HANDS
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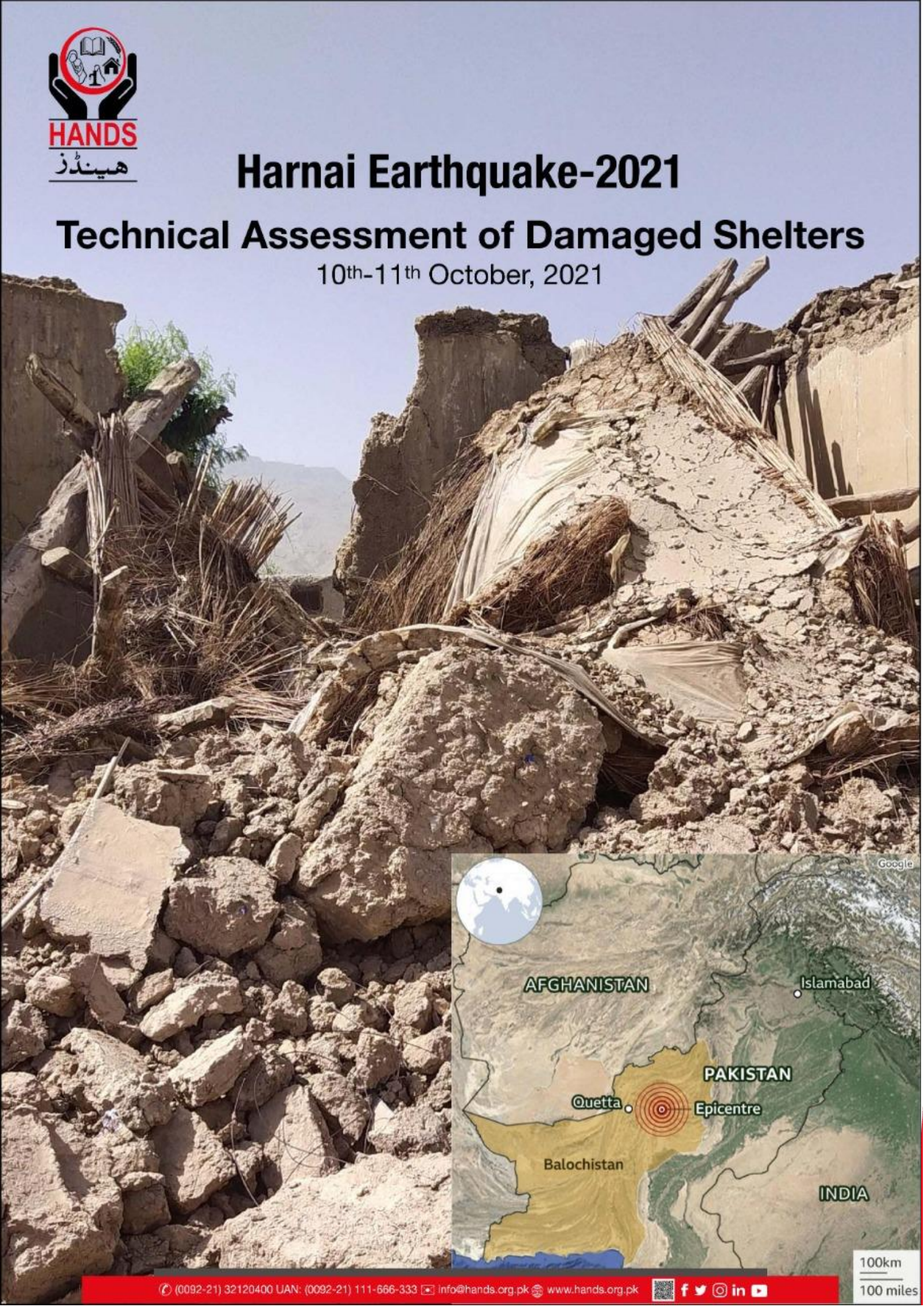
Harnai Earthquake-2021

Technical Assessment of Damaged Shelters

10th-11th October, 2021



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District Profile

Harnai is the principal town of this district and serves as its capital. The predominant first language is Pashto – in the 1998 census it accounted for 80% of the population of the Harnai subdivision of Sibi, while Balochi accounted for 20%.

Demographic Data

According to the census of 2017 Harnai has population of 97052, covers area of 2,492 km², Population Density according to [2017] census 38.95/km² and 1.3% Annual Population Change [1998 → 2017]. The town is quite close to Loralai, Ziarat, Sibi, and Quetta. It is surrounded by imposing hills on all sides. The encircling hill ranges have the resounding names of 'Khalifat' and 'Zarghun. Harnai has two Tehsils Shahrag&Harnai.

Earth Quake detail according to PDMA

Earthquake Jolts of 5.9 Magnitude with depth of 15 KM felt in 10 KM North Harnai on 7th October-2021 at 03:01 PST. Earth Quake affected to Pishin, Kuchlak, Muslim Bagh, Killa Saifullah, Sibi, Loralai, & Ziarat in Balochistan. According to the Pakistan Meteorological Department that epicenter of the Earthquake was Near Harnai.

According to Provincial Disaster Management Authority Balochistan, Media and local Communities that following losses are reported:

- Total 15 lives have been lost which include 1- in Killi Shor, 3- in Killi Mirza, 5- in Gareebabad, 1- in Killi Gurmi, 1- in Jalalabad, 1- in Killi Aspani, 1- in Killi Sharg Bazar, 2- in Killi Grade Sharg.
- More than 227 persons are injured and they are shifted in hospitals
- 15 Persons were stuck in Coal Mine near Harnai which are rescued
- Total 2 Tehsils 6 Union Councils and 25 villages are affected
- 2500 Shelter are fully or partially damaged which are not livable
- Electricity Supply has been suspended in Harnai which has created difficulty in rescue operation
- Harnai to Sanjavi Road near Panch Mal River is blocked due to land sliding Levies and other departments are trying to clear the road
- All Schools are closed in District Harnai by District Government

Shelters fully and partially Damages overview and Failure

08 Villages were visited those are affected severely by Earthquake. The visit was conducted on 10th and 11th October, 2021. Purpose of the visit was to analyze the situation of damaged shelter and causes of damages in design or construction of shelters.

Most of the fully damaged shelters roofs were collapsed down due to two main causes;

1. heavy roof screeds (peoples used to screed their roofs every year on top of the old screed layer, it results much thickness and increase in load)
2. Point load sharing (heavy wooden roof beams been placed by the communities without any strong base and same loads were acting on openings as well)

In partially damaged shelters, the major and visible vertical cracks have been observed due at wall joining portions. Those major cracks occurred due to improper walls joints. Communities just covered their walls with renders and plasters but those were treated improperly during construction process. This caused due to poor construction material or lack of proper construction knowledge. Currently it is also observed that all partially damaged shelters are unsafe for living.

Majority of the people and families living or even sleeping under open sky due to fear of aftershocks. This situation also makes them more vulnerable due to changing weather conditions as the winter is approaching and expected winter rain as per community.

Visit Details:

Sr.	Name of Village	Number of HH	Shelter Damages		Support Received	Other Damages
			Fully	Partially		
1.	Killi Shor	350	140	110	Tent Distributed by NDMA : 50	One Female Death reported by community due to Roof Collapsed.
2.	Passwai	25	10	11		Two Female Fractured reported by community due Roof Collapsed.
3.	BabuMuhalla (Harnai City)	400	60	110		One male Death reported by community Roof Collapsed down
4.	Ghareebabad Muhalla (Harnai City)	500	22	70		Three Death reported by community due to Roof collapse down.
5.	Killi Grade Guza	67	37	19	Tent Distributed by IG FC Baluchistan : 35 Ration Bags : 35	One Boy and One Girl Death reported by community due to Roof collapsed.
6.	Killi Laal Khan	50	20	16		One Male Death and Two Female injured reported by community due to Roof collapsed.
7.	Killi Mirza	60	28	23	Tent Distributed by NDMA : 06	One Death and Three injured reported by community due to Roof collapsed.
8.	KilliUrbooz	182	50	25	Tent Distributed by NDMA : 105 Ration Bags distributed: 105	

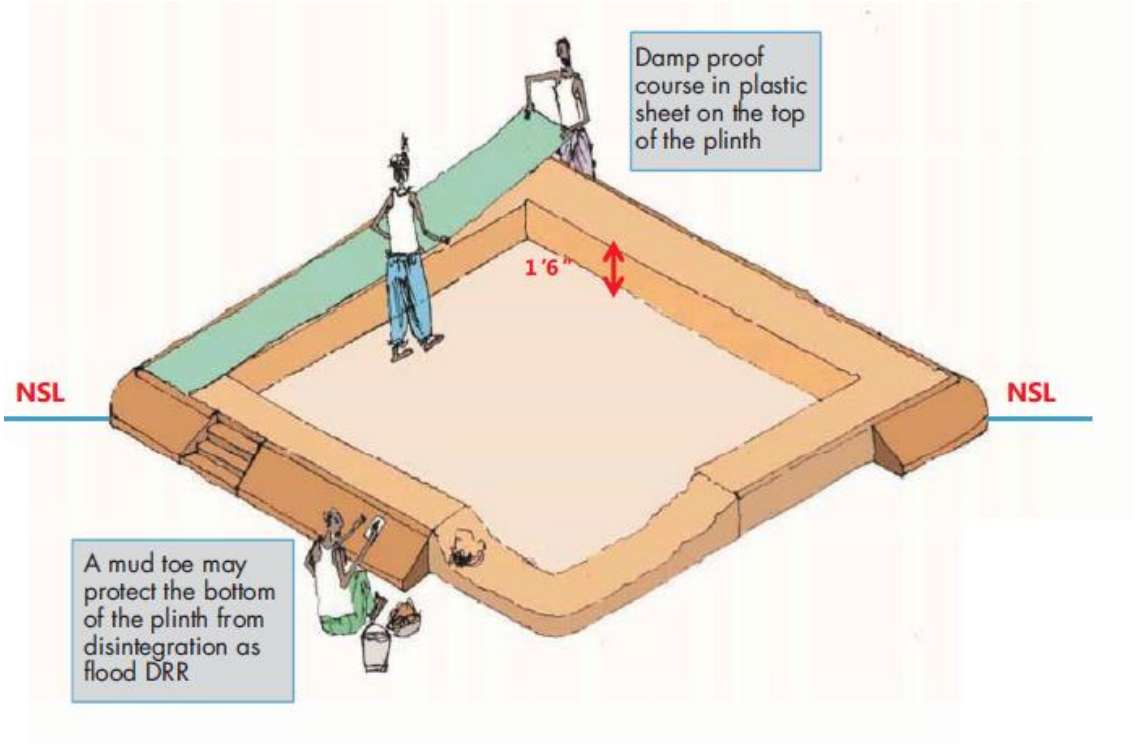
Observations:

- Shelters constructed with stone masonry from foundation to plinth level are not damaged by Earth Quake jolts.
- Majority of fully or partially damaged shelters are constructed with mud or mix of mud and stone.
- Flat Roof is in practice by community for all type of shelters collapsed or partially damaged.
- Very thick mud screed layer is in practice on top of the roof. This layer more than 12" in thickness and causes the roof collapse in earth quake or heavy rains
- Fully Damaged/collapsed mud structure shelters wall thickness was found very thin from natural surface up to the roof with placement of heavy wooden beams without any strong base or an element which may distribute the load uniformly onto the walls, that's also the major reason of failure in EQ situation.
- Steel Girder or wooden Girder placed in line with opening on Door and Window also causes damage of shelters.
- Common failure observed in all villages in partially or fully damaged shelters that corner joints were separate from one wall to other and not connected properly.
- No Ring Beam is placed above walls in mud structure before placing of Girder-T-Iron or bamboos.
- Other reason of shelter damages in the villages is series of joint shelter construction, connected with each other (4 to 6 shelters). Extra length of the wall makes it vulnerable during the disaster.

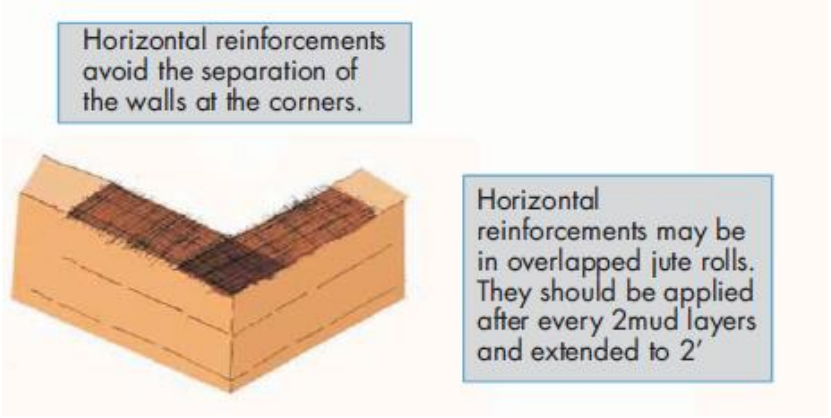
Recommendations for Shelter Construction

Following section contains the recommendations for construction of earth quake resilient shelter through addition of DRR Components to the local shelter designs. The recommendation are based on the guidelines developed by HANDS in coordination with Pakistan Shelter Cluster.

- Mud structure foundation should be 2ft in depth and proper width up to NSL.
- Stone masonry is recommended for sub structure or foundation with enough depth up to NSL with sufficient width up to plinth level in Mud shelter or Fired Bricks Pakka shelters with sufficient width for DRR against Earth Quake.
- A mud toe or plinth protection up to plinth level may protect the bottom of the plinth from disintegration as DRR.

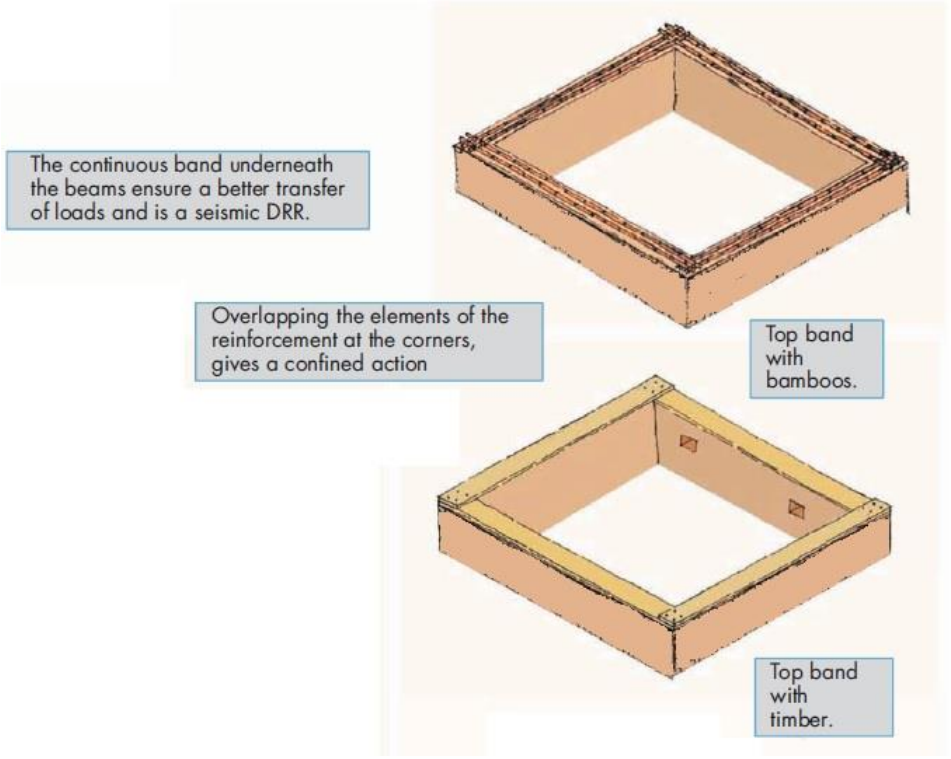


- Proper bonding of walls should be ensured on corners through using the jute bags to avoid separation of walls at the corners.

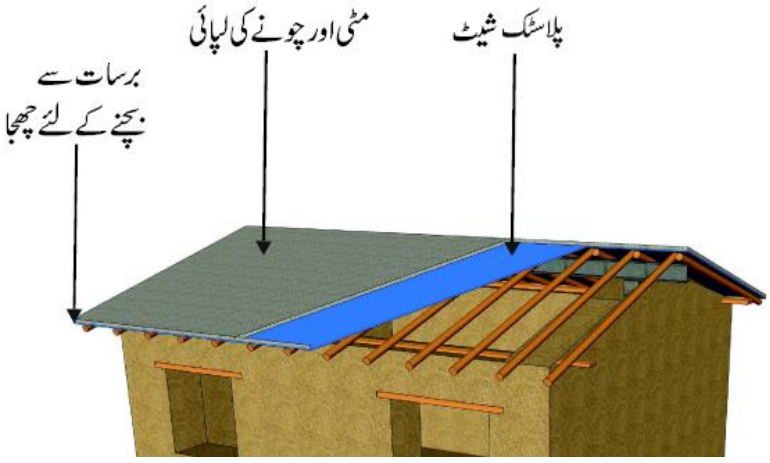


- Tie stones should be used at corners so that proper joining between walls can be ensured.

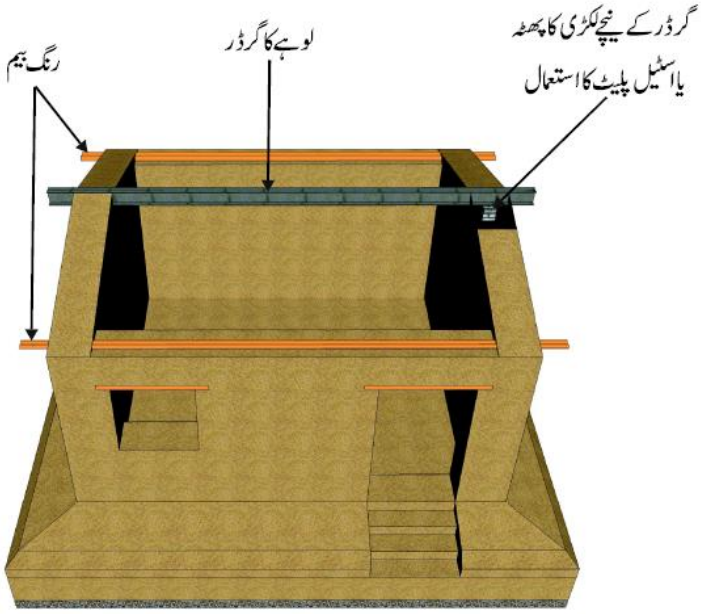
- Continuous ring beam must be provided in mud shelters at plinth level and roof level or before placing roof for proper UDL uniformly distribution of load.
- Timber should also be used as bearing pads at roof level underneath main Beam or Girder.
- Toe wall / plinth protection should also be incorporated to provided additional lateral support to the structure.



- Double pitch shelter model is sustainable for such area and for easy flow of rain water.
- Lintel beam should be provided and placed onto the walls with minimum 9 inches placement area.
- Minimum 3 feet spacing should be ensured between structure corners and openings.
- Roof mud plaster layer should not be more than 3” to 4” inches in mud shelters.
- Bamboos are best option as light weight for roof placing instead of heavy weight T-Iron in Mud shelter structures.



- Thatch roof or Stabilized screeds should be provided in minimum two layers and should not be greater than 3 inches.
- Heavy wooden beams should be replaced with Mild Steel Girder as major element for roofing along with strong steel or wooden base to avoid point load sharing.
- Girder or roof beam never be placed in line with opening to ensure the correct transfer of loads to the bearing wall, which are weak portion of the shelter.
- Lintel beam should be as per need according to the shelter structure for uniformly distributed load.



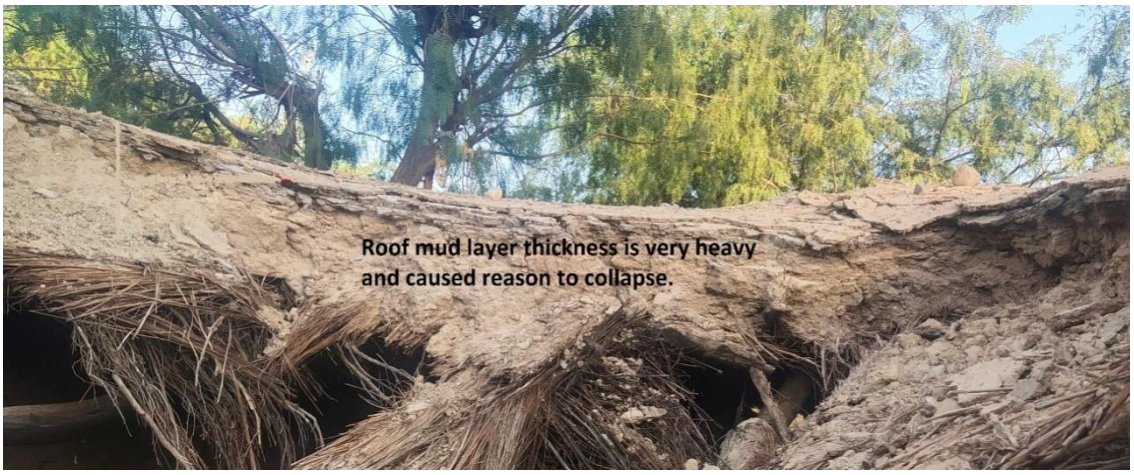
- Avoid constructing more than two joint shelters to reduce damages in Earth Quake.
- Locally available materials should be ensured to make structure economical and easy to construction for local skilled and un-skilled community members.
- Lime and lime stabilized soil techniques can make structure flood resilient and it works well in EQ situation as well.
- Confined masonry techniques should be ensured in case of RCC construction as it gives structure to work as a single unit in EQ situation and it minimizes seismic effects to the structure.

Observation Details about Fully Damaged Shelters:

1. Reason: Heavy weight of roof on top of walls with less thickness causes the collapse in earth quake or heavy rain.
   Recommendation: Mud Shelter wall thickness should not be less than 13” inches to 14” inches at top and continuous ring beam must be provided on top of the wall or roof level in order to uniformly distributed load on whole structure. Timber is also used as bearing pads at roof level underneath main Beam or Girder. (Lightweight roof should be used in this type of structures. While Steel Girder and T-iron with roof tile requires a strong bearing structure.

House owner is worried about his collapsed shelter

2. Thick mud layer will add a lot of load to the roof and cause of severe damaging strain to the roof structure and load bearing wall. (Common practice in the villages that every year community applies a new mud layer on roof due to heavy load of mud layers including load of Girder and T-Iron with roof tile, the roof will be collapsed in Earth Quake or Heavy rain)



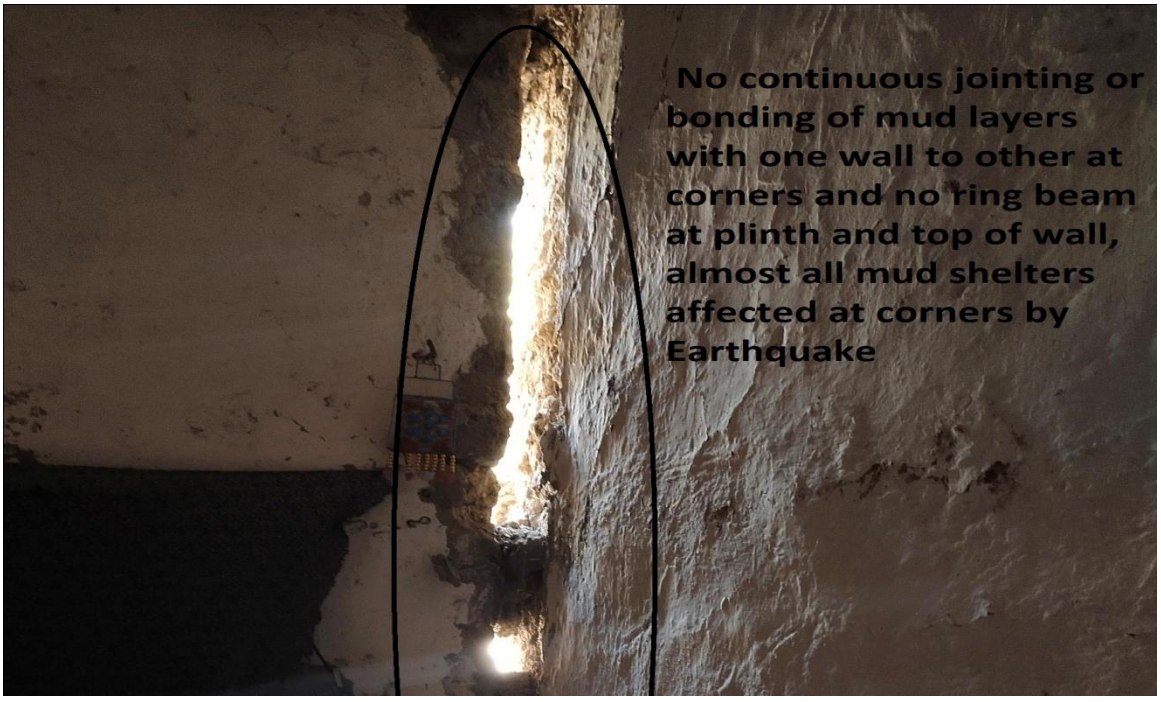
3. Common practice of joint mud shelter construction have seen in few villages and these all affected due to continuous Long span of wall partially damaged from internal side by Earth Quake in all visited villages. Mud wall longer than 14’ft should have intermediate cross partition wall.

   Shelter front protection support floor have seen in the villages as good practice in construction by District Harnai community.

People are living in temporary shelters or in Tents distributed by Government.

4. Construction gapes in all fully or partially damaged Shelters are same in all visited villages. Almost In all partially damaged shelters corner walls separate from each other; the gap is visible in all shelters. It is observed physically and discussion with community that during construction community is not jointing corners continuously for proper binding or jointing of mud walls.

   Standard thickness from foundation to top should be ensured in all mud structures and continuous ring beam on top wall or at roof level avoid the separation of wall and distributed load uniformly on load bearing walls.



5. Most of the Community using Soil and Stone mix in construction of Mud Shelters but not in all villages.

Few pictures of fully and partially Damaged in different villages.

Community females are worried about damaged shelter and waiting for support.

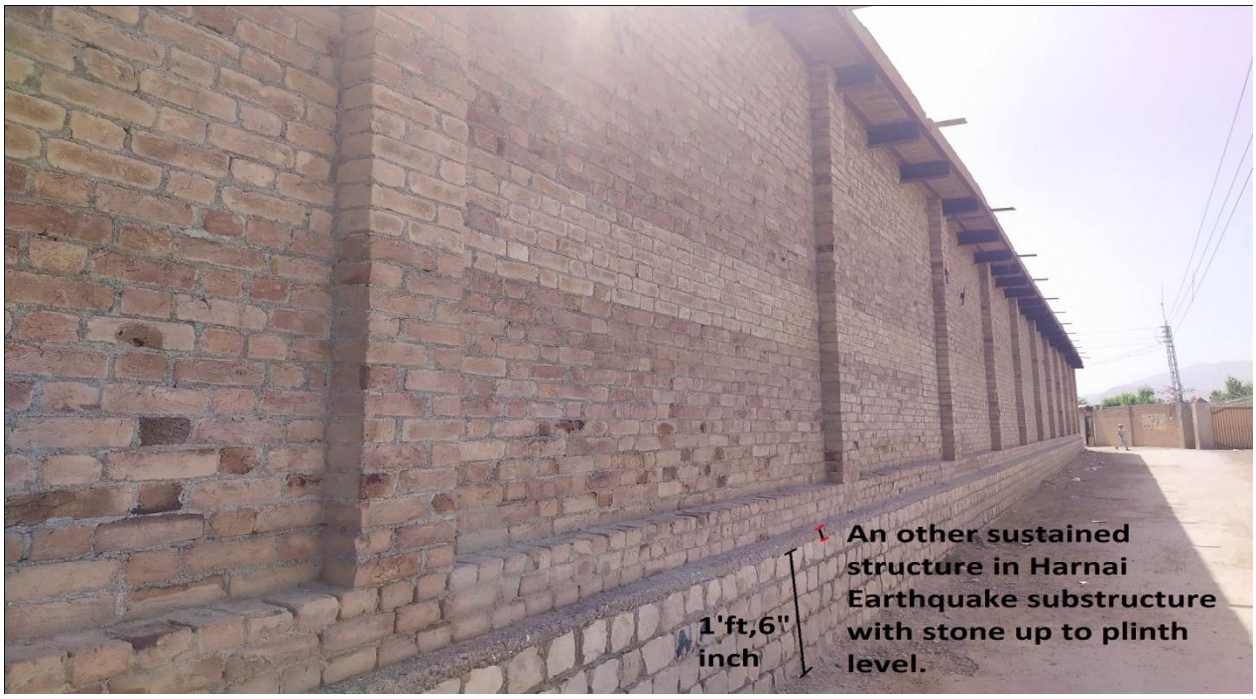
Roof collapsed due to heavy weight roof load by Earth Quake Harnai

Mud layers from corner walls not joint continuously in all mud shelters affected by Earth Quake

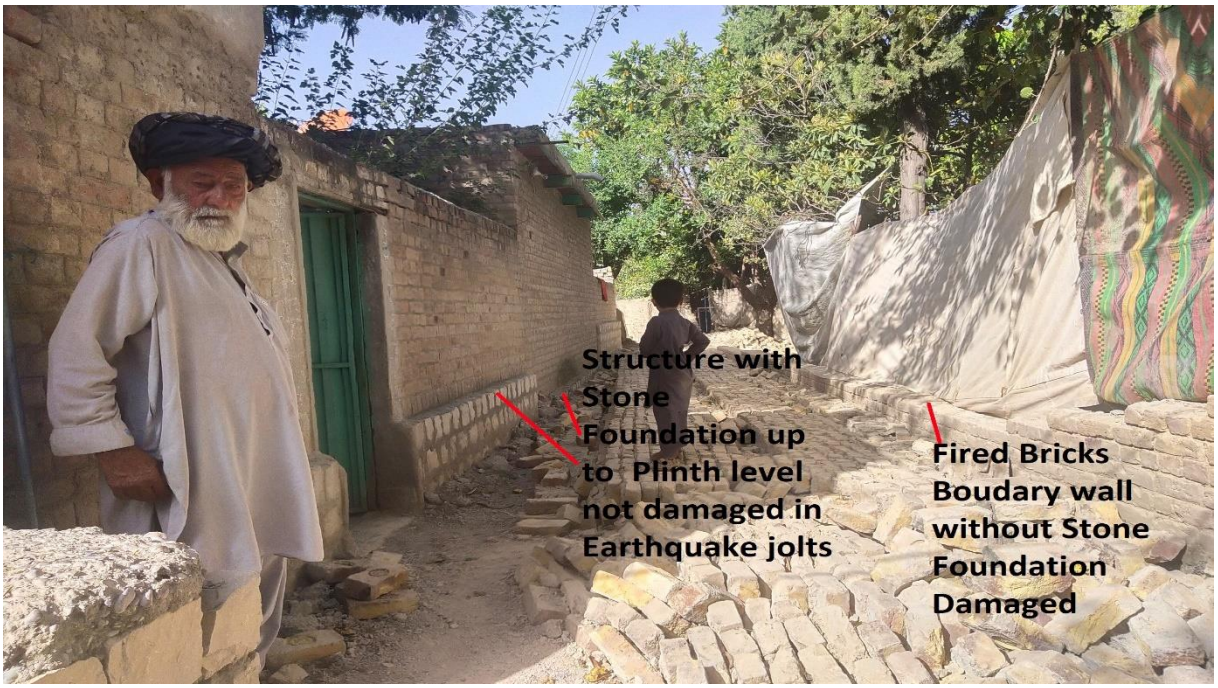
Community started separating their damaged shelter material for reuse in new shelter construction.

Observations about Shelters sustained in Earth Quake

In same villages some structures sustained the jolts and are safe. The below pictures of village Killi Urbooz Total 182 HHs are in this village and estimated 50 mud shelters collapsed down or damaged but shelters with Fired or Pakka Bricks sustained in Earth Quake and the same pattern shelter models found safe from Earth Quake in other visited villages. For Stone masonry community practicing Foundation depth = 1'ft ,6" to 2'ft,6" depending upon the structure, Width = 2'ft to 2'ft,6"inch up to NSL and 1'ft ,6"inch width above NSL with 1'ft ,6" depth with 2" DPC.



During visit in different villages observed that the sub structure with Stone and Stone masonry up to plinth level in Pakka Shelter or Mud shelters are DRR structures against Earth Quake.



Another example of Mud Shelters sustainable in Earth Quake at Harnai village with using Stone in Sub structure with Width = 2'ft and Depth = 1'ft,6" up to NSL and 1ft,3" inch up to Plinth level.

WASH (Water and Sanitation Hygiene)

It is observed in most of the villages main water source is mountain river water through Karezand also Water supply line in Harnai city or few villages nearby. River water from mountains is easy access at their houses. The Government and other organizations also work on pakka channels from river as in attached picture.

This is a good practice by District Harnai villagers that they constructed washing pad separate or near water supply line in their Houses**.**

It was observed in discussion with community about usage of latrine in the villages that female use latrine but male comfort with open defecation.

During door to door visit in the villages, at least one latrine in the house for four to five families was common. Mostly constructed latrine were pour flush latrine with separate septic tank and a separate bathing area in many houses.

Community facing difficulty after earth quake specially females because latrines damaged in few villages and the condition for female also same as open defecation.

Market rate analysis

Brick kiln were not available near the the villages or surroundings but Cement Block making work yard is available. They are selling on cost of Rs. 25 per block.

Communities, who can afford are mostly keen to purchase fired bricks near to Quetta kilns as per disucssion with them.

Discussing about rates and quaility of blocks with Block yard owner at Harnai.

Bricks purched by community person for shelter construction

Fully and Partially Damaged shelter beneficiaries are demanding for Tents because its too cold at night and winter season near to start. Government and other agencies distributed Tents in Harnai city and affected villages in smal quantities but not 100% coverage.

Traditional Stoves found in each visited villages for cooking

This little Agel was under collapsed Roof of her Shelter due to Earth Quake at District Harnai and she was unconscious for three days in ICU but MashaAllah now she is Happy with her Family.

Children were among the injured in the earthquake in Balochistan