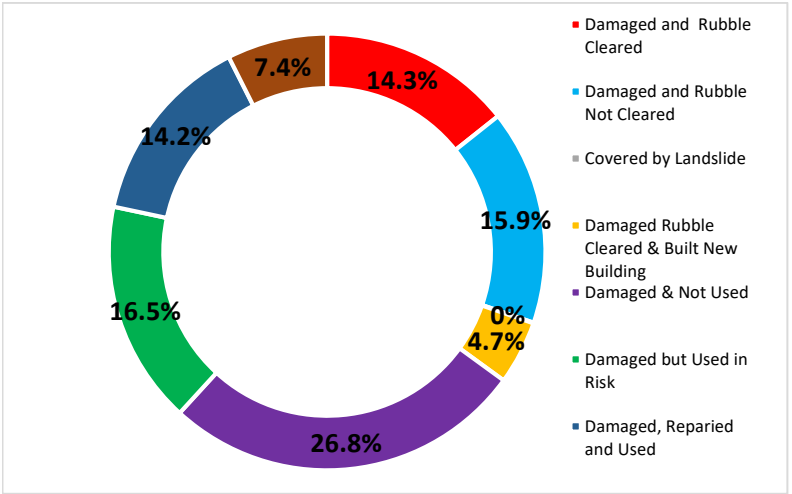
Key Findings on Household Registration for Housing Reconstruction Survey in 14 Districts



Central Bureau of Statistics

Ramshahpath, Kathmandu, Nepal

3 Key Findings of the Survey (First and Second Phase) in 14 districts

3.1 Houses, Households and Population

The major objective of the Household Registration for Housing Reconstruction Survey (Beneficiary Survey) is to assess the damage of the residential houses by the earthquake and to collect socio-economic and demographic information of the people living in those affected households. In this regard, the registration program performed detailed damage assessment of about 1 million houses with the implementation of the program in 31 districts in three phases. The full report covering 31 districts can be found as a separate document.

The first and second phases of the program was launched separately in 11 and 3 affected districts namely **Dolakha, Ramechhap, Okhaldhunga, Sindhupalchok, Kavrepalanchok, Sindhuli, Makawanpur, Dhading, Nuwakot, Rasuwa and Gorakha** as the first phase districts and **Kathmandu, Lalitpur and Bhaktapur** as the second phase districts. These 14 districts were categorized as the most affected districts.

In this regard, the survey program performed detailed damage assessment of **8,76,520** houses in 14 most affected districts and collected key socio-economic and demographic information from **8,66,060** (865,337) households living in those houses. The total population usually residing in the surveyed households count to **3407804** with 47.8 percent (1627668) male and 52.2 percent (1780136) female.

The largest number of houses surveyed was in Kavrepalanchok (98019) followed by Makawanpur (90994), Dhading (89122), Sindhupalchok (88,741) and Gorkha (78074). Rasuwa is the smallest district with 12644 houses in terms of number of surveyed houses followed by Bhaktapur (30197) and Lalitpur (33093) which consists of 1.4, 3.4 and 3.8 percent of the total surveyed houses.

In terms of population, Makawanpur is the largest district surveyed with total usually residing population of 407199. Kavrepalanchok and Dhading are the second and third largest district in terms of usually residing population among the 14 most affected districts. Rasuwa comes as the smallest district with population of 47122 followed by Okhaldhunga (145080), Lalitpur (145286) and Ramechhap (202765).

Table 3.1: Houses, Households, Population and HH Size in 14 surveyed districts

SN	District	Number of Houses	Number of Households	Sex of the Household Head			Population (Usual Place of Residence)	HH Size
				Male	Female	Total		
1	Okhaldhunga	39,352	36114	24210	11904	36114	145080	4.0
2	Sindhuli	68,750	64913	41056	23857	64913	298175	4.6
3	Ramechhap	58,623	55262	37043	18219	55262	202765	3.7
4	Dolakha	60,639	70496	50807	19689	70496	202855	2.9
5	Sindhupalchowk	88,741	90083	67797	22286	90083	312713	3.5
6	Kavrepalachowk	98,019	91906	65872	26034	91906	371913	4.0
7	Lalitpur*	33,093	33162	25472	7690	33162	145286	4.4
8	Bhaktapur*	30,197	31819	24686	7133	31819	148779	4.7
9	Kathmandu*	51,124	52991	38445	14546	52991	221877	4.2
10	Nuwakot	77,148	75454	54137	21317	75454	288439	3.8

11	Rasuwa	12,644	12384	9420	2964	12384	47122	3.8
12	Dhading	89,122	86381	58943	27438	86381	344190	4.0
13	Makawanpur	90,994	88461	53950	34511	88461	407199	4.6
14	Gorkha	78,074	75911	44691	31220	75911	271411	3.6
	Total	**876,520**	865337	596529	268808	865337	3407804	3.9

*verification model was used in these districts (except rural areas of Lalitpur where census was done) in which only households enlisted as earthquake affected households by the local authorities were reassessed by the survey team.

3.1.1 Ownership of the Houses by Sex

More than two-thirds (78.38 percent) of the total ownership is owned by male whereas the female ownership of the houses accounts for only about 22 percent. The highest number of female-owned houses are in Makawanpur with 25.45 percent of the surveyed houses followed by Ramechhap (25 Percent) and Kathmandu (24.4 percent) whereas lowest percentage of houses surveyed is owned by female in Rasuwa (16.9 Percent) followed by Nuwakot (18 percent) and Sindhupalchok (18.9 percent). (Table 1.8 & 1.9)

Table 3.2.1: Sex of Owner of Surveyed Houses in 14 districts

Districts	Sex of House Owner						Total
	Male		Female		Third Sex		
	Population.	Percent	Population.	Percent	Population.	Percent	.
Okhaldhunga	29,292	76.65	8,922	23.35			38,214
Sindhuli	49,918	76.20	15,590	23.80			65,508
Ramechhap	42,977	75.00	14,326	25.00	1	0.00	57,304
Dolakha	53,101	78.80	14,289	21.20			67,390
Sindhupalchowk	73,677	81.05	17,222	18.95	2	0.00	90,901
Kavre	78,269	80.10	19,441	19.90	1	0.00	97,711
Lalitpur	26,941	80.82	6,393	19.18			33,334
Bhaktapur	25,946	80.08	6,453	19.92			32,399
Kathmandu	39,888	75.61	12,864	24.39			52,752
Nuwakot	63,597	82.01	13,952	17.99			77,549
Rasuwa	10,342	83.15	2,096	16.85			12,438
Dhading	70,738	79.64	18,082	20.36			88,820
Makawanpur	66,864	74.55	22,830	25.45			89,694
Gorkha	60,780	76.67	18,490	23.33			79,270
Total	692,330	78.38	190,950	21.62	4	0.00	883,284

3.2 Legal Ownership of Land

The survey collected the information on the legal ownership of the land where the surveyed houses were built. The survey found that most of the houses surveyed (95.9 percent) were built on the personally owned land. The percentage of houses built on the institutional (Guthi), government/public and other types of land constitutes only 1.1 percent, 2.3 percent and 0.64 percent respectively.

Table 3.3: Legal ownership of land by District

Districts	Legal Ownership	Total

	Owned		Institutional/Guthi		Government/public		Others		
	No.	%	No.	%	No.	%	No.	%	No.
Okhaldhunga	39,264	99.78	15	0.04	8	0.02	65	0.17	39,352
Sindhuli	60,241	87.62	105	0.15	7,379	10.73	1,025	1.49	68,750
Ramechhap	57,643	98.33	468	0.80	390	0.67	122	0.21	58,623
Dolakha	58,491	96.46	1,677	2.77	299	0.49	172	0.28	60,639
Sindhupalchowk	85,479	96.32	1,894	2.13	662	0.75	706	0.80	88,741
Kavre	96,233	98.18	1,047	1.07	550	0.56	189	0.19	98,019
Lalitpur	31,208	94.30	436	1.32	305	0.92	1,144	3.46	33,093
Bhaktapur	29,055	96.22	644	2.13	47	0.16	451	1.49	30,197
Kathmandu	49,315	96.46	1,111	2.17	391	0.76	307	0.60	51,124
Nuwakot	75,717	98.15	559	0.72	638	0.83	234	0.30	77,148
Rasuwa	11,971	94.68	477	3.77	102	0.81	94	0.74	12,644
Dhading	87,415	98.08	333	0.37	1,054	1.18	320	0.36	89,122
Makawanpur	83,148	91.38	124	0.14	7,294	8.02	428	0.47	90,994
Gorkha	75,785	97.07	1,124	1.44	856	1.10	309	0.40	78,074
Total	840,965	95.94	10,014	1.14	19,975	2.28	5,566	0.64	876,520

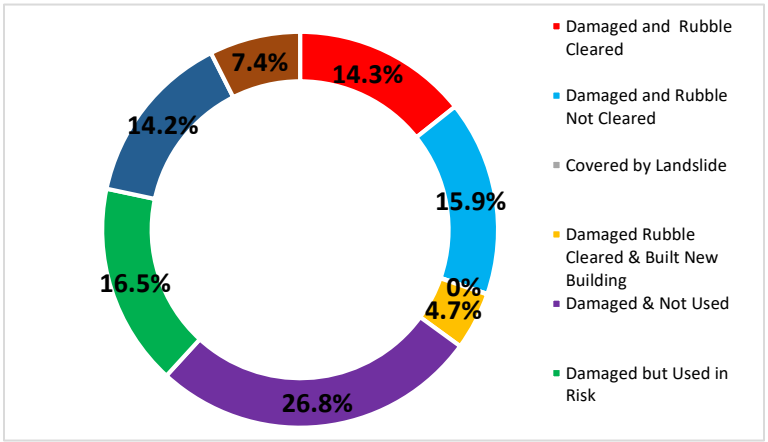
3.3 Current Status of Houses

Among the 876520 houses being surveyed in 14 most affected districts, 92.6 percent (811,344) of the houses were damaged by the earthquake to some extent and only 17.4 percent (65176) houses were found not damaged by the earthquake.

The survey collected the information related to the current status of the houses in the 14 districts under the eight categories namely (i) House is completely damaged and rubble is cleared (ii) House is completely damaged but rubble is not cleared (iii) the house is covered by the landslide (iv) the house is completely damaged, rubble cleared and new house has built (v) the house is damaged and nobody stays in the house (vi) the house is damaged and using by the households under risk (vii) the house was damaged but repaired and occupied by the household (viii) the house is not damaged.

The survey has found that more than one-fourth of the surveyed houses (26.8%) were abandoned (damaged and not used) by the house owners whereas 16.5 percent of the damaged houses are used by the owners without repairing at their own risk. Likewise, about 16 percent of the surveyed houses were completely collapsed but the rubble of the houses are yet to remove from the site. However, the completely collapsed houses with the rubble cleared from the site at the time of survey accounts to 14.3 percent of the total surveyed house. The damaged houses that has

Figure 3.4: Current Status of Surveyed Houses in 14 districts



already been used by the owners after repairing accounts to 14.2 percent of the total surveyed houses. Moreover, about 5 percent of the surveyed houses has been found reconstructed before the time of the survey.

Table 3.4: Current Status of Surveyed Houses in 14 districts

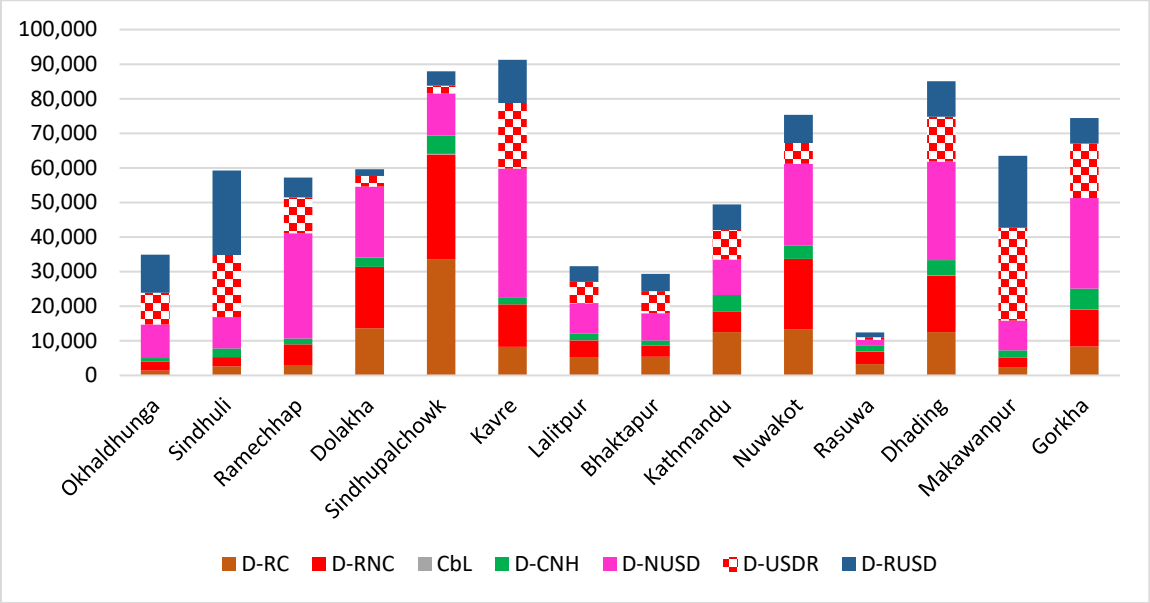
SN	District		Current Status of Surveyed House							
			Damaged - Rubble cleared	Damaged - Rubble unclear	Covered by landslide	Damaged - Rubble Clear- New building built	Damaged - Not used	Damaged - Used in risk	Damaged - Repaired and used	Not damaged
1	Okhaldhunga	No.	1463	2522	5	1074	9722	9088	11022	4456
		%	3.7%	6.4%	.0%	2.7%	24.7%	23.1%	28.0%	11.3%
2	Sindhuli	No.	2618	2673	8	2516	9059	17916	24432	9528
		%	3.8%	3.9%	.0%	3.7%	13.2%	26.1%	35.5%	13.9%
3	Ramechhap	No.	2807	6222	2	1648	30441	10402	5711	1390
		%	4.8%	10.6%	.0%	2.8%	51.9%	17.7%	9.7%	2.4%
4	Dolakha	No.	13620	17798	11	2641	20574	3075	1894	1026
		%	22.5%	29.4%	.0%	4.4%	33.9%	5.1%	3.1%	1.7%
5	Sindhupalchok	No.	33636	30254	206	5233	12244	2182	4152	834
		%	37.9%	34.1%	.2%	5.9%	13.8%	2.5%	4.7%	.9%
6	Kavrepalanchok	No.	8282	12283	11	1895	37372	18974	12486	6716
		%	8.4%	12.5%	.0%	1.9%	38.1%	19.4%	12.7%	6.9%
7	Lalitpur	No.	5300	4854	40	1960	8692	6176	4535	1536
		%	16.0%	14.7%	.1%	5.9%	26.3%	18.7%	13.7%	4.6%
8	Bhaktapur	No.	5448	3193	1	1459	7875	6354	5044	823
		%	18.0%	10.6%	.0%	4.8%	26.1%	21.0%	16.7%	2.7%
9	Kathmandu	No.	12518	6026	1	4738	10268	8485	7410	1678
		%	24.5%	11.8%	.0%	9.3%	20.1%	16.6%	14.5%	3.3%
10	Nuwakot	No.	13299	20385	15	3882	23590	6028	8138	1811
		%	17.2%	26.4%	.0%	5.0%	30.6%	7.8%	10.5%	2.3%
11	Rasuwa	No.	3287	3501	76	1703	1784	657	1462	174
		%	26.0%	27.7%	.6%	13.5%	14.1%	5.2%	11.6%	1.4%
12	Dhading	No.	12511	16339	12	4527	28414	13007	10225	4087
		%	14.0%	18.3%	.0%	5.1%	31.9%	14.6%	11.5%	4.6%
13	Makwanpur	No.	2259	2948	3	2025	8595	26833	20866	27465
		%	2.5%	3.2%	.0%	2.2%	9.4%	29.5%	22.9%	30.2%
14	Gorkha	No.	8409	10725	33	5986	26173	15687	7409	3652
		%	10.8%	13.7%	.0%	7.7%	33.5%	20.1%	9.5%	4.7%
	Total		125457	139723	424	41287	234803	144864	124786	65176
	Percent		14.3	15.9	0.0	4.7	26.8	16.5	14.2	7.4

3.3.1 Damaged Houses with Rubble Not Cleared

The damaged houses with "Rubble not yet cleared" numbered 139,723 in 14 districts. The highest number of such damaged houses are found in Sindhupalchowk (30254) followed by Nuwakot (20385), Dolakha (17798), Dhading (16339) and Gorkha (10725). The lowest number of damaged houses under this category are found in Okhaldhunga (1463) followed by Sindhuli (2618) and Makawanpur (2259). However, the rubble from 1,25,457 completely damaged houses has been

found cleared from the site in 14 districts. The highest number (33,636) of such fully damaged houses has been found in Sindhupalchok (33,636) followed by Dolakha (13620), Nuwakot (13299), Kathmandu (12518), Dhading (12511) and Gorkha (8409).

Figure 3.4.1: Status of the damaged-houses by district



Three-fourth of the damaged houses in Sindhupalchok are under the category of "Rubble not Yet Cleared" or "Rubble Cleared" which shows the extent of damage by the earthquake in this particular district. Likewise, Sindhupalchok has the highest proportion, 34 percent, of damaged houses with "Rubble not yet cleared" status. The number of damaged houses with the highest proportion of "Rubble cleared" is also in Sindhupalchowk with 38 percent of damaged houses. However, the proportion of the damaged houses in Rasuwa with "Rubble cleared" and "Rubble not cleared" is only 26 percent and 27.7 percent respectively.

There are very few, only 424, houses that were covered by the debris of the landslide and about half of them (206) are in Sindhupalchok.

3.3.2 Reconstructed New Houses

The survey found that 41,287 new houses has been reconstructed in the 14 districts where the houses were completely collapsed which accounts for about six percent of the total Severely Damaged Houses (SDH). The highest number of the new houses (5986) been rebuilt was found in Gorkha districts at the time of survey which is about 9.3 percent of the total severely damaged houses in Gorkha (64216). The other districts with the larger number of new houses reconstructed are Sindhupalchok (5233) and Kathmandu (4738) whereas Okhaldhunga has the lowest number (1074) of houses reconstructed or under-reconstruction.

3.3.3 Houses repaired

Sindhuli has repaired highest proportion (41.3 percent; 24432) of the damaged houses that are currently being used by the households in 14 districts followed by Makawanpur (32.8 percent; 20866) and Okhaldhunga (31.6 percent; 34896). The largest number of houses being repaired in those districts may be because of having the largest number of partially damaged houses in those districts. Likewise, Dolakha and Sindhupalchok have only 3.2 percent (1894) and 4.7 percent (4152) of damaged houses repaired which is the lowest among the 14 districts and is consistent with the finding of highest number of collapsed houses in those districts.

3.3.4 Damaged Not Used/ Used in Risk

The survey found that the proportion of damaged houses not being used by the households are 28.9 percent (234,803) with the highest number of damaged houses in such category are in Kavrepalanchok (37372; 40.9%) and Ramechhap (30441; 53.3%) whereas Rasuwa (1784; 14.3%) and Bhaktapur (7875; 26.8%) has the lowest number of damaged houses under that category.

There are 144864 number of damaged houses in 14 districts that are used by the households in risk without repairing possibly because of not having other alternative shelters and couldn't repair the house. Makawanpur has the highest number of damaged houses under this category with 26833 houses followed by Kavrepalanchok (18974) and Sindhuli (17916). Rasuwa and Sindhupalchok have the lowest number of damaged houses under this category with 657 & 2182 houses respectively.

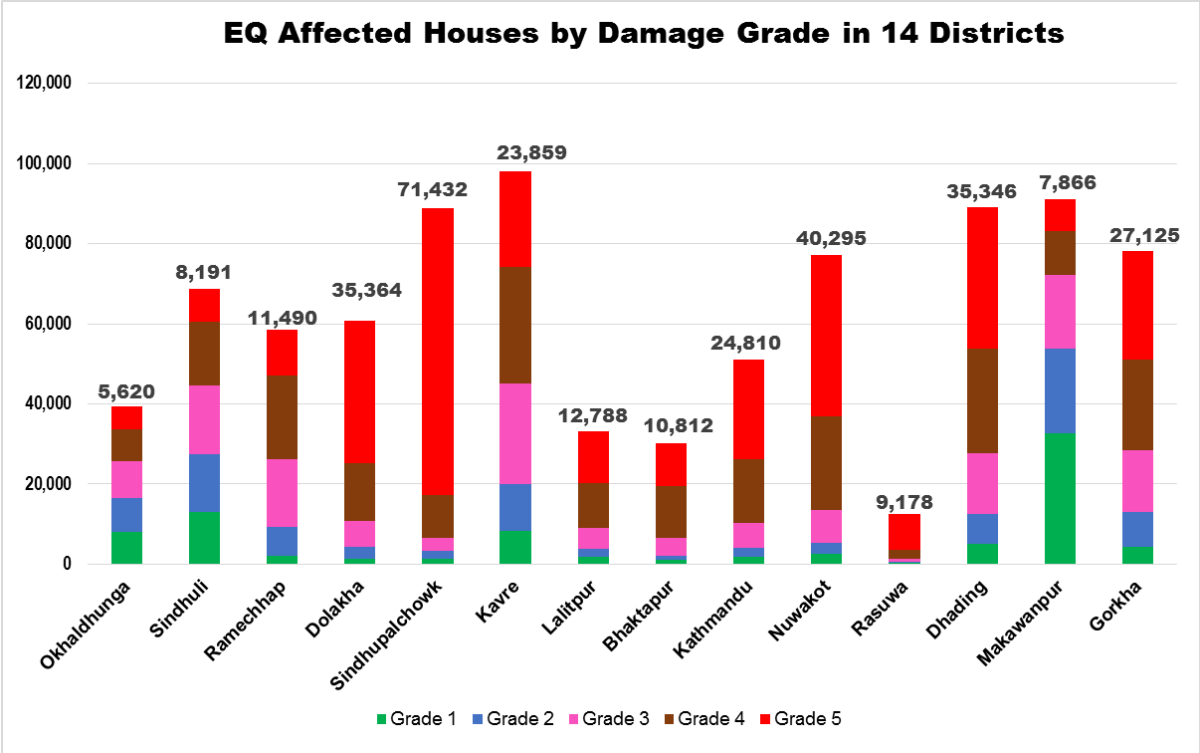
3.4 Houses by Damage Grade

The survey categorized the level of damage of the residential private houses into five grades depending on the severity of the damage. The survey manual which was used for providing training to the surveyor-engineers mentions that

Table 3.51: Damage Grading followed in the survey in 14 districs

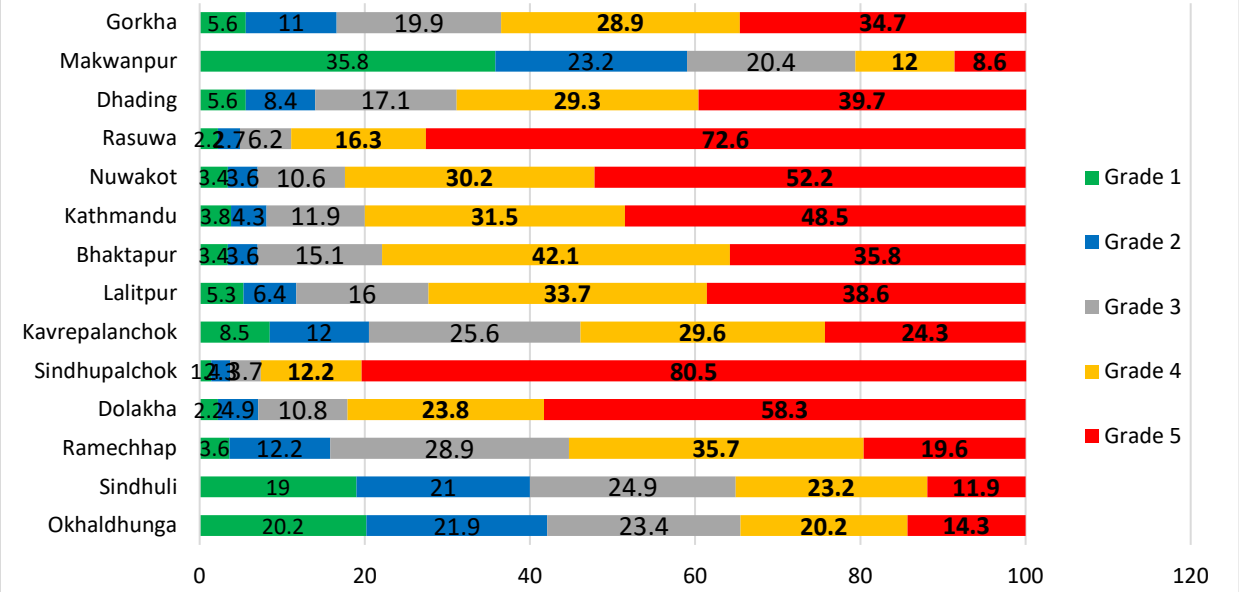
Grade 1	Hairline to thin cracks in plaster on few walls, falling of plaster bits in limited parts, fall of loose stone from upper part of building in few cases, only architectural repairs needed.
Grade 2	Cracks in many walls, falling of plaster in last bits over large area, damage to non-structural parts like chimney, projecting cornices. The load carrying capacity is not reduced appreciably.
Grade 3	Large and extensive cracks in most walls, collapse of small portion non-load bearing walls, roof tiles detach, tilting or falling of chimneys, failure of individual non-structural elements such as partition/gable walls, delamination of stone/adobe walls, load carrying capacity of structure is partially reduced. Significant structural repair required
Grade 4	Large gaps occur in walls, walls collapse, partial structural failure of floor/ roof, building takes a dangers state.
Grade 5	Total or near total collapse

Figure 3.51: EQ Affected Houses by Damage Grade in 14 Districts



With the above categorization for the severity of damage caused by the EQ, the survey found that 62.5 percent of the surveyed houses were damaged to the grade level 4 or 5 whereas 20 percent of the surveyed houses were found with damage grade of 1 and 2

Table 3.52: Percentage of Damaged House by Grade in 14 Districts



Among the 14 districts, Sindhupalchok and Rasuwa was found hardest hit by the earthquake with 93 percent and 89 percent of the surveyed houses with Grade 4 or 5. Likewise, Nuwakot and Dolakha was also seriously affected by the earthquake with more than 82 percent of the houses damaged to grade 4 or 5. Makawanpur was least hit by the earthquake with only 21 percent of houses damaged to grade 4 or 5 whereas over one-third of the houses were damaged to the grade 4 or 5 in Okhaldhunga and Sindhuli.

Table 3.52: Damage of Surveyed Houses by Grading in 14 districts

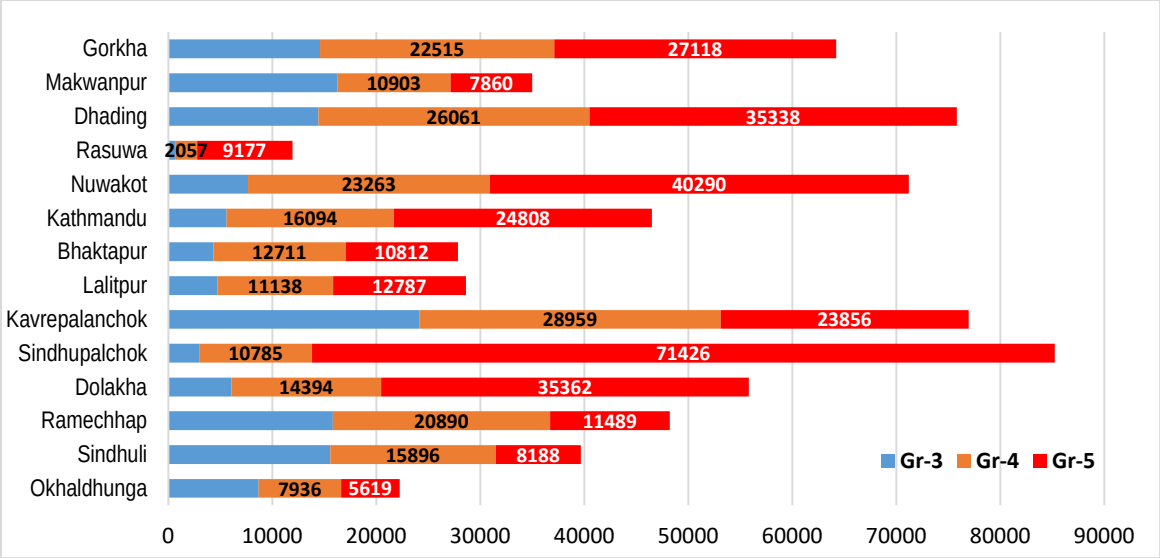
SN	District		Damage grade of house					Total
			Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	
1	Okhaldhunga	No	7961	8605	9220	7946	5620	39352
		Row %	20.2%	21.9%	23.4%	20.2%	14.3%	
2	Sindhuli	No	13087	14470	17085	15917	8191	68750
		Row %	19.0%	21.0%	24.9%	23.2%	11.9%	
3	Ramechhap	No	2116	7156	16951	20910	11490	58623
		Row %	3.6%	12.2%	28.9%	35.7%	19.6%	
4	Dolakha	No	1353	2993	6520	14409	35364	60639
		Row %	2.2%	4.9%	10.8%	23.8%	58.3%	
5	Sindhupalchok	No	1233	2009	3271	10796	71432	88741
		Row %	1.4%	2.3%	3.7%	12.2%	80.5%	
6	Kavrepalanchok	No	8330	11726	25130	28974	23859	98019
		Row %	8.5%	12.0%	25.6%	29.6%	24.3%	
7	Lalitpur	No	1746	2125	5282	11152	12788	33093
		Row %	5.3%	6.4%	16.0%	33.7%	38.6%	
8	Bhaktapur	No	1022	1083	4560	12720	10812	30197
		Row %	3.4%	3.6%	15.1%	42.1%	35.8%	
9	Kathmandu	No	1926	2177	6106	16105	24810	51124
		Row %	3.8%	4.3%	11.9%	31.5%	48.5%	
10	Nuwakot	No	2615	2745	8209	23284	40295	77148
		Row %	3.4%	3.6%	10.6%	30.2%	52.2%	
11	Rasuwa	No	277	343	782	2064	9178	12644
		Row %	2.2%	2.7%	6.2%	16.3%	72.6%	
12	Dhading	No	4952	7526	15218	26080	35346	89122
		Row %	5.6%	8.4%	17.1%	29.3%	39.7%	
13	Makwanpur	No	32540	21135	18525	10928	7866	90994
		Row %	35.8%	23.2%	20.4%	12.0%	8.6%	
14	Gorkha	No	4351	8555	15507	22536	27125	78074
		Row %	5.6%	11.0%	19.9%	28.9%	34.7%	
Total			83509	92648	152366	223821	324176	876520
Percent			9.5	10.6	17.4	25.5	37.0	

3.5 Severely Damaged Houses (SDH)

For the analysis purpose, the houses with damage level grade 5, grade 4 and grade 3 (with Technical solution of “Major repair”) are labeled as “Severely damaged houses”. The survey found that about 94 (92.6??? according to current status of house) percent of the total surveyed houses

i.e. 8,21,780 houses were damaged by the earthquake to some extent and severely damaged houses (SDH) accounts to 6,89,244 houses which is 79 percent of the total surveyed houses.

Figure 3.6: Severely Damaged Houses by the Earthquake in 14 Districts



Among the 14 districts, Sindhupalchok has the largest number (85228) and highest proportion (96 percent) of severely damaged houses followed by Kavrepalanchok (76959), Dhading (75819), Nuwakot (71202), Gorkha (64216) and Dolakha (55828). In terms of lowest number of severely damaged houses, Rasuwa comes in the first place with 11934 houses severely damaged. However, in terms of the proportion of SDH wihin the district, more than 94 percent of the total surveyed houses were severely damaged in Rasuwa. Okhaldhunga has the second lowest number of SDH (22230) followed by Bhaktapur (22230), Lalitpur (28617), Makawanpur (34997), Sindhuli (39659), Kathmandu (46504) and Ramechhap (48200).

Table 3.6: Number and Percentage of Severely Damaged Houses by Damage Grade in 14 districts

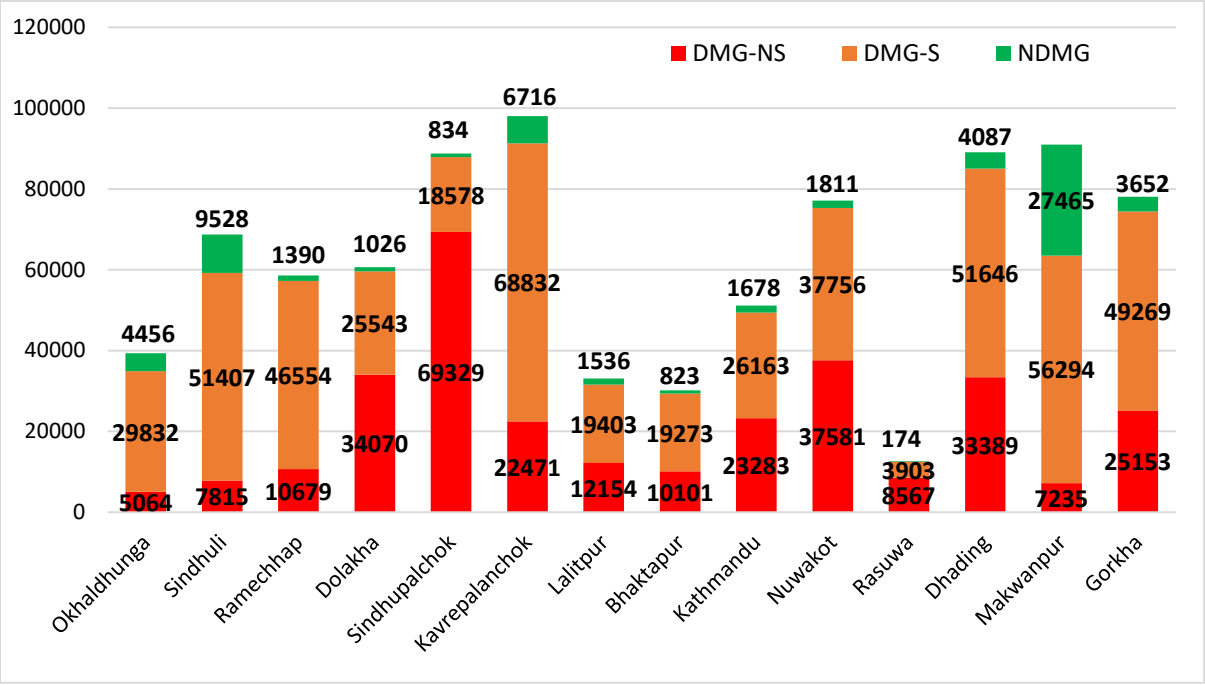
SN	Districts	Grade 3		Grade 4		Grade 5		Total
		Number	Percent	Number	Percent	Number	Percent	
1	Okhaldhunga	8,675	6.1	7,936	3.5	5,619	1.7	22,240
2	Sindhuli	15,575	11.0	15,896	7.1	8,188	2.5	39,677
3	Ramechhap	15,821	11.2	20,890	9.3	11,489	3.5	48,221
4	Dolakha	6,072	4.3	14,394	6.4	35,362	10.9	55,839
5	Sindhupalchok	3,017	2.1	10,785	4.8	71,426	22.0	85,235
6	Kavrepalanchok	24,144	17.1	28,959	13.0	23,856	7.4	76,989
7	Lalitpur	4,692	3.3	11,138	5.0	12,787	3.9	28,625
8	Bhaktapur	4,328	3.1	12,711	5.7	10,812	3.3	27,860
9	Kathmandu	5,602	4.0	16,094	7.2	24,808	7.7	46,515

10	Nuwakot	7,649	5.4	23,263	10.4	40,290	12.4	71,218
11	Rasuwa	700	0.5	2,057	0.9	9,177	2.8	11,935
12	Dhading	14,420	10.2	26,061	11.7	35,338	10.9	75,841
13	Makwanpur	16,234	11.5	10,903	4.9	7,860	2.4	35,013
14	Gorkha	14,583	10.3	22,515	10.1	27,118	8.4	64,236
Total		41,512	100	223,602	100	324,130	100	689,444

3.6 Standing and Not-Standing Houses

The eight categories of "current status of houses" mentioned above can be re-classified as houses (i) Not-Standing (ii) Standing and (iii) Not damaged. Categories under the current status of (a), (b), (c) and (d) are "Not-Standing" houses whereas categories under the status of (e), (f) and (g) are "Standing" houses.

Figure 3.7: Damaged Houses Categorized with the Position "Standing" or "Not Standing"



**DMG-NS: Damaged "Not Standing"; DMG-S: Damaged "Standing"; NDMG: Not Damaged*

The survey found that more than one-third (35 percent) of the surveyed houses in 14 districts are completely collapsed or "not-standing" whereas more than half (57.6 percent) of the surveyed

houses are damaged but in the “Standing” position and only 7.4 percent is not damaged by the earthquake.

Table 3.7: Current Status of Surveyed Houses in 14 districts

SN	District	Not Standing		Standing		Not Damaged		Total
		Number	Percent	Number	Percent	Number	Percent	
1	Okhaldhunga	5,064	1.7	29,832	5.9	4,456	6.8	39,352
2	Sindhuli	7,815	2.5	51,407	10.2	9,528	14.6	68,750
3	Ramechhap	10,679	3.5	46,554	9.2	1,390	2.1	58,623
4	Dolakha	34,070	11.1	25,543	5.1	1,026	1.6	60,639
5	Sindhupalchok	69,329	22.6	18,578	3.7	834	1.3	88,741
6	Kavrepalanchok	22,471	7.3	68,832	13.6	6,716	10.3	98,019
7	Lalitpur	12,154	4.0	19,403	3.8	1,536	2.4	33,093
8	Bhaktapur	10,101	3.3	19,273	3.8	823	1.3	30,197
9	Kathmandu	23,283	7.6	26,163	5.2	1,678	2.6	51,124
10	Nuwakot	37,581	12.2	37,756	7.5	1,811	2.8	77,148
11	Rasuwa	8,567	2.8	3,903	0.8	174	0.3	12,644
12	Dhading	33,389	10.9	51,646	10.2	4,087	6.3	89,122
13	Makwanpur	7,235	2.4	56,294	11.2	27,465	42.1	90,994
14	Gorkha	25,153	8.2	49,269	9.8	3,652	5.6	78,074
	Total	306,891	100	504,453	100	65,176	100	876,520

The top five districts with the highest number of completely collapsed or “Not-Standing” houses are (i) Sindhupalchok (69,329) (ii) Nuwakot(37,581) (ii) Dolakha (34,070) (iv) Dhading (33,389)and (v) Gorkha (25,153) where almost two-third (65 percent) of the totally collapsed houses in 14 districts found. Okhaldhunga (5,064) has the lowest number of “completely collapsed” houses among the 14 districts.

Likewise, the five districts with the highest number of “Standing” damaged houses are (i) Kavre (68,832) (ii) Makawanpur (56,294) (iii) Dhading (51,646) (iv) Sindhuli (51,407) and (iv) Gorkha (49,269) that accounts more than half (55 percent) of the “Standing” damaged houses in 14 districts. The lowest number of “Standing” damaged houses were found in Rasuwa (3,903).

3.7 Age of the Houses

Considering the possible linkage between the age of houses and seismic resistance, the survey also collected the age of houses in 14 affected districts. The survey found that the age of more than half (59 percent) of the surveyed houses are less than 20 years old whereas 28.5 percent of the surveyed houses are 20 to 40 years old. There are only 12.7 percent houses that are older than 40 years.

Table 3.8: Severely Damaged Houses by Age of Houses in 14 Districts

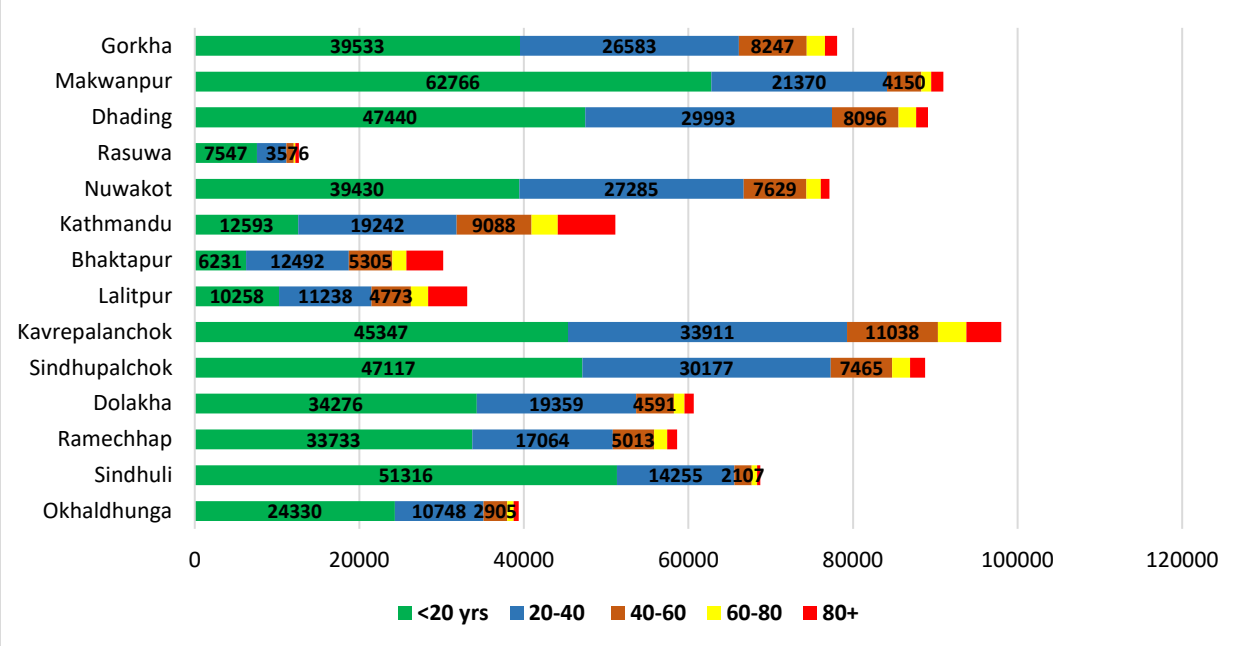
Age of House	Surveyed Houses		Severely Damaged Houses		SDH as Percentage of Surveyed House
	Frequency	Percent	Frequency	Percent	
<20 yrs	514818	58.7	364869	52.9	70.9
20-40	250181	28.5	221311	32.1	88.5

40-60	65591	7.5	60483	8.8	92.2
60-80	23611	2.7	22223	3.2	94.1
80+ yrs	22319	2.5	20623	3.0	92.4
Total	876520	100.0	689509	100.0	78.7

The proportion of SDH in the surveyed houses is lowest among the newly built houses aged less than 20 years. The proportion of damaged houses increases with the increase in the age of the houses irrespective of the types of foundation and building.

Among the 14 surveyed districts, Sindhuli has almost three-fourth (75 percent) of houses that were less than 20 years older followed by Makawanpur and Okhaldhunga where the proportion is 69 and 62 percent respectively. Bhaktapur district has relatively higher proportion of houses that are older than 20 years. About 80 percent of the damaged houses in Bhaktapur were older than 20 years. Likewise Kathmandu and Lalitpur districts have 75 percent and 70 percent of the damaged houses that were older than 20 years of age. About 14 percent of the surveyed houses that were damaged in Kathmandu Valley by the earthquake were older than 80 years of age.

Figure 3.8 : Number of houses by age in 14 districts



3.8 Houses by Type of Foundation

The severity of damage caused by the earthquake on the residential houses may vary depending on the type of foundation, floor, roof, superstructure, position and shape of houses. In this regard, this survey has gathered related information from the surveyed houses in 14 districts.

The survey found that more than 83 percent (7,29,574) of the surveyed houses in 14 districts are built on the foundation with "Mud-mortar with Stones/Bricks" whereas 6.6 percent (57,783) of the houses have the foundation built of "Bamboo/Timber". The proportion of houses with foundation made up of "Cement – Stone/Bricks" and "Reinforced Concrete" constitutes 5.3 percent (46,791) and 4.3 percent (37,326) of the total surveyed houses respectively (See Table below).

Table 3.91: Severely Damaged Houses by Type of Foundation in 14 districts

SN	Foundation	Surveyed House		SDH		Proportion of SDH
		Number	Percent	Number	Percent	
1	Mud mortar - Stone/Brick	729574	83.24	632914	91.8	86.8
2	Cement - Stone/Brick	46791	5.34	22522	3.3	48.1
3	Reinforce Concrete	37326	4.26	5300	0.8	14.2
4	Bamboo/Timber	57783	6.59	25581	3.7	44.3
5	Other	5046	0.58	3192	0.5	63.3
Total		876520	100	689509	100	78.7

The houses built on the foundation of "Mud-mortar with Stone/Brick" seems more vulnerable to sustain the seismic effect as about 87 percent of total surveyed houses were severely damaged by the earthquake in 14 districts. Likewise, about half of the surveyed houses that were built either on the foundation of "Cement –Stone/Brick" or "Bamboo/Timber" were also severely damaged. However, the houses that were built on the foundation of "Reinforced Concrete" seems sustained during the earthquake as the proportion of severely damaged houses were only 14.2 percent.

The severity of damage due to earthquake may vary with the age of house. In this regard, Table below shows the severity of damage in houses aged less than 20 years of age by the earthquake.

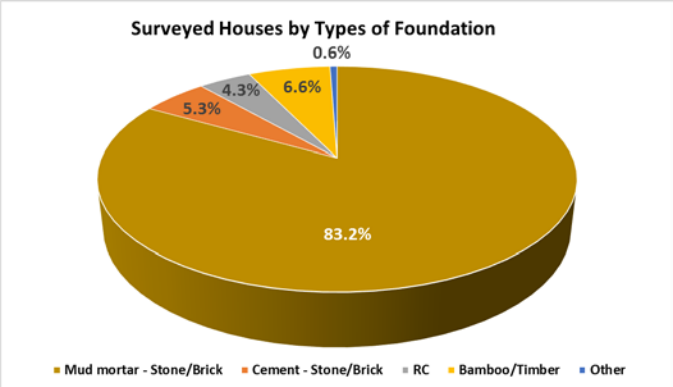
Table 3.92 : Severity of Damage of Houses less than 20 years old by Types of Foundation

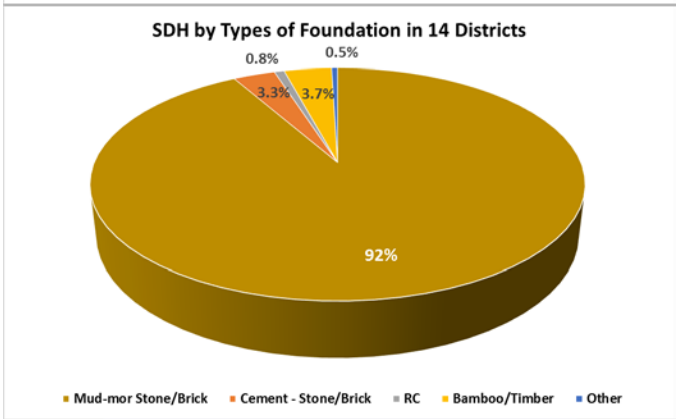
SN	Foundation	Severely Damaged		Minor or No Damage	
		Number	Percent	Number	Percent
1	Mud mortar - Stone/Brick	323026	82.5	68365	17.5
2	Cement - Stone/Brick	14394	40.8	20888	59.1
3	Reinforced Concrete (RC)	4635	13.3	30163	86.6
4	Bamboo/Timber	20829	41.9	28884	58.1
5	Other	1985	54.6	1649	44.7

The Table shows that severity of damage is highest in houses built on foundation with “Mud mortar – Stone/Brick” compared to the houses built on foundation with “Cement – Stone/Brick” or “Bamboo/Timber” or other types of foundation even though the houses are not too old. Again,, the damage caused by the earthquake is least in houses built on “Reinforced Concrete” foundation as only 13.3 percent of such houses were severely damaged. Around 40 percent of houses built on “Cement – Stone/Brick” or “Bamboo/Timber” were severely damaged by the earthquake which seemingly shows the equal strength of bearing the seismic load by the houses built on “Cement – Stone/Brick” or “Bamboo/Timber”.

3.8.1 Mud-Mortar with Stone/Bricks

The figure in the right shows the proportion of houses surveyed and SDHs by types of foundation. It is very apparent in the figure that the proportion of SDH built on the foundation of “Mud mortar –Stone/Bricks” exceeds the proportion of surveyed houses built on the foundation of same category. The proportion of SDHs built on the foundation of other categories is lesser than the surveyed households with the same categories of foundation which could be due to the varied impact of earthquake on the houses built on the types of foundation. Table 2 below shows the severely damaged houses by types of foundation of the houses. About 87 percent (6,32,914) of the total houses with foundation built of “Mud-Mortar with Stones/Bricks” were severely damaged which accounts to about 92 percent of the total SDHs in the 14 districts. The number of severely damaged houses with the foundation built of “Cement – Stone/Bricks” and “Reinforced Concrete (RC)” found to be 3.3 and 0.8 percent of total SDHs which seems nominal compared to the proportion of the SDH with other categories of foundation.





Looking into the individual districts on the proportion of SDHs, more than 90 percent of the SDHs were the houses with foundation built of “Mud-Mortar with Stones/Bricks” in 11 out of 14 districts namely Ramechhap (97.9%), Dolakha (97.2%), Okhaldhunga (97%), Kavrepalanchok, Sindhupalchok (95.4%), Lalitpur (95.2%), Nuwakot (96.2%), Dhading (95.1%), Gorkha (94.7%), Kathmandu (91.8%), Bhaktapur (94.8%). Sindhuli has the lowest proportion of SDH with such type of foundation among 14 districts because of the highest proportion of houses built on foundation of “Bamboo/Timber”.

3.8.2 Cement – Stone/Brick

The survey found that only 3.3 percent of the severely damaged houses in 14 districts were built on "Cement – Stone/Brick" foundation. Highest number (13719) of surveyed houses built on "Cement – Stone/Brick" foundation were found in Makawanpur followed by Kavre and Sindhuli. However, the largest number (2708) of SDH built on the foundation of Cement- Stone/Brick were severely damaged in Kathmandu followed by Sindhupalchok (2493) , Makawanput (2471) and Kavrepalanchok (2400). However, Rasuwa, Sindhupalchok and Dolakha suffered severely in terms of damage of houses built on "Cement – Stone/Brick" foundation where more than 80 percent of the houses built on "Cement – Stone/Brick" were severely damaged. But Makawanpur, Sindhuli and Kavrepalanchok district suffered least in terms of damage of houses built on "Cement – Stone/Brick" (See Table).

Table 3.93: Severely Damaged Houses by Types of Foundation in 14 Districts

SN	District		Foundation of House					Total
			Mud mortar - Stone/ Brick	Cement - Stone/Brick	RC	Bamboo/ Timber	Other	
1	Okhaldhunga	Number	21581	512	19	113	16	22241
		Percent	97.0%	2.3%	.1%	.5%	.1%	100.0%
2	Sindhuli	Number	20822	1530	205	16882	244	39683
		Percent	52.5%	3.9%	.5%	42.5%	.6%	100.0%
3	Ramechhap	Number	47213	853	84	59	12	48221
		Percent	97.9%	1.8%	.2%	.1%	.0%	100.0%
4	Dolakha	Number	54302	1224	166	109	44	55845
		Percent	97.2%	2.2%	.3%	.2%	.1%	100.0%
5	Sindhupalchok	Number	81361	2493	1140	149	102	85245
		Percent	95.4%	2.9%	1.3%	.2%	.1%	100.0%
6	Kavrepalanchok	Number	73775	2400	337	321	144	76977
		Percent	95.8%	3.1%	.4%	.4%	.2%	100.0%
7	Lalitpur	Number	27263	918	221	118	112	28632
		Percent	95.2%	3.2%	.8%	.4%	.4%	100.0%
8	Bhaktapur	Number	26425	948	297	13	177	27860
		Percent	94.8%	3.4%	1.1%	.0%	.6%	100.0%
9	Kathmandu	Number	42687	2708	814	157	151	46517
		Percent	91.8%	5.8%	1.7%	.3%	.3%	100.0%
10	Nuwakot	Number	68497	2150	449	80	52	71228
		Percent	96.2%	3.0%	.6%	.1%	.1%	100.0%
11	Rasuwa	Number	10122	412	141	136	1131	11942
		Percent	84.8%	3.5%	1.2%	1.1%	9.5%	100.0%
12	Dhading	Number	72160	2197	619	654	216	75846
		Percent	95.1%	2.9%	.8%	.9%	.3%	100.0%
13	Makwanpur	Number	25898	2471	360	6208	91	35028

		Percent	73.9%	7.1%	1.0%	17.7%	.3%	100.0%
14	Gorkha	Number	60808	1706	448	582	700	64244
		Percent	94.7%	2.7%	.7%	.9%	1.1%	100.0%
Total		Number	632914	22522	5300	25581	3192	689509
		Percent	91.8%	3.3%	.8%	3.7%	.5%	100.0%

3.8.3 Reinforced Concrete

The proportion of SDH built on "Reinforced Concrete" is 0.8 percent of the total SDH which is the lowest among the houses built on other categories of foundation. Highest proportion of SDH built on "Reinforced Concrete" were found in Sindhupalchok, Kathmandu and Rasuwa where almost one third of houses built on "Reinforced Concrete" in the districts were found damaged. Kavre, Makawanpur and Okhaldhunga are the least affected by the earthquake in terms of the damage of houses built on "Reinforced Concrete".

3.8.4 Bamboo Timber

Sindhuli and Makawanpur has highest proportion i.e. 47.5 and 22.1 percent of houses built on the foundation with "Bamboo/Timber"among the most affected 14 districts. In Sindhuli, almost half of this category of houses were severely damaged whereas the proportion is only 17 percent in Makawanpur.

3.9 Surface of the Land

Surface of the land where the houses were built are also considered important factor while considering the level of damage caused by the earthquake. It is considered that the houses built on the steep land are more vulnerable to the severe damage than the houses built on the flat land.
The survey found that 83.3 percent of the total surveyed houses were built on the flat land whereas 13.5 percent and 3.2 percent houses were built on the "moderate slope" and "Steep" land respectively.

Table 3.10: SDH by Type of Land Surface in 14 districts

SN	Land Surface	SDH		Minor or No Damaged Houses		Total	
		Number	Percent	Number	Percent	Number	Percent
1	Flat	571067	78.2	159358	21.8	730503	83.3
2	Moderate slope	95037	80.5	22996	19.5	118114	13.5
3	Steep slope	23405	83.4	4657	16.5	28145	3.2
	Total	689509	78.6	187011	21.3	876762	100

The survey found that extent of damage of houses built on "Steep" or "Moderate Slope" is slightly higher than the damage on houses built on "Flat" houses in 14 districts.

3.10 Damage in Houses with Side Attachment

The position of the surveyed houses, i.e. attached to other houses is important factor to assess the damage of the houses caused by the earthquake. Houses attached to other houses are considered as more vulnerable to damage than the stand-alone houses. The position of about three-fourth of the total surveyed houses were stand-along or "not attached" to other houses whereas houses attached to "one-side" and "two-side" constitutes 18.1 and 5.6 percent respectively.

Table 3.11 (a): Number of Houses by Type of Foundation and Position of House

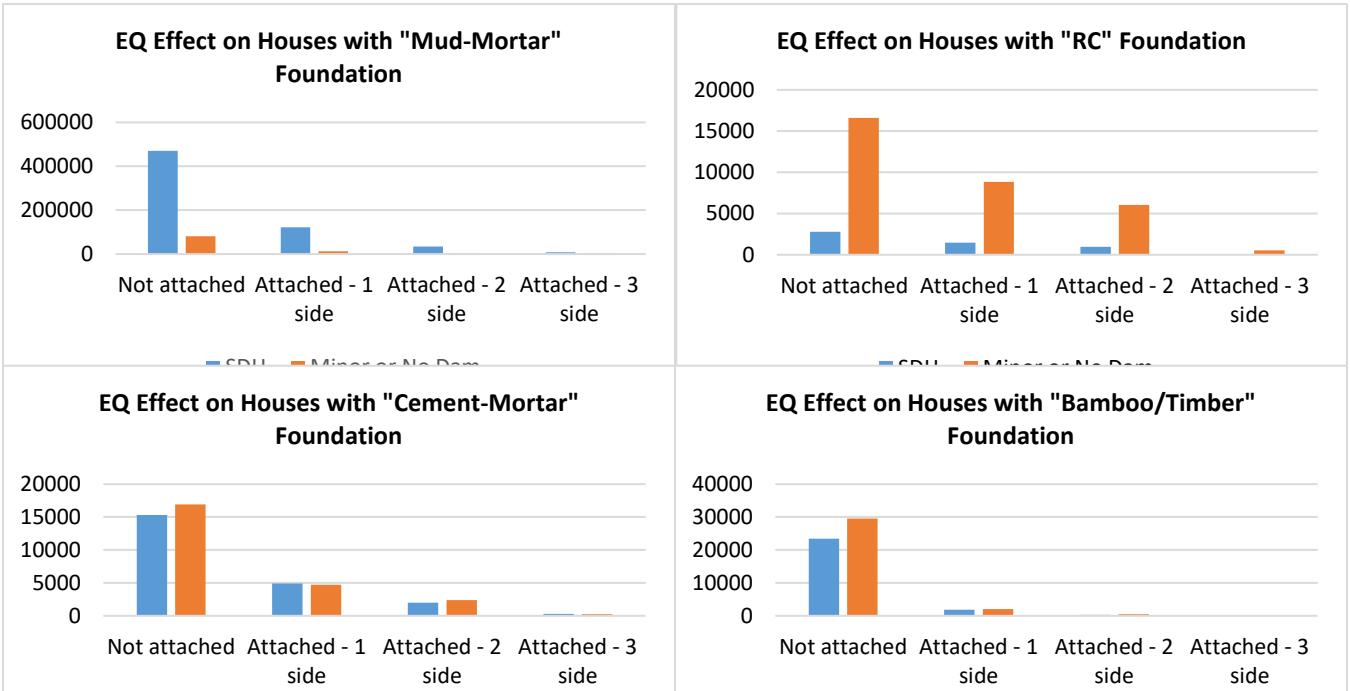
SN	Position of House	Mud mortar - Stone/Brick	Cement - Stone/Brick	RC	Bamboo/ Timber	Other	Total	Percent
1	Not attached	551417	32228	19389	52977	3512	659523	75.2
2	Attached - 1 side	133400	9658	10321	3912	1017	158308	18.1
3	Attached - 2 side	36783	4347	7029	792	503	49454	5.6
4	Attached - 3 side	7973	558	587	102	14	9234	1.1

Looking at the damage caused by the earthquake based on the type of foundation, the proportion of SDH built on the "Mud-mortar Stone/Brick" or "Cement – Stone/Brick" increases with the number of sides of the house that were attached to other houses. Interestingly, the houses with two-sides attached to another houses suffered less than other categories of houses (in terms of side-attachment of the house). In case of houses built on "RC" and "Bamboo/Timber" foundation, the proportion of SDH is lesser with the increased side-attachment of the house (See Table below).

Table 3.11(b): Proportion of SDH by the Type of Foundation and Position of House (Side-Attachment)

SN	Position of House	Mud mortar - Stone/Brick	Cement - Stone/Brick	RC	Bamboo/ Timber	Other	Total
1	Not attached	85.3	47.5	14.4	44.2	53.2	75.2
2	Attached - 1 side	91.1	50.9	14.2	46.4	85.3	18.1
3	Attached - 2 side	91.7	45.6	13.8	37.9	89.7	5.6
4	Attached - 3 side	94.7	55.6	11.4	27.5	50.0	1.1

Figure: 3.11: SDH by Type of Foundation in 14 districts



3.11 Houses by Building Foot Print

Considering the possible seismic effect on the shape of the foundation of the houses, this survey collected the information on the shape of building foot print. The vast majority of the surveyed houses were found of having “Rectangular” foundation shape. The houses erected on the square and L-shaped building foot print were found in only 2.3 and 1.5 percent of the surveyed houses.

3.12 Houses by Shape of the Foundation

More than 95 percent of the surveyed houses in 14 districts were built on the “Rectangular” shaped foundation. The houses built on “Square” shaped foundation is only 2.3 percent.

Number and Percentage of Houses built by Shape of Foundation in 14 districts.

SN	Shape of Foundation	Number	Percent	SDH	
				Number	Percent
1	Rectangular	839123	95.7	664576	96.4
2	Square	20379	2.3	15279	2.2
3	L-shape	13141	1.5	7515	1.1
4	Multi-projected	1196	0.1	610	0.1
5	T-shape	1131	0.1	708	0.1
6	U-shape	520	0.1	272	0.0
7	Building with Central Courtyard	171	0.0	96	0.0
8	E-shape	156	0.0	106	0.0
9	H-shape	90	0.0	66	0.0
10	Others	612	0.1	281	0.0
Total		876519	100	689509	100

3.13 Types of Geo-Technical Hazards

Considering the geotechnical hazards could cause damage or threaten safety of building structures, the survey gathered information categorizing the hazards as (i) Ground settlement (ii) Fault crack (Ground fissures) (iii) Soil liquefaction (iv) Slope movement / Landslide (v) Rock falls (vi) Flood (v) others

Figure : Ground Fissures at Kaushaltar, Bhaktapur, 2015

The occurrences of geo-technical hazards in or nearby the surveyed houses has been reported by 22.4 percent house-owners. More than half (55.4%) of the reported geo-technical hazards were "Landslide" and Sindhupalchok reported the occurrences of highest number (13135) of Landslide. More than one-third of owners in the 14 districts reported the occurrences of "Fault crack" on the land whereas more than one-fourth of the respondents reported the "Rock falls" and "Ground settlement" on their land. Sindhupalchok district seems highly affected by the largest number of occurrences of the geo-technical hazards.

District	Type of Geo-Technical Hazards							Total	Percent
	Ground Settlement	Fault crack	Soil Liquefact	Landslide	Rock falls	Flood	Others		
Okhaldhunga	904	1,622	211	2,847	1,448	356	23	5,092	4.4
Sindhuli	4,442	3,344	275	7,874	2,531	2,095	208	13,711	11.8
Ramechhap	2,022	2,132	112	3,452	2,477	228	11	7,014	6.0
Dolakha	3,438	5,388	75	4,855	2,520	551	20	10,199	8.8
Sindhupalchowk	5,298	8,200	33	13,135	7,491	1,588	14	20,190	17.3
Kavre	2,257	3,329	322	4,230	1,215	355	362	9,384	8.1
Lalitpur	1,619	798	110	1,427	894	77	15	2,951	2.5
Bhaktapur	265	126	30	774	27	9	6	1,067	0.9
Kathmandu	997	931	54	1,272	201	31	21	2,762	2.4
Nuwakot	2,371	4,373	60	3,566	1,895	323	16	9,028	7.8
Rasuwa	665	1,528	14	2,684	2,440	186	31	3,855	3.3
Dhading	2,423	4,619	19	5,611	3,455	330	33	9,576	8.2
Makawanpur	2,528	2,141	124	7,177	2,949	2,459	70	11,351	9.7
Gorkha	2,703	3,872	885	5,643	3,572	460	27	10,246	8.8
Total	31,932	42,403	2,324	64,547	33,115	9,048	857	116,426	100.0
Percent	27.4	36.4	2.0	55.4	28.4	7.8	0.7	100.0	