



Rural Management & Development Department  
Government of Sikkim



सत्यमेव जयते



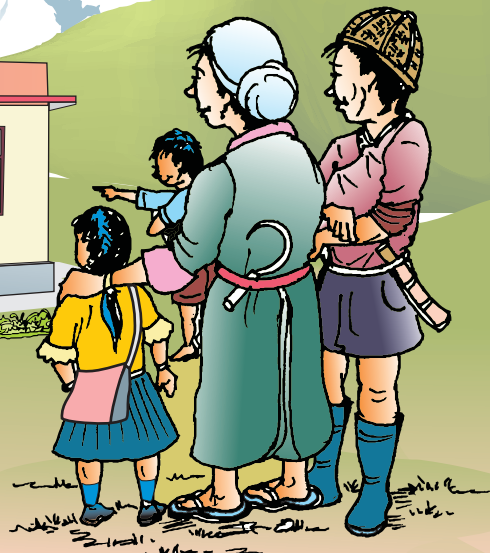
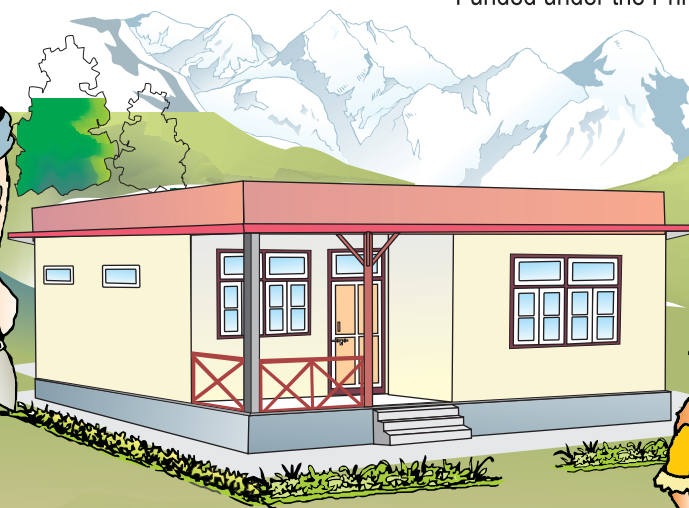
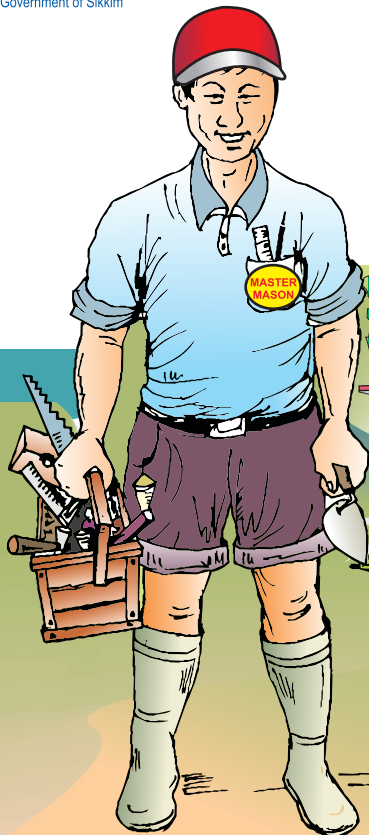
Sikkim State Disaster Management Authority  
Government of Sikkim

# Mason Training Handbook

Reconstruction of Earthquake Damaged Rural Houses (REDRH) Project

Funded under the Prime Minister's Special Relief Package

[www.sikkimrmd.gov.in](http://www.sikkimrmd.gov.in)



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## INTRODUCTION

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Increasing frequency and intensity of natural disasters has renewed the urgency in improving the preparedness and in making the infrastructure earthquake-resistant. After any natural disaster, rebuilding becomes the most important task for the administration and the communities involved. It also gives an opportunity to rebuild structures that are ecologically and environmentally sound and safe, focusing on green reconstruction. For this, the pre-disaster circumstances need to be carefully studied and measures undertaken for reducing the vulnerability in the event of another such disaster or devastation. Disasters can thus be reduced to a great extent if appropriate construction and site specific environmental factors are taken into consideration and are properly addressed while planning infrastructure. The goal is not just to replace what was lost during the disaster but to move beyond pre-disaster conditions to meet the longer-term development needs of disaster-affected people, and to build better and safer infrastructure.

Sikkim, a northeastern Indian Himalayan state, was hit by a 6.8 magnitude earthquake of intensity VII on 18 September 2011, which triggered hundreds of boulder falls and landslides, causing extensive damage to public and private infrastructure. An assessment of the strengths and weaknesses of the various structures present in rural areas was carried out. Assessment of the post-earthquake damage indicated that nearly half (54,000) of the rural houses in the state had suffered various degrees of damage. While the superstructure of these wooden framed houses with bamboo walling and a light iron-sheet roof was found to be mostly intact, the stone masonry load-bearing walls laid on mud mortar and not having reinforcement suffered maximum damage.

Private houses with RC-frame structure with brick masonry infill and CGI sheet roof performed well, showing non-structural damage mostly in the form of cracks in the infill walls. It was realized that mass training of masons and orientation of the local community is needed to make earthquake-resistant house construction a standard practice in future.

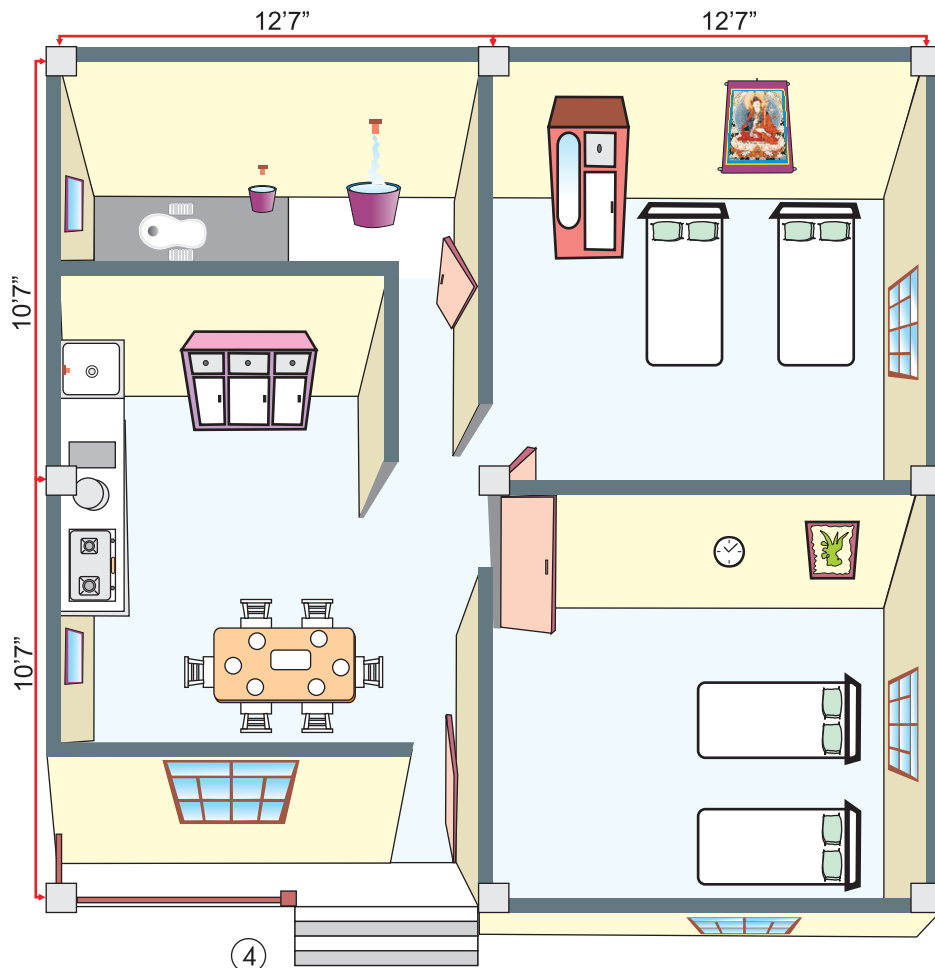
With funding support from Government of India, the Reconstruction of Earthquake Damaged Rural Houses (REDRH) Project is being taken up by the Rural Management and Development Department (RM&DD), Government of Sikkim with an objective to reconstruct 7,972, fully or severely damaged rural houses. Reconstructing these 7,972 houses which are scattered in the highest and steepest mountain terrain with the existing manpower is a formidable task at hand. The unit cost of INR 489,000 per house is based on a standard unit cost. While construction is being undertaken in 2012-13, this estimate is based on the 2006 schedule of rates. Completing these houses without compromising on the design, construction quality, budgetary ceiling and time frame will need strong commitment, determination and team work.

Capacity building of the masons constructing these houses is thus critical, as the quality of the houses will depend largely on their knowledge and expertise. Hence, in order to simplify the technical aspects of house construction, this illustrated “Mason Training Handbook” has been designed for the field engineers and masons to be used as a ready reckoner for reference during field construction. WWF-India is partnering with the RM&DD for implementing this capacity building programme for masons throughout the state.

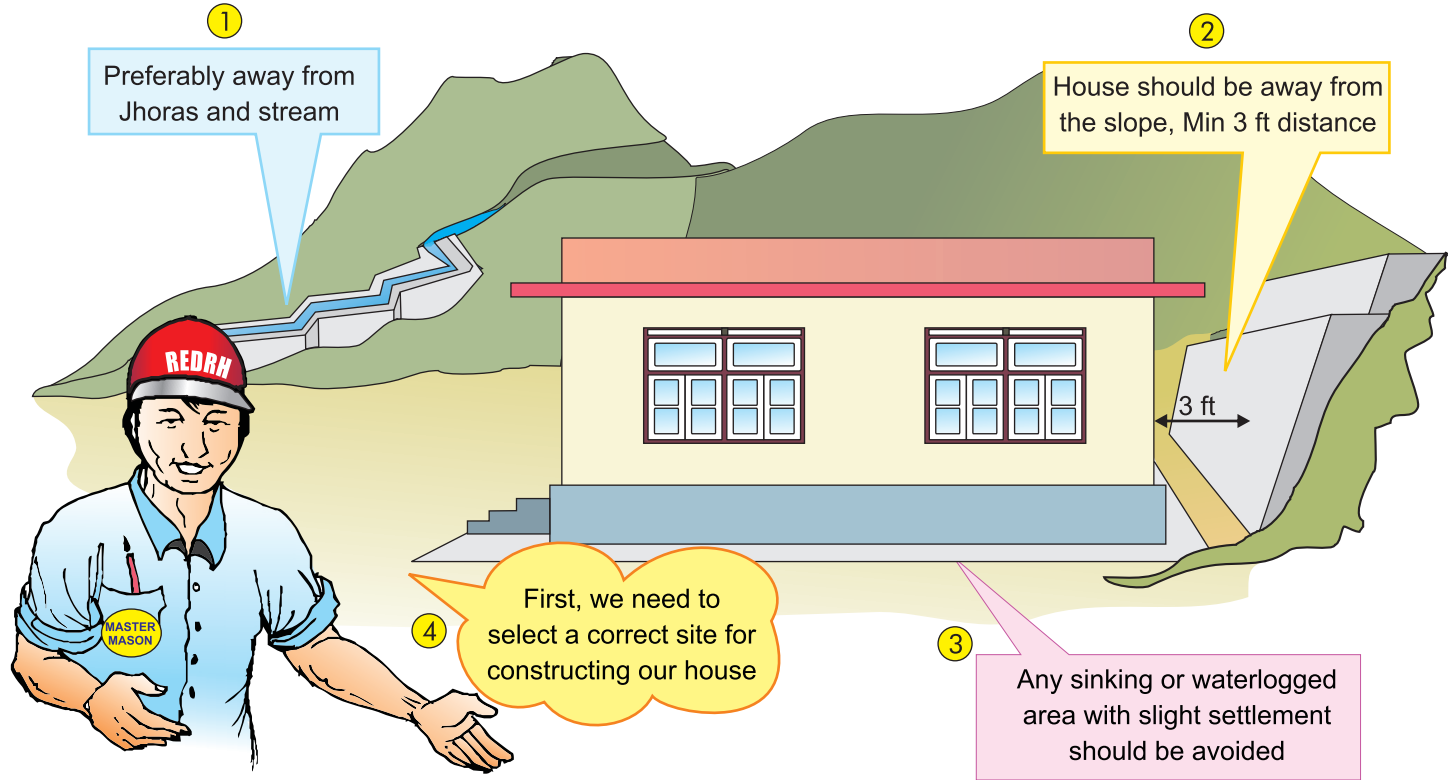


## AERIAL VIEW OF ROOMS

This is what it looks  
like from the inside.  
It has two bedrooms,  
kitchen cum dining room  
and a bathroom



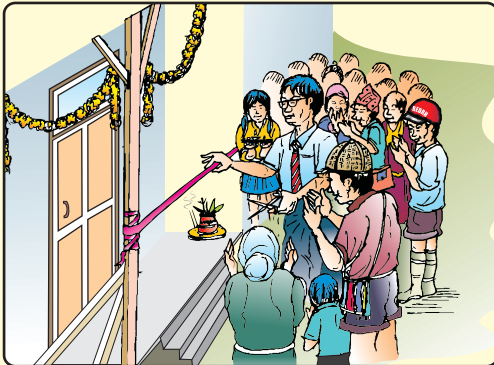
## SITE SELECTION



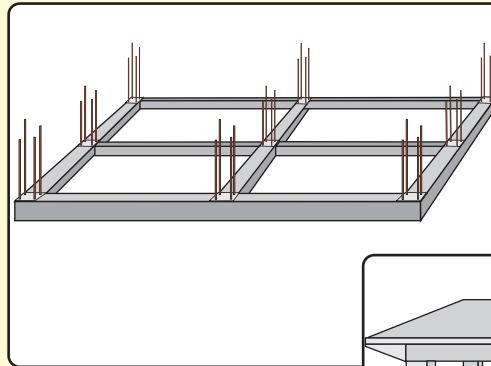
## STAGES OF PROGRESS



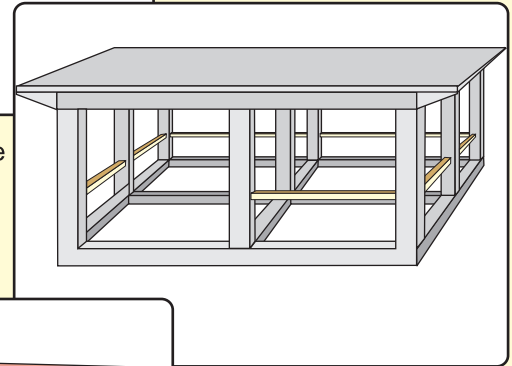
**Stage 1:** Beneficiary selection completed



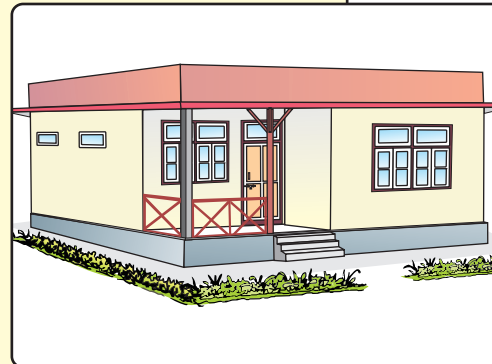
**Stage 5:** Handing over of house



**Stage 2:** Plinth level complete



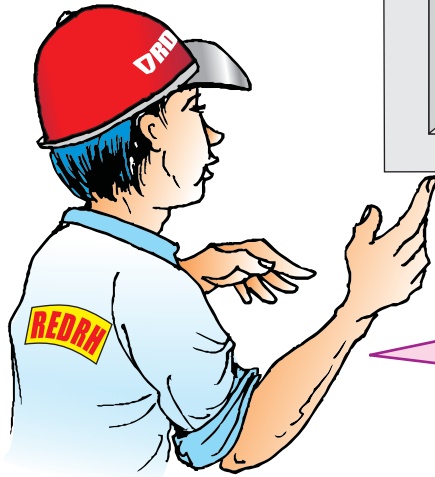
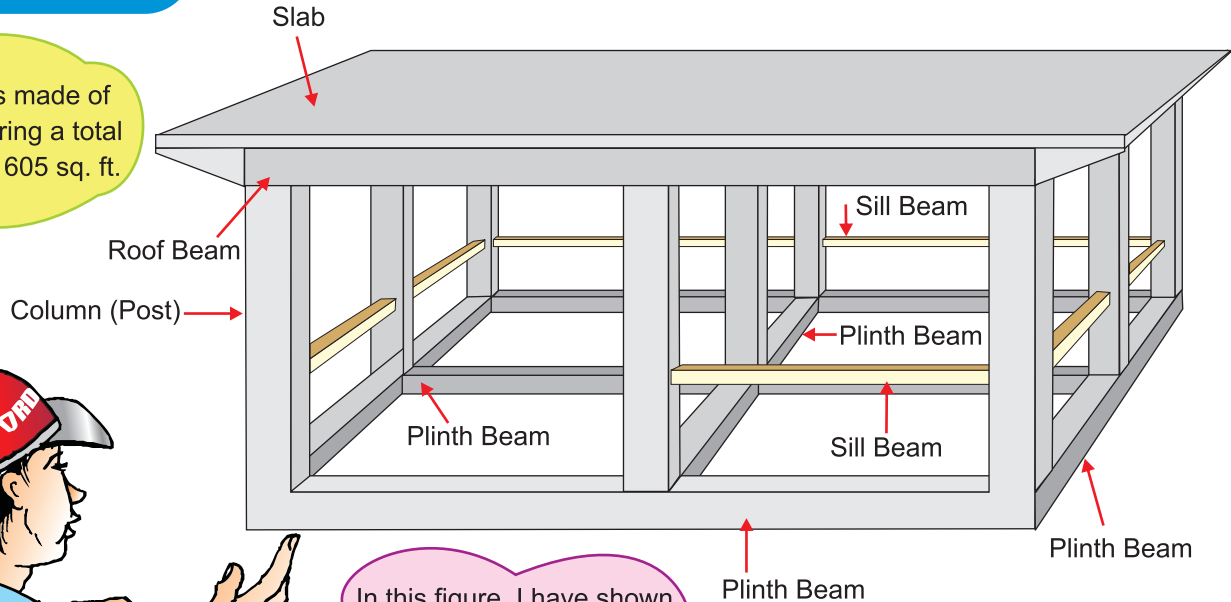
**Stage 3:** Roof complete



**Stage 4:** House fully complete

## PARTS OF THE HOUSE

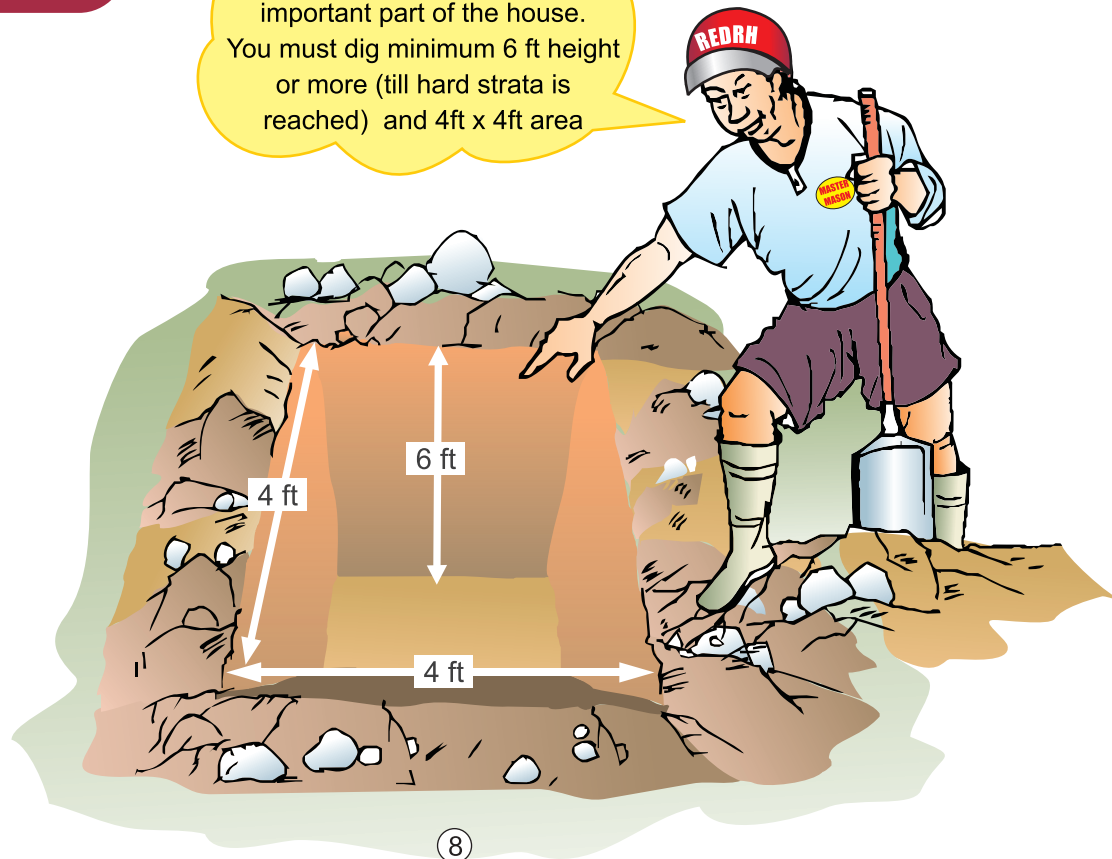
The house is made of 9 posts, covering a total plinth area of 605 sq. ft.



In this figure, I have shown the super structure of the house and we will see how each one is made from the ground up

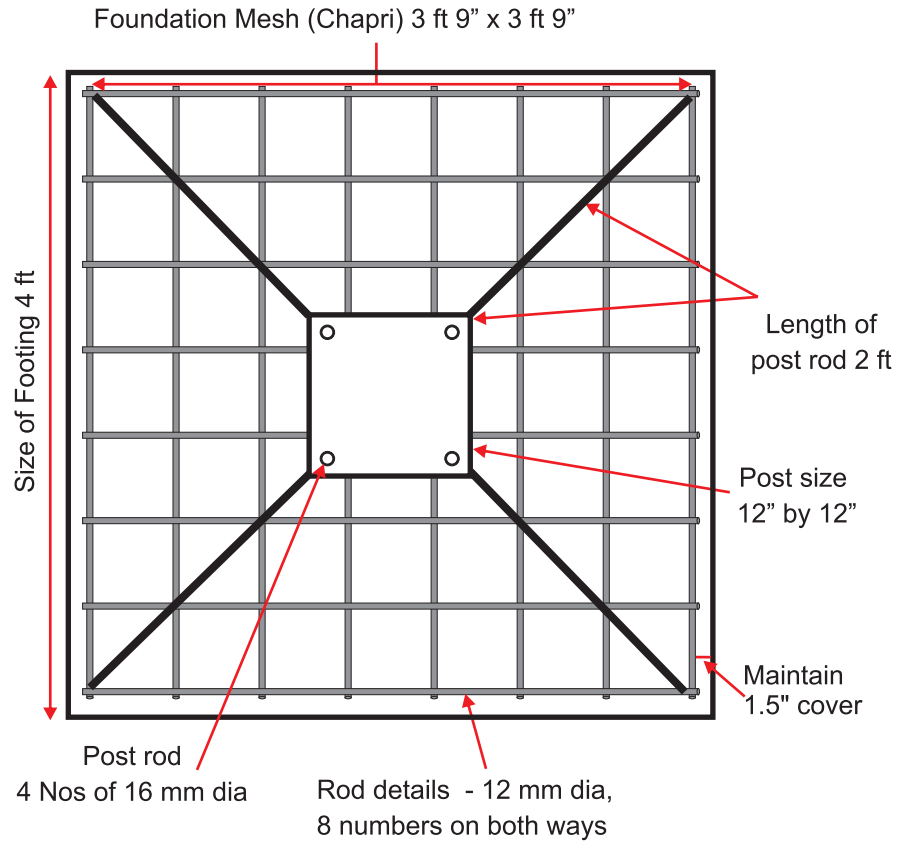
## FOUNDATION

Next the foundation is the most important part of the house. You must dig minimum 6 ft height or more (till hard strata is reached) and 4 ft x 4 ft area

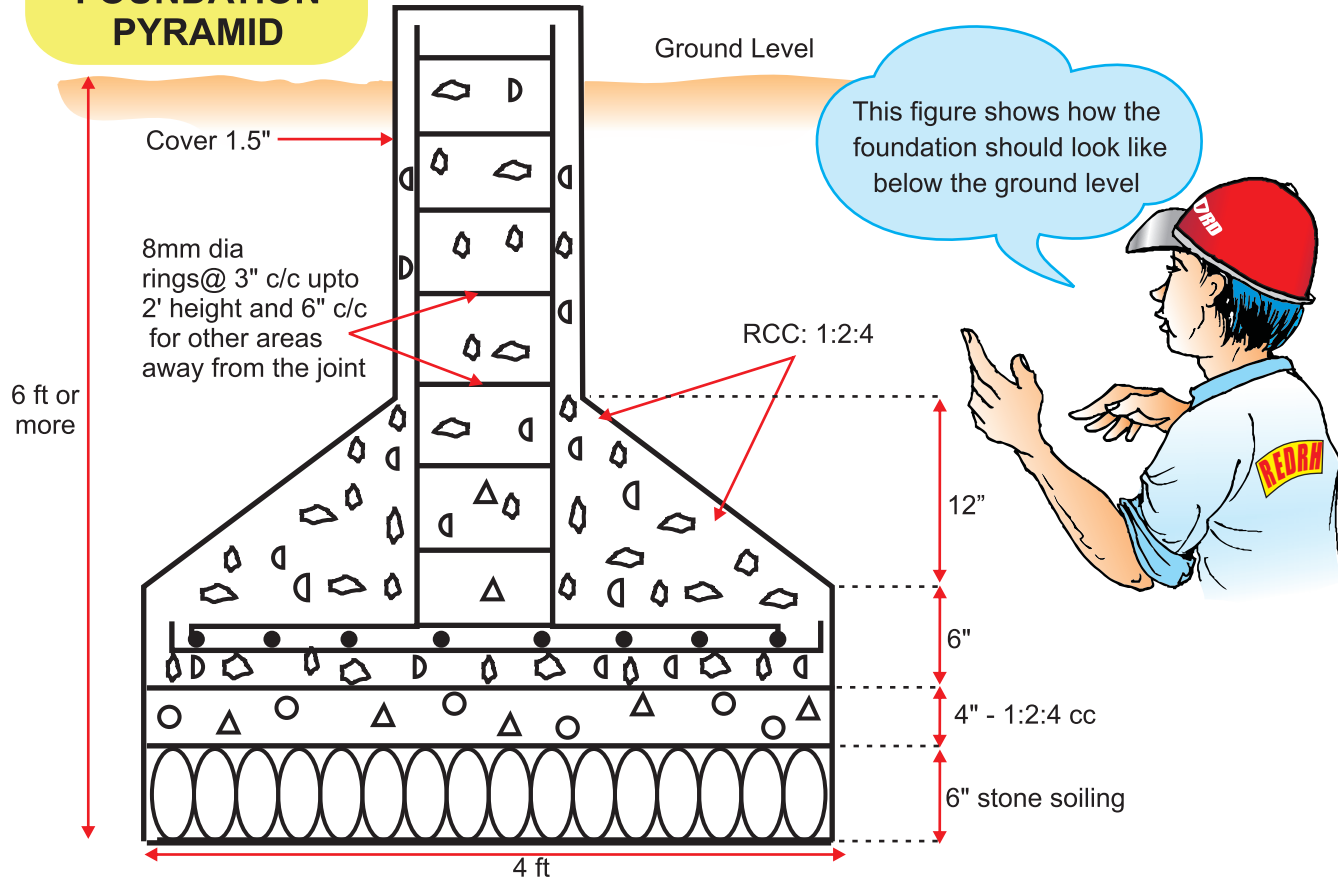


## FOUNDATION FOOTING (CHAPRI)

Size of footing for  
foundation is 4 ft x 4 ft  
and the chapri must look  
as in this diagram



## FOUNDATION PYRAMID



## MAKING RINGS

This is how rings are made. Bend them as shown in figure, bending ends to 135 degree.

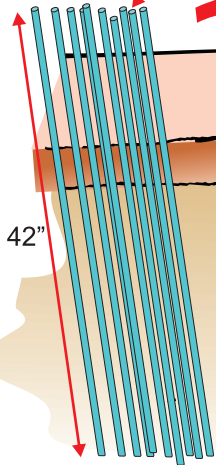
This is very important during earthquakes as it does not come loose causing posts to collapse

Here's a picture of what happens when these are not followed.

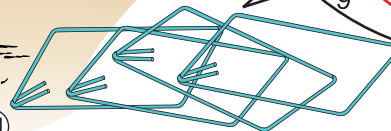
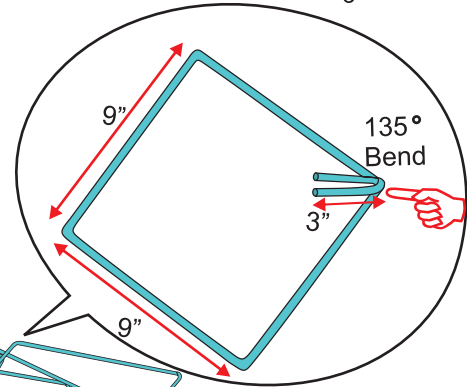
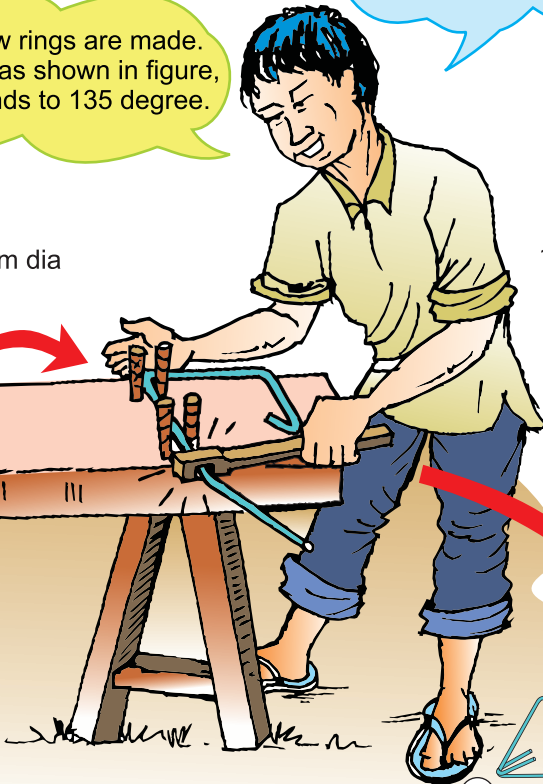


Cut the rod 42" in length

8 mm dia



42"

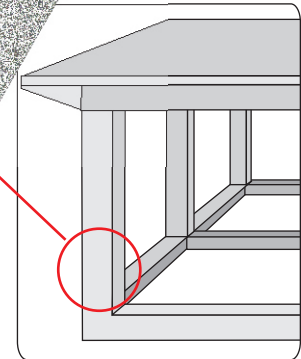
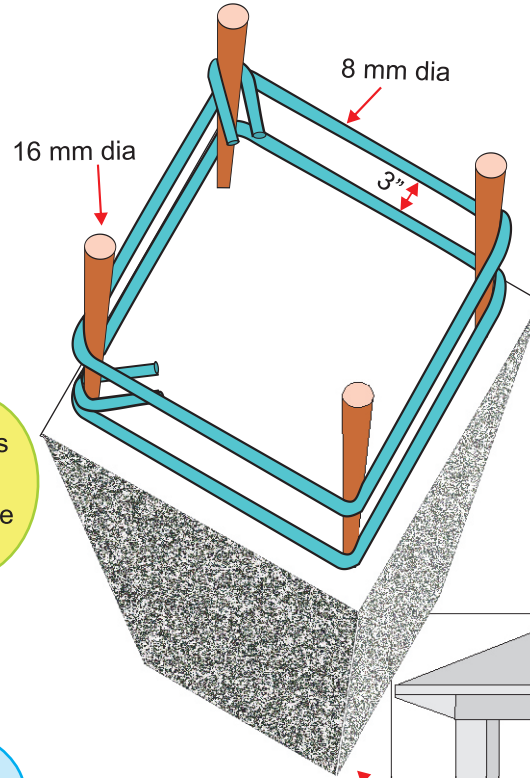


## POSTS

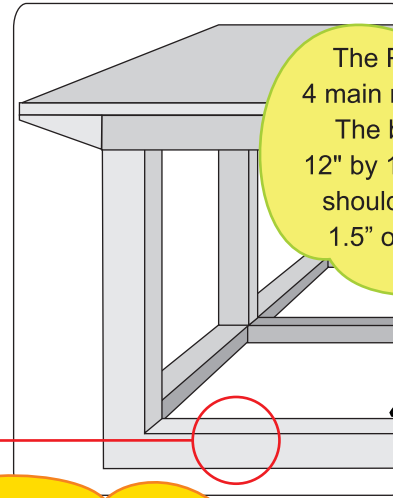
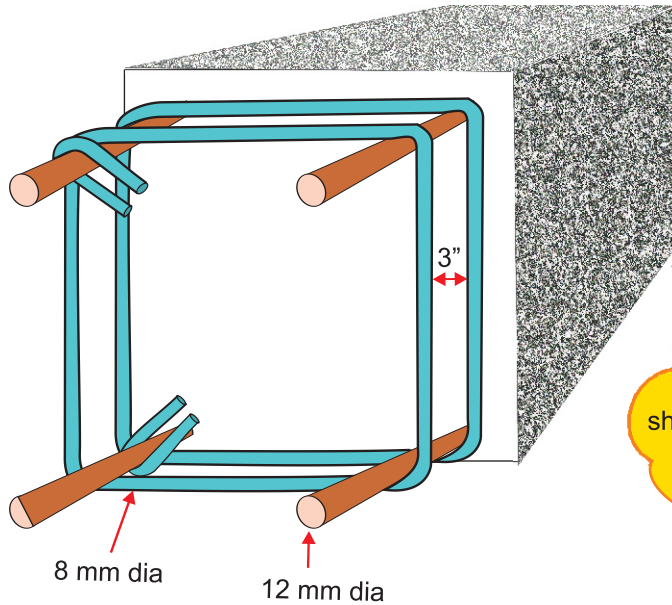
The Post has 4 main rods of 16 mm dia. The post should be 12" by 12", so the rings should be 9" by 9" with 1.5" of concrete cover

Remember again!!  
Gap between rings near joints should be 3". This will again help give strength to the house during earthquakes

Also place rings parallelly (with no tilt) with their open ends at alternate positions as shown in figure

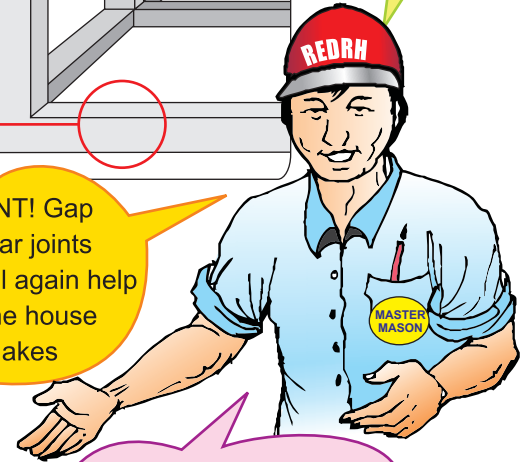


## PLINTH BEAM



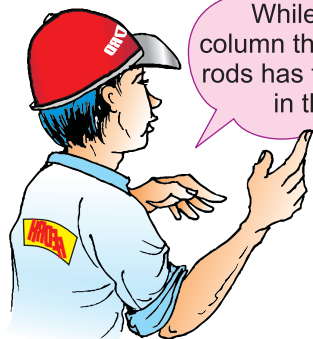
The Plinth Beam has 4 main rods of 12 mm dia. The beam should be 12" by 12", while the rings should be 9" by 9" with 1.5" of concrete cover

VERY IMPORTANT! Gap between rings near joints should be 3". This will again help give strength to the house during earthquakes

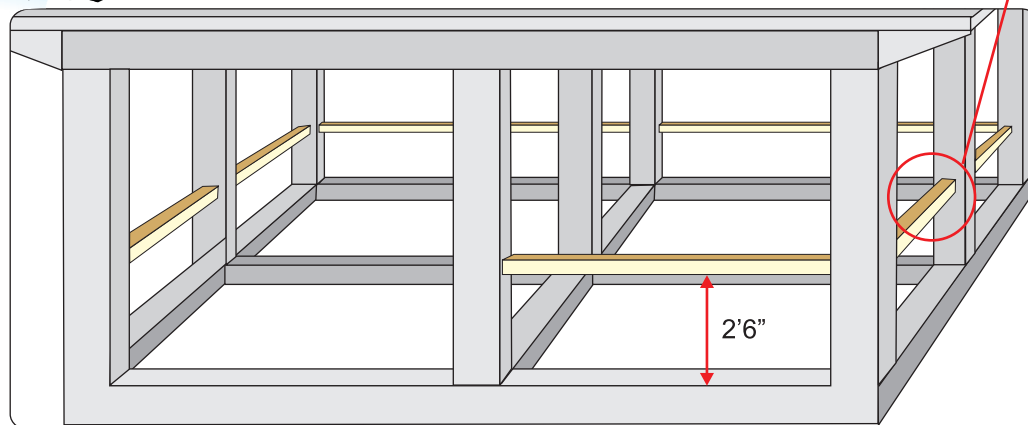
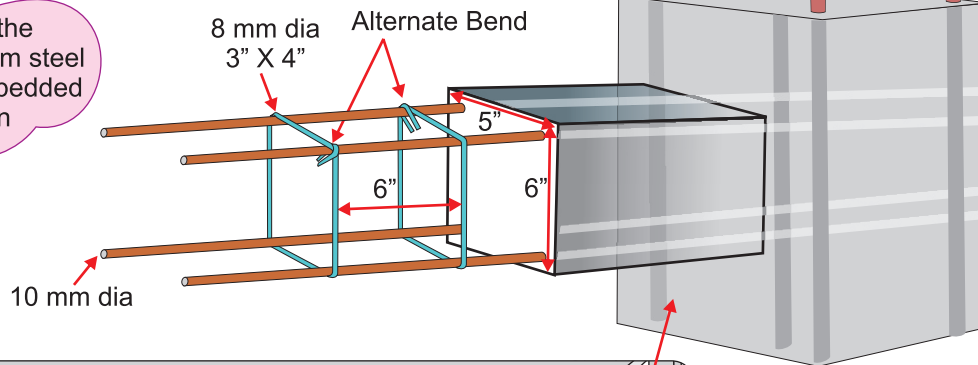


Also place rings parallelly (with no tilt) with their open ends at alternate positions as shown in figure

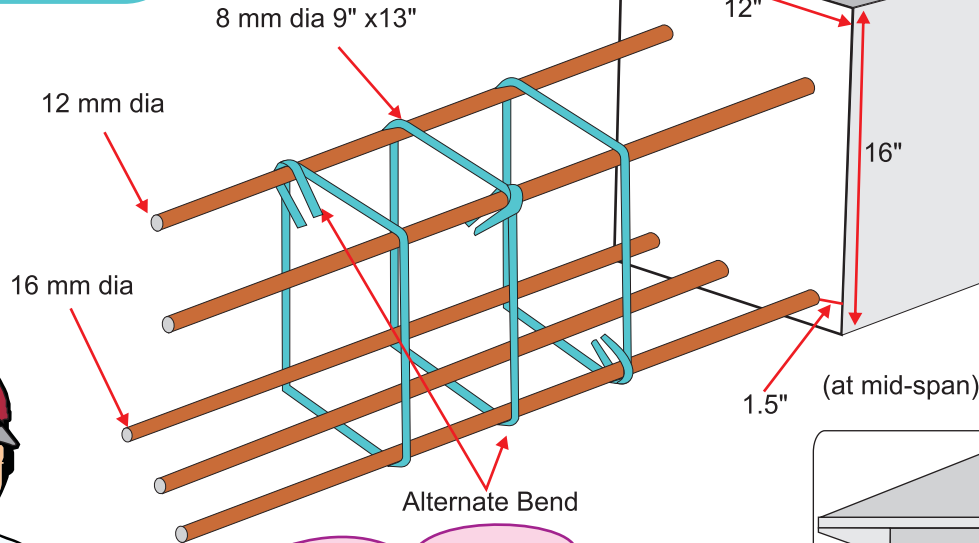
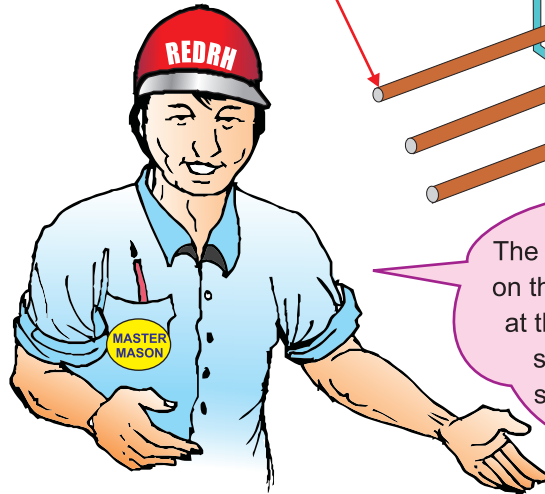
## SILL BEAM



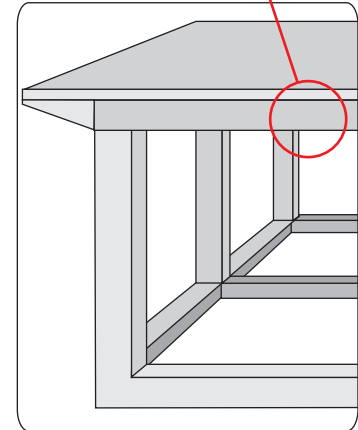
While casting the column the sill beam steel rods has to be embedded in the column



## ROOF BEAM

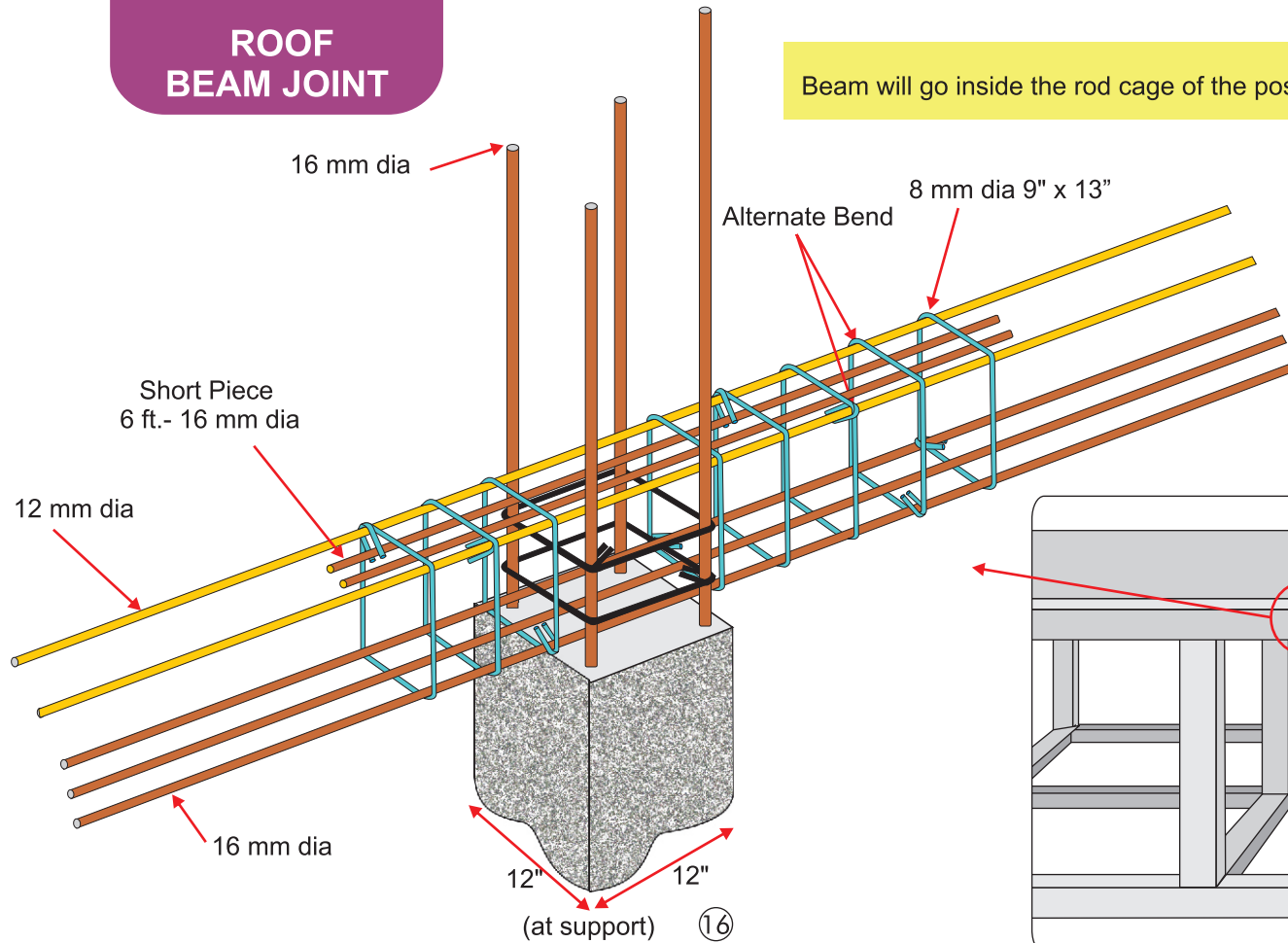


The Roof beam has 2 rods of 12 mm dia on the top and 3 main rods of 16 mm dia at the bottom. Beam including the slab should be 12" by 16", so the rings should be made of 9" by 13" size

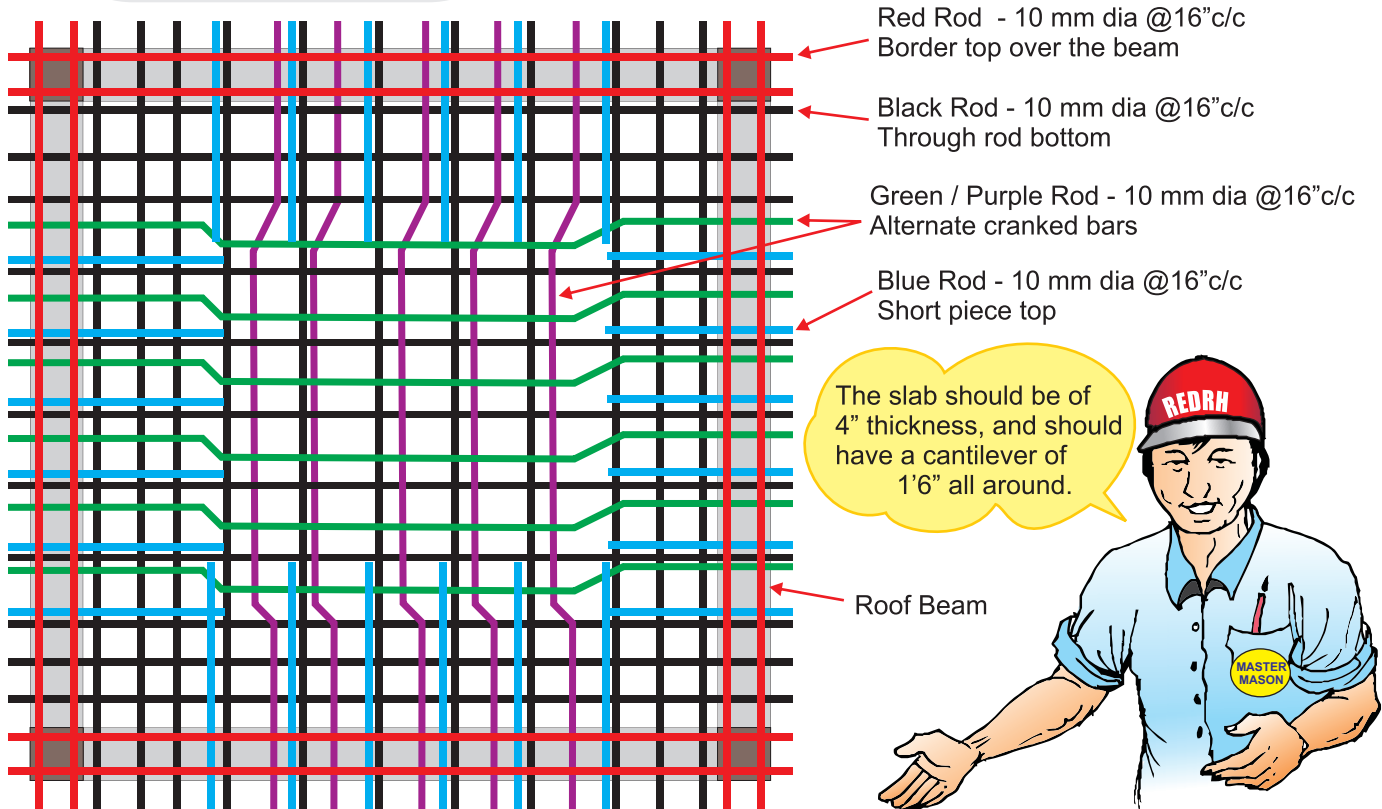


## ROOF BEAM JOINT

Beam will go inside the rod cage of the post

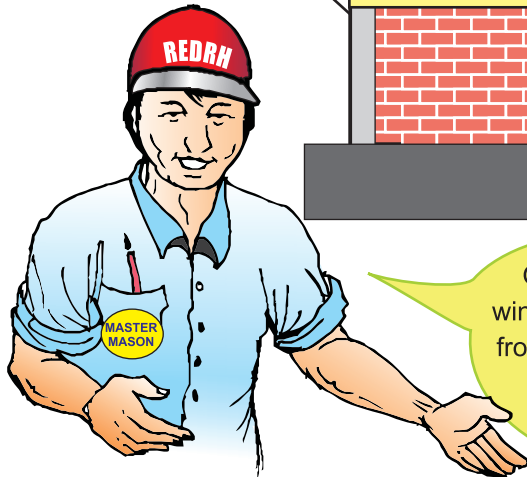
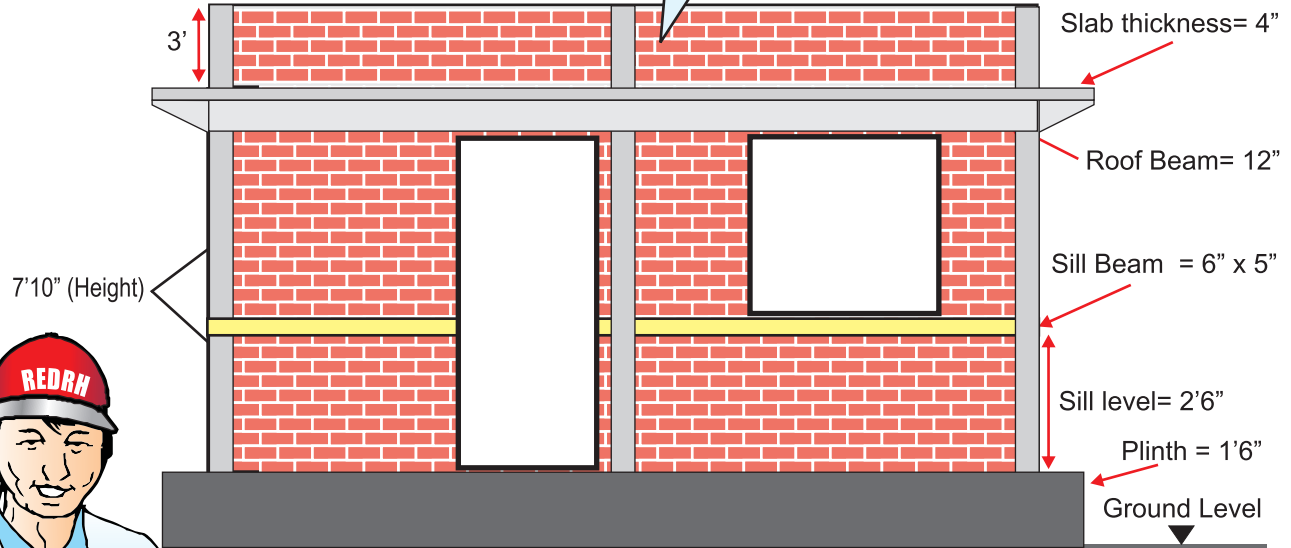


## MAKING THE SLAB



## WALLS-BRICK LAYING

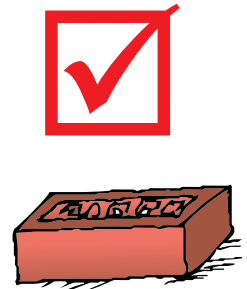
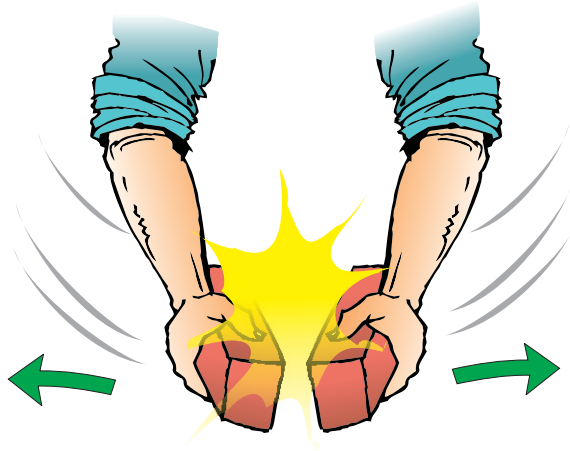
This is the Parapet wall and it can also be made from durable materials with adequate strength



Our house should also have a window sill beam at a height of 2'6" from the plinth, as shown in yellow colour. This is important as it makes house stronger

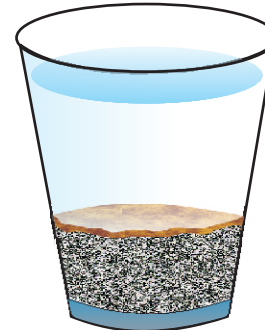
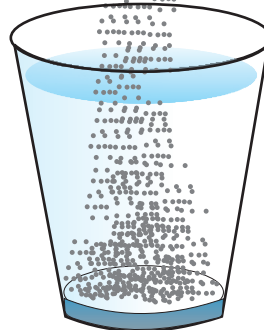
## CHECKING THE QUALITY OF BRICKS

Using good quality material is very important during house construction. Here is how we can check the quality of bricks

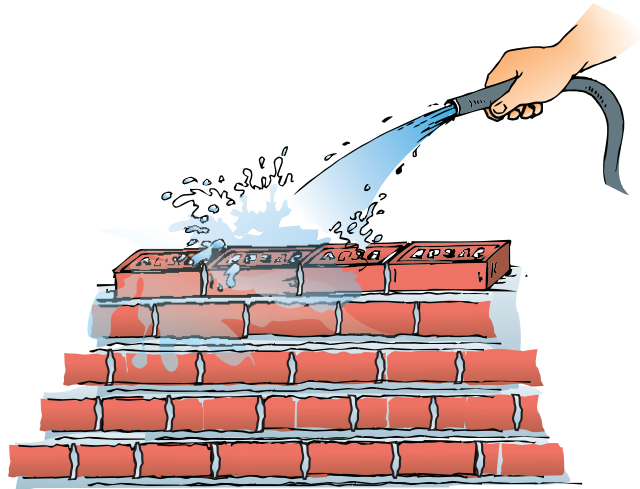


## TESTING SAND QUALITY

Here is how we can check the quality of SAND. Pour sand in glass of water and let it settle. More mud means sand is not good quality.



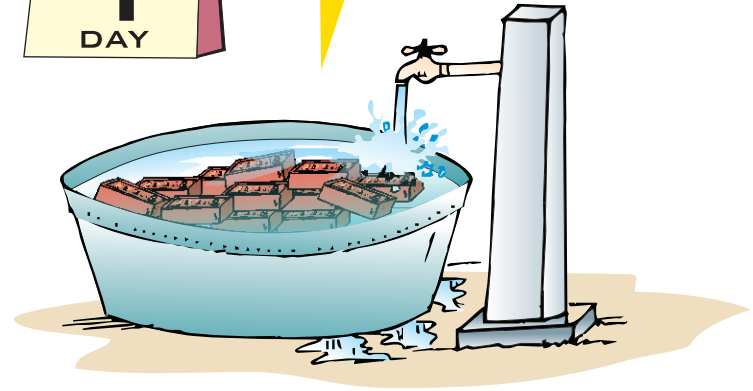
## CURING OF BRICKS AND MORTAR



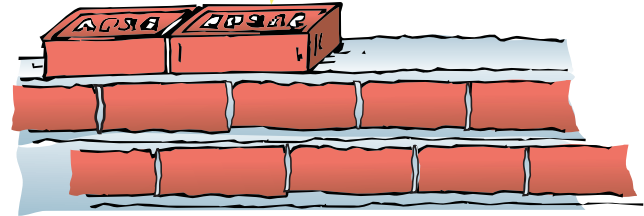
28  
DAYS

1  
DAY

Bricks must be soaked prior to their use. Minimum 24 hours



Use bricks by keeping the logo facing up



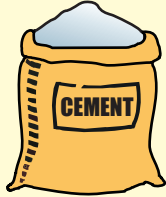
## BRICK LAYING

The laying of bricks should not exceed more than 3 ft height in a day

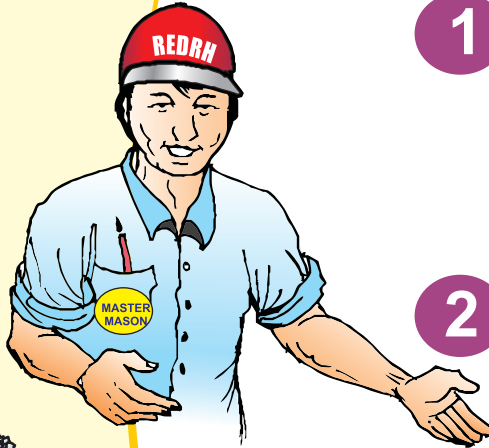
Masala mix – 1:4 (cement: sand)



## MAKING THE CONCRETE MIX



This figure shows the concrete mix for posts and beams, Slab.



1



First mix giti and sand

2



Then add cement to the mixture. Mix well

3



Finally add water

## BATCHING (BAAN)

Giti should be mud free and kept clean

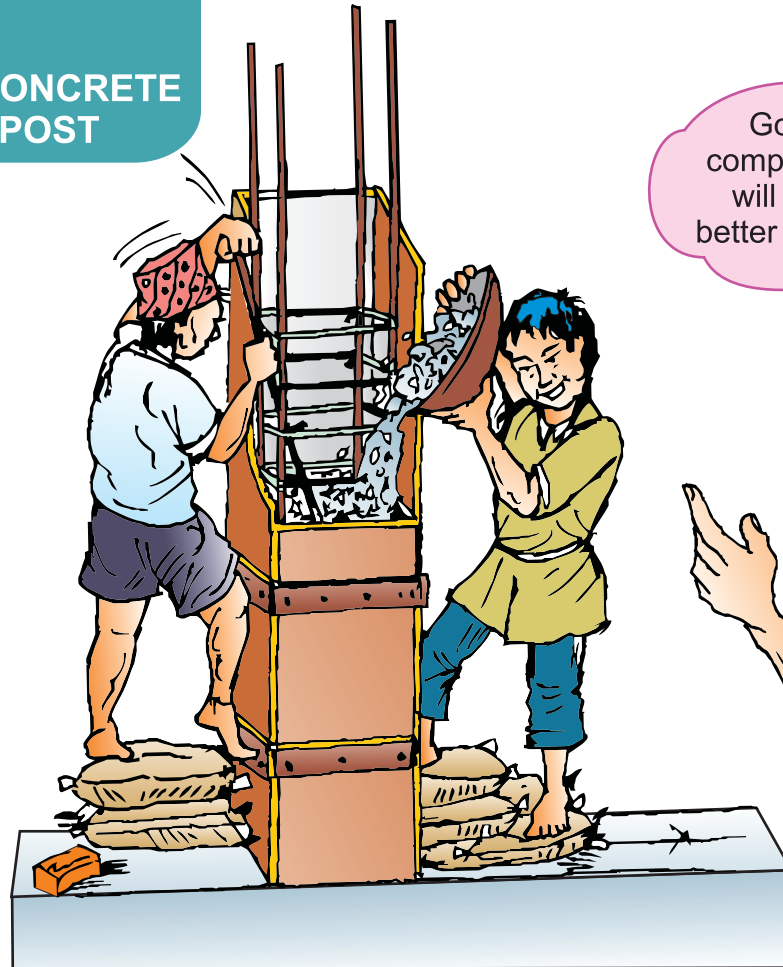
Mixed concrete should be laid within half an hour otherwise it will start becoming hard (setting) after 30 minutes

Always mix cement, sand and giti on a GCI sheet or concrete floor, avoid mixing the same on the ground as it will affect the quality of concrete mixture

Use of leftover concrete after long period of time is not allowed and should be avoided at all cost



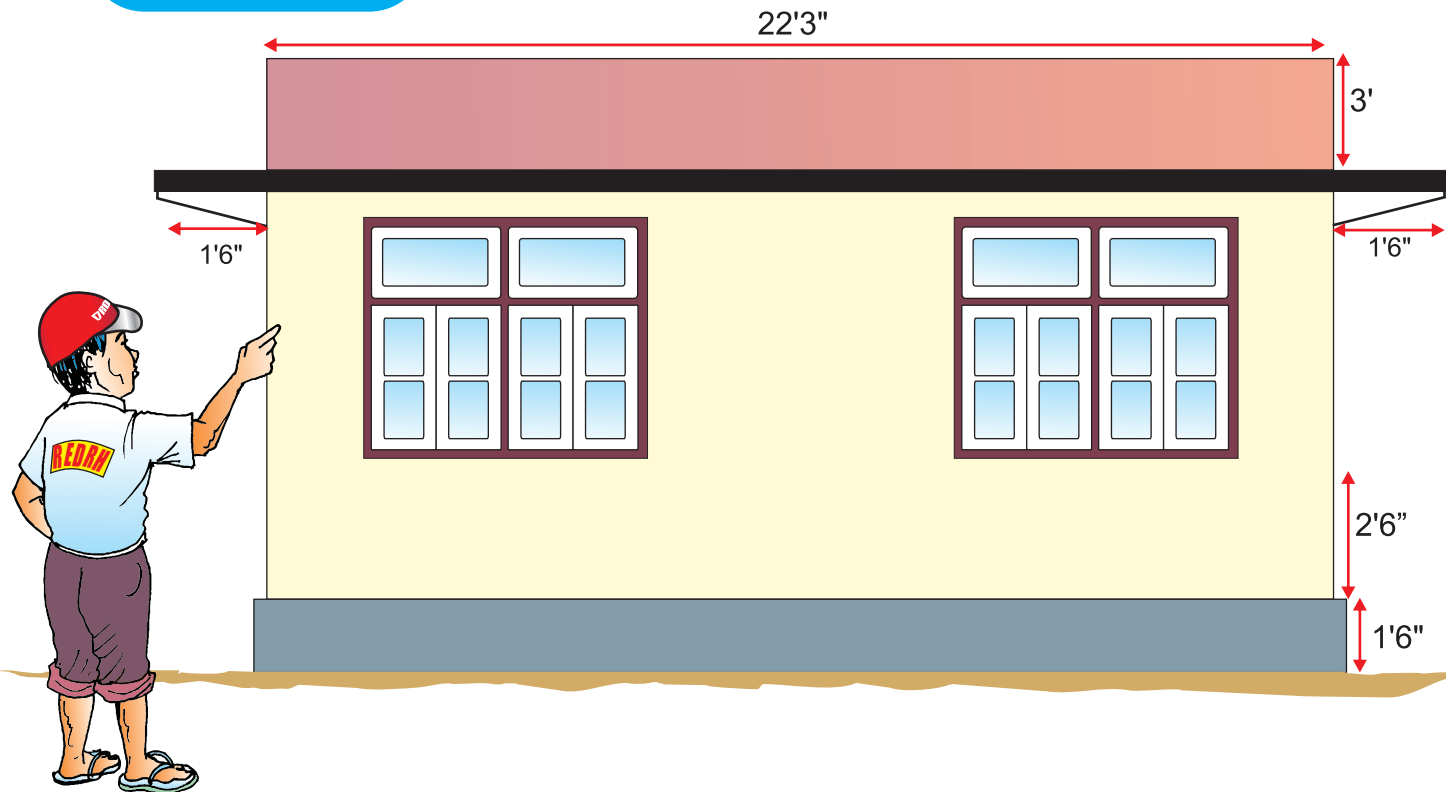
## FILLING CONCRETE INTO POST



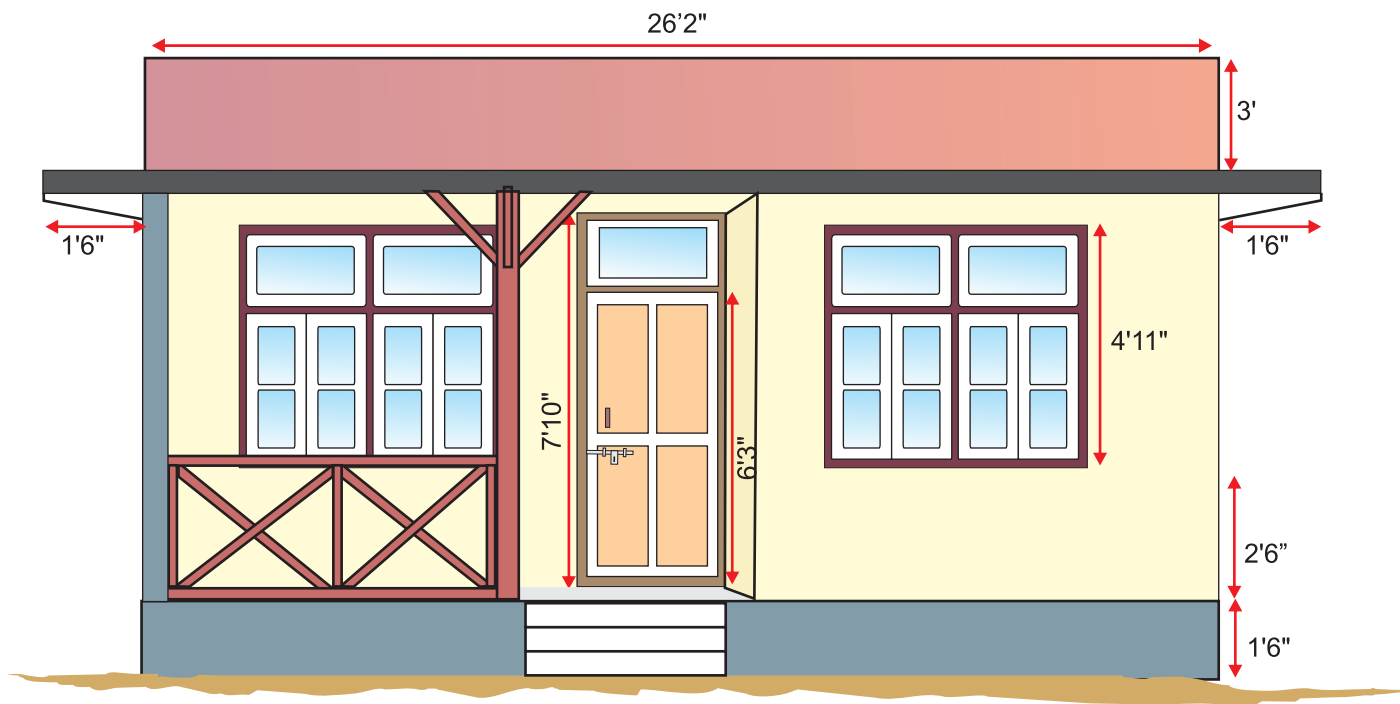
Good  
compaction  
will give  
better results



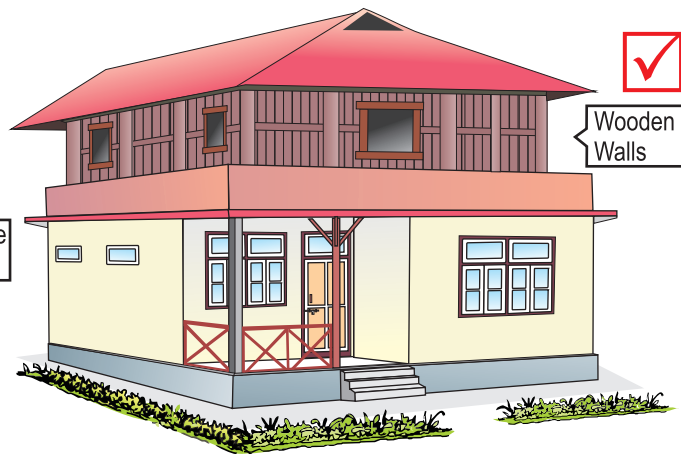
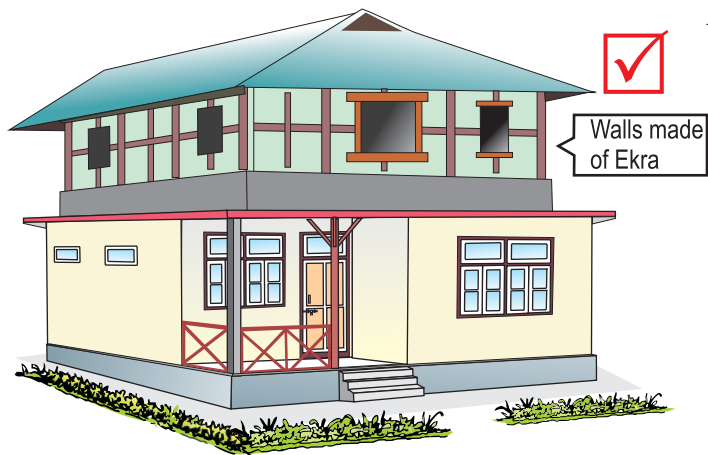
## RIGHT SIDE ELEVATION



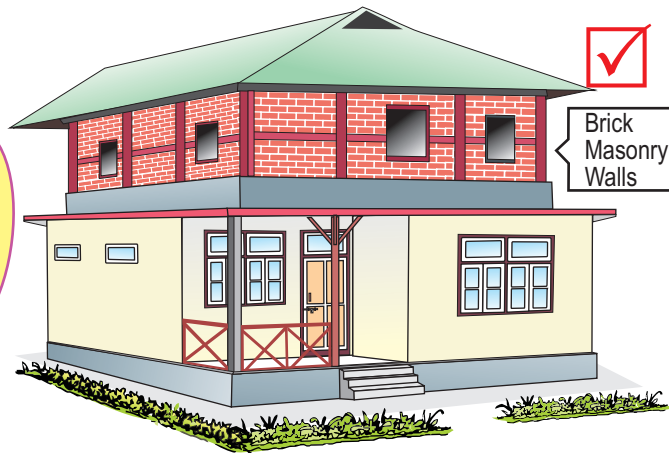
# FRONT ELEVATION



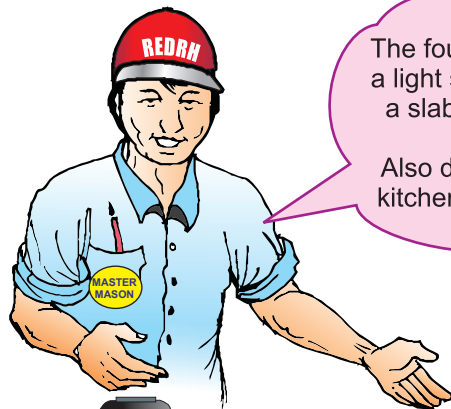
## ADVISORY FOR SECOND STOREY CONSTRUCTION



The foundation is designed for maximum two storeys. In case you plan to construct the second storey, ensure that it is light with a GCI sheet roof. The walls could be made from ekra, timber or brick masonry



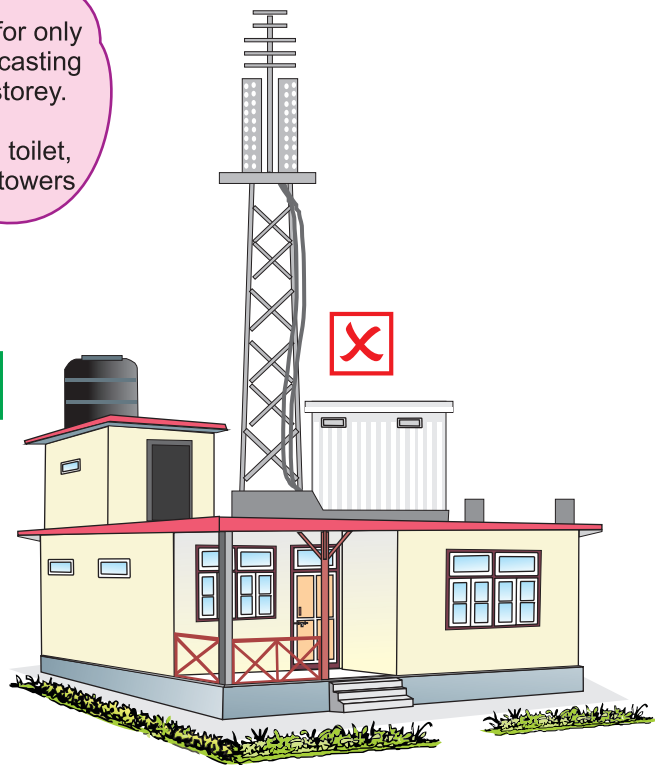
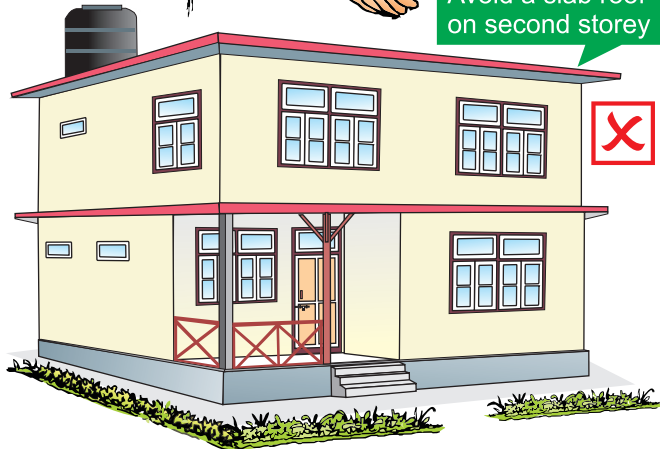
## ADVISORY FOR SECOND STOREY CONSTRUCTION



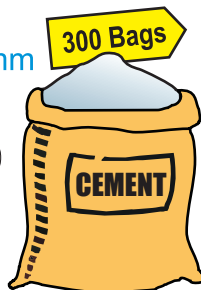
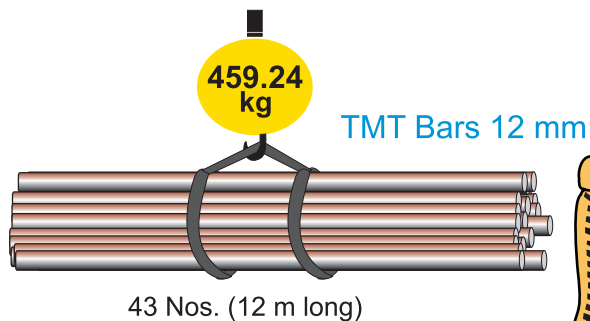
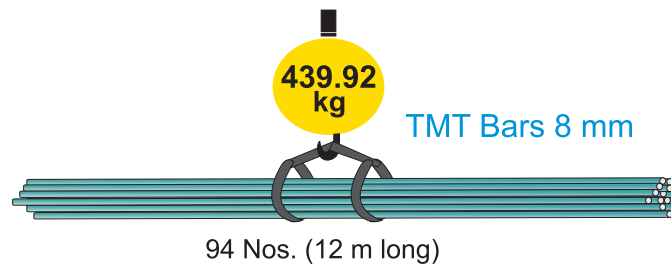
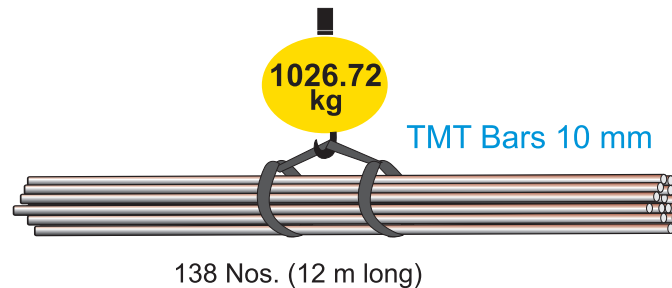
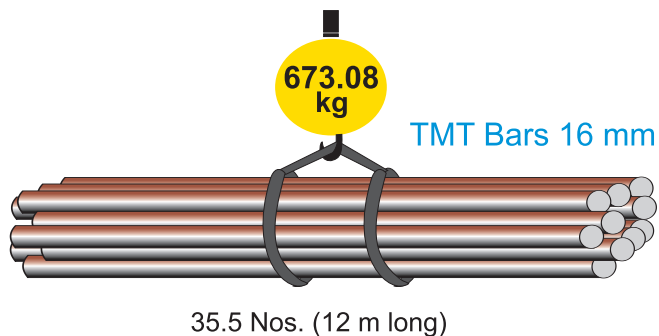
The foundation is designed for only a light second storey. Avoid casting a slab roof on the second storey.

Also do not construct store, toilet, kitchen, water tank, mobile towers etc. on the roof

Avoid a slab roof on second storey



## MATERIALS NEEDED FOR ONE HOUSE





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**Supported by:**

Sikkim State Disaster Management Authority (SSDMA),  
Government of Sikkim

**Illustration, Design & Print**

Peter Lepcha- Arts & Graphix, GtK. Ph. 9434184281