

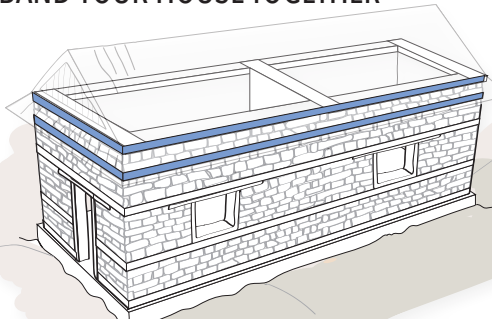


Well built **STONE** houses can better withstand earthquakes. Here are **10 TIPS ON HOW TO BUILD BACK SAFER**

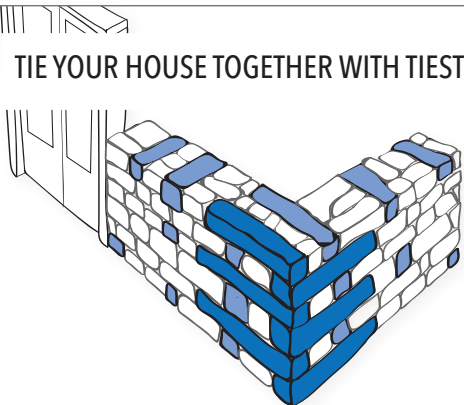
1 GET TECHNICAL ADVICE BEFORE YOU START



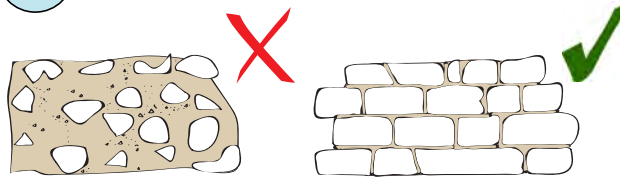
2 BAND YOUR HOUSE TOGETHER



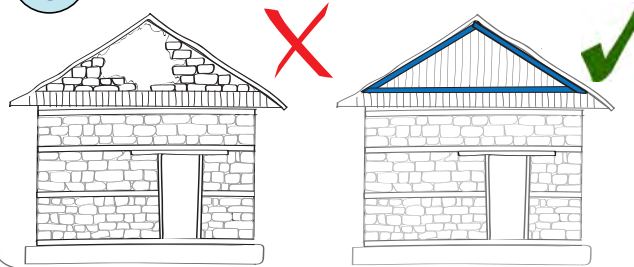
3 TIE YOUR HOUSE TOGETHER WITH TIESTONES



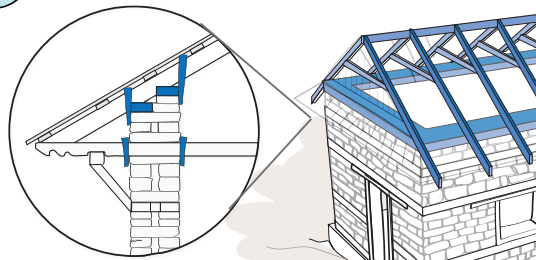
4 BUILD YOUR HOUSE WITH GOOD MATERIALS



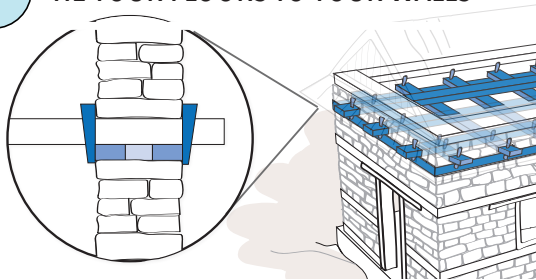
5 TIE YOUR GABLES UP



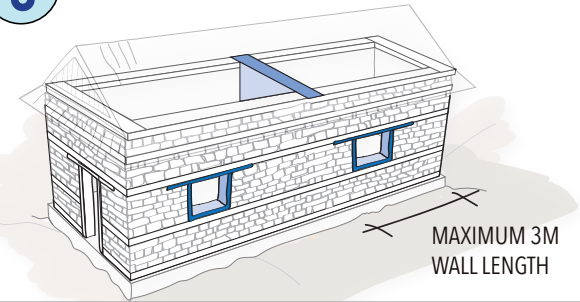
6 TIE YOUR ROOF DOWN



7 TIE YOUR FLOORS TO YOUR WALLS



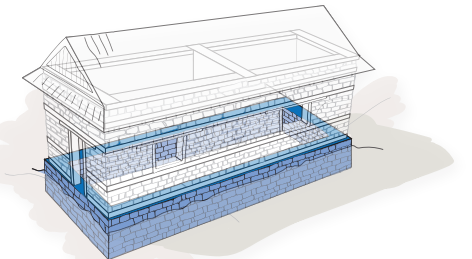
8 BUILD A STRONG SHAPE



9 HAVE A SAFE SITE AND A SAFE EXIT



10 BUILD ON STRONG FOUNDATIONS





#1 : GET TECHNICAL ADVICE BEFORE YOU START

The recommendations provided in this leaflet/poster should help you to build back safer than before in stone.

1. You can build a house out of many different materials such as stone, bricks, timber or concrete, but the most important thing is that you know how to use the materials properly or find a mason to build the house who does. **A badly built house in any material can be dangerous!**
2. These messages are based on what made houses fall down and why some stone houses stood up. They are **not intended as a substitute for training but just to help explain basic principles of strong stone houses.**
3. It is important to register your damaged home with the local authorities before you begin rebuilding, and speak to them about **building permits** and how you can follow the **building codes.**
4. The government is planning a major reconstruction assistance program which will include training in earthquake resilient construction methods.
5. Ensure you or masons helping you build your house are trained in earthquake resilient construction methods.



6. If you have any questions seek technical assistance from a trained mason or your local authority.
7. These tips are only as general guidance for small traditional houses made from stone, if you are building bigger buildings or using other materials there are many other things you must consider! **Get technical advice, use trained masons, and build back safer!**

KEY MESSAGE NUMBER #1 OF 10

DUDBC LOGO
PENDING APPROVAL

LOGO
LOCATION

LOGO
LOCATION

SHELTER CLUSTER LOGO
PENDING APPROVAL

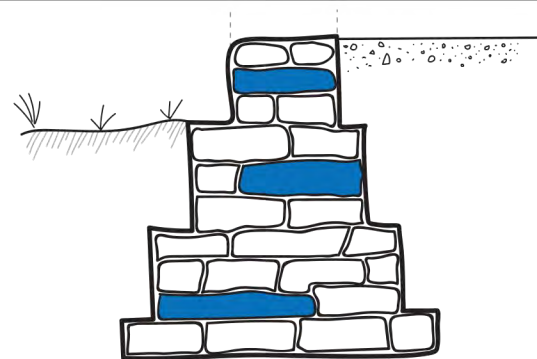


#10 : BUILD ON STRONG FOUNDATIONS

A house is stronger if it is built on strong foundations.

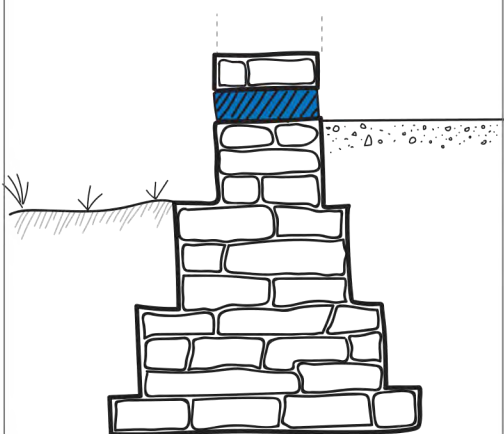
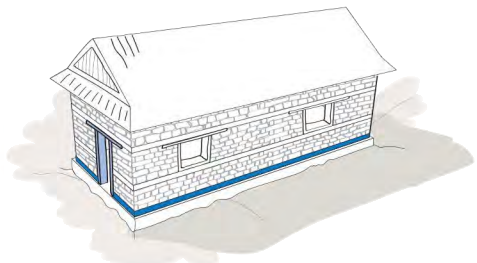
TIESTONES

Tiestones are just as essential in the foundation as they are in the wall above



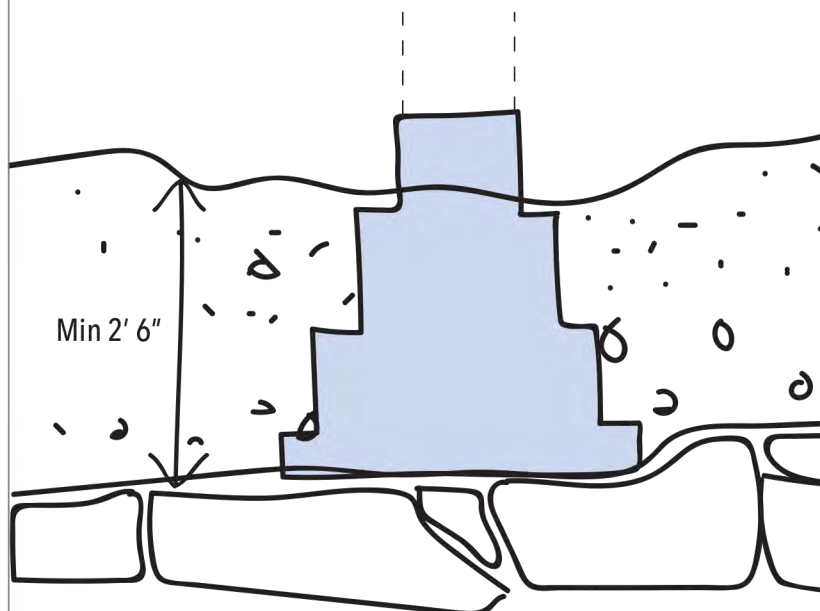
PLINTH BAND

Plinth bands add strength to the footings. Plinth bands must be continuous.



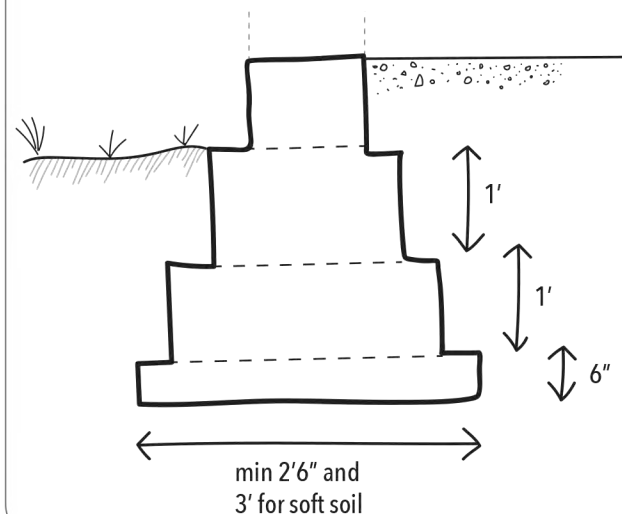
DIG TO FIRM GROUND

For soft ground you may have to dig deeper



THE RATIO IS IMPORTANT

The foundation should be as deep as it is wide



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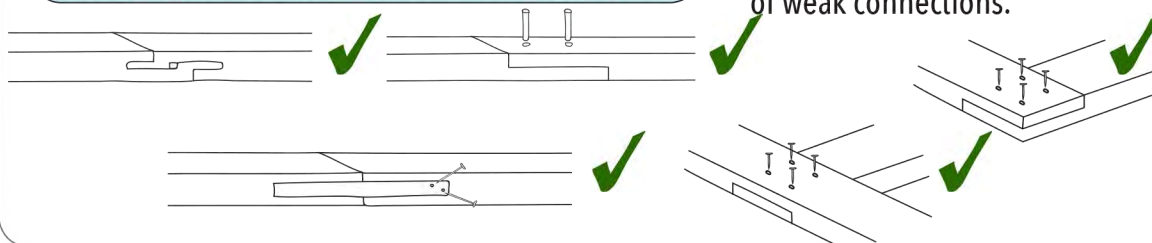
KEY MESSAGE
NUMBER #10 OF 10
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#2 : BAND YOUR HOUSE TOGETHER

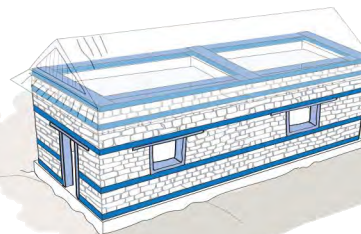
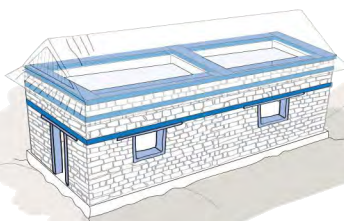
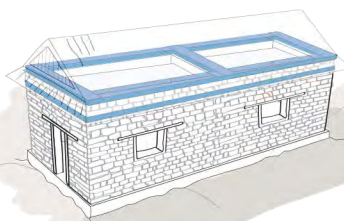
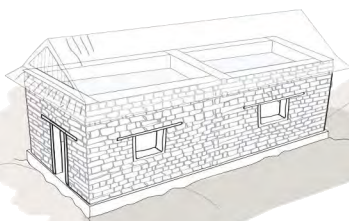
Banding prevents your walls from being pulled or pushed apart.

PROVIDE STRONG BAND CONNECTIONS



Some bands failed because of weak connections.

PROVIDING BANDS IS ESSENTIAL



Provide as many bands as you can

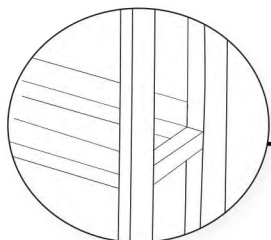


Building code compliant

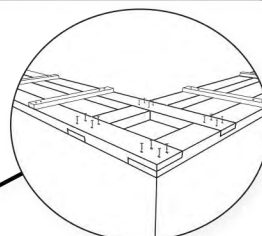
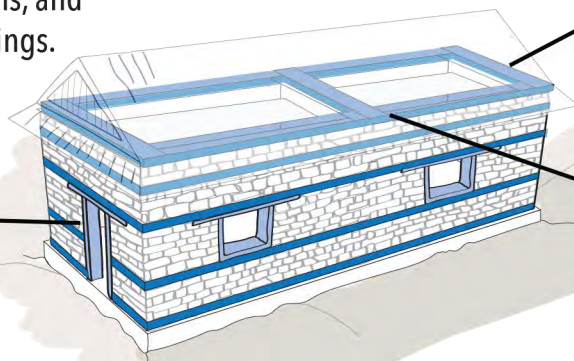
- 1 Top of wall band
- 2 Floor plate band
- 3 Window and door lintel band
- 4 Window sill band
- 5 Bottom of wall band

ENSURE BAND CONTINUITY

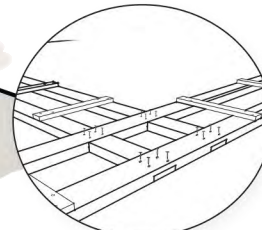
It's important to make strong connections at band corners, band intersections, and where bands intersect door openings.



Doors

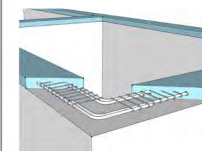


Corners

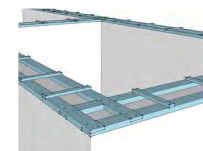


Intersections

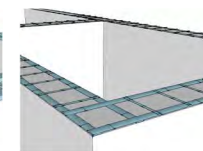
USE STRONG MATERIALS FOR BANDING



Reinforced concrete band



Timber band



Bamboo band
(Strips with skin removed)



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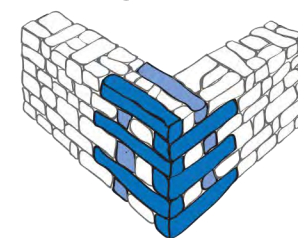
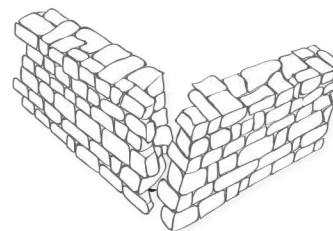


#3 : TIE YOUR HOUSE TOGETHER WITH TIESTONES

Tiestones (including throughstones and cornerstones) hold your walls together and reduce the risk of walls collapsing or peeling apart.

CORNERSTONES

Cornerstones strengthen your walls and help reduce the risk of corner collapse. Use them on every corner in your building.



TIESTONE MATERIALS

Choose strong materials for use as tiestones.



Select long flat stones for use as tiestones. Shape stones with a tool if needed.



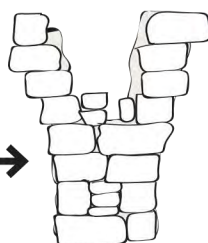
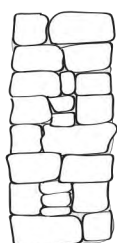
Reinforced concrete tiestones



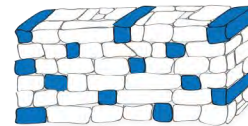
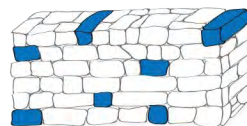
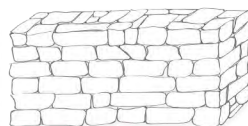
Timber Dowel tiestones

THROUGHSTONES

Throughstones help prevent your walls from peeling apart.



Carefully select long and flat throughstones. Make sure they span the thickness of the wall.



weak



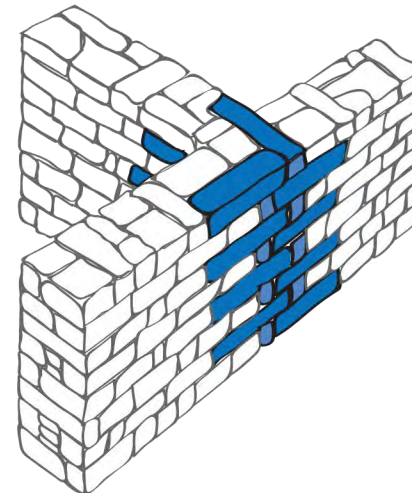
Use throughstones at maximum 2 foot vertical and horizontal spacings.



strong

TIESTONES AT WALLS

Tie your walls together, otherwise they can easily collapse.



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#4 : BUILD YOUR HOUSE WITH GOOD MATERIALS

Some houses fell down because poor quality materials were used. Using good materials in the right way is essential for a strong house.

STONE SELECTION

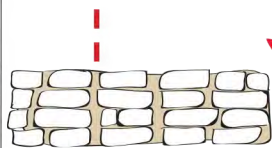
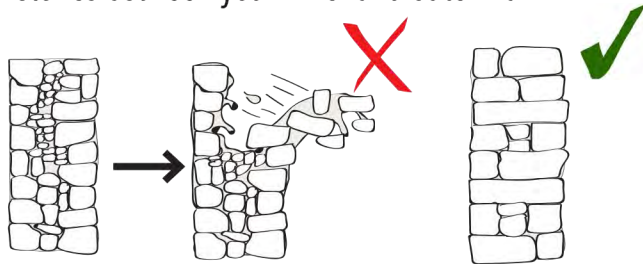
Select large rectangular stones if possible. Where you cant, shape them.



If using stones from your demolished house, clean any mortar from them.

STONE USAGE

Small stones and mud between your outer and inner wall can push your walls apart in an earthquake. Instead use well stacked larger stones between your inner and outer wall.



Large stones, no overlap

The larger the stones you use and the more they overlap the better



Small stones



Large stones, long overlap

MORTAR

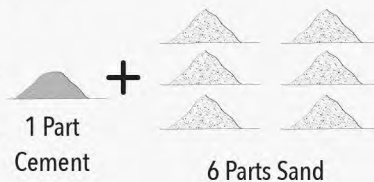
Mud Mortar



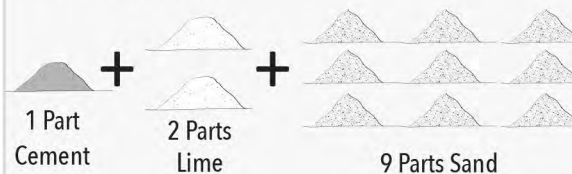
It's important to use good quality mud, free of Gravel

Cement Mortar Mix

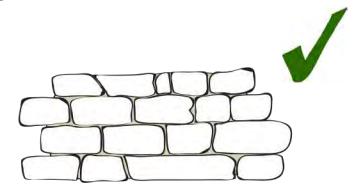
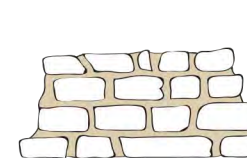
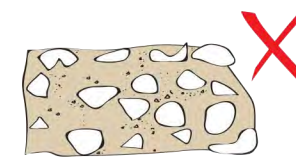
Be careful!
Cement mortar is not always safer if you don't know how to use it.



Cement Mortar Mix #2



Whether you use cement mortar or mud it is important to have the stones touching as much as possible. Rub the stones until they touch and minimise the gap/space between the stones as much as possible. The gap/space should be completely filled with mortar



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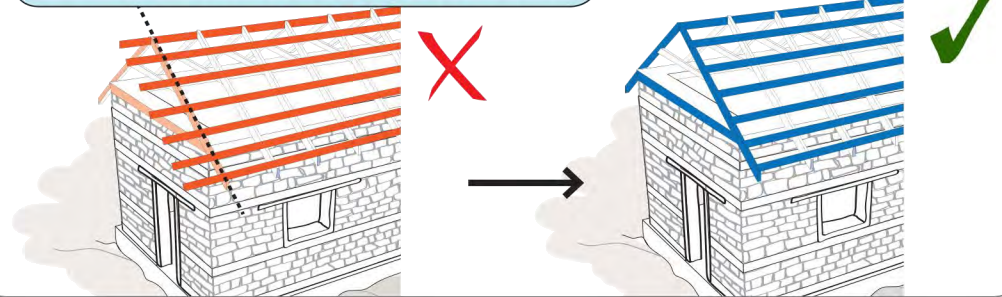
KEY MESSAGE
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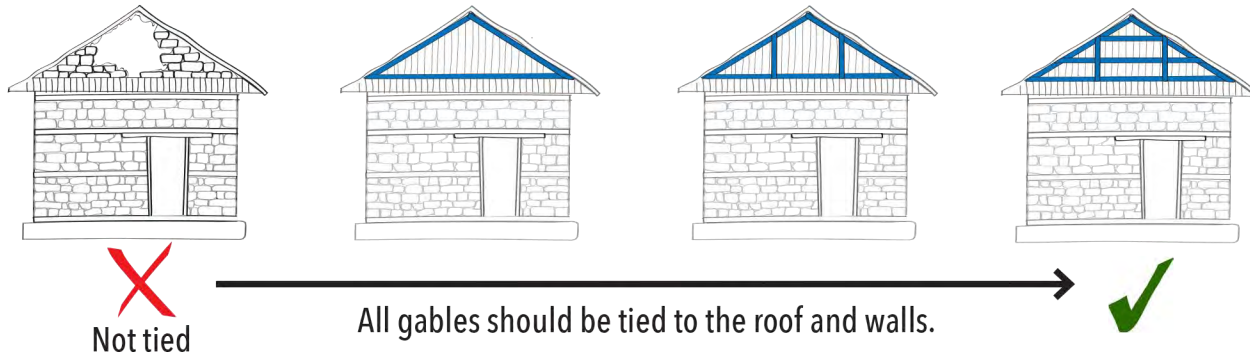
#5 : TIE YOUR GABLES UP

Many gables fell down. Making them lighter and tying them to the roof and walls can make them safer.

TIE YOUR END RAFTERS TOGETHER

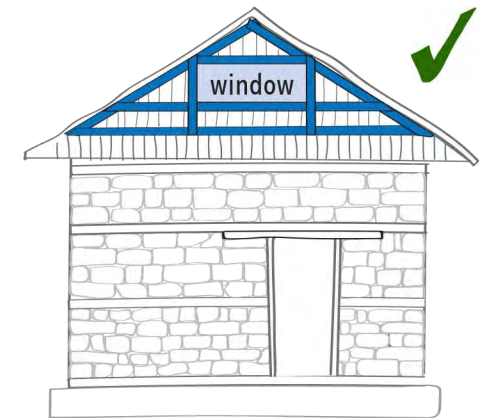


TIE YOUR GABLE



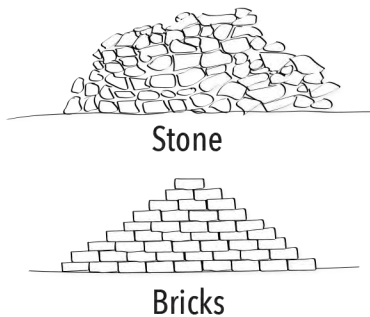
WINDOW OPENINGS

Any openings should be banded on all sides



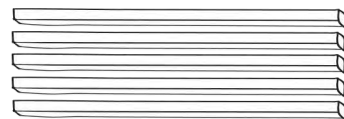
Window opening banded on all sides

LIGHTER GABLES



Heavier → Lighter

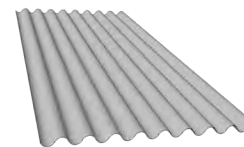
Lighter gables will attract less force in an earthquake



Timber



Bamboo



CGI



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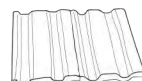
#6 : TIE YOUR ROOF DOWN

Some houses fell down because the roof collapsed pushing the walls apart.

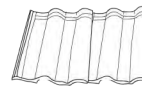
USE LIGHTER MATERIALS



Stone tiles



Concrete tiles



Clay tiles



Wood



Thatched mud



CGI

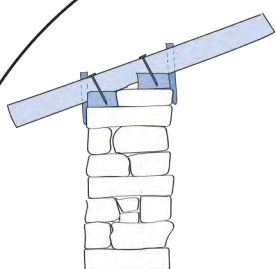
Heavy

Lighter

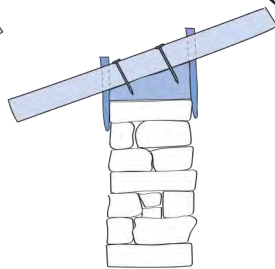


USE STRONG ROOF CONNECTIONS

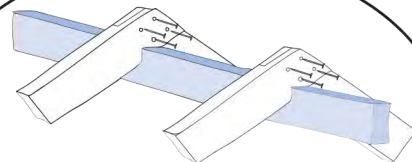
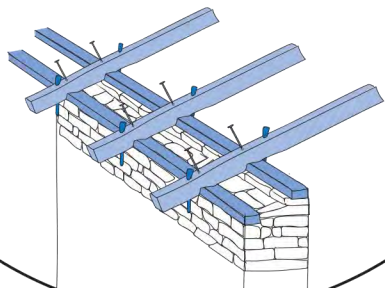
Use a wall plate at the top of your walls and firmly tie your roof to it. Make sure your rafters have a strong connection with the ridge beam.



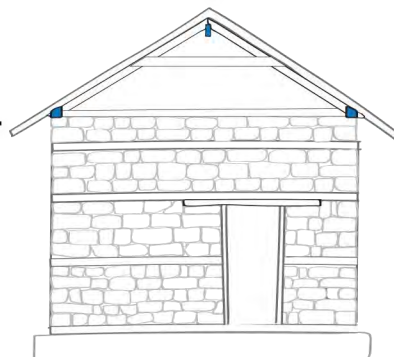
Roof and wall plate connection #1



Roof and wall plate connection #2

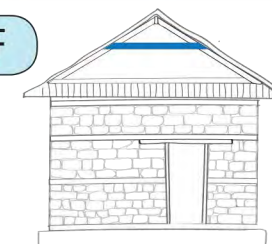


Ridge beam and rafter connection.

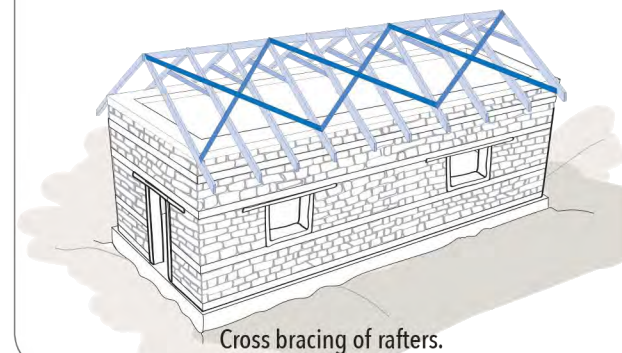


BRACE YOU R ROOF

Your roof is like the top of a box, a stiffer roof will give you a stronger house.



Collar tie



Cross bracing of rafters.



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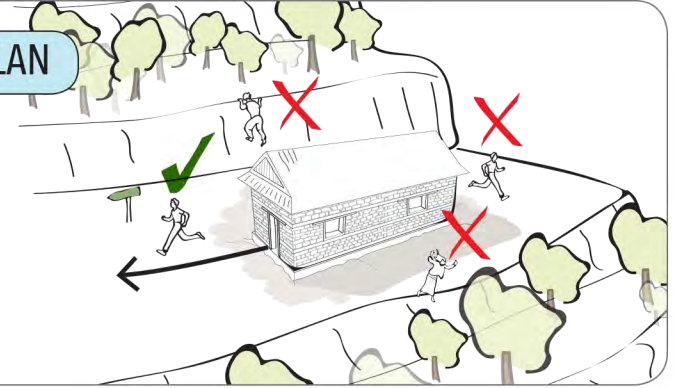


#7 : HAVE A SAFE SITE AND ESCAPE ROUTE

Choose a safe location for your house, but even if you can't choose there are things you can do.

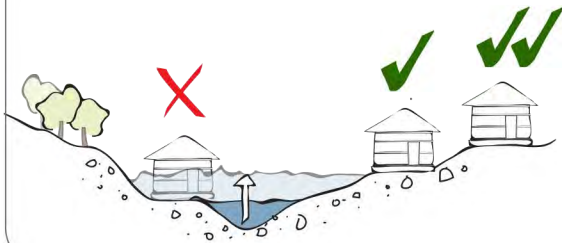
HAVE AN ESCAPE PLAN

Ensure safe escape from the site. Have a preparedness plan.

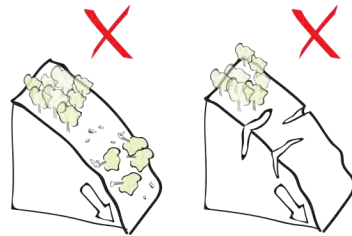


CHOOSE A SAFE SITE

Avoid flood prone areas, like the bottom of valleys or near river beds.



Don't build on steep slopes. Look for landslide signs (cracks, fallen trees)

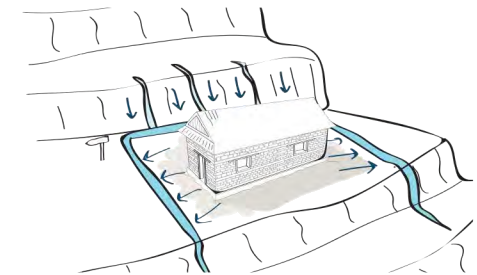


Remove damaged buildings first.

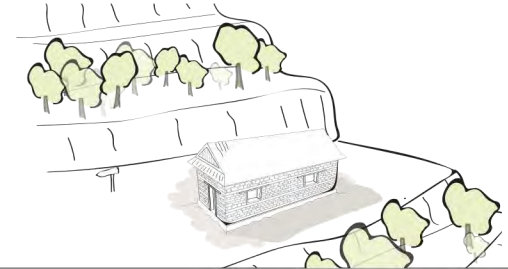


MAKE YOUR SITE SAFER

Ensure proper drainage of the site.

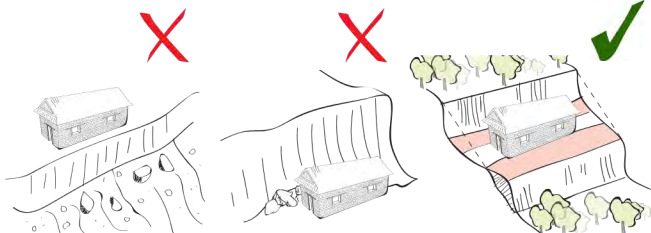


Plant retaining vegetation on the slope above.



POSITION YOUR HOUSE SAFELY

Keep a safe distance between your house and retaining walls.



Keep away from cliffs.



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KEY MESSAGE
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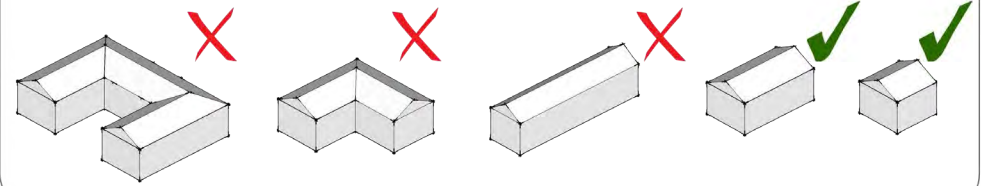


#8 : BUILD A STRONG SHAPE

The shape of your house and the design and construction of you walls are important for a stronger house

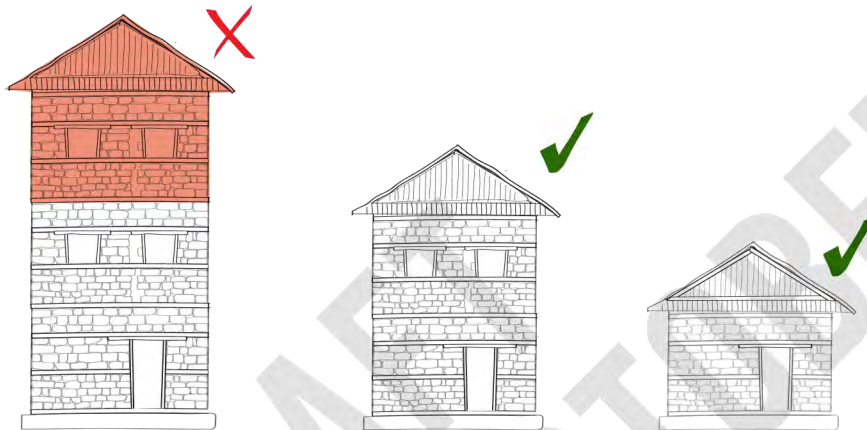
SHAPE

Use a regular shape that is not too narrow. L and U shapes will twist during earthquakes.



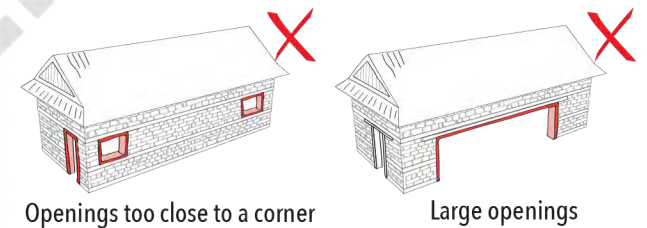
HEIGHT

Don't build more than 2 storey plus an attic. If you want to build a taller building you need stronger materials. Floor to floor height should not be more than 9'10" and less than 6'6".



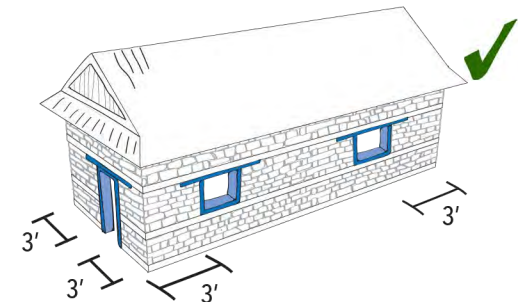
DOOR AND WINDOW OPENINGS

Large openings weaken a wall. Place openings away from corners and leave at least 3ft gap from corners and between openings.



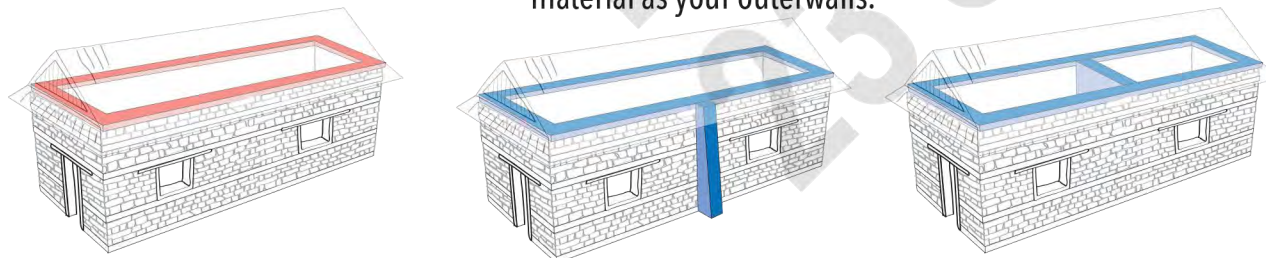
Openings too close to a corner

Large openings



LONG WALLS NEED SUPPORT

For a longer house use regular wall supports or buttresses. It is important to build any divide walls from the same strong material as your outerwalls.



Wall too long without supports

Provide buttresses

Provide internal walls



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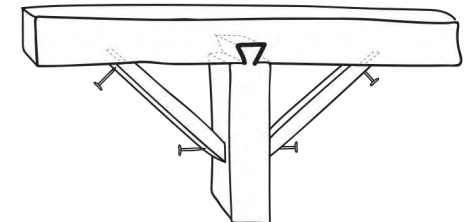
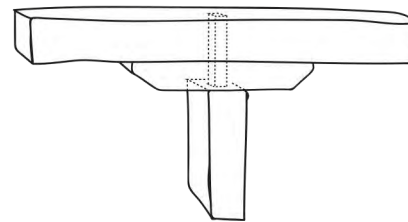
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#9 : TIE YOUR FLOORS TO YOUR WALLS

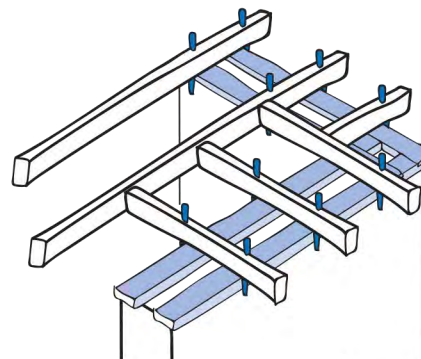
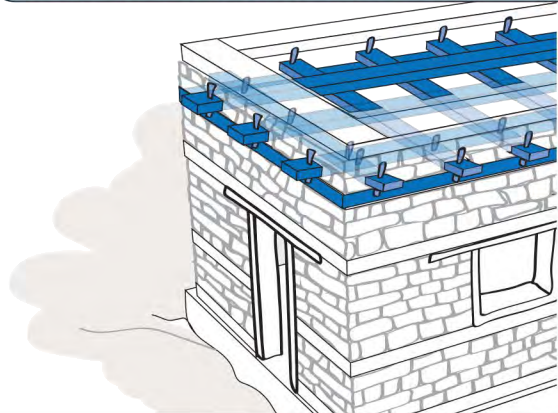
Stiff floors with strong connections to the walls can help stop your walls falling down in an earthquake.

STRONG CONNECTIONS BETWEEN POSTS AND FLOORS

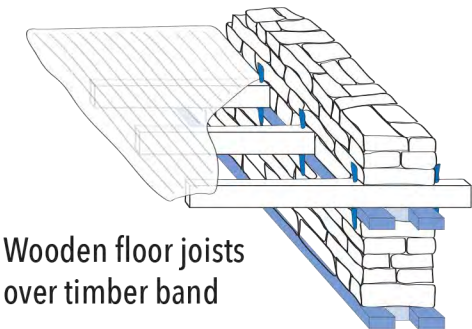


CONNECT YOUR FLOORS TO ALL YOUR WALLS

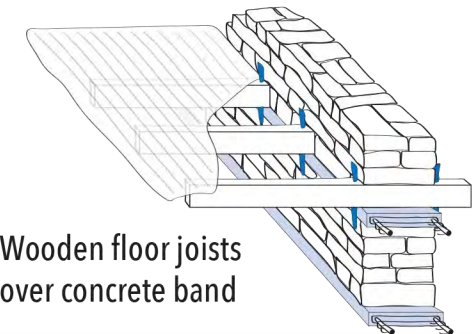
It is important to have a strong connection between your floors and walls.



Connect joists to wall bands



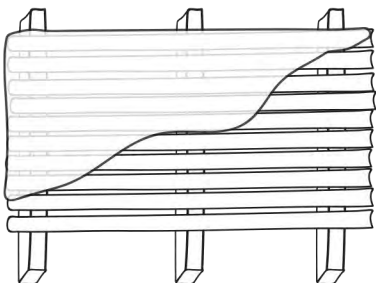
Wooden floor joists over timber band



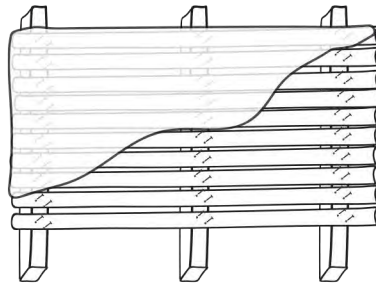
Wooden floor joists over concrete band

STRONG FLOOR

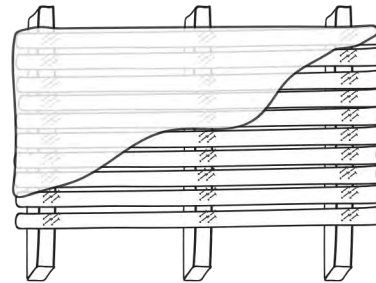
The stiffer your floor the stronger your house.



No nails



2 nails, diagonal



4 nails



Government of Nepal
Ministry of Urban Development
Department of Urban Development
and Building Construction



Shelter Cluster Nepal
ShelterCluster.org
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