally Loaded Masonry Walls, Chalmers University of Technology, Publication 80:5, Göteborg 1980.
8) HENDRY, A. W.: Structural Masonry, MacMillan, 1990.