

VULNERABILITY REDUCTION SOLUTIONS

Date:	05/10/2018
VRS Code:	WRC
Author:	UCL
Sheet:	1 OF 2

LOAD BEARING MASONRY BUILDINGS

STRENGTHENING INTERVENTION:

WALL-ROOF CONNECTION STRENGTHENING

APPLICABLE BUILDING TYPES:

	Taxonomy Parameters				
Main Structural System:.....	A <input checked="" type="checkbox"/>	UCM-URM <input checked="" type="checkbox"/>	CM <input checked="" type="checkbox"/>	RM <input checked="" type="checkbox"/>	SFM <input checked="" type="checkbox"/>
Height Range:.....		Low (LR) <input checked="" type="checkbox"/>	Medium (MR) <input checked="" type="checkbox"/>	High (HR) <input checked="" type="checkbox"/>	
Seismic Design Level:.....	Poor (PD) <input checked="" type="checkbox"/>	Low (LD) <input checked="" type="checkbox"/>	Medium (MD) <input checked="" type="checkbox"/>	High (HD) <input type="checkbox"/>	
Diaphragm Type.....			Flexible <input checked="" type="checkbox"/>	Rigid <input type="checkbox"/>	

EXISTING STRUCTURAL DEFICIENCIES:

- Timber or steel roof structure with inadequate rigidity; - Poorly connection with the main LBM walls; - Susceptible to sliding during lateral loading

STRUCTURAL IMPROVEMENTS AFTER STRENGTHENING:

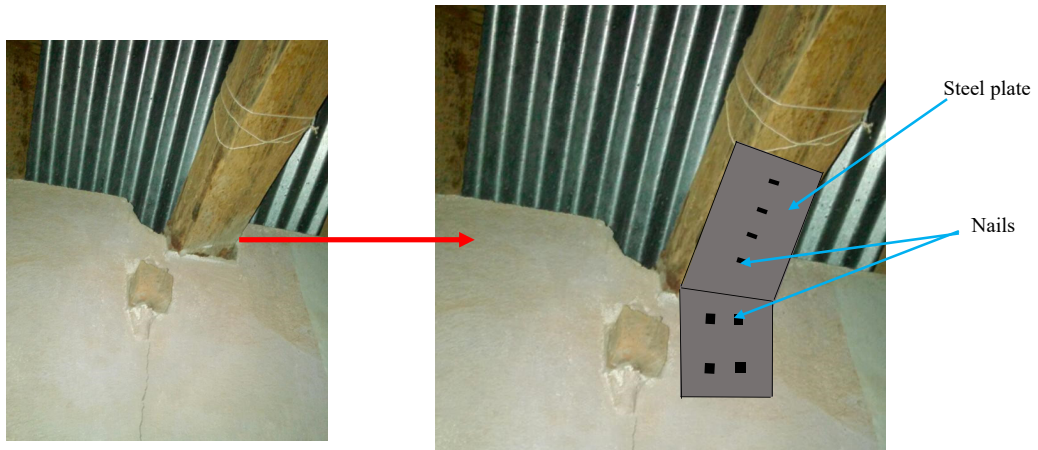
- Rigidity of the roof is improved.
- Global seismic behavior of building is improved (because of the rigidity of stiffer roof).
- Roof structure vulnerability is reduced.

STRENGTHENING INTERVENTION DESCRIPTION:

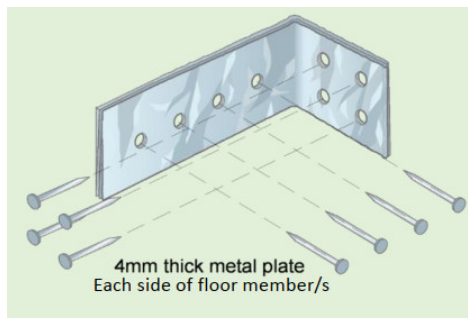
This is an intervention on horizontal structure (i.e. roof) and is applied to the poorly built flexible roofs which have steel or timber joists poorly connected to the walls (resting or partially embedded).

As an intervention, the quality of wall-roof connections is improved. This can be done using metal straps or plates anchored to the wall and timber joists using nails depending on the situation. For more information on roof strengthening, refer to NSET (2002), NRA (2017).

ILLUSTRATIVE FIGURES:



Strengthening of a timber roof rafter to wall connection using metal plates and nails. (Photos show a timber roof structure in a LBM school from Nepal, Copyright: The World Bank).



Example illustration of the steel plate and nails.(Reproduced from NRA, 2017)

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PRECAUTIONS AND LIMITATIONS:

This intervention requires skilled carpenters. Roof cladding needs to be removed and rebuilt. This strengthening can be done together with roof-to-wall connection improvement works.

REFERENCES:

NSET (2002). Protection of Education Buildings Against Earthquakes: A Manual for Designers and Builders. NSET-Nepal, Kathmandu, Nepal.

NRA (2017). Repair and Retrofitting Manual for Masonry Structure, Nepal Reconstruction Authority, Government of Nepal, Kathmandu, Nepal.

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.