



# KEY TECHNICAL MESSAGES

Earthquake Response Khost & Paktika



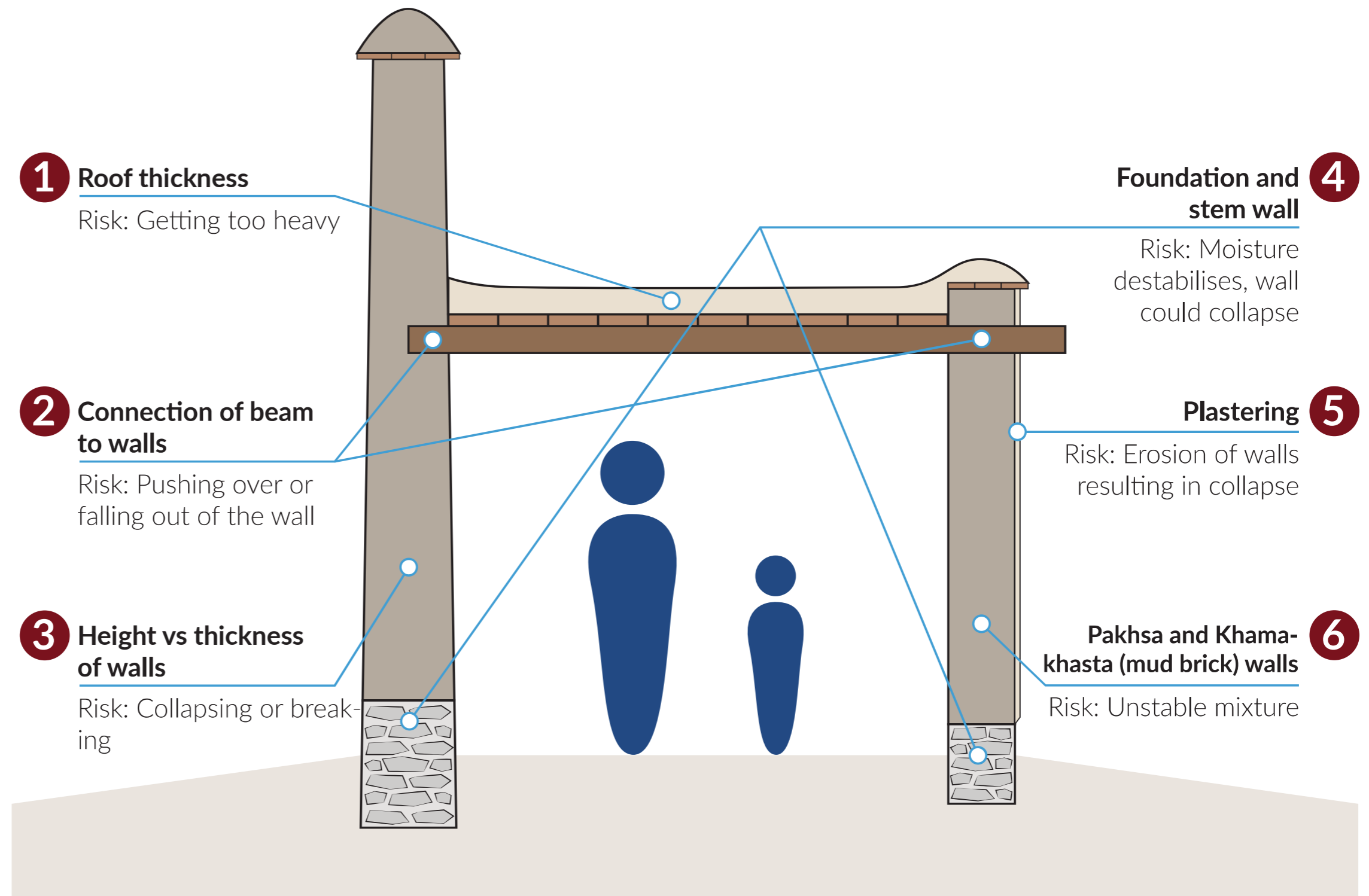
**Shelter Cluster Afghanistan**  
ShelterCluster.org  
Coordinating Humanitarian Shelter

Regional traditional vernacular construction has been improved over the years developing local building solutions.

However, a limited number of poor practices have led to life-critical failures:

1. Overloading of soil cover on roofs
2. Disconnection of roof beams to walls
3. Inappropriate wall dimensions
4. Detachment of foundation stones
5. Irregular erosion of walls
6. Inappropriate soil work for walls and cover on roofs

To mitigate these failures, 6 key technical messages were developed based on local know-how, materials and existing culture.





# 1

## ROOF THICKNESS

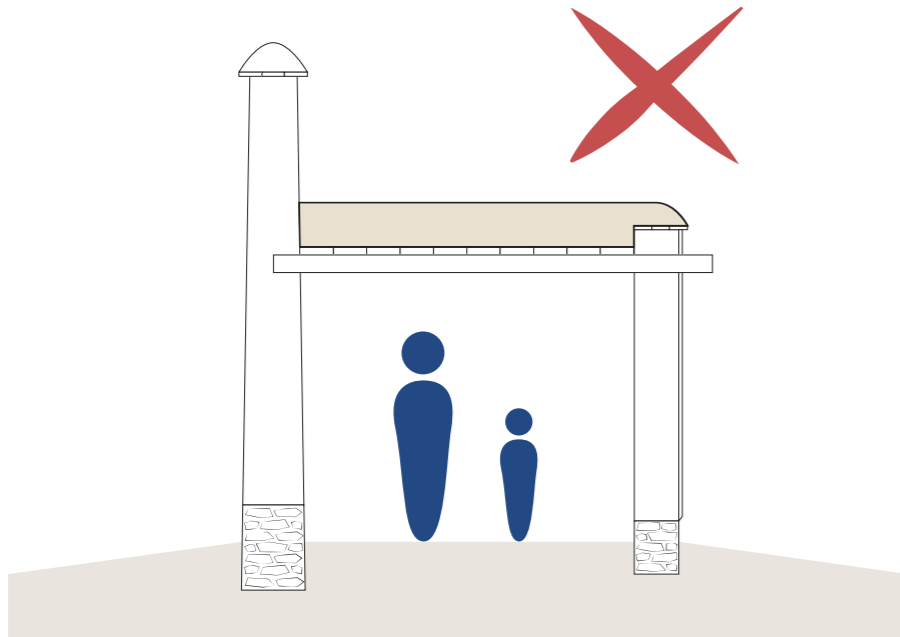
Earthquake Response Khost & Paktika



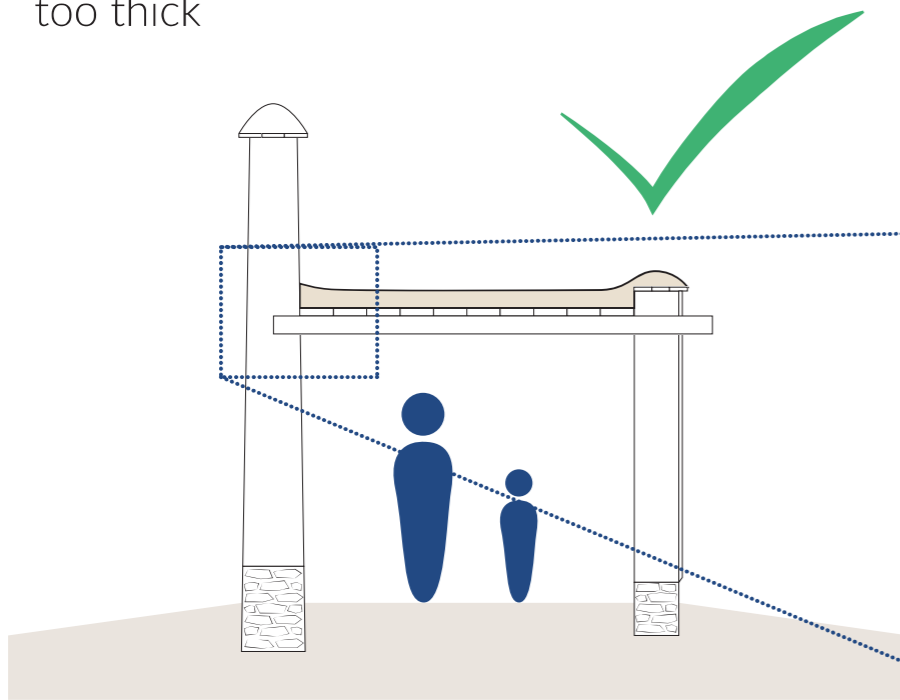
Shelter Cluster Afghanistan  
ShelterCluster.org  
Coordinating Humanitarian Shelter

### Cause: Too thick and heavy roof

Risk: Collapse during earthquake; avoid overloading the roof

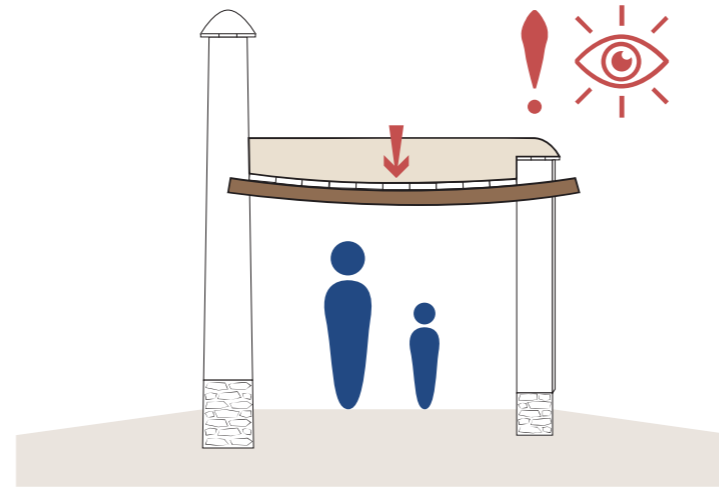


A well-made roof can be waterproof and provide thermal comfort without becoming too thick

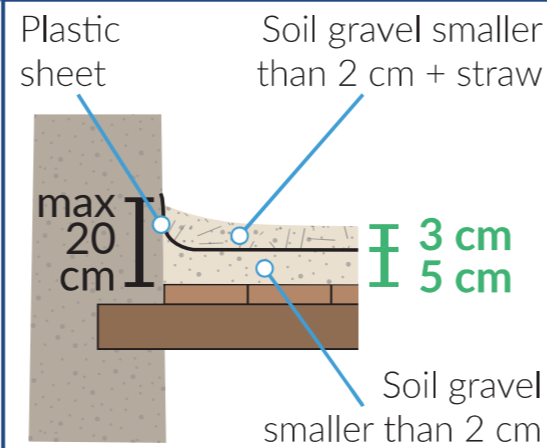


### Identify by:

A beam that bends down may mean the roof is too heavy, pay attention!



### Roof soil cover

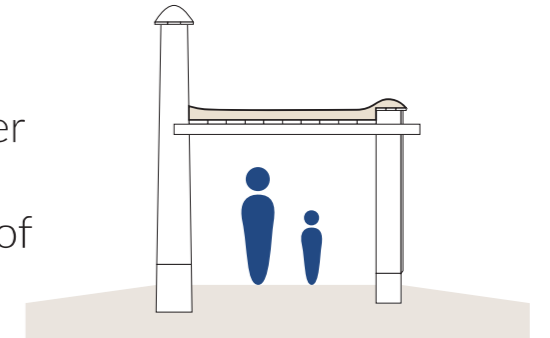


Common practice is to not have roofs thicker than 8 cm total along the thinnest part. Edges for drainage go up to max 20 cm

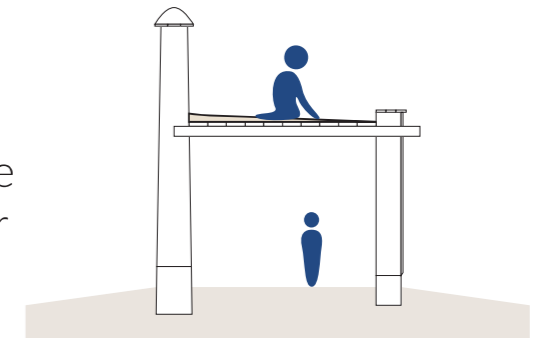
### Actions to prevent:



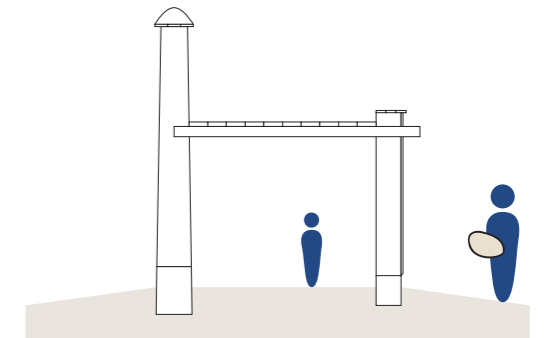
It is a good practice to maintain the water proofing and thermal capacity of the soil cover



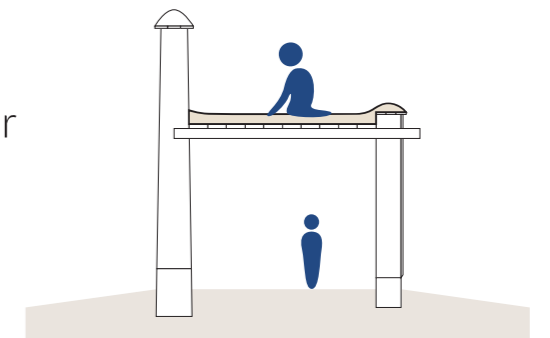
Before adding a new layer, remove the previous layer



Workwell the soil and avoid using the top layer soil



Add the new layer of soil, with a good draining system





# 2

## CONNECTION OF BEAM TO WALLS

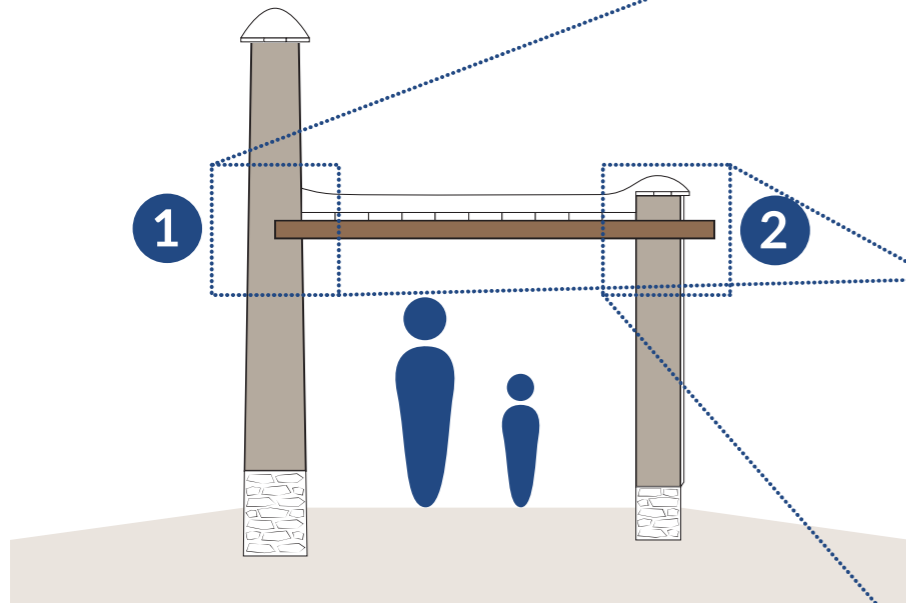
Earthquake Response Khost & Paktika



Shelter Cluster Afghanistan  
ShelterCluster.org  
Coordinating Humanitarian Shelter

### Cause: Unstable connections to walls

Risk: Collapse during earthquake



Do not firmly attach the rafters to the beams (e.g. with nails) or to the wall to ensure free movement!

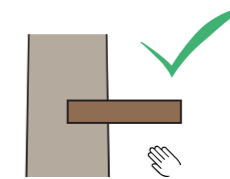
### Identify by:

- 1 The beam should have a stable connection to the compound wall



### Action to prevent:

- 1 Check that the beam sticks halfway into the compound wall



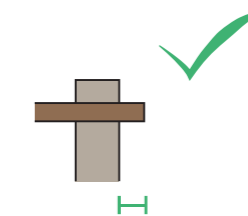
### Identify by:

- 2 The beam should stick through and out of the internal wall



### Action to prevent:

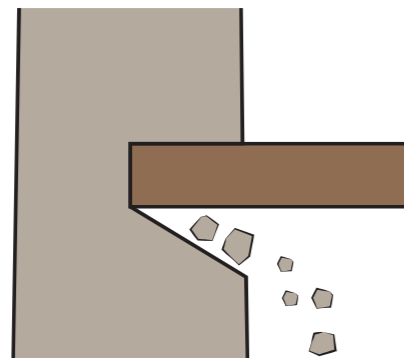
- 2 Check that the beam sticks out of the internal wall



### Cause: The hole in the wall supporting the beam has become too big

Risk: Collapse during earthquake

The wall no longer supports the beam properly because some of the clay under the beam has fallen away

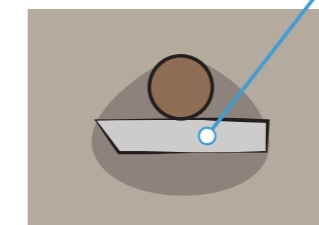
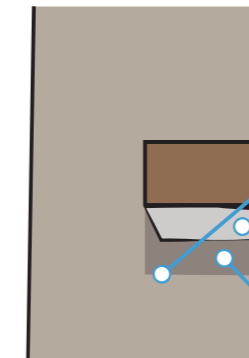


### Identify by:



### Actions to fix:

- 1 Remove some soil to level the hole
- 2 Use a stone or piece of wood to support the beam from below evenly
- 3 Refill the rest of the hole under the stone or wood with new soil





# 3

## HEIGHT VERSUS THICKNESS OF WALLS

Earthquake Response Khost & Paktika

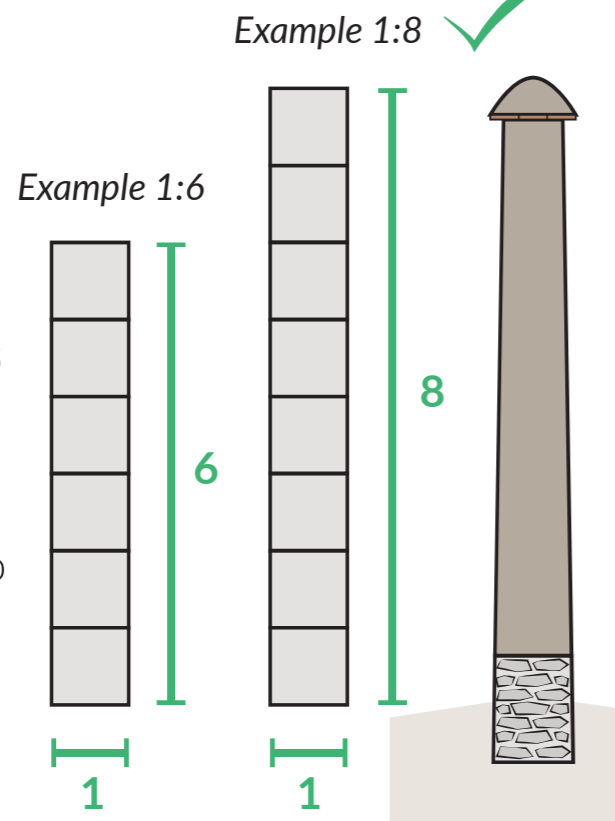


Shelter Cluster Afghanistan  
ShelterCluster.org  
Coordinating Humanitarian Shelter

### Cause: The wall is too tall/too thin, not appropriate height versus thickness

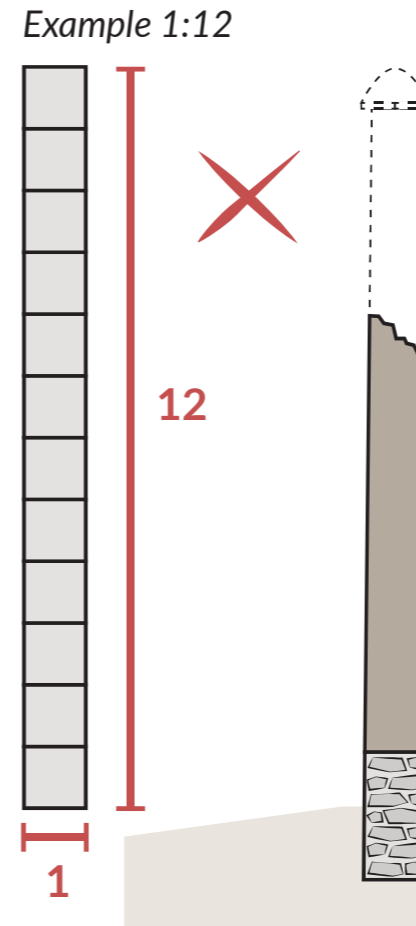
Risk: Falling over during earthquake

The best height versus thickness of the wall is to make it between 6 to 8 times as tall as it is thick



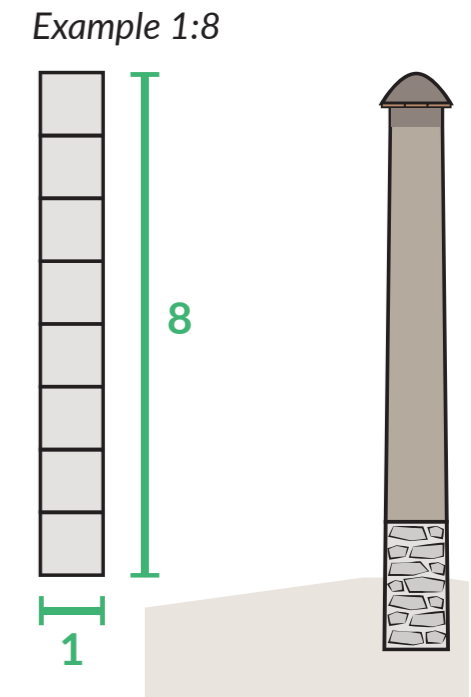
### Identify by:

Often the top of a wall may have broken off because it was too thin and tall.



### Actions to fix:

Level out the broken part and reconstruct with a better proportion between the height and thickness, such as 1:6 to 1:8.



### Pakhsa walls: Control tests

Pack the pakhsa well without air bubbles or big stones too close together

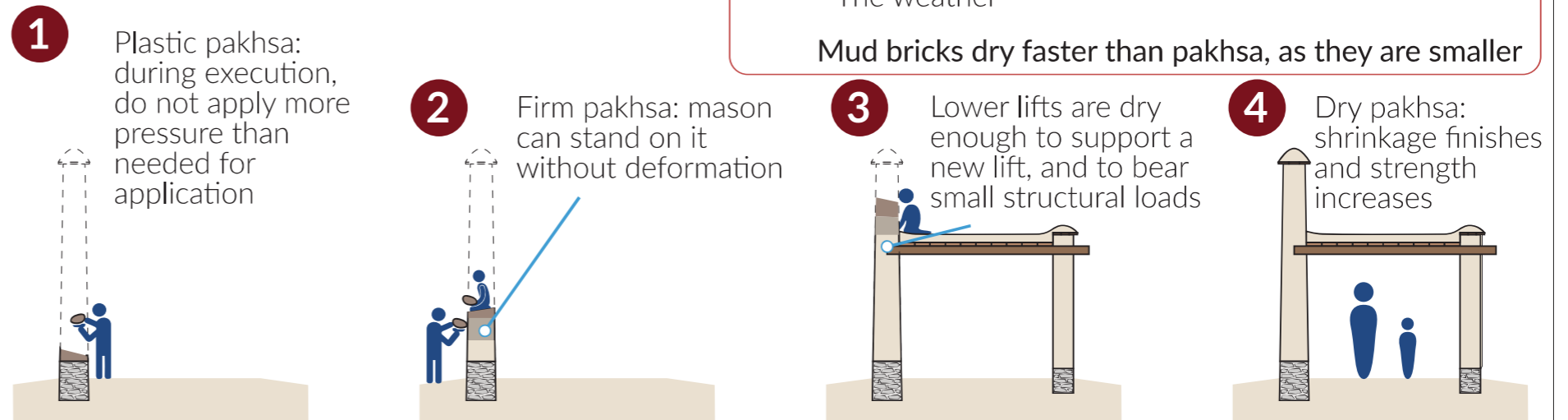
When cutting off the outer side layers, check if the pakhsa has dried underneath

If the pakhsa responds to weight as below, it has not yet dried enough



### Pakhsa walls: water content and strength

Evolution and states of pakhsa:



**!** Pakhsa drying time varies greatly depending on:

- The type of soil
- The water content
- Thickness of the wall
- The weather

**Mud bricks dry faster than pakhsa, as they are smaller**

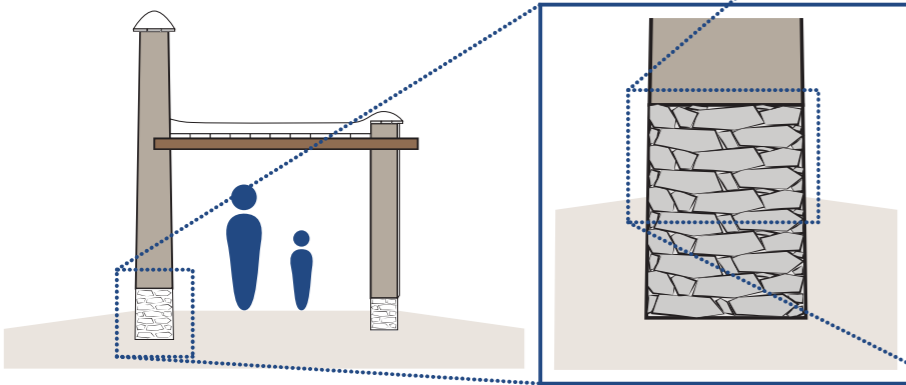


# 4 FOUNDATION AND STEM WALL

## Earthquake Response Khost & Paktika

### Cause: Detachment of the stem wall stones

Risk: Collapse during earthquake



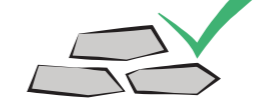
### Identify by:

Rounded stones are not stable in dry wall construction

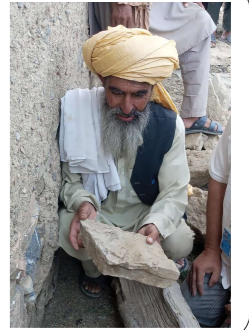
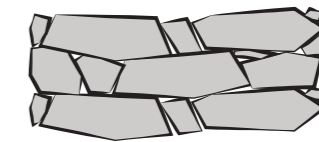


### Actions to prevent:

Use only angular stones for dry stone construction

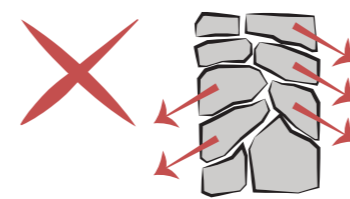


Find stones that fit well together and fill the gaps with small stones



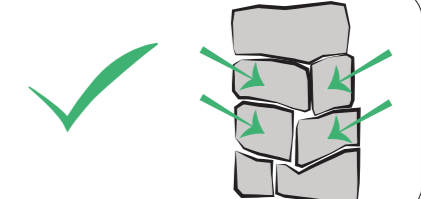
### Identify by:

The stones should not lean outwards, as they may fall out



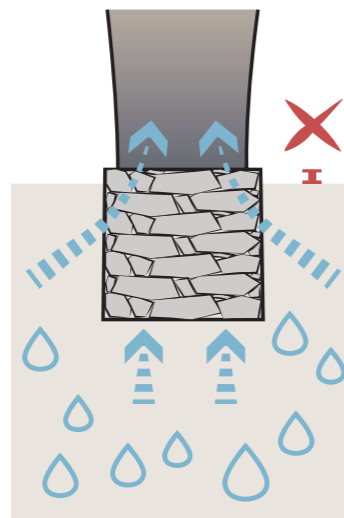
### Actions to prevent:

The stone should lean slightly towards the center of the wall so they do not fall out



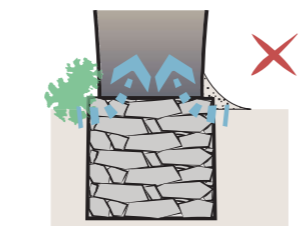
### Cause: Stem wall is not high enough

Risk: Moisture gets into the walls, affecting the clay composition and destabilising the wall



### Identify by:

Vegetation or rubble sand may collect along the stem wall, facilitating moisture to reach the wall

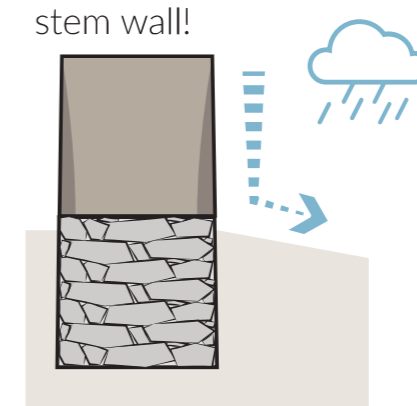


Bad drainage away from the stem wall

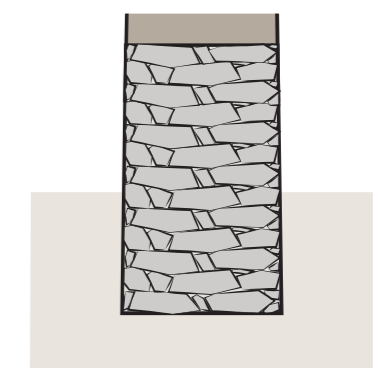


### Actions to fix and prevent:

When repairing, use new soil where it was eroded. Pay attention to good drainage away from the stem wall!

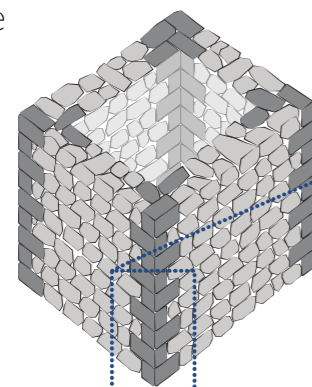
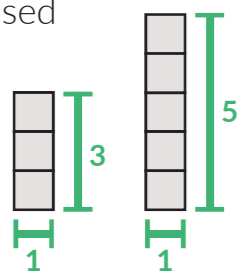


If building a new wall, construct a higher stem wall in more humid areas

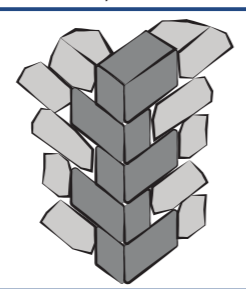


### Important:

The ratio for stone walls is 1:3 or 1:5, if a secondary top timber structure is used

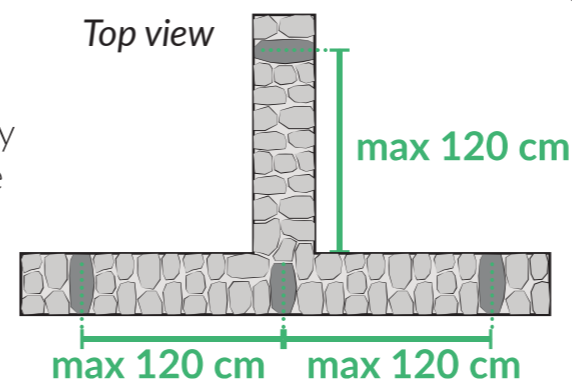


Make sure to cross-lay the corners with big stones for stability!



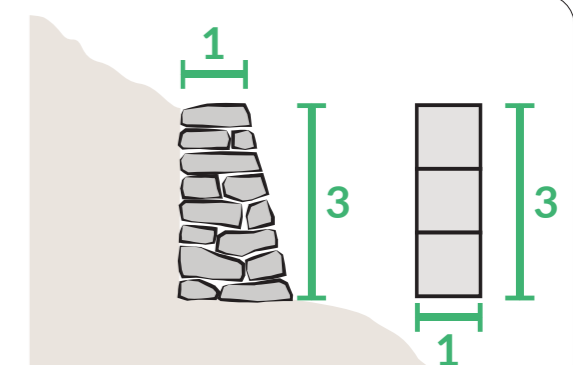
### Important:

When large stones are available, regularly use these to bind the foundation together by placing them through (max every 120 cm)



### Important:

The ratio for a stone retention wall is 1:3, as counted from the top, narrower side





# 5

## PLASTERING

Earthquake Response Khost & Paktika



**Shelter Cluster Afghanistan**  
ShelterCluster.org  
Coordinating Humanitarian Shelter

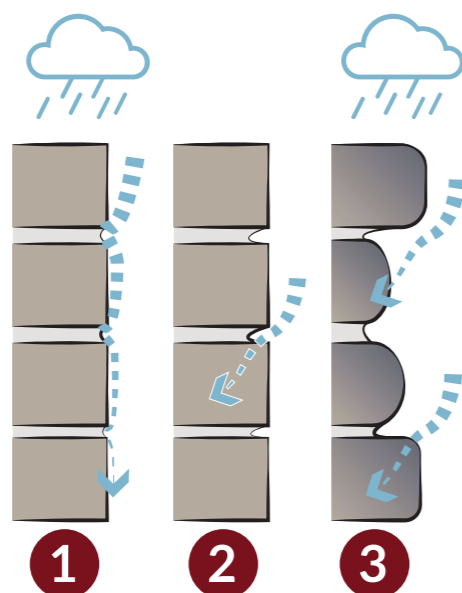
### Cause: Non-plastered internal walls can erode with time and humidity

Risk: Decrease of the structural capacity of the wall

Uneven erosion changes the center of gravity, leading to instability of the wall

This risk is more common with non-plastered khama-khasta (mud brick) walls

- 1** Rain flows along the wall, seeping into the joints
- 2** Over time this washes away the mortar, leaving bigger spaces between the bricks
- 3** Over time this allows rain to flow in and weaken the mud brick from inside



### Identify by:

Possible water leaking. Plaster peeling and eroded joints between the mud bricks.



Issues due to water capillarity. Plaster layer peeling off



Irregular width erosion on pakhsa walls



### Actions to fix and prevent:

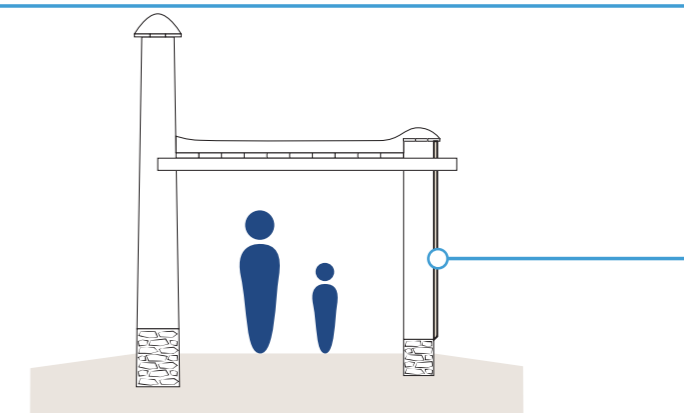


2-3 cm of plaster;  
a mixture of soil and straw

Important! Use earth-based plaster to allow perspiration!

Be sure to remove stones bigger than the thickness of the plaster before making the mixture

Prioritise the outer side of the inner walls



If a wall is newly constructed, let it dry at least 6 months before plastering. Recommendation is 1 year.

- !** Pakhsa and khama khashta walls self-regulate the passage of moisture inward and outward to remain stable.
- Soil-based plasters allow this regulation of humidity. Cement plastering should be avoided

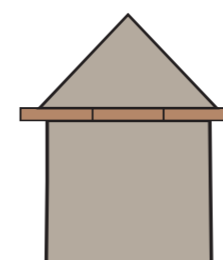
### Capping degradation

Risk: Water stagnation that will eventually lead to water leakage along the walls



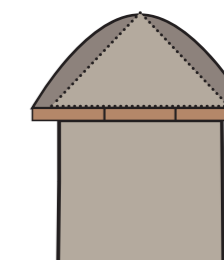
### Identify by:

A less curved/pointed cap that does not reach all the way to the edge of the existing seat



### Actions to fix and prevent:

The capping must be reshaped (same soil composition) with a smooth form, covering to the edge of the existing seat





# 6

## PAKHTA AND KHAMA-KHASTA WALLS

Earthquake Response Khost & Paktika



Shelter Cluster Afghanistan  
ShelterCluster.org  
Coordinating Humanitarian Shelter

### Cause:

Although the soil in the area has a very good composition for the construction techniques used for soil cover, pakhta and khama khashta walls, a bad work of the soil and the use of top soil layer can lead to bad behaviour of construction elements

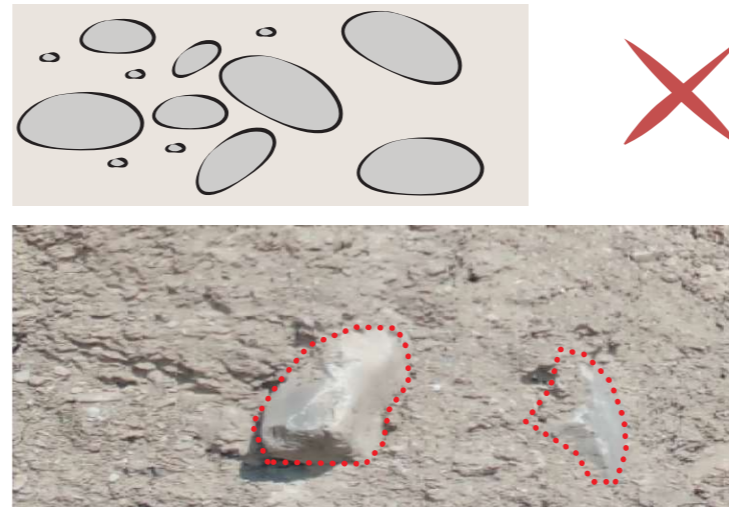
### Risk:

Collapse of wall elements during earthquake



### Identify weaknesses by:

Use very large stones very close to each other



### Identify weaknesses by:

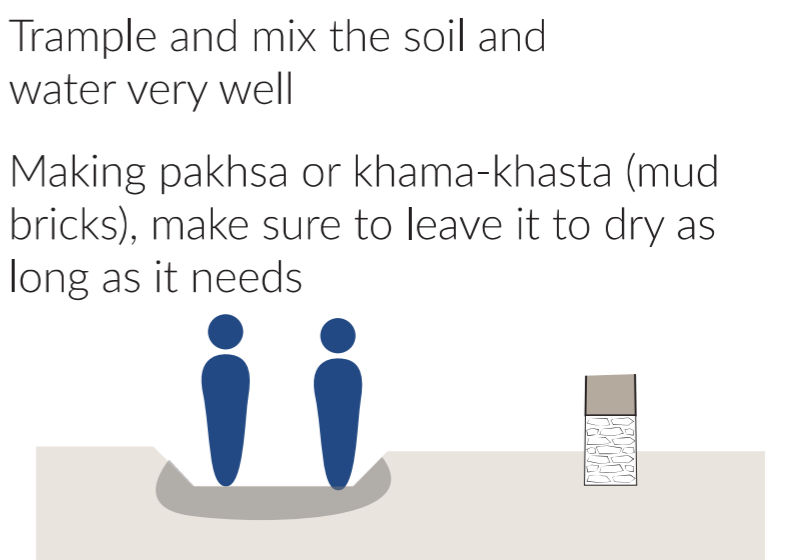
Use of the top soil layer can cause problems in the built structure due to high amount of organic matter and not enough clay and aggregates

Lower soil layers consist of good clay and good aggregates that give the good mechanical and elastical capacity



### Actions to fix:

- 1 Dig away the top soil layer
- 2 Add water in the hole and leave it there at least 1 day
- 3 Trample and mix the soil and water very well
- 4 Making pakhta or khama-khasta (mud bricks), make sure to leave it to dry as long as it needs



- \* For khama-khasta and plastering: take big stones out of the mixture before molding

