STRENGTHENING OF MASONRY WALLS

Strengthening of masonry walls is required to prevent failure and collapse during major earthquake or addition of extra load on buildings. Strengthening of masonry walls also may be required during rehabilitation of buildings. Unreinforced masonry walls have good compressive strength, but they are brittle and very weak under the action of lateral loads which causes tension in walls. Whenever tension forces acts on a masonry wall, it tends to crack. Cracking of masonry walls may occur due to settlement of foundation, during earthquakes, application of lateral loads. There can be several causes for masonry wall cracks, but occurrence these cracks may lead to complete collapse of wall. Some of the failures of masonry walls are shown in images below:

Fig: Corner Failure of Masonry Wall

Fig: Vertical Cracks in Masonry Walls

Fig: Roof Collapse due to Removal of Wall

In a load bearing masonry buildings, loads from the building is transferred through walls and failure and collapse of such masonry walls can lead to complete collapse of the building. In case of reinforced concrete framed structures, although loads are transferred through columns, but in the event of an earthquake, these walls are more susceptible to develop cracks and fail. Uses of half brick thick masonry walls are common as partitions in the interior of RC framed buildings. These half brick masonry walls are unsafe under the action of lateral forces during earthquake. Out of plane strengthening of partitions can be clubbed together with lateral strengthening of building by providing reinforced concrete jackets to the partitions. To prevent the collapse of masonry walls during earthquake, it is advisable to use reinforced brick masonry walls in new construction. Existing masonry walls can also be strengthened by providing reinforced concrete jackets on one or both sides of the walls.

Methods of Masonry Wall Strengthening

Masonry walls can be strengthened by following methods: 1. Providing reinforced concrete jackets on one or both faces of walls. 2. Use of FRP Structural Repointing for strengthening of masonry walls (Source: Strengthening of Masonry Walls by FRP Structural Repointing by Gustavo Tumialan, Pei-Chang Huang, Antonio Nanni, Pedro Silva)

Masonry wall Strengthening using RC Jackets:

Reinforced concrete (RC) jackets technique for strengthening of masonry structure consists of application of jackets on one or both sides of masonry walls. This method is used for brick masonry as well as for stone masonry walls. For using reinforcement jackets, first the plaster is removed from the walls. Mortar joints between bricks are cleaned. In case of any cracks in masonry walls, those are first grouted. Anchor ties are are inserted in pre-drilled holes. The surface of drill is cleaned, moistened, and cement slurry is spread on the masonry surface and in drills. The concrete is applied in two-layers with reinforcement mesh in between them. The reinforcing mesh on both sides of wall is connected with the help of steel anchors. These anchors are welded with the mesh or tied using tying wire. The usual total thickness of RC jackets varies from 30mm to 100mm. The thickness depends on the method for application of concrete layers. **Rules for Strengthening of Masonry Walls by Reinforced Concrete Jacketing:**

- The minimum horizontal and vertical reinforcement should be 0.25% of the jacket section.
- The minimum reinforcement with which the ends of the wall are strengthened should be 0.25% of jacket section.
- The diameter of the ties at the well ends should not be less than 8 mm with a maximum spacing of 150 mm.
- The jacket must be anchored to the old concrete with dowels spaced at no more than 600 mm in both directions.

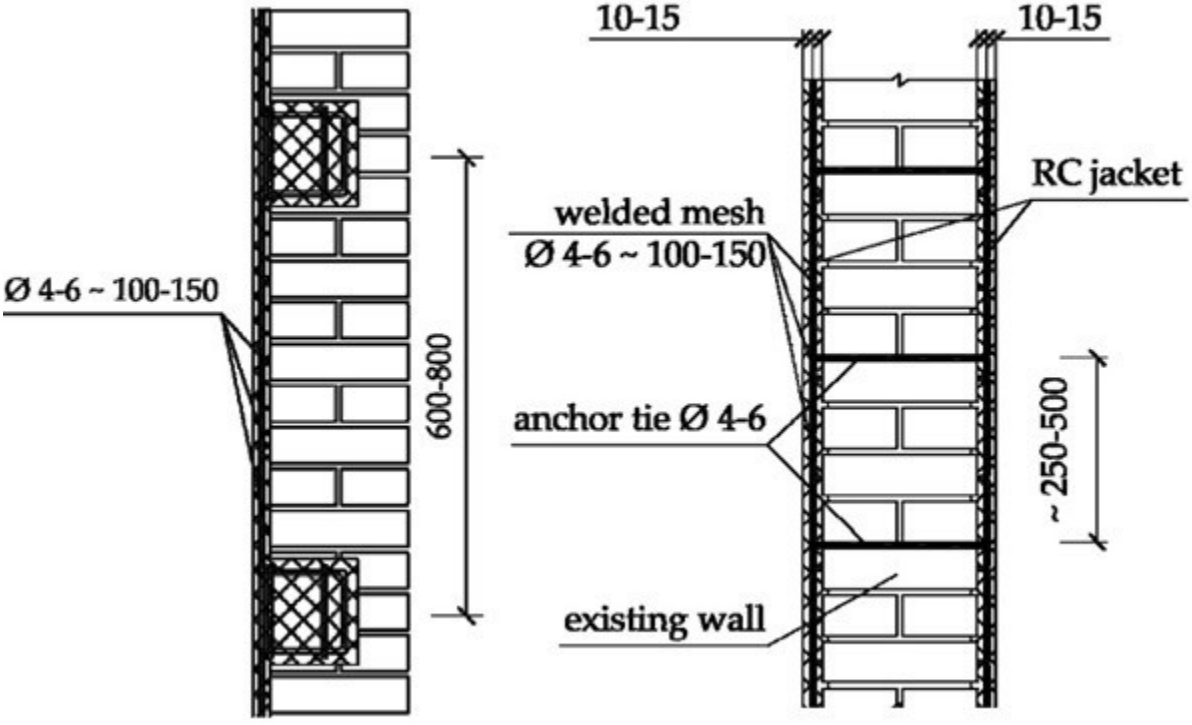

Fig: Strengthening of Masonry Walls by Application of Single and Double sided reinforced concrete (RC) jackets (source: Paper by S. Churilov & E. Dumova-Jovanoska on "Analysis of

masonry walls strengthened with RC jackets" It is also important that the jacket should be able to transfer forces to slab diaphragms. This can be achieved by providing epoxy grouted anchors and diagonal connecting bars through holes made in slabs.

Strengthening of Masonry Walls by Using FRP Structural Repointing:

Structural repointing of masonry walls has advantages compared to the use of FRP laminates. This method of masonry wall strengthening is simple since the surface preparation is reduced (sandblasting and puttying) is not required. In addition the aesthetic of masonry is preserved. Following figure illustrates the strengthening procedure of masonry walls:

Fig: Strengthening of Masonry Walls using FRP Structural Repointing; (a) Grinding of masonry joints, (b) Masking of masonry to avoid staining, (c) Application of epoxy based paste to masonry joint, (d) Installation of GFRP Rod