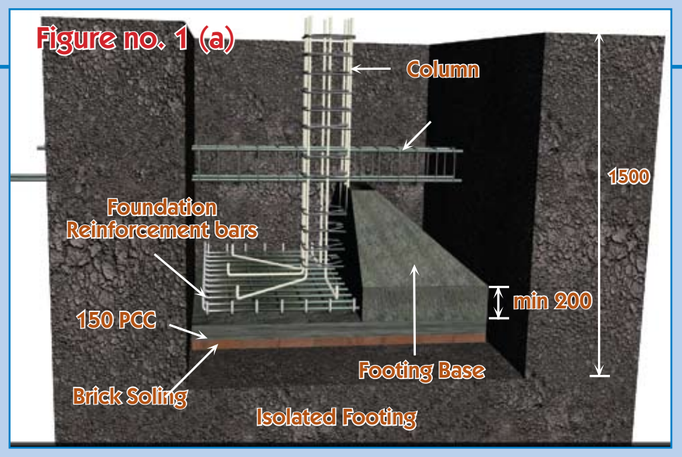
Recommendations for construction of Earthquake Safer Buildings

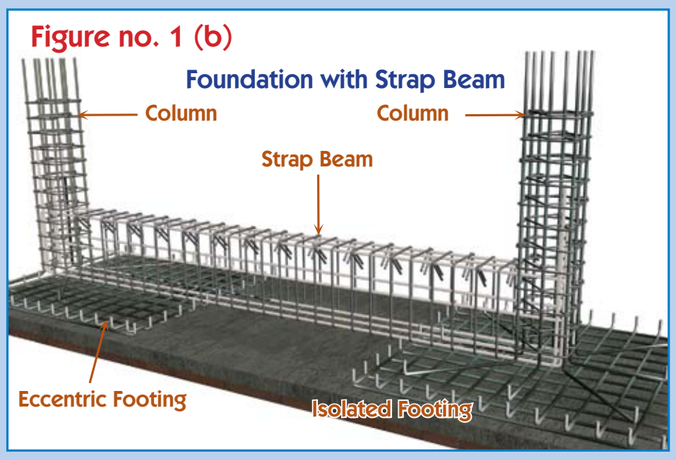
For RCC Frame Structure buildings up to three stories

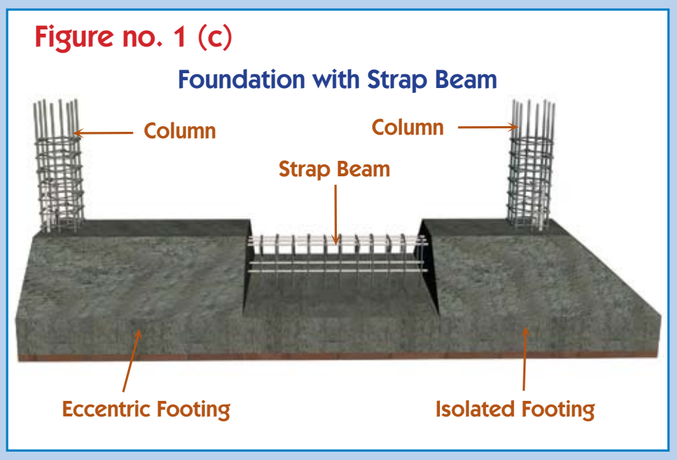
(For Buildings with room sizes up to 3.0 x 4.5m)

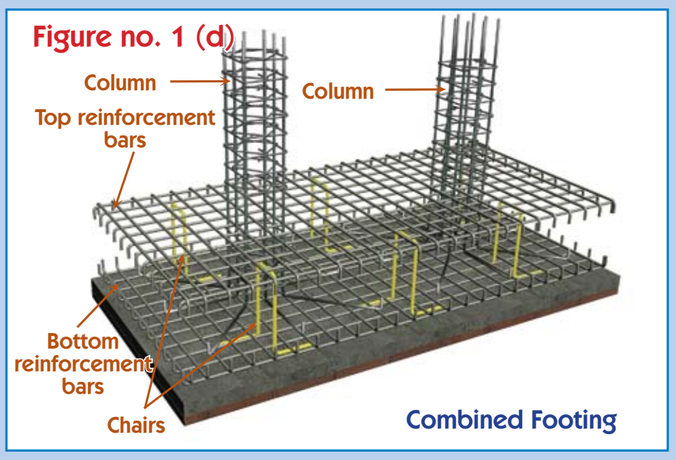
1. Construction of Foundations

- The minimum depth of foundation should be up to 1500 mm.
- Foundation should not be laid on filling soil and should goes up to original firm soil.
- The thickness at side of sloped footing should be minimum of 200 mm.
- If columns are located at property line of neighboring plot either combined footing or strap beams should be constructed to avoid the eccentricity of foundation.
- When the columns are located very close combined footings should be provided. The thickness of footing, numbers, size and layers of reinforcement bars (single or double layer) depend upon the load in foundations.
- Vibrators must be used during concreting works in foundation.



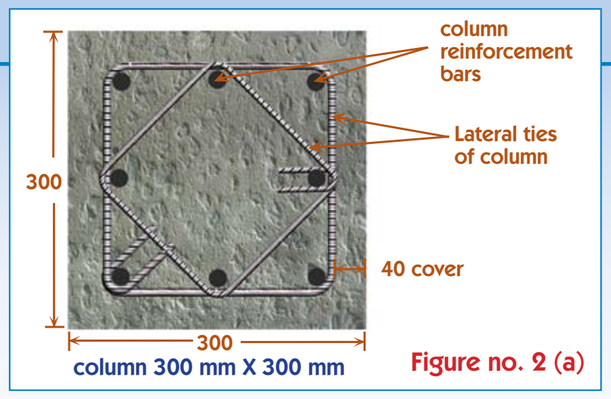


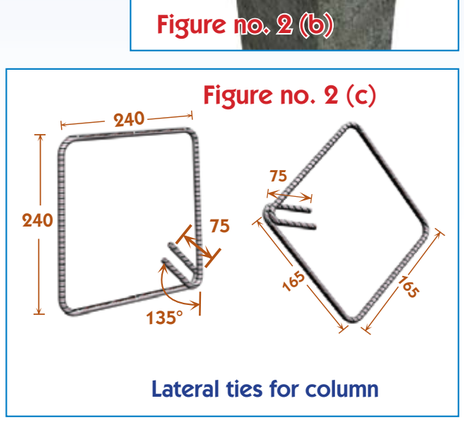




2. Construction of Columns

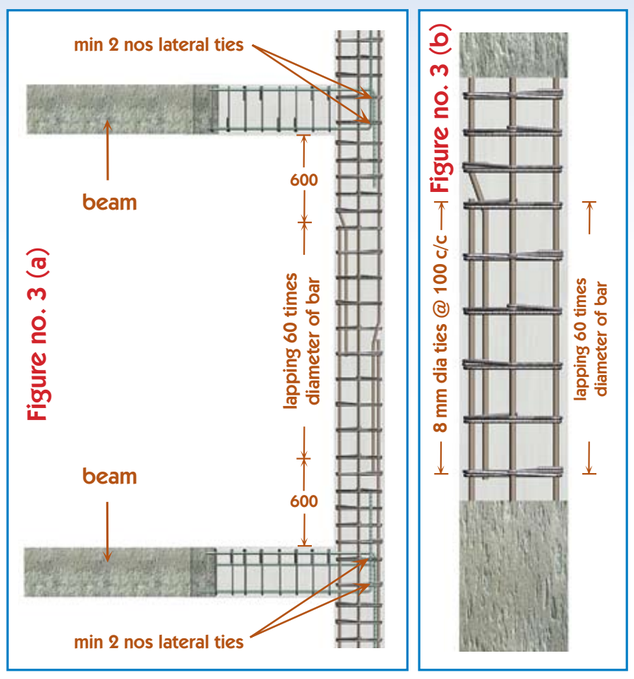
- Columns should be comparatively stronger as all vertical loads of building transfer to the foundations through columns and as well as they withstand lateral seismic forces generated by earthquake.
- All columns should be in grid in both direction in plan.
- The minimum sizes of columns for building up to three stories with room sizes not more than 4.5 m. x 3.0 m. should be 300 mm x 300 mm or 75 mm more than width of beam.
- There should be minimum 4 numbers of 16mm diameter reinforcement bars in columns located in outer faces of building and minimum 8 numbers of 12 mm diameter reinforcement bars in columns located at centers.
- 8mm reinforcement bars should be used for lateral ties. The spacing of ties below the foundation should be 100 mm c/c up to tie beam. In the superstructure the spacing of ties should be 100 mm c/c up to 600 mm above and below the beam bottom/top and 150 mm spacing in mid height of columns. The length of hooks of ties should be 75 mm and should be bent in 135° inside the column as shown in figure no. 2 (d).
- The ratio of concrete mix should be preferably M20 (1 cement : 1.5 sand: 3 aggregates) with concrete cover 40 mm (clear distance from face of column/formwork to the vertical reinforcement).
- The formwork should be removed only after 24 hours of concreting. The curing of columns should be carried properly by putting water on the column surfaces for minimum 7 days. Jute bags can be used to cover the column surfaces during curing to keep the surfaces wet.
- Shear key of size 100 x 100 x 100 mm should be provided at the top surface of the column to avoid cold joint between old and new concrete and to strengthen the column as shown in the figure 2 (b).





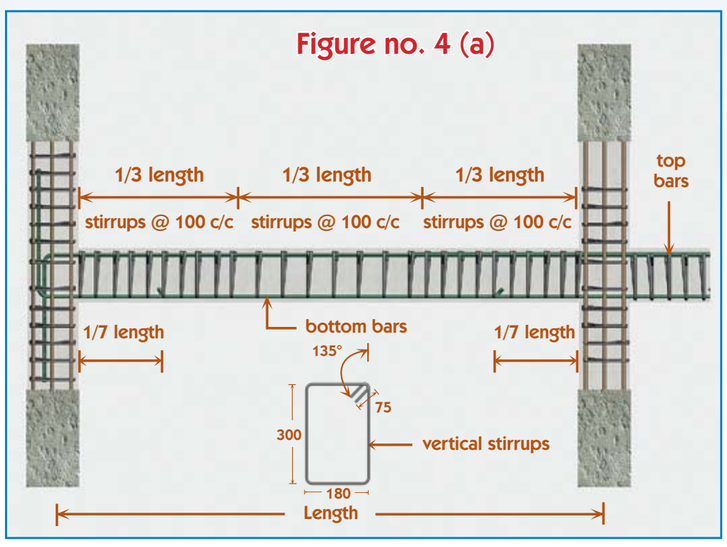
3. Lapping in Columns

- The lapping in columns should be at the mid height of column starting from 600 mm from top of beam or ending up to 600 mm from bottom of beam as shown in figure no. 3 (a).
- The reinforcement bars should not be lapped at one level i.e. should be lapped in staggered position aligned in a vertical line as shown in figure no. 3 (b).
- The lapping length should be 60 times the diameter of reinforcement bars (for concrete mix 1:2:4). The spacing of lateral ties should be 100 mm c/c through out the length of lapping.



4. Construction of Beams

- There should be minimum 2 nos of 16 mm diameter reinforcement bars at top and bottom of beams.
- Extra bars should be provided at support and span as per the length of beams
- Extra top bars should be provided up to 1/3 span of beam measured from the inside face of the columns and extra bottom bars should be provided at mid span leaving 1/7 length of beam measured from inside face of column in both sides.
- The minimum size of vertical stirrups should be 8 mm diameter. The spacing should be 100 mm c/c at 1/3 span of beam at supports and 150 mm c/c at remaining mid span of beam.



Based on Nepal National Building Code

Government of Nepal
Ministry of Physical Planning and Works
Earthquake Risk Reduction and Recovery Preparedness Programme for Nepal
(UNDP/ ERRRP-Project: NEP/07/010)
Department of Urban Development and Building Construction, Babar Mahal, Kathmandu, Nepal
Tel: (977-1) 4262474 | Fax: (977-1) 4262431 | Email: amritmtuladhar@yahoo.com | Website: www.errrp.org.np