

Learning Earthquake Design and Construction

14. Why are Horizontal Bands Necessary in Masonry Buildings?

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Role of Horizontal Bands

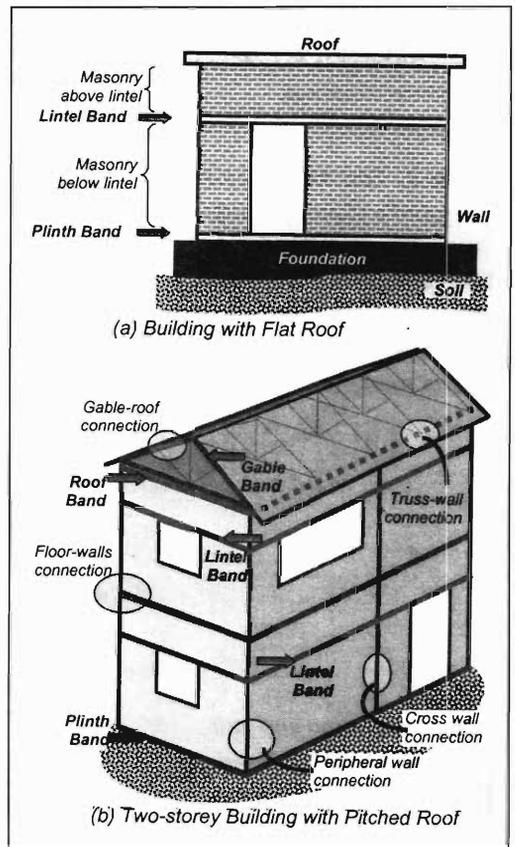
Horizontal bands are the most important earthquake-resistant feature in masonry buildings. The bands are provided to hold a masonry building as a single unit by tying all the walls together, and are similar to a closed belt provided around cardboard boxes. There are four types of bands in a typical masonry building, namely *gable band*, *roof band*, *lintel band* and *plinth band* (Figure 1), named after their location in the building. The lintel band is the most important of all, and needs to be provided in almost all buildings. The gable band is employed only in buildings with pitched or sloped roofs. In buildings with flat *reinforced concrete* or *reinforced brick* roofs, the roof band is not required, because the roof slab also plays the role of a band. However, in buildings with flat timber or CGI sheet roof, roof band needs to be provided. In buildings with pitched or sloped roof, the roof band is very important. Plinth bands are primarily used when there is concern about uneven settlement of foundation soil.

The lintel band ties the walls together and creates a support for walls loaded along weak direction from walls loaded in strong direction. This band also reduces the unsupported height of the walls and thereby improves their stability in the weak direction. During the 1993 Latur earthquake (Central India), the intensity of shaking in Killari village was IX on MSK scale. Most masonry houses sustained partial or complete collapse (Figure 2a). On the other hand, there was one masonry building in the village, which had a

Keywords

Earthquake, masonry buildings, horizontal bands.

Figure 1: Horizontal Bands in masonry building – Improve earthquake-resistance.





(a) Building with no horizontal lintel band: collapse of roof and walls



(b) A building with horizontal lintel band in Killari village: no damage

Figure 2. The 1993 Latur Earthquake (Central India) – one masonry house in Killari village had horizontal lintel band and sustained the shaking without damage.

lintel band and it sustained the shaking very well with hardly any damage (Figure 2b).

Design of Lintel Bands

During earthquake shaking, the lintel band undergoes bending and pulling actions (Figure 3). To resist these actions, the construction of lintel band requires special attention. Bands can be made of wood (including bamboo splits) or of reinforced concrete (RC) (Figure 4); the RC bands are the best. The straight lengths of the band must be properly connected at the wall corners. This will allow the band to support walls loaded in their weak direction by walls loaded in their strong direction. Small lengths of wood spacers (in wooden bands) or steel links (in RC bands) are used to make the straight lengths of wood runners or steel bars act together. In wooden

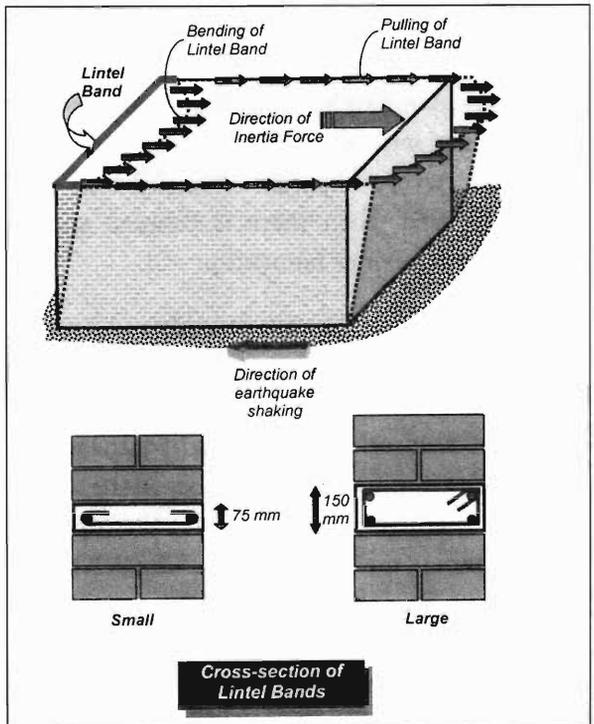


Figure 3. Bending and pulling in lintel bands – Bands must be capable of resisting these.

bands, proper nailing of straight lengths with spacers is important. Likewise, in RC bands, adequate anchoring of steel links with steel bars is necessary.

Indian Standards

The Indian Standards IS:4326-1993 and IS:13828 (1993) provide sizes and details of the bands. When wooden bands are used, the cross-section of *runners* is to be at least 75mm \times 38mm and of *spacers* at least 50mm \times 30mm. When RC bands are used, the minimum thickness is 75mm, and at least two bars of 8mm diameter are required, tied across with steel links of at least 6mm diameter at a spacing of 150 mm centers.

Suggested Reading

- [1] IAEE, *Guidelines for Earthquake Resistant Non-Engineered Construction*, International Association for Earthquake Engineering, Tokyo, 1986, available on www.nicee.org.
- [2] IS 4326, *Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings*, Bureau of Indian Standards, New Delhi, 1993.
- [3] IS 13828, *Indian Standard Guidelines for Improving Earthquake Resistance of Low-strength Masonry Buildings*, Bureau of Indian Standards, New Delhi, 1993.

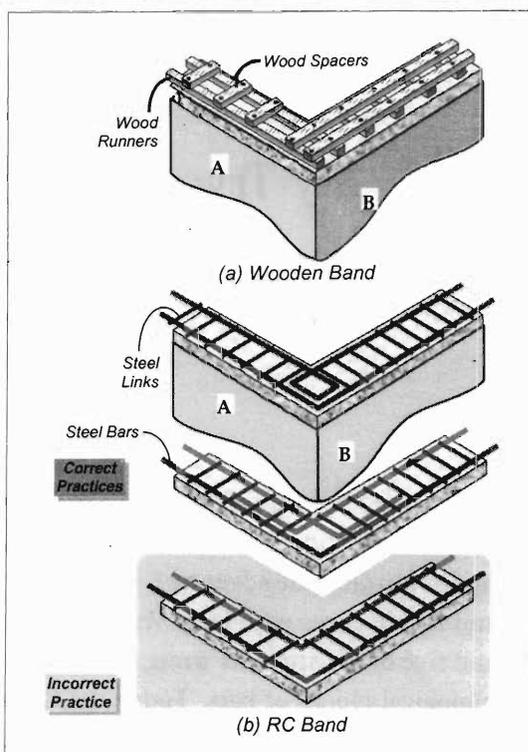


Figure 4. Horizontal Bands in masonry buildings – RC bands are the best.

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"A major element in all this human interest in animals is a deep seated sympathy for animals as sentient creatures. We try to understand our pets or whatever wild animals we have an opportunity to observe. We are challenged by the very difficulties of putting oneself in the skin of another animal, but we also are searching for empathy, a consideration that has not received nearly the attention it deserves. We like and admire other animals to a considerable extent because we enjoy trying to imagine what their lives are like to them".

Donald Griffin
From *Animal Thinking*