Matrix of Past Disaster in the District

Disasters occur when forces of nature damage the environment or destroy manmade structures. If people live in the area, hazards can cause a great deal of human suffering. As a result of hazards, people may be injured or killed, or may lose their homes and possessions. The impact is so great that the affected community often must depend on outside help in order to cope with the results. The District Kangra of Himachal Pradesh is prone to multiple hazards such as earthquake, floods, Forest Fire, drought, landslides and seasonal hail storms. The population is mainly vulnerable to earthquake and others like perennial floods, forest fire, drought and environmental degradations. Disasters cause sudden disruption to the normal life of a society and cause enormous damage to property to a great extent. Chronological reviews of the past major disasters given below clearly show the possibilities of similar events in future.

SN	Disasters	Year	Magnitude	Affected Talukas /Blocks & Villages	Life loss	Cattle loss	Damage to Infrastructure in numbers	Economic* Losses	Environmental Degradation & livestock Management
1	Earthquake	4th April 1905	7.8	Dharamshala, Palampur, Kangra, Mcleod ganj, Chadi	20,000	53,000	1,00,000 Houses	0.29 Crore	NA
2	Earthquake	15th June, 1978	5.0	Dharamshala	NA	NA	NA	NA	NA
3	Earthquake	26th April 1986	5.5	Narghota, Naddi, Kaned, Sukar & Khanyara	06	NA	NA	65 Crore	NA
4	Flash Floods	29th & 30th July 2001	NA	Chhota Bhangal and Baijnath Sub Division	12	150	NA	18.27 Crore	NA
5	Cloud burst	2009	NA	NA	2 women	17 (Goats)	09 (8 Houses & 01 Cow shed)	NA	NA
6	Snake Bite	2008	NA	NA	52	50	NA	NA	NA
7	Snake Bite	2009	NA	NA	20	98	NA	NA	NA
8	Snake Bite	2010	NA	NA	72	104	NA	NA	NA
9	Snake Bite	2011	NA	NA	97	NA	NA	NA	NA
10	Domestic Fires	2009	113 Cases	Dharamshala, Kangra, Palampur	NA	NA	NA	NA	NA
11	Road accidents	2009-2010	569Cases	NA	154	NA	569	NA	NA
12	Road accidents	2010-2011	602Cases	NA	106	NA	NA	NA	NA
13	Domestic Fires	2010	104	Dharamshala, Kangra, Palampur	NA	NA	NA	NA	NA
14	Domestic	2011	85	Dharamshala,	NA	NA	NA	NA	NA

	Fires			Kangra, Palampur					
15	Forest Fire	2009	131	Dharamshala, Kangra, Palampur	NA	NA	NA	NA	NA
16	Forest Fire	2010	118	Dharamshala, Kangra, Palampur	NA	NA	NA	NA	NA
17	Forest Fire	2011	63	Dharamshala, Kangra, Palampur	NA	NA	NA	NA	NA
18	Heavy rain damage	2007	NA	NA	11	105	512	NA	NA
19	Heavy rain damage	2008	NA	NA	11	504	2902	NA	NA
20	Heavy rain damage	2009	NA	NA	05	42	219	NA	NA
21	Heavy rain damage	2010	NA	NA	03	45	953	NA	NA
22	Heavy rain damage	2011	NA	NA	09	88	2025	NA	NA
23	Flash flood loss	2001	NA	NA	17	150	55	3591	NA

***Economic Losses = (Crops + Relief + reconstruction + livelihood rehabilitation**

Table: 2.24 Tehsil-wise number of forest fire-sensitive villages

Tehsil	High	Medium	Low	Very low
Baijnath	33	56	74	1
Baroh	30	74	65	0
Dhera Gopipur	21	77	144	1
Dharamshala	42	61	51	1
Dhira	23	64	41	0
Fathepur	3	14	122	15
Harchakian	8	44	4	0
Indora	3	11	54	3
Jaisinghpur	91	47	104	0
Jaswan	7	20	63	0
Jwalamukhi	9	39	48	0
Jawali	8	77	15	0
Kangra	33	44	105	0
Khundian	18	150	61	0
Multhan	0	0	0	0
Nagrota Bagwan	27	44	68	0
Nurpur	38	148	232	18
Palampur	84	143	121	2
Rakkar	19	1	89	0
Shahpur	13	80	16	0
Thural	34	24	25	0

(From Source Research Paper: Nat Hazards (2015) 78:203–217 on Research Gate)

Table: 2.20 The status of medical institutions, workforce

Year	Medical officer		Nurses/ Female health Worker		Mid wife		CHC / PHC's		
	Allo.	Ayur.	Allo.	Ayur.	Allo.	Ayur.	Allo.	Ayur.	Homoe-pathic
2014	218	205	175	45	54	81	118	109	1
Development Block wise : 2014									
Nurpur	28	13	30	3	5	3	16	6	
Indora	8	12	9	4	1	6	6	2	
Fatehpur	9	12	4	3	3	7	6	8	
Nagrota Surian	12	12	10	4	2	7	6	11	
Rait	11	14	8	2	3	3	7	5	
Dharamshala	5	11	0	11	1	2	4	10	1

Kangra	16	14	12	2	5	5	9	10	
Nagrota Bagwan	9	11	6	3	3	6	6	5	
Dehra	21	17	23	4	5	3	12	8	
Paragpur	13	27	12	4	6	12	10	15	
Suleh	17	16	7	1	5	7	8	7	
Lambagaon	13	12	8	1	2	4	7	5	
Baijnath	29	20	22	1	4	8	10	8	
Panchrukhi	23	7	23	0	7	3	9	2	
Bhawarna	4	9	1	2	2	5	2	7	

Table: 2.25 Police Network

SN	Name of post & station		Inspr.	S.I.	ASI	HC	Cs.
1	Dharamshala	1,3	1	2	7	6	28
2	Mcloadganj	Police Stations	-	1	2	3	9
3	Yol	Police Posts	-	-	1	2	8
4	Baijnath	0,1	1	2	4	5	18
5	Dehra	1,2	-	2	5	4	23
6	Terrace	Police Posts	-	-	1	1	09
7	Haripur	Police Stations	-	1	1	4	13
8	Ranital	Police Posts	-	-	1	1	6
9	Nagrota Surian	Police Posts	-	-	1	1	5
10	Indora	3,1	1	2	6	5	21
11	Damtal	Police Posts		-	1	3	8
12	Thakur dawara	Police Posts	-	-	1	2	7
13	Dhangpir	Police Posts	-	-	1	1	1
14	Jawalamukhi	0,1	1	2	2	4	19
15	Khundian	0,1	-	-	1	1	5
16	Kangra	2,1	1	5	5	5	19
17	Nagrota Bagwan	0,1	-	-	2	2	14
18	Gaggal	Police Posts	-	-	1	3	8
19	Jawali	2,1	1	2	3	6	18
20	Fatehpur	0,1	-	1	1	3	7
21	Lambagaon	Police Stations	-	1	3	4	16
22	Thural	0,1	-	-	1	1	5
23	Nurpur	3,1	1	4	3	6	32
24	Rahan	Police Posts		-	1	2	11
25	Gangath	Police Posts	-	-	1	2	5
26	Palampur	1,1	1	3	3	6	21
27	Panchrukhi	Police Posts	-	-	1	4	7
28	Bhawarana	Police Stations	-	1	3	5	14
29	Shahpur	0,1	-	2	4	6	19
30	Kotla	Police Posts		-	1	1	8
31	Rakkar	0,1	-	-	1	1	5
32	Jaswan	1,0					
33	Multhan	1,0					

34	Jaisinghpur	0,1					
35	Dheera	0,1					

Table: 2.26 Study on Earthquake in District Kangra

As per the housing statistics contained in the below table, 59.9% of the building stock of the district falls in Category A which is highly susceptible to earthquake damage. A lot of wood is used in the house construction in the district hence the houses are also vulnerable to fire hazard resulting due to earthquake shaking. Steep slopes in the district would result into landslides and block the arteries of the district resulting in delay in emergency response.

Table– Distribution of House by Predominant Materials of Roof and Wall and Level of Damage Risk

State: HIMACHAL PRADESH District: Kangra

Wall/ Roof		Census Houses		Level of Risk under								
				EQ Zone				Wind Velocity m/s				Flood Prone Area in %
		No. of Houses	%	V	IV	II I	I I	55 & 50	47	44 & 39	33	
				Area in %				Area in %				
				97.8	2.2					100		
WALL												
A1-Mud Unburnt Brick Wall	Rural	2,96,650	58.9									
	Urban	5,123	1.0									
	Total	301,773	59.9	**VH**	**H**					**M**		
A2- Stone Wall	Rural	2,3110	4.6									
	Urban	2,675	0.5									
	Total	25,785	5.1	**VH**	**H**					**L**		
Total-Category-A		327,558	65.1									
B-Burnt Bricks Wall	Rural	145,653	28.9									
	Urban	18,332	3.6									
	Total	163,985	32.5	**H**	**M**					**L**		
Total-Category-B		163,985	32.6									
C1-Concrete Wall	Rural	700	0.1									
	Urban	148										
	Total	848	0.1	**M**	**L**					**VL**		
C2-Wood Wall	Rural	2,289	0.5									

	Urban	404	0.1									
	Total	2,693	0.6	**M**	**L**					**M**		
Total-Category-C			0.7									
X-Other Material	Rural	7,662	1.5									
	Urban		0.2									
	Total	8,419	1.7	**M**	**VL**					**M**		
Total-Category-X 8,419			1.7									
TOTAL BUILDINGS 503,503												
ROOF												
R1-Light Weight Sloping Roof	Rural	33,355	6.6									
R1-Light Weight Sloping Roof	Urban	6,014	1.2									
	Total	39,369	7.8	**M**	**M**					**H**		
R2-Heavy Weight Sloping Roof	Rural	319,656	63.5									
R2-Heavy Weight Sloping Roof	Urban	5,911	1.2									
	Total	325,567	64.7		**M**					**L**		
R3-Flat Roof	Rural	123,053	24.4									
R3-Flat Roof	Urban	15514	3.1									
	Total	138567	27.5	***Damage Risk as per that for the wall supporting it***								
TOTAL BUILDINGS 41453												

Probable Maximum Precipitation at a station of the district in 24 hrs is 720mm

Housing Category : Wall Types

Category-A: Buildings in field-stone, rural structures, unburnt brick houses, clay houses.

Category-B: Ordinary brick building: buildings of the large block &prefabricated type, half-timbered structures, building in natural hewn stone.

Category-C: Reinforced building well-built wooden structures.

Category-X: Other materials not covered in A.B.C. These are generally light.

Notes:

1. Flood prone area failure that protected area which may have more severe damage under failure of protection works. In some other areas

Housing Category: Roof Type

Category-R1- Light Weight (Grass, Thatch, Bamboo, Wood, Mud, Plastic, Polythene, GI Metal, Asbestos Sheets, Other Material)

Category-R2-Heavy Weight (Tiles, Slate)

Category-R3-Flat Roof (Brick, Stone, Concrete)

EQ Zone V: Very High Damage Risk Zone [MSK>IX]

EQ Zone IV: High Damage Risk Zone [MSK VIII]

EQ Zone III: Moderate Damage Risk Zone [MSK<VII]

EQ Zone II: Low Damage Risk Zone

the local damage, may be secure under heavy rains and chocked drainage. 2. Damage Risk for wall types is indicated assuming heavy flat roof in categories A, B and C (Reinforced Concrete) buildings. 3. Source of **Housing Data:** Census of Housing, GOI,2001	[MSK<VI] **Level of Risk :** VH=Very High; H=High; M=Moderate; L=Low; VL=Very Low

(Source: BMTPC Vulnerability Atlas of India 2006)

Housing Vulnerability

The census of Houses, 2001 Census of India, gives the following details of houses bases on materials of construction for walls and roofs (BMTPC Vulnerability Atlas):

a) Type of Roof:

- Pitched or sloping including Tiles, slate or shingle; Corrugated iron, zinc or other metal sheets; Asbestos cement sheet's thatch, grass, leaves, bamboo etc.
- Flat including brick, stone and lime; reinforced brick concrete/reinforced cement concrete.

b) Type of Wall:

- Mud, unburnt bricks, stone laid in mud or lime mortar.
- Burnt bricks laid in cement, lime or mud mortar.
    1. Cement concrete.
    2. Wood or Ekra walling.
    3. Corrugated iron, zinc or other metal sheets.
    4. Grass, leaves, reeds or bamboo or thatch and others.

c) Type of Flooring:

- Various types like mud, stone, concrete etc.
- On the basis of building material, the houses have been categorized in four types to assess the vulnerability to earthquake hazard:-
    1. **Category A:** Mud Wall (all roofs), Unburnt brick or Adobe wall with sloping roof, unburnt brick or Adobe wall with flat roof, stone wall with pitched/sloping roof, stone wall with flat roof.
    2. **Category B:** Burnt brick wall with sloping roof, burnt brick wall with flat roof.
    3. **Category C:** Concrete wall with sloping roof, concrete wall with flat roof, wooden wall (all roofs), ekra wall (all roofs)
    4. **Category X:** Corrugated iron, zinc or other metal sheet walling (all roofs), bamboo, thatch, grass leaves etc. (all roofs).

House types and Risk

The damage risk of various house types is based on their average performance observed during past occurrence of damaging events. In view of numerous variations in the architectural planning, structural, detailing, quality of construction and care taken in maintenance, the performance of each category of houses in a given event could vary substantially from the average observed. For example, under seismic occurrence, the following observations have been made in many cases (BMTPC Vulnerability Atlas).

(a) All Masonry Houses (Categories A and B).

- Quality of construction comes out as a major factor in the seismic performance particularly under intensities MSK IX and lower. Good quality constructions perform much better than poor quality constructions in any category. Appropriate maintenance increases durability and maintains original strength.

- Number of storeys in the house and storey height are other factors. Higher the storey and more the number of storeys, greater is the observed damage.
- Size, location and number of door and window openings in the walls also determine seismic performance, since the openings have weakening effect on the walls. Smaller and fewer openings and located more centrally in the walls are better from seismic performance viewpoint.
- Architectural layout, particularly in large buildings, that is, shape of building in plan and elevation, presence of offsets and extended wings also play important role in initiation of damage at certain points and its propagation as well. More symmetrical plans and elevations reduce damage and unsymmetrical ones lead to greater damage.
- Where clay/mud mortar is used in wall construction, its wetness at the time of earthquake is very important factor in the seismic performance since the strength of fully saturated mortar can become as low as 15% of its dry strength.

(b) Wooden Houses:

- Quality of construction, that is, seasoning of wood and the joinery are important in seismic and cyclone wind performance. Better the quality better the performance.
- Wood decays with time due to dry rot, insect and rodent attack etc. therefore, the joints tend to become loose and weak. The state of maintenance of the wooden building will determine its performance during earthquake, high wind, as well as flooding.

(c) Reinforced Concrete Houses:

- In reinforced concrete construction, good structural design and detailing and good quality construction only could ensure excellent performance. Carelessness in any of these can lead to poor behaviour both under earthquake and cyclones.

Now the average risk levels to various categories of houses for various hazards and their intensities are defined here below for use in the house vulnerability tables.The damage risk to various house types is defined under various seismic intensities on MSK scale. The following damage risks are defined based on this Intensity Scale:

Category	Loss
Very High Damage Risk (VH) –	Total Collapse of building.
High Damage Risk (H) –	Gaps in walls; parts of buildings may collapse; separate parts of the building lose their cohesion; and inner walls collapse.
Moderate Damage Risk (M) –	Large and deep cracks in walls, fall of chimneys on roofs.
Low Damage Risk (L) –	Small cracks in walls; fall of fairly large pieces of plaster, pentiles slip off; cracks in chimneys, part may fall down.
Very Low Damage Risk (VL) –	Fine cracks in plaster; fall of small pieces of plaster.

Prof Bilham states that his new Global Positioning System (GPS) data reading reveals,

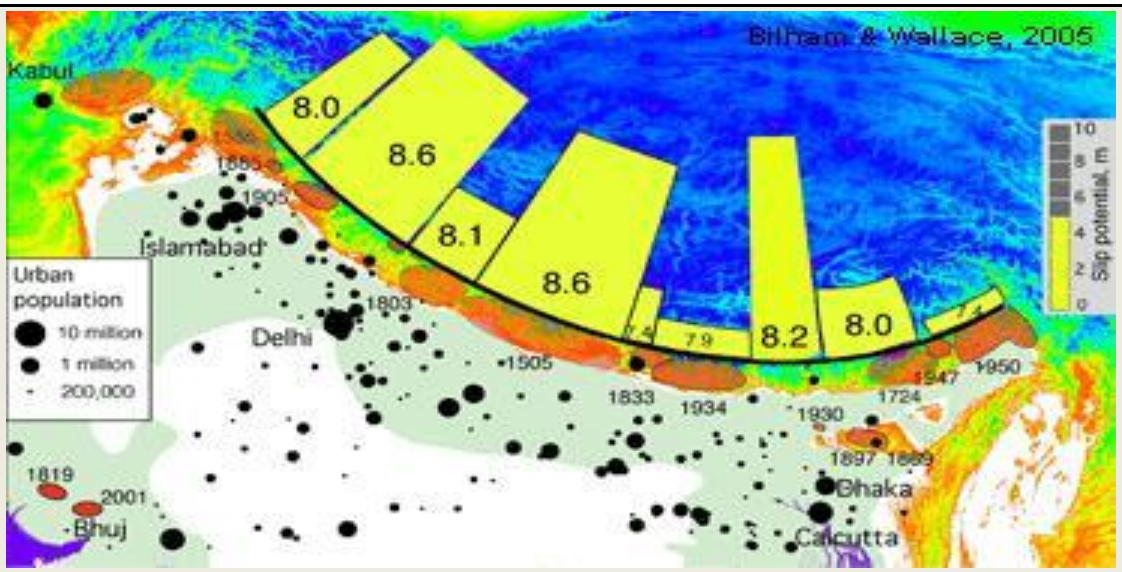

Fig: Probable built-up stress and likely magnitude of earthquakes in different regions of the Himalayas

"The Indian plate is slowly burrowing under the Tibetan plateau. Studies on where the relative movement of the Tibetan plateau was slowest, indicates where compression is building up, and a rupture is eventually likely to occur, I expected this to be in the Pir Panchal range, to the south of the Kashmir Valley, but instead it was in the Zanskar range to the north."

Prediction of future earthquake in the Himalayas (Source Roger & Bilham).

Dr. Anand S Arya (Department of Earthquake Engineering, University of Roorkee has worked out a hypothetical recurrence of earthquake of M 8.0 in Kangra area of Himachal Pradesh (like that of 1905). The scenario highlights the disastrous situation that could have developed if the repeat earthquake had occurred in the census year 1991. The results are obtained for two cases of all buildings being of traditional construction:

(i) Without earthquake safety features,

(ii) With earthquake resistant features as per the Indian Standard Building Codes.

It is seen that If all the 18, 15, 858 houses are without earthquake safety provisions, the direct losses will amount to Rs. 51.04 billion. Since about 65,000 lives may be lost and 399,695 houses ruined completely, the trauma will be too great and cost of emergency relief will be exorbitant.

If all the houses were made earthquake resistant as per IS: 4326 and IS: 13928, when built initially, the direct losses will amount only to Rs. 19.6 billion. The extra cost of earthquake safe provision for all houses would only be Rs. 6.35 billion. Hence, the lives lost will only be a net saving of Rs. 25.09 billion or about 50%. Besides, the lives lost will only be one-fifth and totally ruined houses reduced to about one-fourth. The damage scenario brings out clearly the economic and other social benefits of pre-earthquake preventive measures.