UN HABITAT
FOR A BETTER URBAN FUTURE

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GUIDELINES
for flood resistant house

UN HABITAT
FOR A BETTER URBAN FUTURE

PAKISTAN NDMA

United Nations Pakistan
Improving lives and helping people

INTRODUCTION

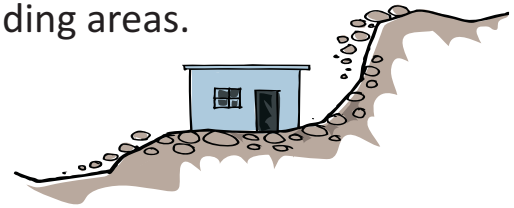
Pakistan is located in a region where disasters like floods and earthquakes are observed frequently and cause of major destruction to infrastructure and houses. 2010 floods are worst in history of Pakistan in which 1.8 million houses damaged.

UNHABITAT has prepared guidelines for flood resistant houses.
By following the guidelines given in this booklet you can build flood resistant house.

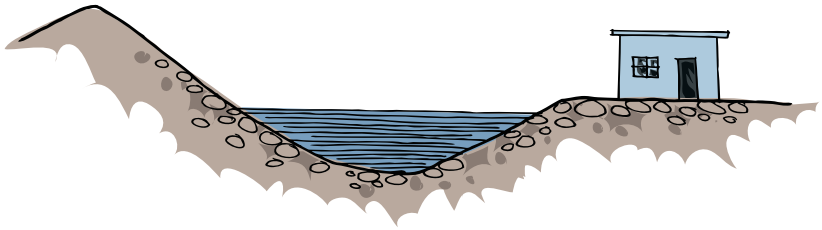
CONTENTS

LOCATION

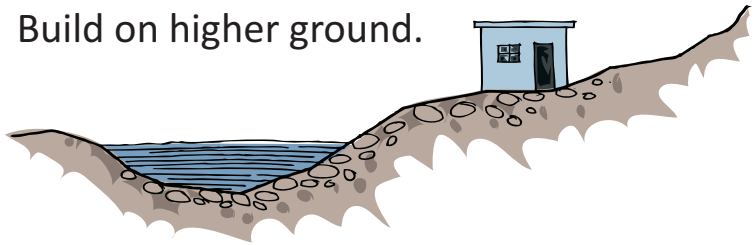
☒ Avoid land sliding areas.



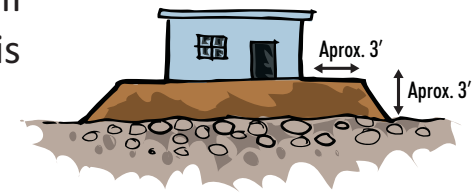
☒ Avoid low laying/river bed.



☑ Build on higher ground.

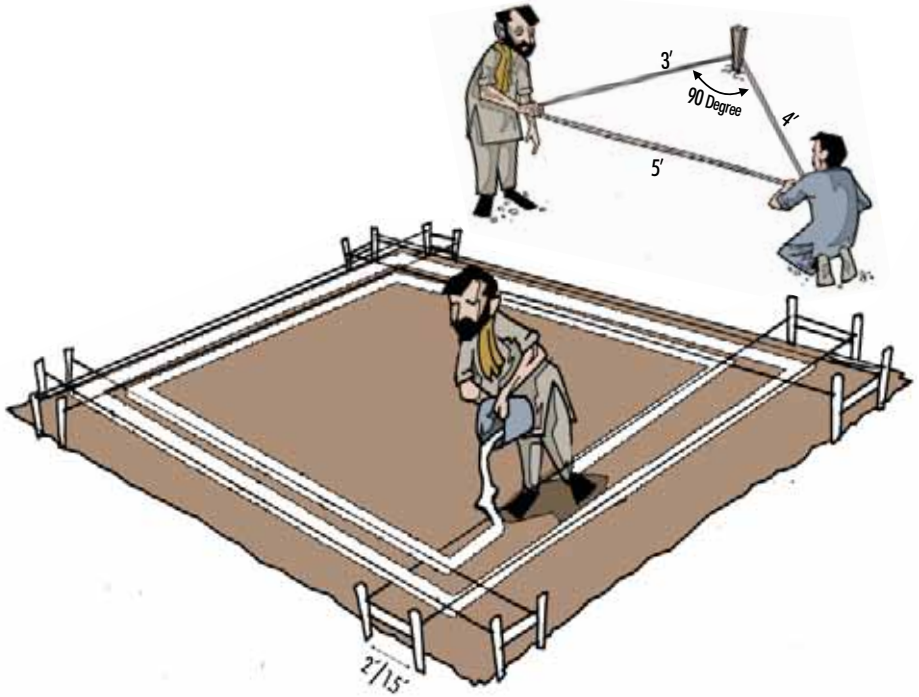


☑ Raise platform if higher ground is not available.



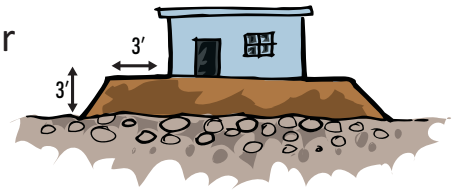
LAYOUT

- Foundation should be min 1.5 to 2 ft wide for proper transfer of wall weight on ground underneath.
- Use rope to put chalk/lime for demarcation.
- To keep walls straight make 3,4,5 triangle at corners.
- Fired Brick/stone/concrete block walls can have maximum length 16 ft and mud walls maximum length 14 ft.



EXCAVATION

- Construct deep and strong foundation.
- Incase of soft and filled soil, after excavation do compaction.
- Excavate 4 ft for soft/filled soil and 2 ft for hard soil.
- For construction on platform, keep a minimum 3 ft distance from outer edges of platform.



FOUNDATION & PLINTH

Foundation

- Build strong foundation with fired bricks/ stones/ concrete blocks in 1:4 C/S mortar.

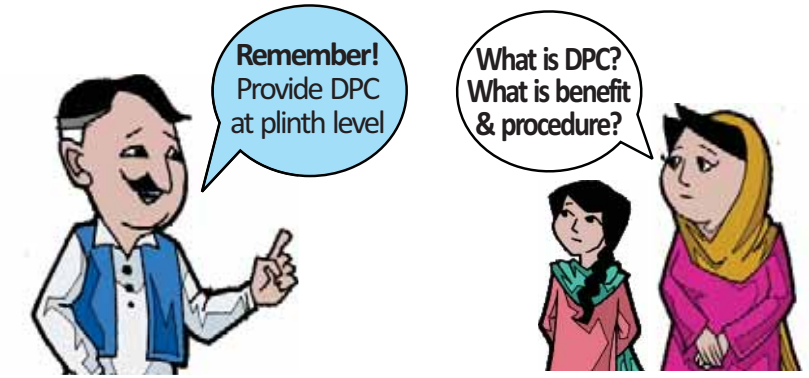
Pointing

- Carryout pointing with 1:4 C/S, if no mortar used for masonry work.

Plinth Level

- Plinth should be minimum 1.5 ft above ground level.

DPC

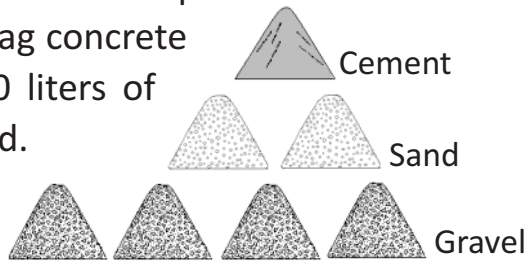


DPC (Damp Proof Coat) stops dampness to travel upward in walls and give long life to our house and walls.

DPC is providing layer of concrete band, bitumen and plastic sheet at plinth level.

PROCEDURE:

- Provide 2 inch thick 1:2:4 concrete band at plinth level.
- Use 1 portion cement, 2 portion sand and 4 portion gravel for concrete preparation.
- For 1 cement bag concrete approximate 30 liters of water is required.



DPC

- Provide 2 mm thick bitumen layer over concrete band.

- Lay 0.2 mm thick plastic sheet over bitumen layer.

FLOOD RESISTANT HOUSE

Fired Brick House

Adobe House

Mud House

Loh-Katt House

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SELECTION OF HOUSE

Don't worry!!!!!

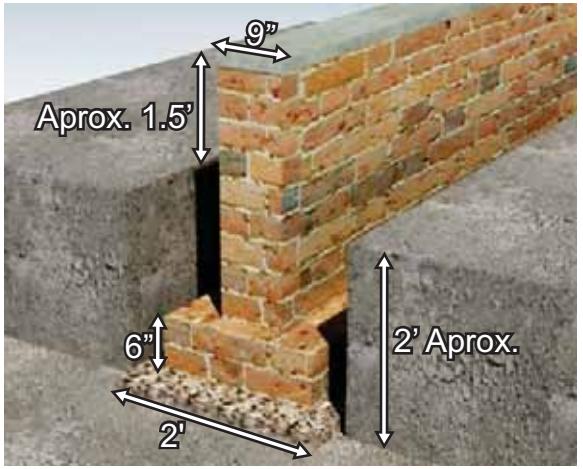
Adopt any one of the mentioned below designs for flood resistant house in which you have expertise and relevant to your area.

- ☑ **Fired Brick House**
- ☑ **Adobe House**
- ☑ **Mud House**
- ☑ **Loh-Katt House**

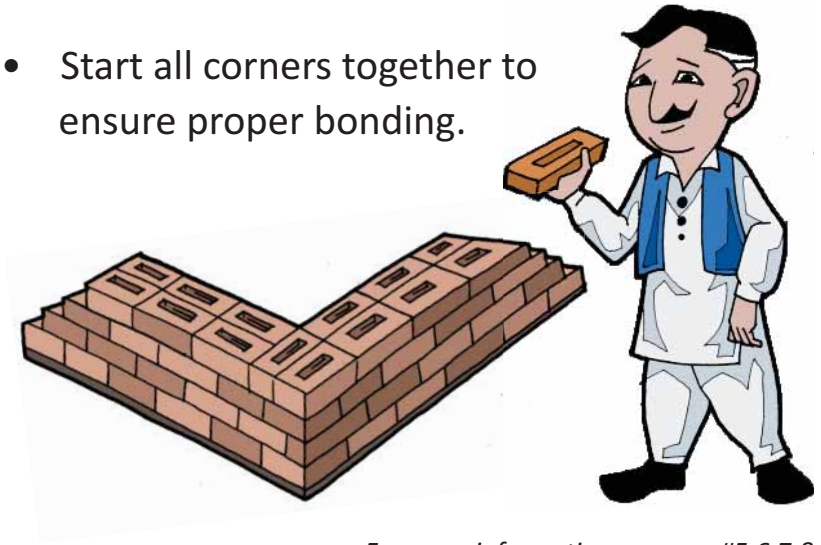
FIRED BRICK HOUSE

FOUNDATION

- Minimum wall thickness should be 9 inches.



- Start all corners together to ensure proper bonding.



*For more information see page#5,6,7,&8.

FLOOD PROTECTION

- Apply 1:4 C/S plaster inside and outside of walls up to flood level.

Use steel brush to remove mud/dust from the joints.

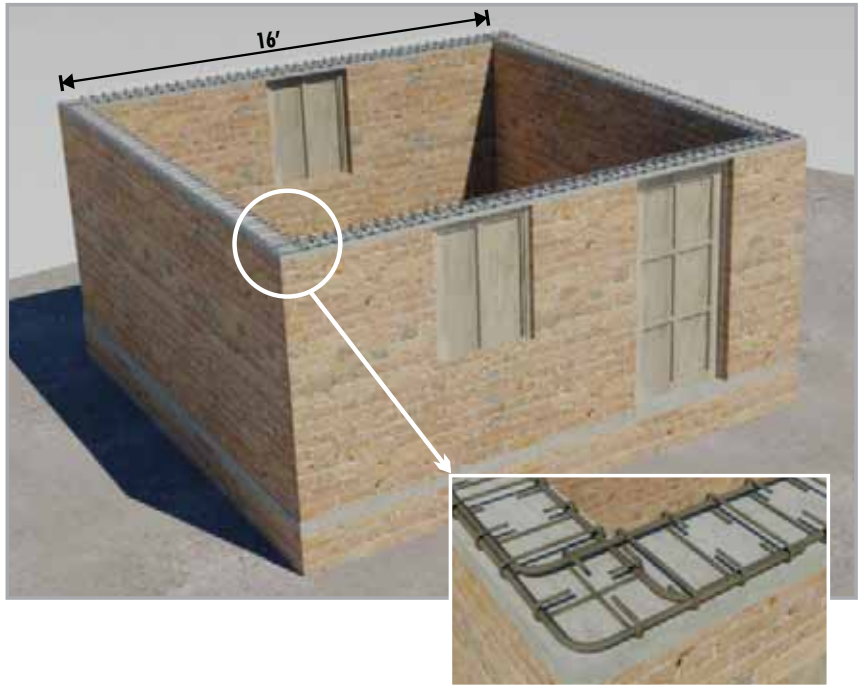
- Sprinkle water on masonry before applying plaster.

Use cement mortar within 30 minutes.

EARTHQUAKE PRONE AREAS

Provide lintel and roof bands in houses constructed in earthquake prone areas.

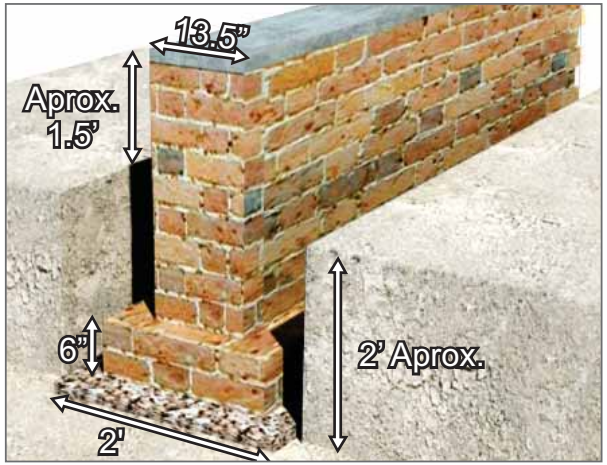
- Use minimum 3 inch thick 1:2:4 concrete band. Place two horizontal 3''' bars with 2''' stirrups at 6inch c/c.
- Keep room height maximum 10 ft and wall length maximum 16 ft.



ADOBE BRICK HOUSE

FOUNDATION

- Minimum wall thickness should be 13.5 inches.



REMEMBER!!!
Use fired brick/ stone/concrete foundation in adobe brick house.

*For more information see page#5,6,7,&8.

FLOOD PROTECTION

- Use fired brick/stone/concrete block masonry in 1:4 C/S mortar upto flood level.

Use steel brush to remove mud/dust from the joints.

- Sprinkle water on masonry before applying plaster.
- Incase masonry done with mud mortar; apply cement plaster or pointing of joints or water proof mud plaster.

Use cement mortar within 30 minutes.

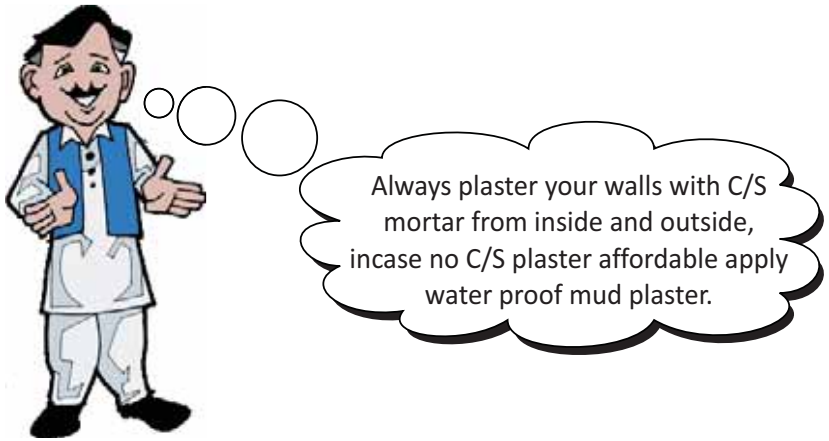
* *See water proof mud mortar preparation on next page*

ADOBE BRICK PREPARATION

- Select clean soil free of stones, leaves, grass and debris.
- Add sand incase soil is clayey.
- Add required quantity of water and knead it.
- Pour kneaded mud in brick mould and compact it.
- Take out adobe brick and let it dry on dry sand platform.
- Turn the bricks on all edges until it gets a uniform colour.

Adobe brick preparation

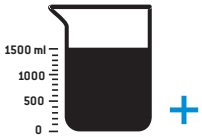
WATER PROOF MUD



PROCEDURE:

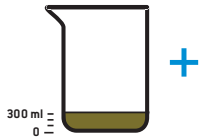
- Prepare mud with mixing sufficient sand and straw in soil.
- For water proofing add bitumen (Tar-coal) in mud. Use kerosene oil to thin bitumen and pour it over mud and knead it well.
- Apply water proof mud before bitumen(Tar-coal) dries.

Mix 1.5 kg hot melted bitumen with 300 ml kerosene oil. Pour mixture on approx. 30 litres of mud mortar and shovel it thoroughly.



Bitumen 1.5 kg

+



Kerosene Oil (300ml)

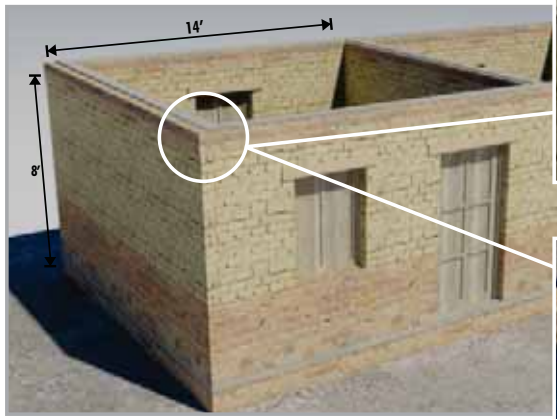
+

Mud (30 ltr)

EARTHQUAKE PRONE AREAS

Provide lintel and roof bands in houses constructed in earthquake prone areas.

- Keep room height maximum 8 ft and wall length maximum 14 ft.



Galonized mesh

Concrete Band

- Provide Reinforced Brick(RB) Band: Place fired bricks on adobe bricks. Place bricks with C/S mortar on edges leaving a cavity for placing two horizontal 3''' bars with 2''' stirrups at 6inch c/c. Fill the cavity with 3 inch thick 1:2:4 concrete.

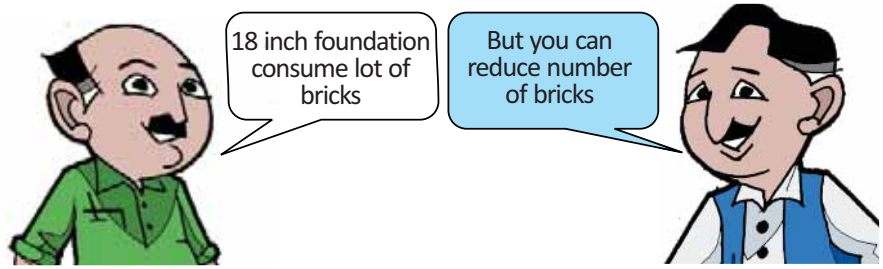
OR

- Provide 16 SWG GI wire with 1.5"x1.5" squares.

MUD HOUSE

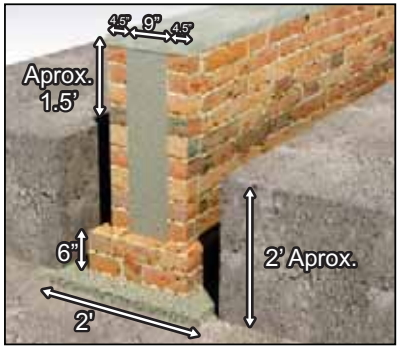
FOUNDATION

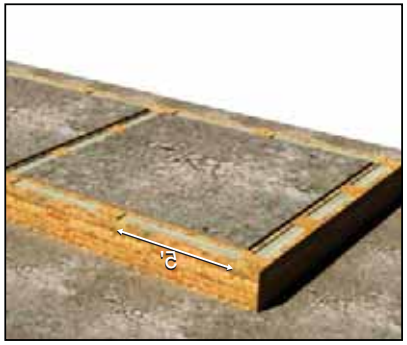
- Minimum wall thickness at base 18 inch and at top 12 inch.



BRICK REDUCTION ADVICE

- To reduce numbers of bricks in foundation construct 4.5 inch walls on both edges of base. Join the brick walls at every 5 ft. Fill the gap with sand and compact it. Provide 2 inch thick 1:2:4 concrete band(DPC) at plinth level.





*For more information see page#5,6,7,&8.

FLOOD PROTECTION

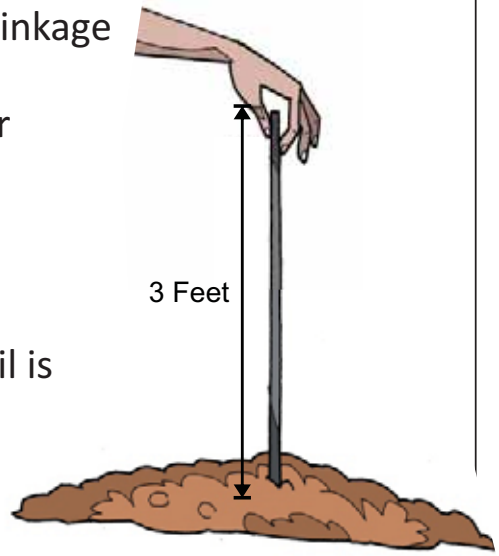
- Select clean soil free of stones, leaves, grass and debris.
- To reduce shrinkage and cracking in mud, add sufficient sand and straw in soil.
- Start mud masonry above plinth and construct 1.5 ft high layer in one day. Wet the surface before placing next layer.
- For flood water resistance apply water proof mud plaster on both sides of wall up to flood level.
- Build all corners together to have strong corners joints.

For flood water resistance apply water proof mud plaster on both sides of wall up to flood level

* See water proof mud mortar preparation on next page

MUD PREPARATION

- Add sufficient amount of sand, straw and water in soil for mud preparation.
- Add sand to reduce shrinkage and cracking.
- Avoid too much sand or sandy soil as it has less bonding capacity.



FIELD TESTS:

- Too clayey or sandy soil is not suitable therefore following simple field test can be done to identify suitable mud for construction.

WATER RATIO(WORKABILITY)

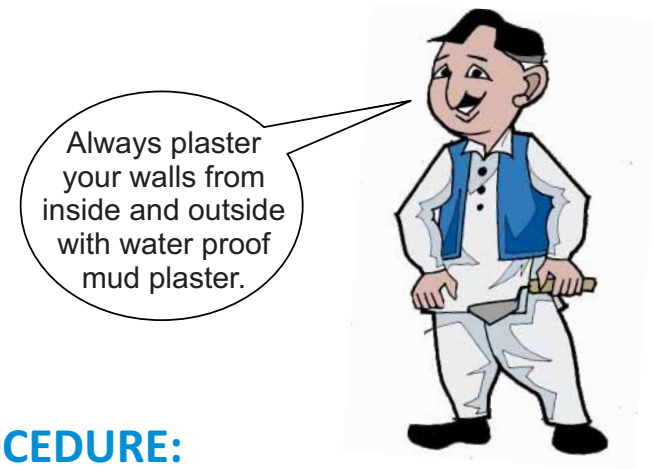
- Take a small lump of mud from prepared mix and place on plane surface. Take a 15inch 3''' bar and rest it on the surface of the damp soil.
- Let the bar sinks with its own weight.
- If bar sinks in 1 inch, not more or less than the water content is right and mud can be used for masonry work otherwise add more sand and clay to reduce water ratio.

MUD PREPARATION

SAND: CLAY RATIO (PLASTICITY)

- Take enough soil and make a roll about the diameter of thumb but about two or three times longer.
- Place a roll on hand and flatten it between thumb and forefinger to form a ribbon 0.5-1 inch and 8 inch long if possible.
- Slide the roll across the palm until it breaks.
- Measure the broken piece, if length is 6 inch or more than clay content is more, so add more sand.
- If length is between 3-4.5 inch the sand and clay contents are fine and soil is suitable for mud construction.
- A short length means clay is not enough and require more clay. Otherwise cannot be used for construction.

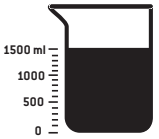
WATER PROOF MUD



PROCEDURE:

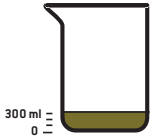
- Prepare mud with mixing sufficient sand and straw in soil.
- For water proofing add bitumen (Tar-coal) in mud. Use kerosene oil to thin bitumen and pour it over mud and knead it well.
- Apply water proof mud before bitumen(Tar-coal) dries.

Mix 1.5 kg hot melted bitumen with 300 ml kerosene oil. Pour mixture on approx. 30 litres of mud mortar and shovel it thoroughly.



Bitumen 1.5 kg

+



Kerosene Oil (300ml)

+

Mud (30 ltr)

EARTHQUAKE PRONE AREAS

Provide lintel and roof bands in houses constructed in earthquake prone areas.

- Keep room height maximum 8 ft and wall length maximum 14 ft.

Horizontal Bands:

- Provide 3 to 4 inch thick 1:2:4 concrete band with two horizontal 3''' bars with 2''' stirrups at 6inch C/C.

OR

- Provide 16 SWG GI wire with 1.5"x1.5" squares.

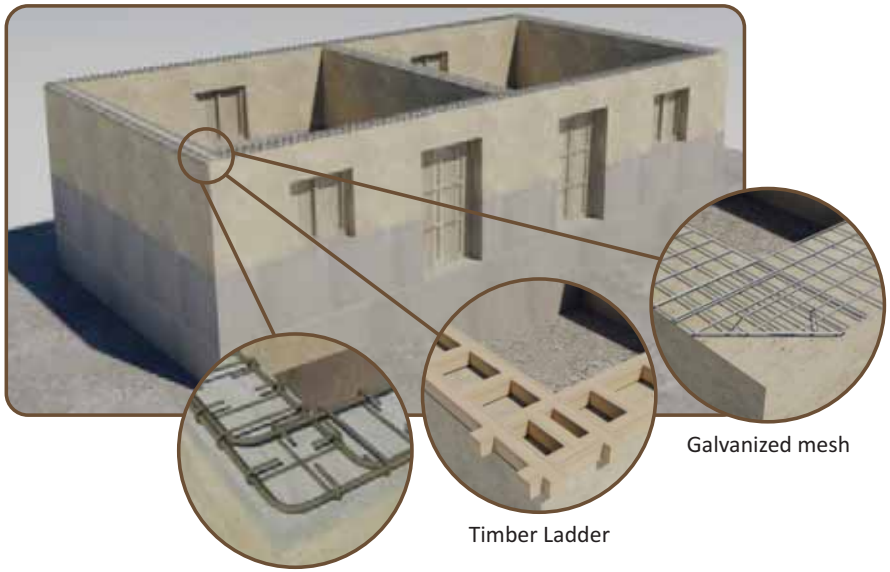
OR

- Provide wooden(ladder type) band with two horizontal pieces of 3"x1.5" size in longitudinal direction and tie them with cross pieces of 2"x1.25" size timber @ 18"c/c with the help of nails.

*Band photos are shown at next page.

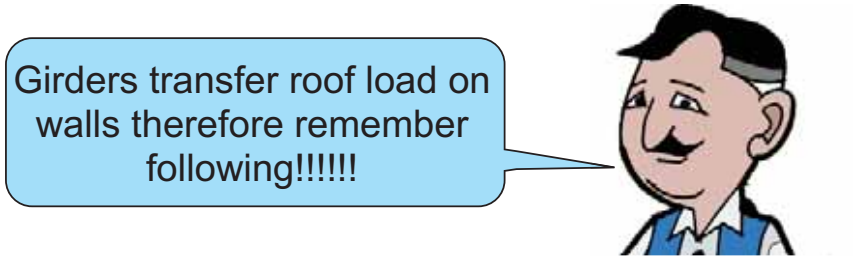
HORIZONTAL BANDS

Provide lintel and roof bands in houses constructed in earthquake prone areas.



ROOF
&
WATER DRAINAGE

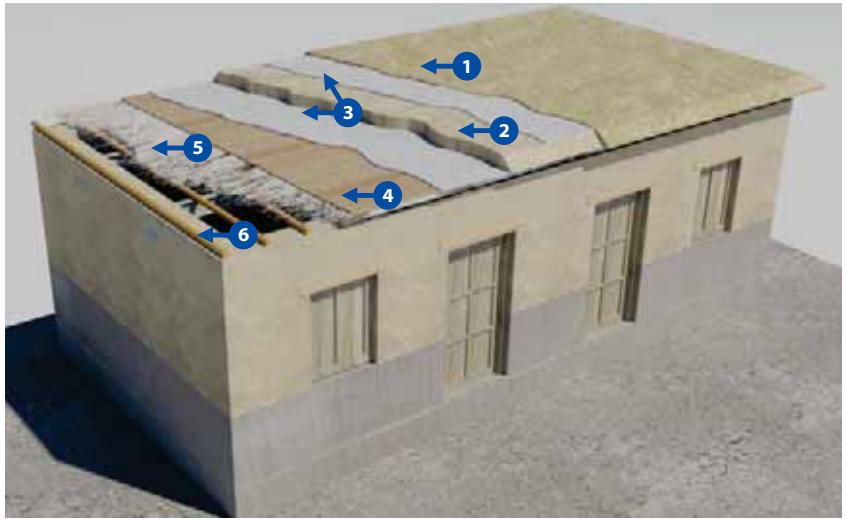
ROOFING



- Girders should have bearing on wall not less than 3/4 inch times the thickness of wall.
- Provide bearing pad of concrete, wooden plate or burnt bricks under girders for uniformly distribution of load.
- Provide 4 inch thick girder at maximum 5 ft c/c spacing.
- Provide 2 inch slope to drain water quickly.

Concrete Pad for Girder

ROOFING



ROOF DETAILING:

1. 1 inch mud plaster.
2. 4 inch compacted mud.
3. 2 layers of plastic sheet.
4. Available thin branches of timber.
5. 3/8 inch thick chick.
6. 3 inch dia. bamboos @ 1 ft c/c spacing.

HEALTH/HYGIENE & WATER DRAINAGE

- Latrine pit should be 30 ft(minimum) away from the water source.
- Cover the pit and drain all waste water away from house.

Mound latrine

Distance between hand pump and latrine too short.

LOH-KAAT HOUSE

FOUNDATION AND POLES

- To erect poles dig 1ft hole at every 3ft.
- Dig holes 4ft deep in soft soil and 2ft deep in hard soil.
- use 4” dia poles. Ensure to use larger diameter poles at corner if all are not available in the same size.

Treatment of poles

FIXING OF POLES

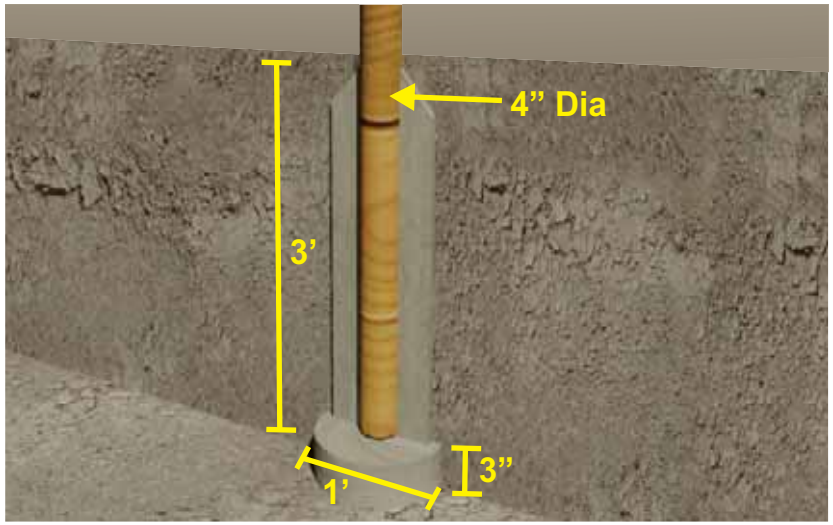
- Lay concrete (1:4:8) around poles.

OR

- Fill sand around poles and compact it.

OR

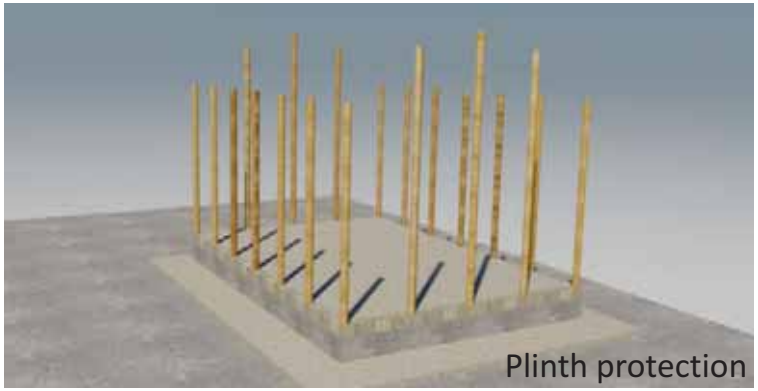
- Fill concrete (1:4:8) in holes and fix timber poles on it with metal straps.



PLINTH

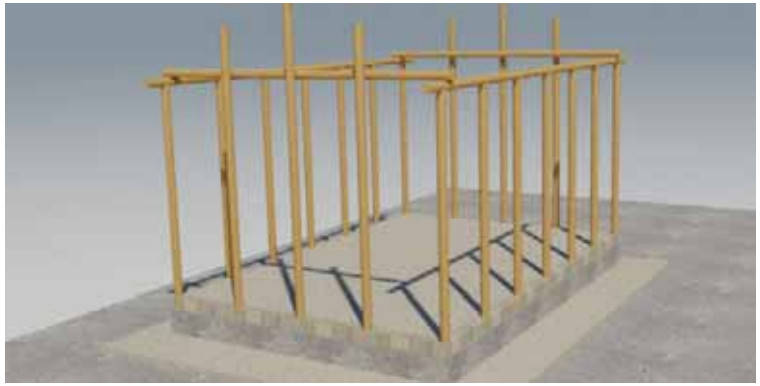
- Keep height of plinth upto 1ft and properly compact it.
- For plinth protection use brick or stone masonry apron with an outward slope.


Keep poles aligned


Plinth protection

FRAME

- Tie the poles together at plinth level with 4”x2” size wooden plate from outside (optional).
- Wall plate maximum height 8ft.
- All corners to be braced with 3” dia diagonal timber.
- Fix 2” dia twigs with steel wire/nails at 1ft spacing horizontally on out face.



Poles & wall plate

Bracing & horizontal plates

IN-FILLING

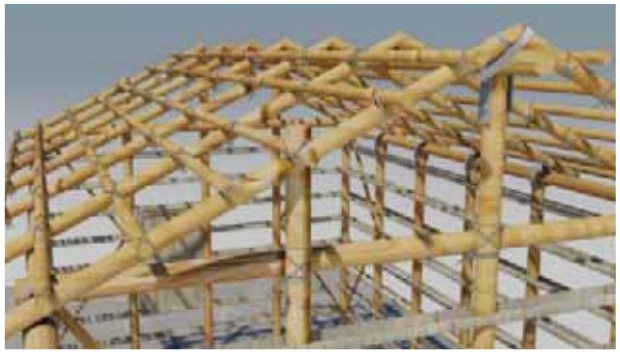
- Place bushes between poles and tie it with timber poles and twigs with steel wire/nylon rope.
- Fix 2” dia twigs with steel wire/nails at 1ft spacing horizontally on inner face.
- Plaster the walls with mud plaster. use sufficient quality of straw to protect if against rain splashes.

Infill with bushier

Mud Plaster

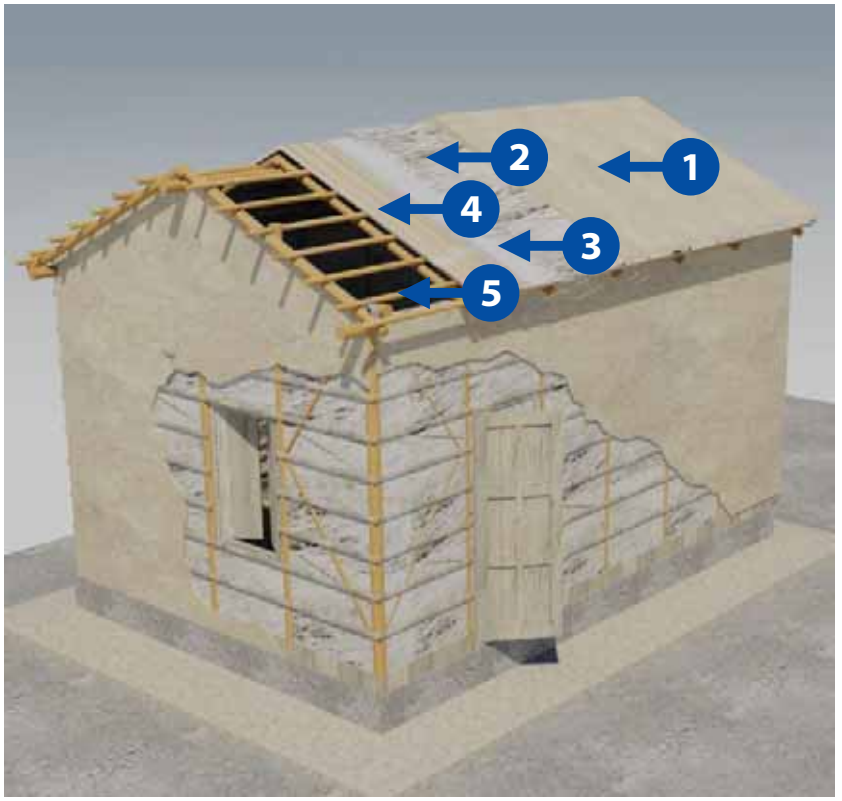
ROOF

- Truss made of 3” dia bamboo or timber should be well tied with each other and walls.
- Ridge pole is laid over post at the gable ends.
- Bamboo of 1.5” dia or wood is provided as purlin. Provide local matting and plaster it with mud mortar.



Tie trusses properly with nylon ropes.

ROOF



1. Mud Plaster
2. Grass
3. Plastic Sheet
4. Chick/Grass Mat
5. Wood Trusses

Thank you

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TELEPHONE INDEX

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