

SCIENCE BASED DISASTER RISK REDUCTION IN NEPAL

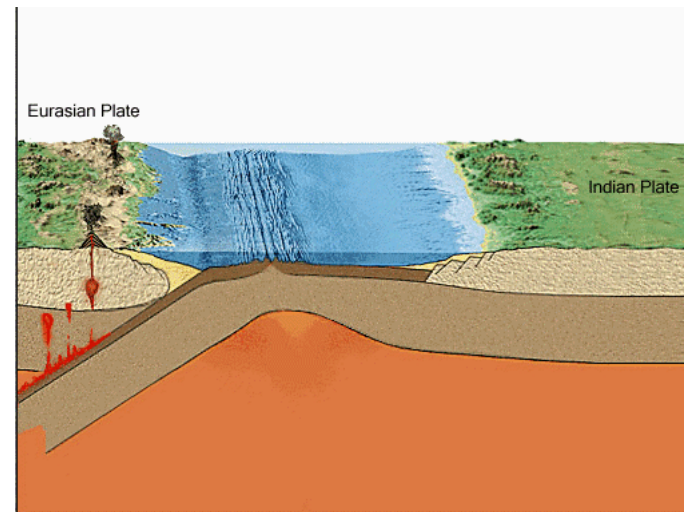
PRESENTED BY

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NEPAL

- Nepal was a sea(part of Tethy Sea) in the pliocene times some 600 million years ago
- The tectonic movement began and what was a sea transformed into the likes of mountain Everest



NEPAL

- Nepal is thus marked by
 - Fragile geology
 - Steep terrain
 - Excessive monsoon rain followed by dry weather
 - Unplanned settlements
- All these have contributed for the occurrence of disasters
 - Landslides
 - Fire
 - Flood
 - Earthquake



FIRE

- Nepal is suffering heavily through fire every year
- 18% of houses in Nepal use thatch as a roofing material (NLSS,2010)
- The losses due to fire
 - 59 Deaths in 2013 (NDR,2015)
 - 1101 Deaths from 1971-2007 (GAR, 2009)



FIRE

- Very little is being done from the Government apart from distributing reliefs after the fire
- Nepal Academy of Science and Technology is however promoting one fire resistant technology
- The science is that this technology does not let convection to take place



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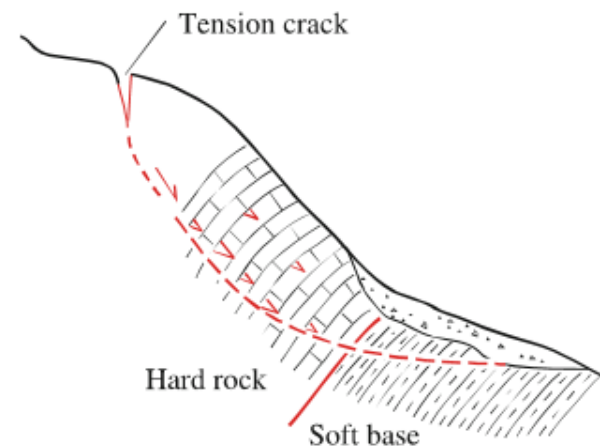


DIFFERENT STAGES



LANDSLIDES

- Nepal is suffering heavily through the occurrence of landslide every year
- The losses due to landslides
 - 87 Deaths in 2013 (NDR,2015)
 - 3987 Deaths from 1971-2007 (GAR, 2009)



Source :Huang, 2015

LANDSLIDE

- Very little has been done in landslide prevention apart from few stone masonry protection works
- It is just waiting for the landslide to occur and distribute relief to the survivors
- The science is that the landslide occurs mostly due to the tension cracks and the following locking section (Huang, 2015)



LANDSLIDE

- One new program of sealing the tension cracks has been initiated
- It begins with the identification of downstream leakage
- If there is leakage the search for the tension cracks is initiated in the upstream



LANDSLIDE

- Landslide mitigation through soil stabilization
- Use of vetiver plantation
- It is called kush in local Nepali language
- It increases the cohesion of the soil and keeps it together firmly



The forward slope toe protected with caged boulder

EARTHQUAKE

- Nepal is suffering heavily through earthquake in several occasions
- The losses due to earthquake
 - 8891 Deaths in 2015 (NDR,2015)
 - 873 Deaths from 1971-2007 (GAR, 2009)



EARTHQUAKE

- The NRA is carrying out several works in this regard
- A damping technology is being initiated
- Absorption of energy occurs due to imperfect elastic property of the medium



EARTHQUAKE DAMPING



EARTHQUAKE DAMPING



EARTHQUAKE DAMPING



Accelometer Reading and Earthquake Damping at NAST Station, Khumaltar, Lalitpur

S.N.	Date and Time	Epicenter and Magnitude in R.S.	KHU 1		Vector Sum (x & y)	NST2		Vector Sum (x & y)	Individual Damping in %	Vector Sum Damping in %	Remarks
			Axis	g		Axis	g				
			X	Y	Z	x	y	z			
1	2015 June 11, 16;22;27	Sindhupalchowk, 5.3	X	0.00223	0.002641752	x	0.00109	0.001560669	-51.12	-40.92	(-- 1+(0.00156/ 0.0026)* 100
			Y	0.00141		y	0.00112		-20.92		
			Z	0.00221		z	0.00112		-49.21		
2	2015 June 13, 16;22;27	Dolakha , 5.2	X	0.00202	0.002371675	x	0.00103	0.001233378	-49.21	-48.00	
			Y	0.00125		y	0.00069		-44.94		
			Z	0.0012		z	0.00067		-44.49		
3	2015 June 25, 15;22;25	Nuwakot/Dhading border, 4.3	X	0.00295	0.003553694	x	0.00152	0.002164551	-48.66	-39.09	
			Y	0.00198		y	0.00155		-21.85		
			Z	0.00159		z	0.00066		-58.54		
4	2015 June 29, 07;37;35	Kathmandu , 3.3	X	0.00501	0.005733988	x	0.00152	0.002283836	-69.76	-60.17	
			Y	0.00279		y	0.00171		-38.72		
			Z	0.00445		z	0.00099		-77.71		
5	2015 July 16, 13;51;09	Dolakha , 2.8	X	0.00279	0.004523636	x	0.001268	0.002224566	-54.56	-50.82	
			Y	0.00356		y	0.001828		-48.66		
			Z	0.00026		z	0.000109		-58.54		
6	2015 July 16, 14;22;20	Kirtipur , 3.2	X	0.00107	0.00159921	x	0.000442	0.000699162	-58.54	-56.28	
			Y	0.00119		y	0.000542		-54.56		
			Z	0.00118		z	0.000607		-48.66		
7	2015 July 16, 22;21;33	Dhading, 3.0	X	0.00084	0.001469211	x	0.000432	0.00079602	-48.66	-45.82	
			Y	0.0012		y	0.000668		-44.48		
			Z	0.00052		z	0.000467		-9.73		
8	2015 July 17, 09;06;29	Kavre, 3.9	X	0.00127	0.001496305	x	0.000578	0.000783051	-54.56	-47.67	
			Y	0.00079		y	0.000528		-32.96		
			z	0.00073		z	0.000375		-48.66		
9	2015 July 17, 13;48;34	2.7 , Dolakha	x	0.00135	0.001741214	x	0.000561	0.001023835	-58.54	-41.20	
			y	0.0011		y	0.000857		-21.85		
			z	0.00171		z	0.000680		-60.11		
AVERAGE DAMPING			x	0.00135	0.001741214	x	0.000561	0.001023835	-54.85	-47.77	
			Y	0.0011		y	0.000857		-36.55		
			z	0.00171		z	0.000680		-54.69		

Source; DoMG

g= gal=Ground acceleration





NEW SETTLEMENT



EXAMPLE OF SETTLEMENT PLAN
ON A RURAL CONTOURED LAND

0 50 100 FEET

1. TEMPLE COMPLEX (STUPA/
HINDU TEMPLE/ MOSQUE, ETC.)
2. OPEN GROUND
3. COMMUNITY CENTRE
4. SCHOOL
5. SHOPS/ COLLECTION CENTRE
6. HEALTH POST
7. POLICE STATION
8. TRAINING CENTRE
9. FUTURE EXPANSION



TYPICAL HILLY SETTLEMENTS

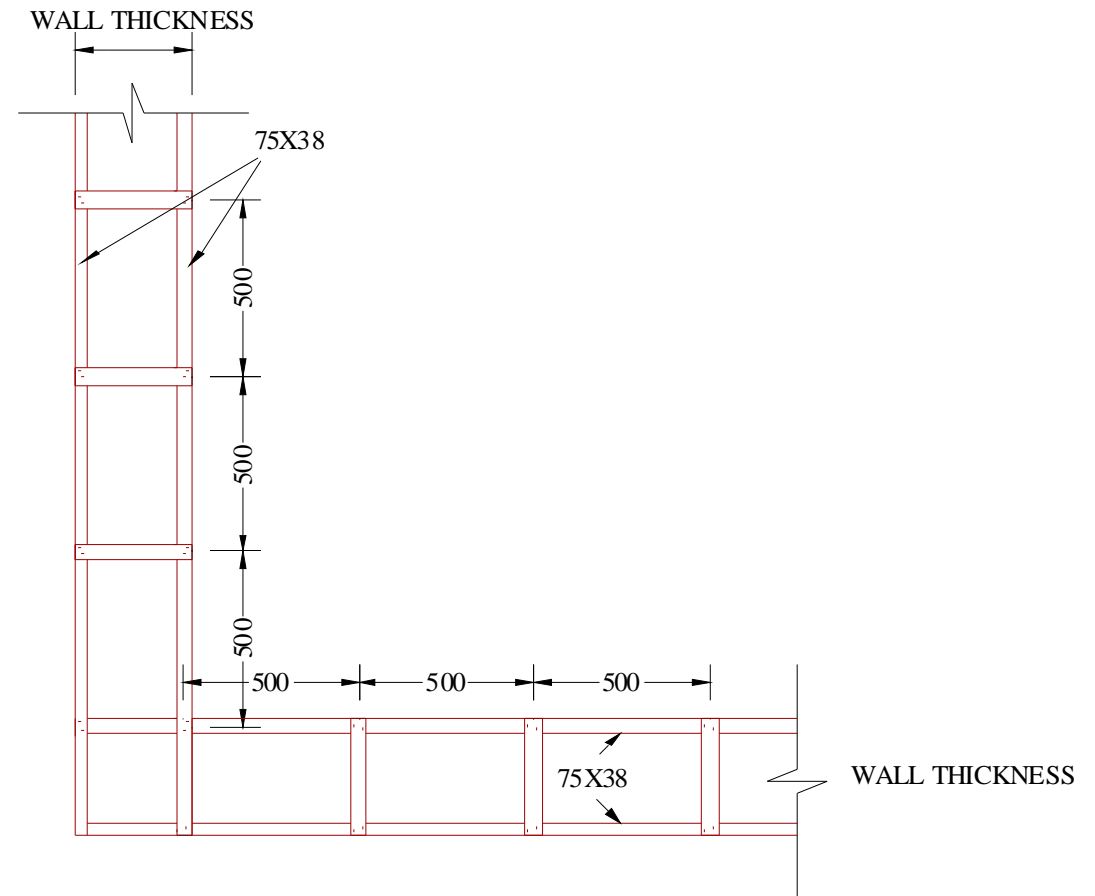


EARTHQUAKE: INDIGENOUS TECHNOLOGY



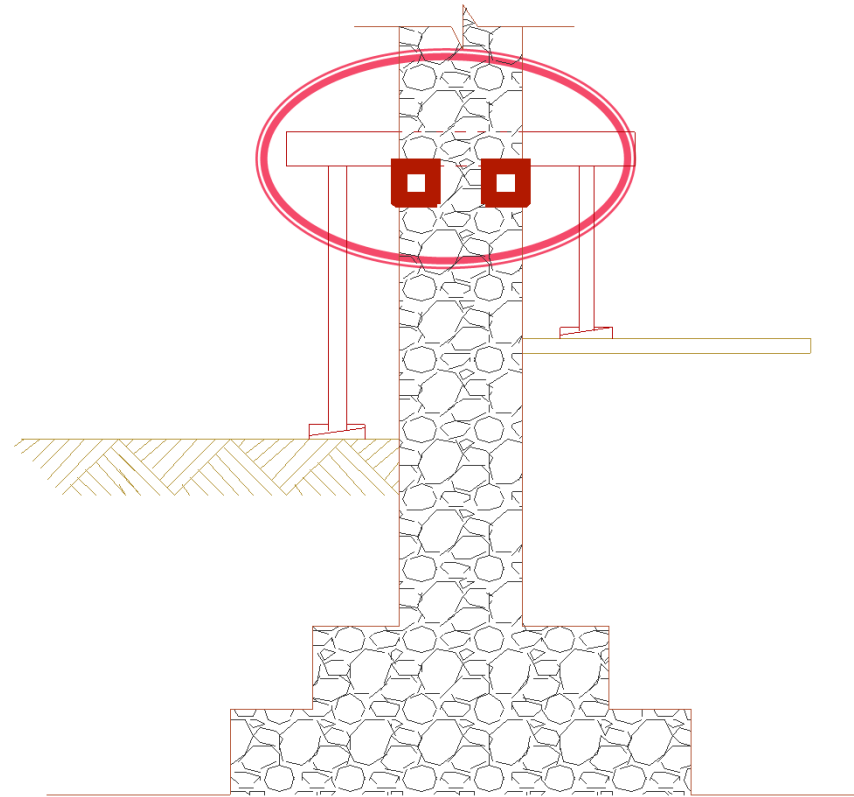
EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Horizontal and transverse members to be laid on the wall



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- First the outer 4" layer is taken out
- A 3" by 1.5" timber can be inserted
- This is made strong
- Insertion of 3" by 1.5" timber can be done in the inner side



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- The house in the lower left has survived the 1934 earthquake
- It had similar technology



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Groove made into the wall



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Groove made on the wall



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Stones taken out making an arched form



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- The arch being filled



EARTHQUAKE: INDIGENOUS TECHNOLOGY

Timber member inserted
into wall



EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Make **holes** in the walls in line with the scaffolding holes to have a grid of **3ft by 3ft**



EARTHQUAKE: INDIGENOUS TECHNOLOGY



- Make a 4" x 4" jali of bamboo

EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Insert the jali in the exterior of the wall



EARTHQUAKE: INDIGENOUS TECHNOLOGY



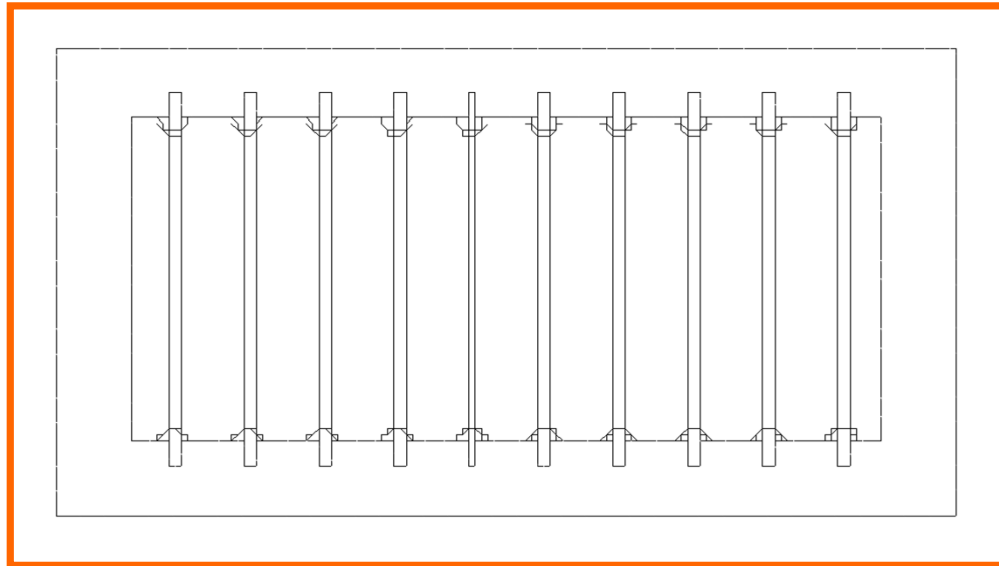
- Insert the jali in the interior wall

EARTHQUAKE: INDIGENOUS TECHNOLOGY

- Tie the interior and exterior bamboo jali by the gabon wire very strongly

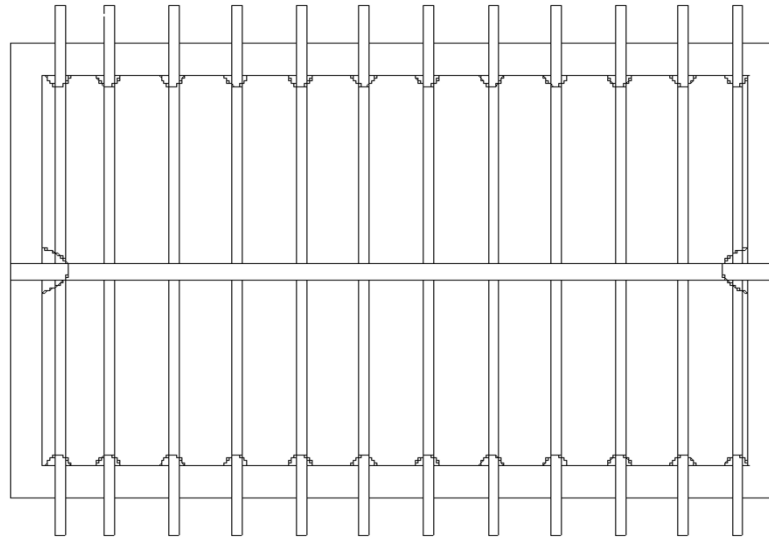


EARTHQUAKE: INDIGENOUS TECHNOLOGY



Tie the joists with the wire

EARTHQUAKE: INDIGENOUS TECHNOLOGY



Tie the rafters with the wire

EARTHQUAKE: INDIGENOUS TECHNOLOGY



- Plaster the wall with the mud.

EARTHQUAKE: INDIGENOUS TECHNOLOGY



RAMECHHAP DISTRICT



DOLAKHA DISTRICT

EARTHQUAKE: INDIGENOUS TECHNOLOGY



RAMECHHAP DISTRICT



EARTHQUAKE: INDIGENOUS TECHNOLOGY



KASKE DISTRICT



KABHREPALANCHOK DISTRICT



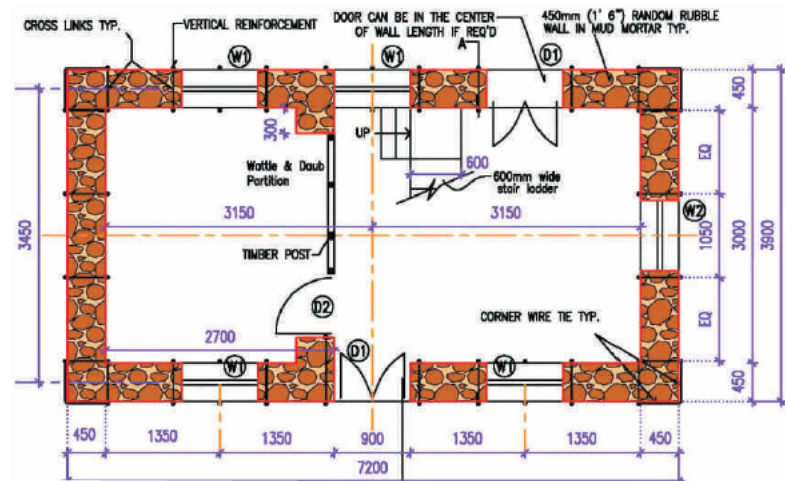
EARTHQUAKE: INDIGENOUS TECHNOLOGY



KABHREPALANCHOK DISTRICT

UNDP EXPERIMENT

- In this one, only gabion wire has been used in the stone wall with mud mortar



Thank You

Questions?