VULNERABILITY REDUCTION SOLUTIONS

Date:	03/10/2018
VRS Code:	JKT
Author:	UCL
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LOAD BEARING MASONRY BUILDINGS

STRENGTHENING INTERVENTION: **JACKETING**

APPLICABLE BUILDING TYPES:

	Taxonomy Parameters									
Main Structural System:……	A	X	UCM-URM	X	CM		RM		SFM	X
Height Range:……..……			Low (LR)	X			Medium (MR)	X	High (HR)	X
Seismic Design Level:……..……	Poor (PD)	X	Low (LD)	X			Medium (MD)		High (HD)	
Structural Health Condition……							Poor (PC)	X	Good (GC)	

EXISTING STRUCTURAL DEFICIENCIES:

- Limited shear and flexural capacity of walls due to poor quality of materials; - Localized failure of walls; - Poor connection between cross walls

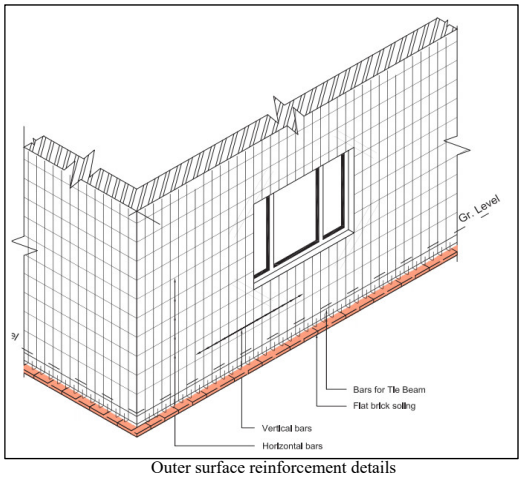
STRUCTURAL IMPROVEMENTS AFTER STRENGTHENING:

- Shear and tensile strength of materials is increased thereby improving the wall integrity, strength and ductility.
- Local failure modes are controlled.
- Corner separation is restricted.
- If applied on all the walls in all stories, global seismic behavior is improved.

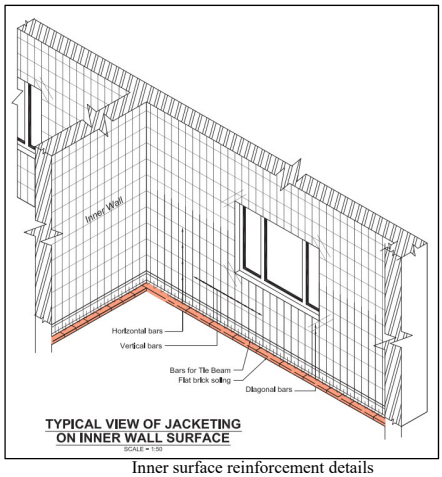
STRENGTHENING INTERVENTION DESCRIPTION:

This is a local (or global if applied on all the walls) type of intervention technique on low strength unreinforced masonry structures and can be applied to few walls or to all the walls in a building. The jacketing is usually applied on both sides (inner and outer) of the walls.
In this technique, galvanized welded wire mesh (WWM) or steel reinforcement bars mesh is placed on both sides of the walls both of which are connected to each other using steel bar connectors through the walls at regular intervals. Or anchored nails can also be used to connect these meshes to the walls. Then, these meshes are covered with cement plaster or shotcrete (of thickness about 50 mm to prevent corrosion of mesh) to form jacketing's. For more details on strengthening walls using jacketing, refer to Shrestha et al. (2012), Anwar et al. (2016).

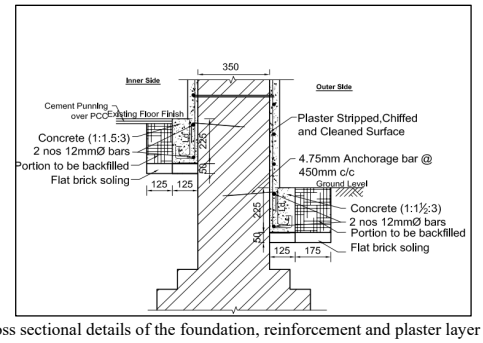
ILLUSTRATIVE FIGURES:



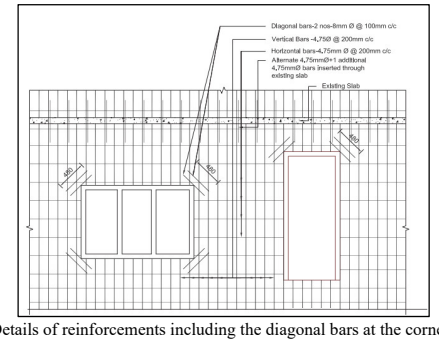
Outer surface reinforcement details



Inner surface reinforcement details



Cross sectional details of the foundation, reinforcement and plaster layer



Details of reinforcements including the diagonal bars at the corners of openings.

Example design details of the seismic strengthening of an low strength UCM-URM walls using RC Jacketing on both (inner and outer) sides (Retrofit Design by NSET-Nepal, adapted from Anwar et al., 2016)

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APPLICATION CASE STUDIES:

A two storied UCM-URM4 type of LBM school building strengthened using RC Jacketing technique. Note that the first story walls are already plastered (curing is ongoing) and the reinforcement mesh is being installed on the second story walls. (Photo from Nepal, Credit: Sunil Kumar Yadav, MoE, Nepal).

PRECAUTIONS AND LIMITATIONS:

This intervention requires highly skilled masons at it involves plaster removal, drilling through the walls etc. New foundation along side the older one should be dug out carefully so that the jacketing starts from the foundation for increased stability and integrity. Part or all of the roof structure might need to be rebuilt depending on the level and location of roof structure connection to the masonry walls. The reinforcement from new RC ring beams must be well connected (hooked or anchored) to the roof structure as well as to the underlying masonry walls. The joints of the cross ring beams should be carefully detailed with adequate reinforcements. This is expensive compared to RC splint and bandage technique.

REFERENCES:

Anwar, N., Adhikari, S., Sahid, M. and Shrestha, S. (2016). Making Schools Safer From Earthquakes - Effective Retrofitting: Case Studies from Nepal, Asian Institute of Technology, Thailand.

Shrestha, H., Pradhan, S., & Guragain, R. (2012). Experiences on retrofitting of low strength masonry buildings by different retrofitting techniques in Nepal. In 15th world conference on earthquake engineering, Lisbon, Portugal.

Notes:

- The design details and figures shown here are for illustration purpose only.
- The authors do not assume any responsibility for the consequences of adopting the proposed strengthening solution.
- Experienced structural engineers have to design (dimensions, details and material specifications) and supervise the interventions for each application case.