

Table 1 - Seismicity parameters for the seven seismogenic zones in Himachal Pradesh

Source No.	Zones	<i>b</i> -value	<i>N</i> (4)	Max. Potential Mag. (M_{max})	No. of earthquakes	No. of Faults
1	Western Himalaya	0.81±0.02	3.70	8.8	999	97
2	Central Himalaya -I	0.67±0.04	2.80	7.8	353	27
3	Central Himalaya-II	0.70±0.04	1.80	8.8	374	39
6	Altya Tegh & Karakoram	0.82±0.03	4.50	7.3	809	31
21	Sindh-Punjab	0.71±0.06	0.58	8.0	93	11
22	Upper Punjab	0.95±0.05	1.95	8.0	235	27
28	Aravali-Bundelkhand	0.75±0.06	0.80	7.0	125	68

Table 2 – IBC 2003 site class definitions based on average properties in top 100 feet

Site class	Soil profile name	Soil shear wave velocity $\bar{v}_s$ (m/s)
A	Hard rock	$\bar{v}_s > 1500$
B	Rock	$760 < \bar{v}_s \leq 1500$
C	Very dense soil and soft rock	$360 < \bar{v}_s \leq 760$
D	Stiff soil profile	$180 < \bar{v}_s \leq 360$
E	Soft soil profile	$\bar{v}_s < 180$

Table 3 - General 1D MASW acquisition parameters

Parameter	Setting
Spread configuration	Linear
Spread length	16 to 72 m
Geophone interval	1 to 5 m
Total number of geophones	16 to 24
Geophone type	4.5 Hz vertical geophones, with base plates for surveys on paved ground
Shot locations	Five. One shot at off-ends from the middle and both end at a distance equaling geophone interval, One shot in-line from either end at a distance equaling the geophone spacing
Shot near offset	-
Source equipment	Sledgehammer (8 kg) and strike plate
Trigger	Hammer switch taped to sledgehammer handle and connected to seismograph trigger port and manual triggering in some cases
Sample interval	0.125 ms
Record length	1 s
Stacking	3 Stacks at each shots

Table 4 - Information on cities covered by this study

S. No.	Test Location	District	Location	Elevation (m)
1	Bilaspur*	Bilaspur	31.33°N 76.75°E	673
2	Chamba*	Chamba	32.55°N 76.13°E	996
3	Dhankar Gompa	Lahaul & Spiti	32.09°N 78.22°E	3,894
4	Dharamshala*	Kangra	32.22°N 76.32°E	1,457
5	Hamirpur*	Hamirpur	31.68°N 76.52°E	738
6	Kalpa	Kinnaur	31.53°N 78.25°E	2960
7	Kangra fort	Hamirpur	32.09°N 76.26°E	
8	Kaza	Lahaul & Spiti	32.22°N 78.08°E	3,650
9	Key Gompa	Lahaul & Spiti	32.30°N 78.01°E	4,166
10	Keylong*	Lahaul & Spiti	32.57°N 77.03°E	3,080
11	Kullu*	Kullu	31.96°N 77.10°E	1,220
12	Manali	Kullu	32.25°N 77.18°E	2,050
13	Mandi*	Mandi	31.71°N 76.93°E	1,044
14	Nahan*	Sirmaur	30.56°N 77.30°E	932
15	Nako	Kinnaur	31.88°N 78.63°E	3,600
16	Rampur	Shimla	31.44°N 77.63°E	1,350
17	Reckong Peo*	Kinnaur	31.54°N 78.27°E	2,290
18	Shimla* ⁺	Shimla	31.10°N 77.15°E	2,205
19	Solan*	Solan	30.92°N 77.09°E	1,580
20	Sundernagar	Mandi	31.53°N 76.90°E	
21	Tabo	Lahaul & Spiti	32.09°N 78.38°E	3,280
22	Una*	Una	31.48°N 76.28°E	369

Note: ⁺ - Capital, * - District Headquarters

Table 5 - Site averaged Vs30 values of the 22 cities measured by MASW tests

S.No.	Site id	Location	Average Vs30	Soil Type
1	Bilaspur1	31.34° N 76.76° E	483	C
2	Bilaspur2	31.32° N 76.76° E	405	C
3	Bilaspur3	31.33° N 76.77° E	659	C
4	Bilaspur4	31.34° N 76.76° E	626	C
5	Bilaspur5	31.34° N 76.76° E	391	C
6	Chamba1	32.55° N 76.13° E	542	C
7	Chamba2	32.54° N 76.13° E	326	D
8	Chamba3	32.55° N 76.13° E	343	D
9	Chamba4	32.56° N 76.12° E	600	C
10	Chamba5	32.56° N 76.13° E	291	D
11	Dankar1	32.09° N 78.22° E	413	C
12	Dhramshala1	32.20° N 76.32° E	473	C
13	Dhramshala2	32.20° N 76.34° E	460	C
14	Dhramshala3	32.21° N 76.32° E	437	C
15	Dhramshala4	32.22° N 76.33° E	597	C
16	Dhramshala5	32.21° N 76.34° E	432	C
17	Hamirpur1	31.69° N 76.52° E	449	C
18	Hamirpur2	31.71° N 76.53° E	637	C
19	Hamirpur3	31.67° N 76.53° E	502	C
20	Hamirpur4	31.69° N 76.51° E	227	D
21	Hamirpur6	31.68° N 76.54° E	561	C
22	Kalpa1	31.54° N 78.26° E	394	C
23	Kangra fort	32.09° N 76.26° E	853	B
24	Kaza1	32.23° N 78.07° E	699	C
25	Kee1	32.30° N 78.01° E	691	C
26	Keylong1	32.57° N 77.03° E	493	C
27	Keylong2	32.57° N 77.04° E	300	D
28	Kullu1	31.94° N 77.11° E	407	C
29	Kullu2	31.96° N 77.11° E	521	C
30	Kullu3	31.96° N 77.11° E	467	C
31	Kullu4	31.96° N 77.11° E	495	C
32	Kullu5	31.96° N 77.12° E	392	C
33	Manali1	32.23° N 77.19° E	416	C
34	Manali2	32.25° N 77.18° E	514	C
35	Manali3	32.24° N 77.19° E	479	C
36	Manali4	32.25° N 77.19° E	569	C
37	Mandi1	31.72° N 76.93° E	240	D
38	Mandi3	31.71° N 76.94° E	539	C
39	Mandi4	31.68° N 76.92° E	352	D
40	Mandi5	31.70° N 76.95° E	406	C
41	Nahan1	30.56° N 77.30° E	486	C
42	Nahan2	30.56° N 77.29° E	407	C
43	Nahan3	30.57° N 77.30° E	484	C
44	Nako1	31.89° N 78.63° E	390	C

Table 5 (contd.) - Site averaged Vs30 values of the 22 cities measured by MASW tests

S.No.	Site id	Location	Average Vs30	Soil Type
45	Peo1	31.54° N 78.27° E	454	C
46	Peo2	31.54° N 78.27° E	348	D
47	Rampur1	31.44° N 77.63° E	313	D
48	Shimla1	31.10° N 77.15° E	525	C
49	Shimla2	31.10° N 77.11° E	254	D
50	Shimla3	31.09° N 77.14° E	351	D
51	Shimla4	31.09° N 77.14° E	779	B
52	Shimla5	31.09° N 77.15° E	367	C
53	Shimla6	31.11° N 77.16° E	346	D
54	Shimla7	31.12° N 77.18° E	352	D
55	Shimla8	31.08° N 77.17° E	378	C
56	Shimla9	31.10° N 77.17° E	472	C
57	Shimla10	31.08° N 77.17° E	296	D
58	Shimla11	31.08° N 77.18° E	329	D
59	Shimla13	31.09° N 77.21° E	541	C
60	Shimla14	31.12° N 77.22° E	494	C
61	Solan1	30.92° N 77.09° E	417	C
62	Solan2	30.91° N 77.10° E	469	C
63	Solan3	30.90° N 77.09° E	447	C
64	Solan4	30.89° N 77.07° E	520	C
65	Solan5	30.92° N 77.09° E	452	C
66	Sundernagar1	31.53° N 76.91° E	379	C
67	Sundernagar2	31.52° N 76.88° E	317	D
68	Tabo1	32.09° N 78.38° E	542	C
69	Una1	31.47° N 76.27° E	204	D
70	Una2	31.46° N 76.26° E	266	D
71	Una3	31.48° N 76.27° E	183	D
72	Una4	31.47° N 76.28° E	270	D
73	Una5	31.52° N 76.29° E	237	D

Table 6 – Uncertainties in Earthquake model parameters

Region	Stress drop $\Delta\sigma$ (bars)	Dip(°)	Focal depth (km)	Reference
Himalaya	50-200	2°-30°	5-40	Kayal (2008)
Indo-Gangetic Plain	50-200	10°-80°	5-40	Kayal (2008)

Table 7 - Coefficients in the attenuation relation for C-Type sites in the Himalayan region

Period (s)	C1	C2	C3	C4	C5	C6	C7	C8	$\sigma(\epsilon)$
0	-4.7738	1.5004	-0.0204	-0.0048	-1.4216	0.0465	0.8748	0.0912	0.3864
0.01	-4.7739	1.5004	-0.0204	-0.0048	-1.4216	0.0465	0.8748	0.0912	0.3863
0.015	-4.3856	1.4517	-0.0166	-0.0048	-1.4447	0.0526	0.8614	0.0822	0.4077
0.02	-3.9633	1.3831	-0.0117	-0.0048	-1.4506	0.0512	0.8648	0.0732	0.4246
0.03	-3.3644	1.2550	-0.0029	-0.0050	-1.4188	0.0385	0.8975	0.0661	0.4248
0.04	-3.2107	1.1993	0.0002	-0.0053	-1.3663	0.0265	0.9381	0.0721	0.4138
0.05	-3.1912	1.1821	0.0007	-0.0056	-1.3237	0.0189	0.9734	0.0805	0.4050
0.06	-3.2716	1.1903	-0.0007	-0.0057	-1.2895	0.0154	0.9926	0.0870	0.3962
0.075	-3.5114	1.2357	-0.0046	-0.0057	-1.2687	0.0141	0.9988	0.0922	0.3877
0.09	-3.7079	1.2796	-0.0082	-0.0057	-1.2572	0.0140	0.9956	0.0960	0.3836
0.1	-3.9358	1.3384	-0.0128	-0.0056	-1.2546	0.0155	0.9808	0.0987	0.3792
0.15	-5.1125	1.6079	-0.0328	-0.0054	-1.2308	0.0186	0.9500	0.1028	0.3688
0.2	-6.2581	1.8845	-0.0531	-0.0052	-1.2201	0.0251	0.9083	0.1013	0.3641
0.3	-8.5491	2.4630	-0.0947	-0.0049	-1.2018	0.0419	0.8384	0.1008	0.3623
0.4	-10.4802	2.9546	-0.1292	-0.0046	-1.1930	0.0632	0.7866	0.0988	0.3628
0.5	-12.1393	3.3690	-0.1578	-0.0045	-1.1906	0.0800	0.7565	0.0964	0.3609
0.6	-13.8153	3.7663	-0.1852	-0.0043	-1.1786	0.0906	0.7363	0.0953	0.3620
0.7	-14.8718	4.0333	-0.2024	-0.0042	-1.1982	0.1174	0.7123	0.0951	0.3591
0.75	-15.4146	4.1593	-0.2106	-0.0041	-1.2007	0.1232	0.7060	0.0941	0.3587
0.8	-15.9659	4.2939	-0.2190	-0.0041	-1.2118	0.1323	0.6998	0.0978	0.3564
0.9	-17.0514	4.5410	-0.2348	-0.0040	-1.2160	0.1491	0.6892	0.0996	0.3539
1	-17.5645	4.6512	-0.2416	-0.0039	-1.2171	0.1562	0.6857	0.0975	0.3519
1.2	-19.1139	4.9647	-0.2602	-0.0038	-1.2145	0.1519	0.6889	0.0987	0.3423
1.5	-20.4006	5.2107	-0.2722	-0.0037	-1.2349	0.1624	0.6888	0.1004	0.3309
2	-21.8815	5.4498	-0.2809	-0.0035	-1.2588	0.1626	0.6999	0.1000	0.3180
2.5	-22.7389	5.5038	-0.2787	-0.0034	-1.2442	0.1228	0.7327	0.1017	0.3128
3	-23.2798	5.4962	-0.2700	-0.0033	-1.2701	0.1139	0.7527	0.1059	0.3086
4	-23.5964	5.3489	-0.2483	-0.0032	-1.2979	0.1001	0.7809	0.1065	0.3093

Table 8 - Coefficients in the attenuation relation for D-Type sites in Himalayan region

Period (s)	C1	C2	C3	C4	C5	C6	C7	C8	$\sigma(\epsilon)$
0	-4.5304	1.4623	-0.0175	-0.0049	-1.4392	0.0365	0.8948	0.0985	0.3881
0.01	-4.5308	1.4624	-0.0175	-0.0049	-1.4392	0.0366	0.8947	0.0985	0.3881
0.015	-4.1180	1.4086	-0.0134	-0.0049	-1.4658	0.0388	0.8877	0.0920	0.4027
0.02	-3.7021	1.3428	-0.0087	-0.0049	-1.4735	0.0379	0.8899	0.0841	0.4161
0.03	-3.1443	1.2262	-0.0008	-0.0051	-1.4423	0.0299	0.9171	0.0759	0.4176
0.04	-2.9824	1.1712	0.0023	-0.0054	-1.3910	0.0216	0.9527	0.0807	0.4097
0.05	-2.9733	1.1591	0.0025	-0.0056	-1.3503	0.0164	0.9806	0.0884	0.4033
0.06	-3.0671	1.1712	0.0007	-0.0058	-1.3091	0.0130	1.0029	0.0934	0.3964
0.075	-3.2796	1.2130	-0.0029	-0.0058	-1.2844	0.0119	1.0099	0.0982	0.3909
0.09	-3.4798	1.2585	-0.0066	-0.0058	-1.2750	0.0119	1.0068	0.1015	0.3872
0.1	-3.7006	1.3144	-0.0110	-0.0057	-1.2695	0.0130	0.9928	0.1034	0.3835
0.15	-4.9730	1.5972	-0.0319	-0.0054	-1.2472	0.0156	0.9636	0.1059	0.3750
0.2	-6.1367	1.8725	-0.0521	-0.0052	-1.2287	0.0200	0.9277	0.1026	0.3711
0.3	-8.5262	2.4675	-0.0948	-0.0049	-1.2106	0.0330	0.8597	0.1025	0.3700
0.4	-10.4727	2.9671	-0.1300	-0.0047	-1.1957	0.0471	0.8125	0.1002	0.3713
0.5	-12.1248	3.3786	-0.1584	-0.0044	-1.1870	0.0575	0.7864	0.0964	0.3698
0.6	-13.8033	3.7733	-0.1856	-0.0043	-1.1740	0.0666	0.7629	0.0948	0.3699
0.7	-14.8673	4.0347	-0.2024	-0.0041	-1.1916	0.0844	0.7419	0.0936	0.3668
0.75	-15.4015	4.1591	-0.2106	-0.0041	-1.1962	0.0909	0.7333	0.0934	0.3664
0.8	-15.9497	4.2928	-0.2189	-0.0041	-1.2086	0.0995	0.7248	0.0968	0.3636
0.9	-17.0185	4.5281	-0.2338	-0.0040	-1.2102	0.1098	0.7169	0.0984	0.3612
1	-17.5410	4.6380	-0.2405	-0.0039	-1.2095	0.1122	0.7166	0.0968	0.3587
1.2	-19.0391	4.9414	-0.2582	-0.0038	-1.2133	0.1120	0.7183	0.0986	0.3489
1.5	-20.2986	5.1796	-0.2697	-0.0037	-1.2349	0.1217	0.7160	0.1005	0.3380
2	-21.7272	5.4074	-0.2774	-0.0035	-1.2636	0.1270	0.7236	0.1018	0.3251
2.5	-22.5444	5.4556	-0.2747	-0.0034	-1.2543	0.0989	0.7538	0.1038	0.3204
3	-23.0657	5.4404	-0.2654	-0.0033	-1.2791	0.0915	0.7739	0.1081	0.3166
4	-23.3445	5.2846	-0.2430	-0.0032	-1.3093	0.0819	0.8013	0.1096	0.3174

Table 9 - Coefficients in the attenuation relation for C-Type sites in the Indo-Gangetic region

Period (s)	C1	C2	C3	C4	C5	C6	C7	C8	$\sigma(\epsilon)$
0	-4.3477	1.2807	-0.0087	-0.0064	-1.2940	0.0084	1.0489	0.1234	0.3930
0.01	-4.3478	1.2805	-0.0087	-0.0064	-1.2938	0.0084	1.0491	0.1234	0.3929
0.015	-3.9582	1.2157	-0.0042	-0.0063	-1.2957	0.0077	1.0595	0.1224	0.4352
0.02	-3.5931	1.1596	-0.0004	-0.0062	-1.2917	0.0072	1.0684	0.1228	0.4514
0.03	-3.1401	1.1051	0.0032	-0.0062	-1.2830	0.0071	1.0705	0.1204	0.4289
0.04	-3.0207	1.1033	0.0032	-0.0062	-1.2733	0.0070	1.0722	0.1185	0.4079
0.05	-3.0180	1.1225	0.0020	-0.0063	-1.2642	0.0067	1.0758	0.1186	0.3960
0.06	-3.1225	1.1567	-0.0007	-0.0063	-1.2528	0.0067	1.0739	0.1160	0.3869
0.075	-3.3532	1.2057	-0.0043	-0.0063	-1.2427	0.0067	1.0719	0.1156	0.3806
0.09	-3.5506	1.2520	-0.0078	-0.0064	-1.2367	0.0071	1.0630	0.1151	0.3772
0.1	-3.7684	1.3094	-0.0118	-0.0064	-1.2395	0.0086	1.0398	0.115	0.3749
0.15	-4.9516	1.5779	-0.0311	-0.0065	-1.2213	0.0108	1.0066	0.1134	0.3709
0.2	-6.1330	1.8563	-0.0512	-0.0065	-1.2076	0.0142	0.9678	0.1089	0.3703
0.3	-8.4797	2.4413	-0.0928	-0.0065	-1.1871	0.0239	0.8986	0.1059	0.3748
0.4	-10.4117	2.9257	-0.1264	-0.0066	-1.1766	0.0365	0.8467	0.1029	0.3785
0.5	-12.0609	3.3261	-0.1538	-0.0066	-1.1689	0.0434	0.8233	0.0997	0.3793
0.6	-13.7506	3.7191	-0.1808	-0.0066	-1.1520	0.0477	0.8059	0.0974	0.3813
0.7	-14.7700	3.9596	-0.1960	-0.0066	-1.1624	0.0567	0.7902	0.0955	0.3791
0.75	-15.2966	4.0758	-0.2036	-0.0066	-1.1613	0.0577	0.7866	0.0946	0.3798
0.8	-15.8293	4.2001	-0.2113	-0.0066	-1.1700	0.0615	0.7806	0.0978	0.3783
0.9	-16.8659	4.4149	-0.2247	-0.0067	-1.1629	0.0606	0.7828	0.0982	0.376
1	-17.3530	4.5072	-0.2303	-0.0066	-1.1569	0.0575	0.7889	0.0956	0.3741
1.2	-18.7600	4.7687	-0.2451	-0.0067	-1.1497	0.0490	0.8061	0.0976	0.3658
1.5	-19.9378	4.9550	-0.2532	-0.0067	-1.1508	0.0392	0.8361	0.0980	0.3554
2	-21.2123	5.0947	-0.2551	-0.0066	-1.1485	0.0248	0.8976	0.0962	0.3431
2.5	-21.8921	5.0838	-0.2484	-0.0066	-1.1250	0.0113	0.9888	0.0962	0.3388
3	-22.2566	4.9833	-0.2334	-0.0066	-1.1222	0.0046	1.1077	0.0965	0.3350
4	-22.2759	4.6884	-0.2015	-0.0066	-1.1090	0.0006	1.3616	0.0935	0.3321

Table 10 - Coefficients in the attenuation relation for D-Type sites in the Indo-Gangetic region

Period (s)	C1	C2	C3	C4	C5	C6	C7	C8	$\sigma(\epsilon)$
0	-4.3343	1.2847	-0.0090	-0.0064	-1.2983	0.0086	1.0439	0.1238	0.3941
0.01	-4.3345	1.2846	-0.0090	-0.0064	-1.2982	0.0086	1.0441	0.1238	0.3940
0.015	-3.9775	1.2241	-0.0047	-0.0063	-1.3000	0.0081	1.0529	0.1226	0.4275
0.02	-3.6236	1.1680	-0.0008	-0.0063	-1.2965	0.0076	1.0612	0.1230	0.4427
0.03	-3.1667	1.1100	0.0030	-0.0062	-1.2878	0.0074	1.0647	0.1203	0.4256
0.04	-3.0243	1.1055	0.0031	-0.0062	-1.2788	0.0073	1.0659	0.1187	0.4080
0.05	-3.0117	1.1228	0.0020	-0.0063	-1.2702	0.0069	1.0706	0.1193	0.3979
0.06	-3.0916	1.1569	-0.0006	-0.0063	-1.2569	0.0068	1.0699	0.1164	0.3903
0.075	-3.2895	1.2047	-0.0042	-0.0063	-1.2450	0.0068	1.0686	0.1158	0.3849
0.09	-3.4831	1.2501	-0.0076	-0.0064	-1.2402	0.0071	1.0604	0.1155	0.3821
0.1	-3.6939	1.3068	-0.0116	-0.0064	-1.2408	0.0085	1.0390	0.1149	0.3802
0.15	-4.9172	1.5764	-0.0310	-0.0065	-1.2254	0.0106	1.0068	0.1138	0.3769
0.2	-6.0931	1.8523	-0.0509	-0.0065	-1.2077	0.0135	0.9713	0.1088	0.3764
0.3	-8.4950	2.4461	-0.0931	-0.0066	-1.1901	0.0226	0.9023	0.1066	0.3807
0.4	-10.4342	2.9399	-0.1275	-0.0066	-1.1754	0.0343	0.8500	0.1030	0.3845
0.5	-12.0682	3.3399	-0.1549	-0.0066	-1.1650	0.0406	0.8268	0.0991	0.3852
0.6	-13.7375	3.7257	-0.1814	-0.0066	-1.1487	0.0438	0.8114	0.0970	0.3871
0.7	-14.7482	3.9608	-0.1962	-0.0066	-1.1602	0.0519	0.7969	0.0953	0.3846
0.75	-15.2670	4.0734	-0.2035	-0.0066	-1.1597	0.0528	0.7935	0.0945	0.3852
0.8	-15.7935	4.1946	-0.2110	-0.0066	-1.1684	0.0564	0.7872	0.0977	0.3835
0.9	-16.8245	4.4071	-0.2243	-0.0067	-1.1622	0.0559	0.7887	0.0983	0.3809
1	-17.3089	4.4987	-0.2298	-0.0066	-1.1567	0.0533	0.7944	0.0960	0.3789
1.2	-18.6974	4.7546	-0.2442	-0.0067	-1.1504	0.0455	0.8116	0.0979	0.3704
1.5	-19.8625	4.9382	-0.2520	-0.0067	-1.1526	0.0371	0.8395	0.0985	0.3601
2	-21.1173	5.0736	-0.2536	-0.0066	-1.1519	0.0240	0.8987	0.0973	0.3477
2.5	-21.7819	5.0600	-0.2467	-0.0066	-1.1299	0.0112	0.9874	0.0974	0.3432
3	-22.1434	4.9604	-0.2319	-0.0066	-1.1280	0.0048	1.0999	0.0977	0.3393
4	-22.1664	4.6684	-0.2002	-0.0066	-1.1153	0.0007	1.3416	0.0949	0.3362

Table 11- Seismic hazard at the test sites in Himachal Pradesh

S. No.	Test Site	Lat.	Long.	PGA (T _R =25)	PGA (T _R =50)	PGA (T _R =100)	PGA (T _R =200)	PGA (T _R =475)	PGA (T _R =2475)
1	Bilaspur1	31.34	76.76	0.026	0.040	0.058	0.085	0.131	0.269
2	Bilaspur2	31.32	76.76	0.025	0.038	0.056	0.081	0.125	0.259
3	Bilaspur3	31.33	76.77	0.027	0.041	0.060	0.088	0.136	0.279
4	Bilaspur4	31.34	76.76	0.021	0.032	0.047	0.069	0.106	0.218
5	Bilaspur5	31.34	76.76	0.023	0.036	0.052	0.076	0.118	0.243
6	Chamba1	32.55	76.13	0.023	0.033	0.047	0.067	0.102	0.217
7	Chamba2	32.54	76.13	0.023	0.034	0.049	0.069	0.106	0.226
8	Chamba3	32.55	76.13	0.023	0.033	0.047	0.067	0.103	0.218
9	Chamba4	32.56	76.12	0.019	0.028	0.040	0.057	0.087	0.185
10	Chamba5	32.56	76.13	0.021	0.030	0.043	0.061	0.092	0.196
11	Dankar1	32.09	78.22	0.020	0.031	0.046	0.066	0.100	0.204
12	Dhramshala1	32.2	76.32	0.020	0.030	0.044	0.064	0.101	0.216
13	Dhramshala2	32.2	76.34	0.020	0.031	0.045	0.066	0.104	0.224
14	Dhramshala3	32.21	76.32	0.020	0.031	0.046	0.067	0.105	0.225
15	Dhramshala4	32.22	76.33	0.020	0.030	0.045	0.065	0.102	0.220
16	Dhramshala5	32.21	76.34	0.018	0.028	0.041	0.060	0.094	0.201
17	Hamirpur1	31.69	76.52	0.020	0.031	0.046	0.066	0.102	0.212
18	Hamirpur2	31.71	76.53	0.018	0.027	0.040	0.058	0.089	0.184
19	Hamirpur3	31.67	76.53	0.021	0.033	0.048	0.070	0.109	0.225
20	Hamirpur4	31.69	76.51	0.018	0.027	0.040	0.059	0.091	0.190
21	Hamirpur6	31.68	76.54	0.021	0.031	0.046	0.067	0.103	0.213
22	Kalpa1	31.54	78.26	0.022	0.033	0.048	0.069	0.107	0.225
23	Kangra fort	32.09	76.26	0.013	0.019	0.029	0.042	0.064	0.138
24	Kaza1	32.23	78.07	0.014	0.021	0.030	0.043	0.064	0.126
25	Kee1	32.3	78.01	0.014	0.022	0.032	0.045	0.068	0.131
26	Keylong1	32.57	77.03	0.020	0.031	0.045	0.066	0.103	0.214
27	Keylong2	32.57	77.04	0.021	0.032	0.048	0.070	0.109	0.228
28	Kullu1	31.94	77.11	0.021	0.032	0.047	0.067	0.101	0.203
29	Kullu2	31.96	77.11	0.023	0.034	0.051	0.073	0.110	0.222
30	Kullu3	31.96	77.11	0.021	0.031	0.045	0.065	0.099	0.200
31	Kullu4	31.96	77.11	0.021	0.032	0.046	0.066	0.101	0.203
32	Kullu5	31.96	77.12	0.019	0.028	0.041	0.059	0.090	0.180
33	Manali1	32.23	77.19	0.019	0.029	0.043	0.062	0.095	0.199
34	Manali2	32.25	77.18	0.018	0.028	0.042	0.060	0.093	0.195
35	Manali3	32.24	77.19	0.020	0.031	0.046	0.066	0.102	0.214
36	Manali4	32.25	77.19	0.018	0.027	0.040	0.058	0.090	0.189
37	Mandi1	31.72	76.93	0.023	0.035	0.051	0.074	0.113	0.228
38	Mandi3	31.71	76.94	0.024	0.037	0.054	0.077	0.118	0.238
39	Mandi4	31.68	76.92	0.023	0.035	0.051	0.074	0.114	0.229
40	Mandi5	31.7	76.95	0.025	0.037	0.055	0.079	0.119	0.241
41	Nahan1	30.56	77.3	0.018	0.028	0.042	0.061	0.096	0.204
42	Nahan2	30.56	77.29	0.024	0.038	0.056	0.082	0.128	0.276
43	Nahan3	30.57	77.3	0.017	0.026	0.039	0.057	0.089	0.189
44	Nako1	31.89	78.63	0.018	0.028	0.041	0.058	0.090	0.186
45	ReckongPeo1	31.54	78.27	0.017	0.025	0.036	0.052	0.080	0.167
46	ReckongPeo2	31.54	78.27	0.020	0.030	0.044	0.063	0.097	0.204
47	Rampur1	31.44	77.63	0.020	0.030	0.044	0.064	0.098	0.203

Table 11 (contd.) - Seismic hazard at the test sites in Himachal Pradesh

S. No.	Test Site	Lat.	Long.	PGA (TR= 25 yrs)	PGA (TR=50)	PGA (TR= 100)	PGA (TR= 200)	PGA (TR= 475)	PGA (TR= 2475)
48	Shimla1	31.1	77.15	0.024	0.037	0.054	0.078	0.119	0.242
49	Shimla2	31.1	77.11	0.025	0.038	0.056	0.082	0.126	0.258
50	Shimla3	31.09	77.14	0.022	0.033	0.049	0.071	0.109	0.222
51	Shimla4	31.09	77.14	0.023	0.034	0.050	0.073	0.112	0.225
52	Shimla5	31.09	77.15	0.023	0.035	0.052	0.075	0.116	0.236
53	Shimla6	31.11	77.16	0.024	0.036	0.054	0.077	0.119	0.241
54	Shimla7	31.12	77.18	0.022	0.033	0.049	0.071	0.109	0.219
55	Shimla8	31.08	77.17	0.025	0.038	0.056	0.080	0.123	0.250
56	Shimla9	31.1	77.17	0.027	0.040	0.059	0.085	0.131	0.265
57	Shimla10	31.08	77.17	0.023	0.034	0.050	0.073	0.112	0.228
58	Shimla11	31.08	77.18	0.025	0.037	0.055	0.079	0.122	0.247
59	Shimla13	31.09	77.21	0.024	0.036	0.053	0.076	0.117	0.237
60	Shimla14	31.12	77.22	0.025	0.038	0.056	0.081	0.124	0.251
61	Solan1	30.92	77.09	0.021	0.031	0.046	0.067	0.103	0.212
62	Solan2	30.91	77.1	0.023	0.034	0.051	0.074	0.114	0.235
63	Solan3	30.9	77.09	0.024	0.036	0.053	0.076	0.118	0.244
64	Solan4	30.89	77.07	0.021	0.032	0.048	0.069	0.106	0.219
65	Solan5	30.92	77.09	0.026	0.039	0.057	0.083	0.128	0.263
66	Sundernagar1	31.53	76.91	0.025	0.038	0.056	0.081	0.124	0.253
67	Sundernagar2	31.52	76.88	0.029	0.044	0.065	0.094	0.145	0.296
68	Tabo1	32.09	78.38	0.016	0.024	0.035	0.050	0.076	0.152
69	Una1	31.47	76.27	0.013	0.019	0.028	0.041	0.063	0.131
70	Una2	31.46	76.26	0.012	0.018	0.026	0.038	0.059	0.122
71	Una3	31.48	76.27	0.011	0.017	0.025	0.036	0.056	0.115
72	Una4	31.47	76.28	0.013	0.020	0.029	0.042	0.064	0.133
73	Una5	31.52	76.29	0.013	0.019	0.028	0.040	0.062	0.128

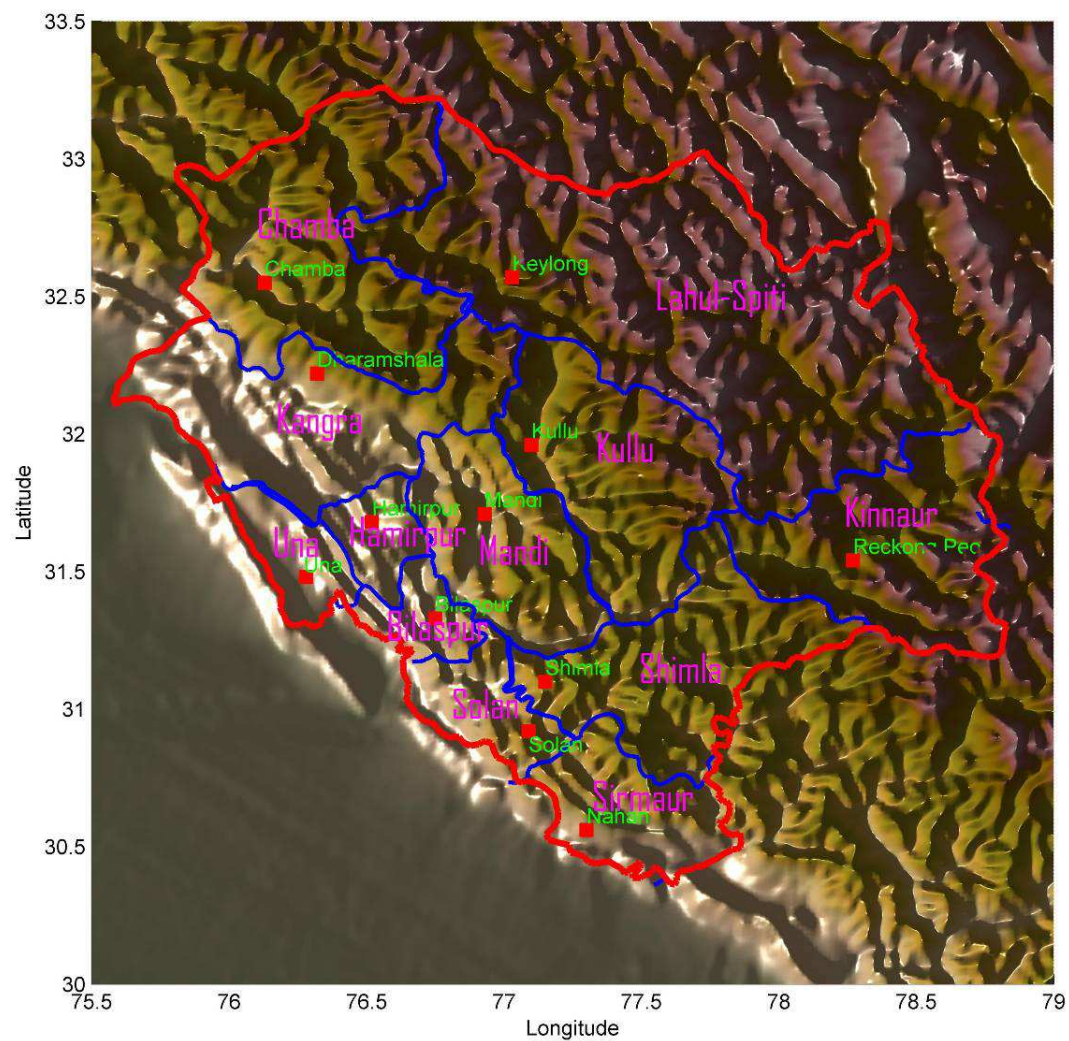


Figure 1. Map of Himachal Pradesh

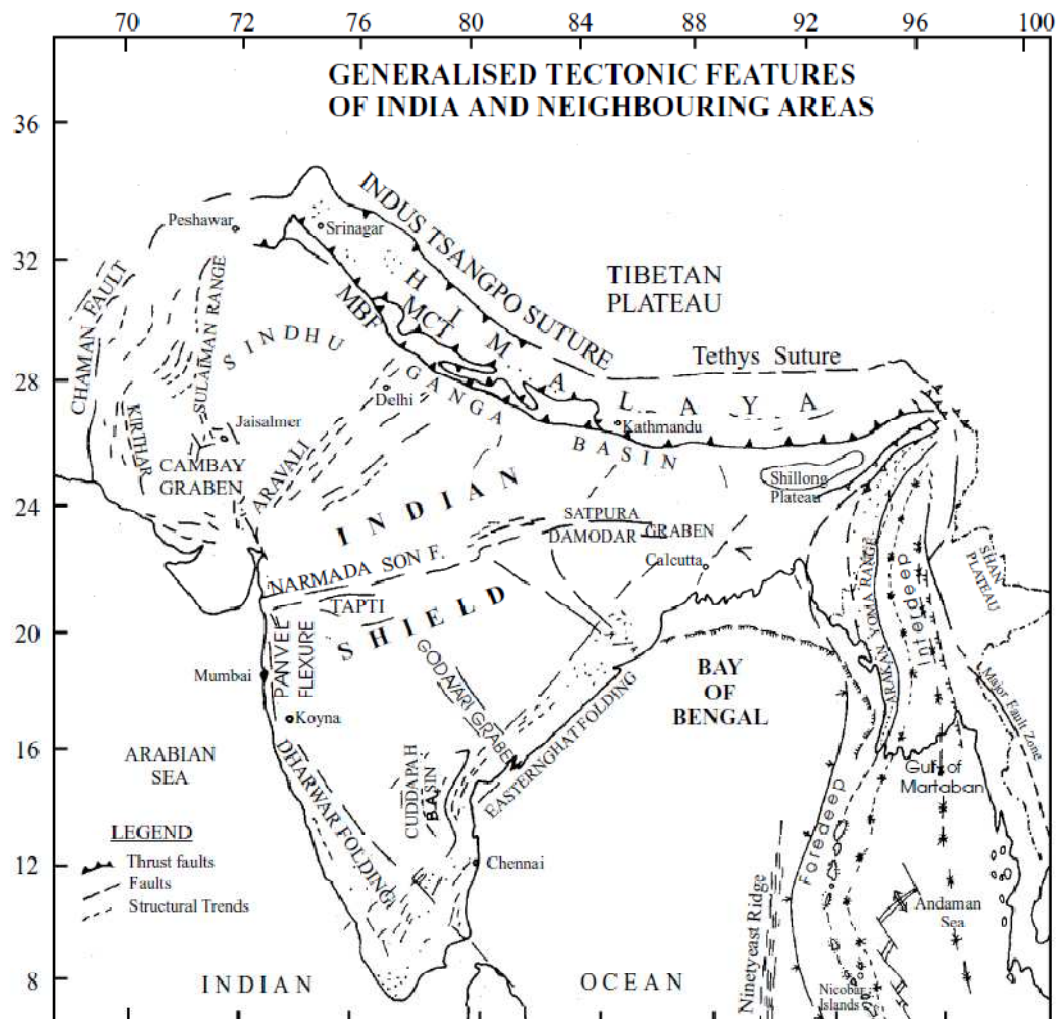


Figure 2. Generalized tectonic map of India and adjacent areas (Khattri *et al.* 1984; Parvez *et al.* 2003).

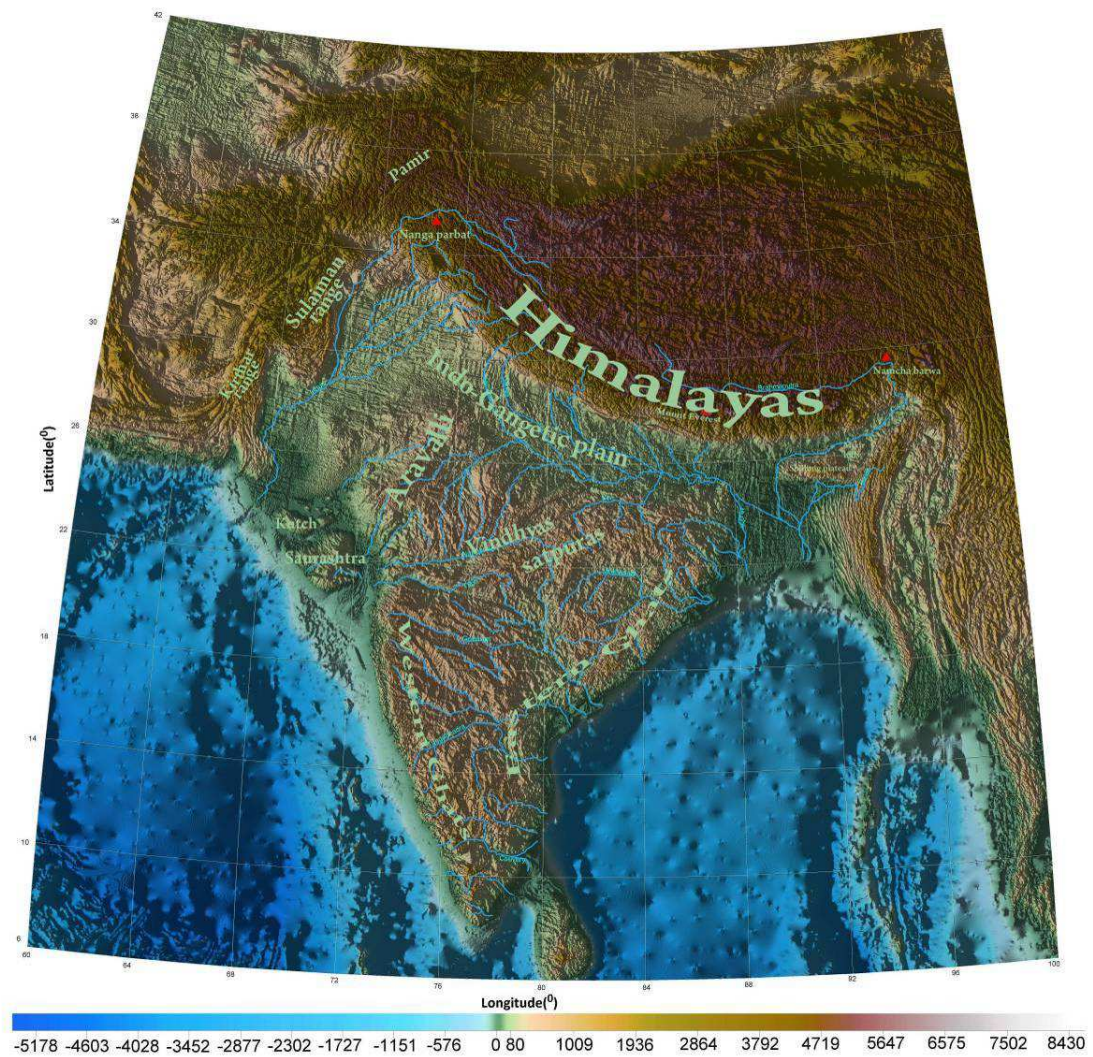


Figure 3. Elevation map of India

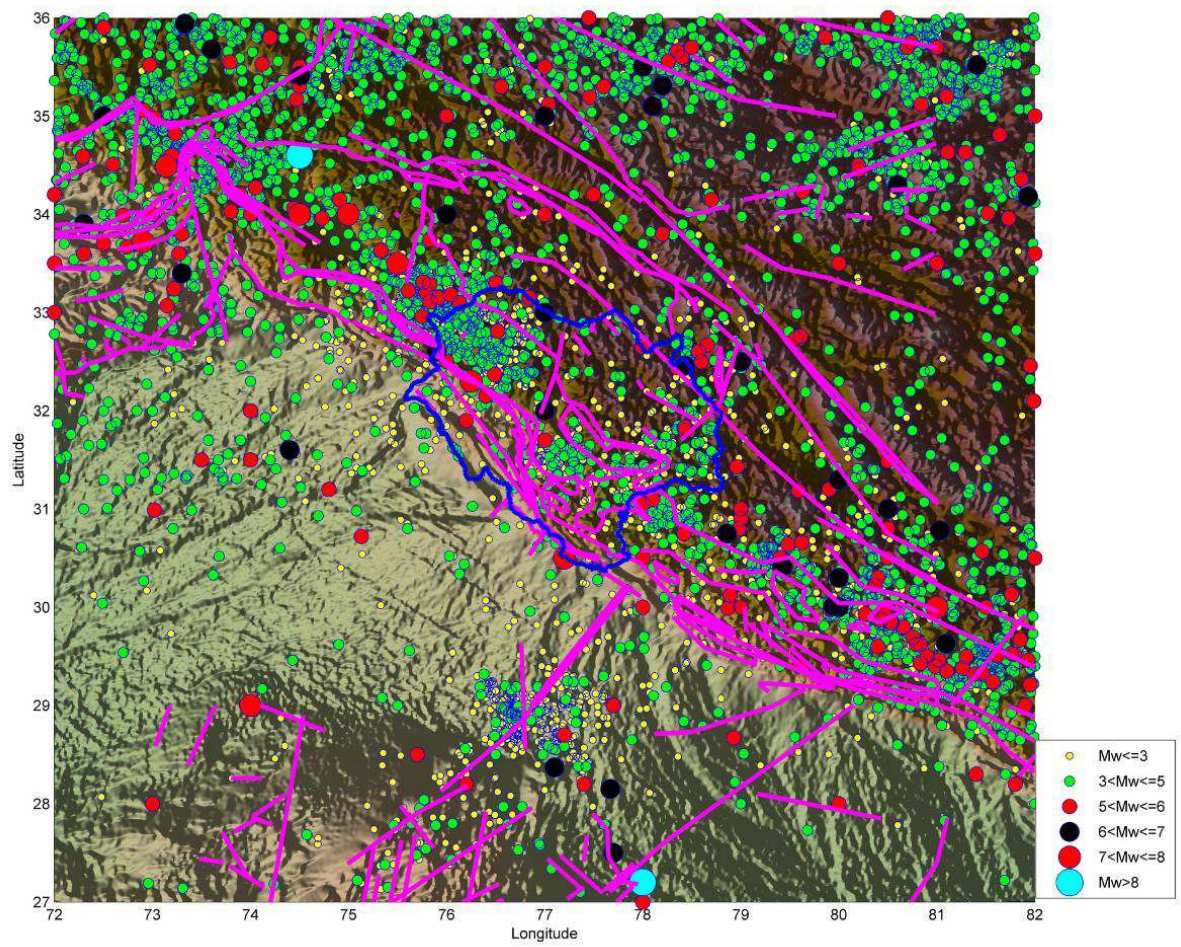


Figure 4. Seismicity map of HP

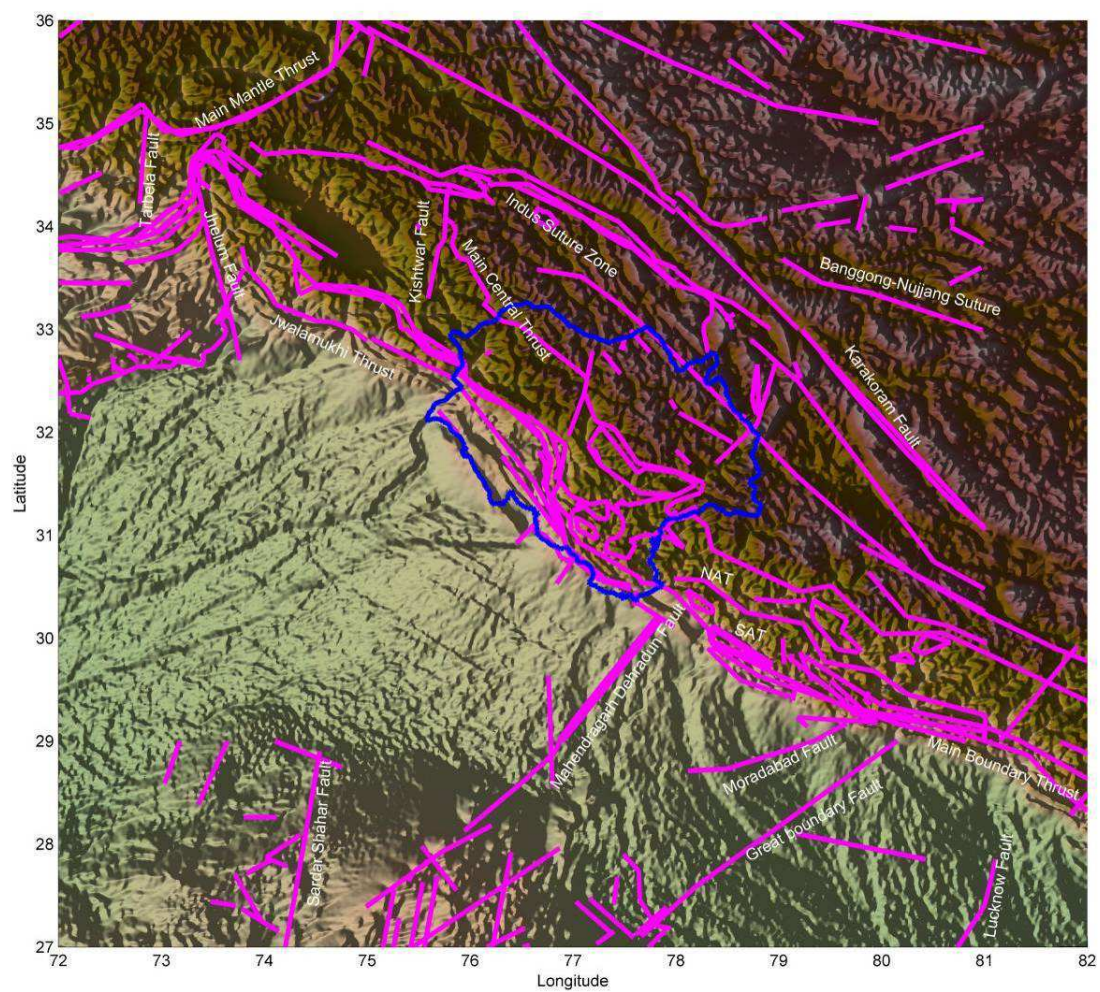


Figure 5. Fault map of HP

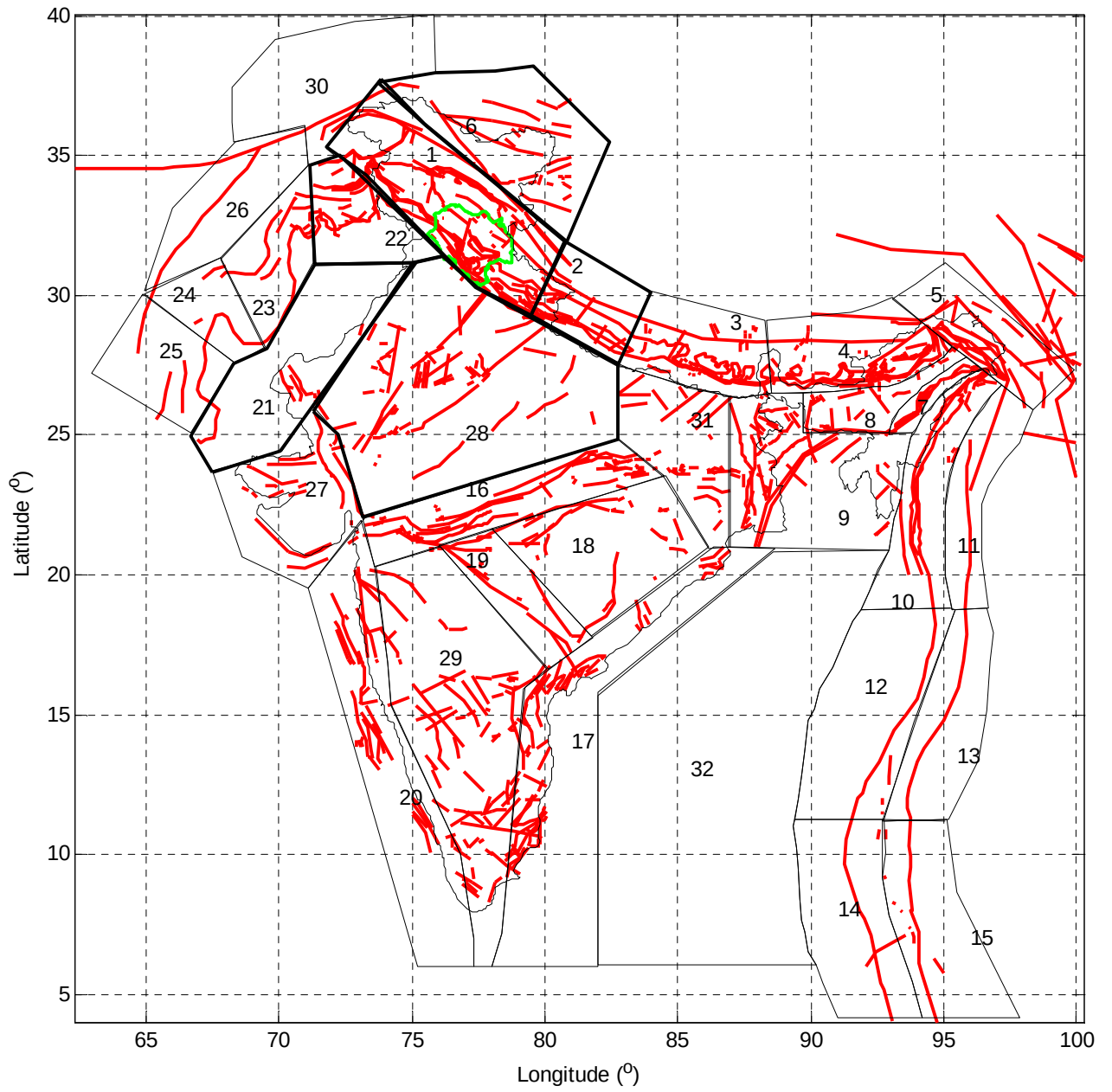


Figure 6. Seismogenic zones of India

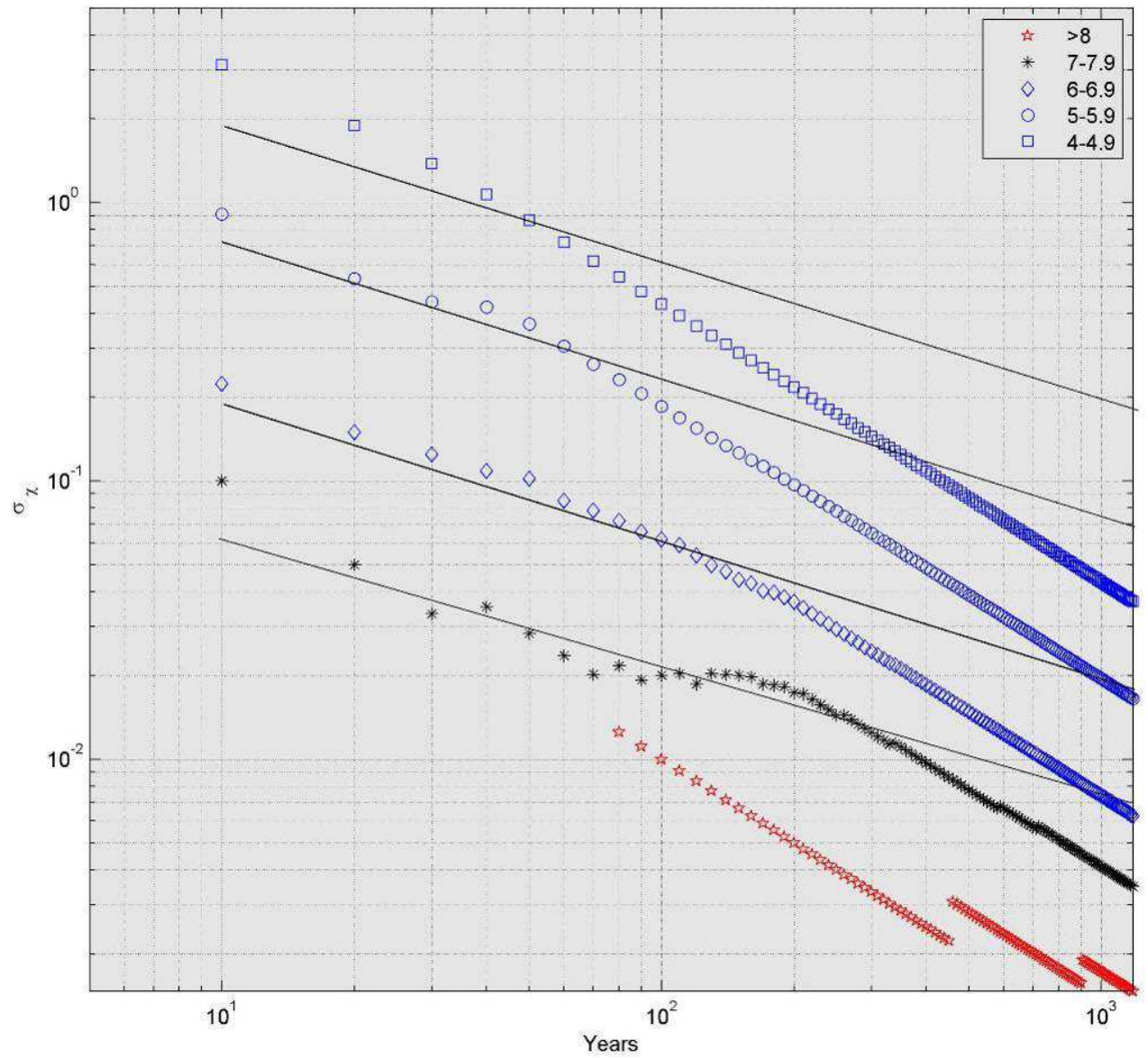


Figure 7. Completeness test for Earthquake data

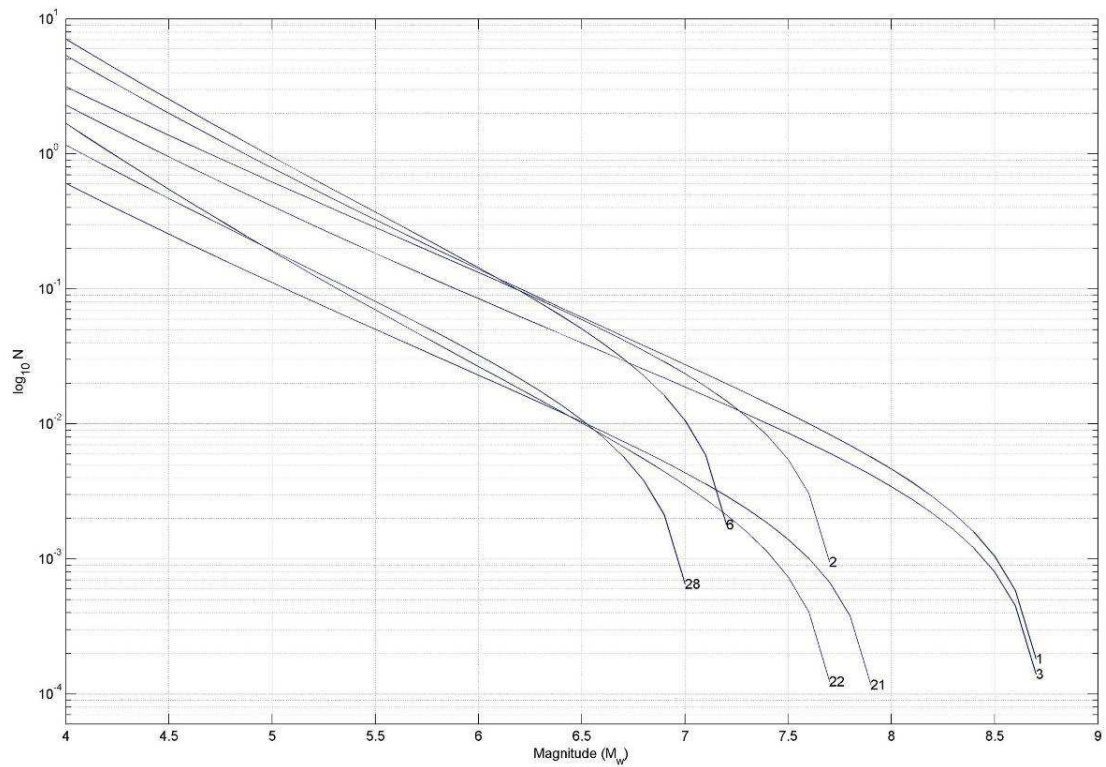


Figure 8. Earthquake Recurrence relation for seven seismic zones



Geode seismic recorder
(Source: www.geometrics.com)



Geophones for soft ground types (Type I)

Figure 9. Instruments used for MASW experiment

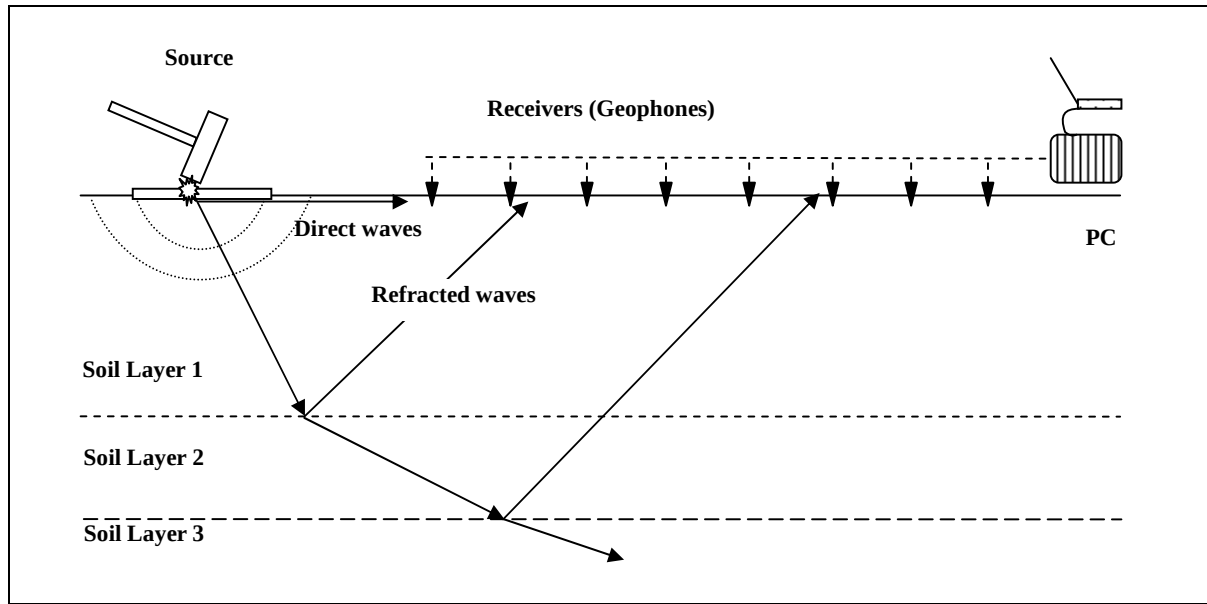
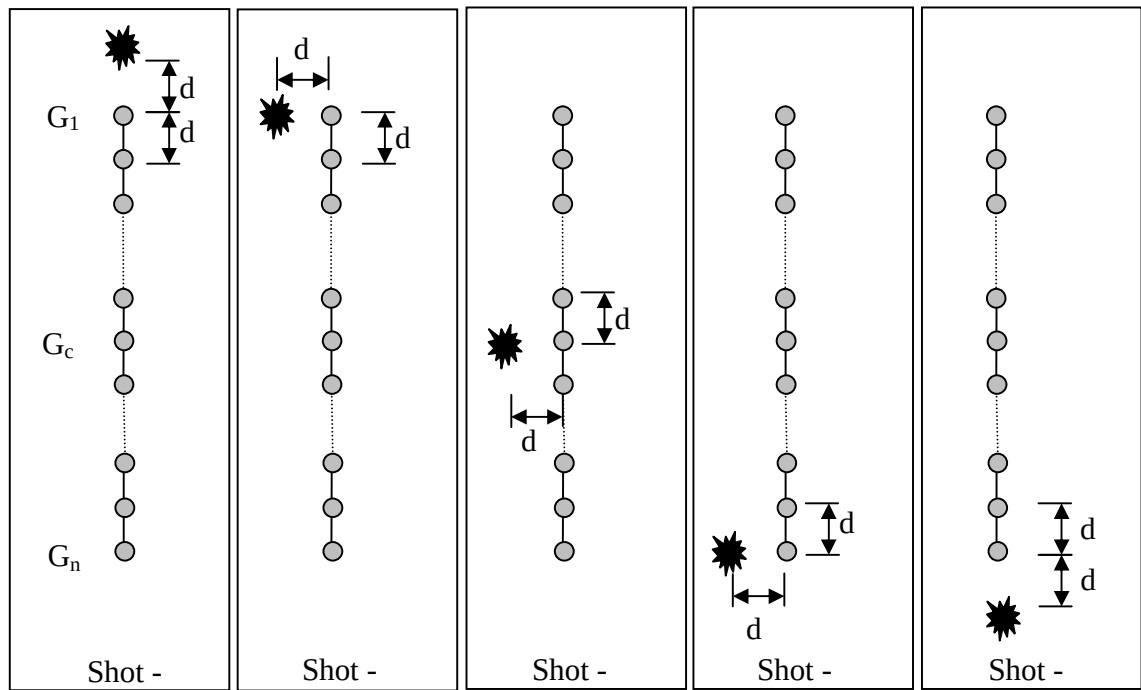


Figure 10. Seismic refraction survey



G_1 - First geophone, G_c - Geophone at the centre of the array, n - Number of geophones

Figure 11. Shot locations adopted at each test site

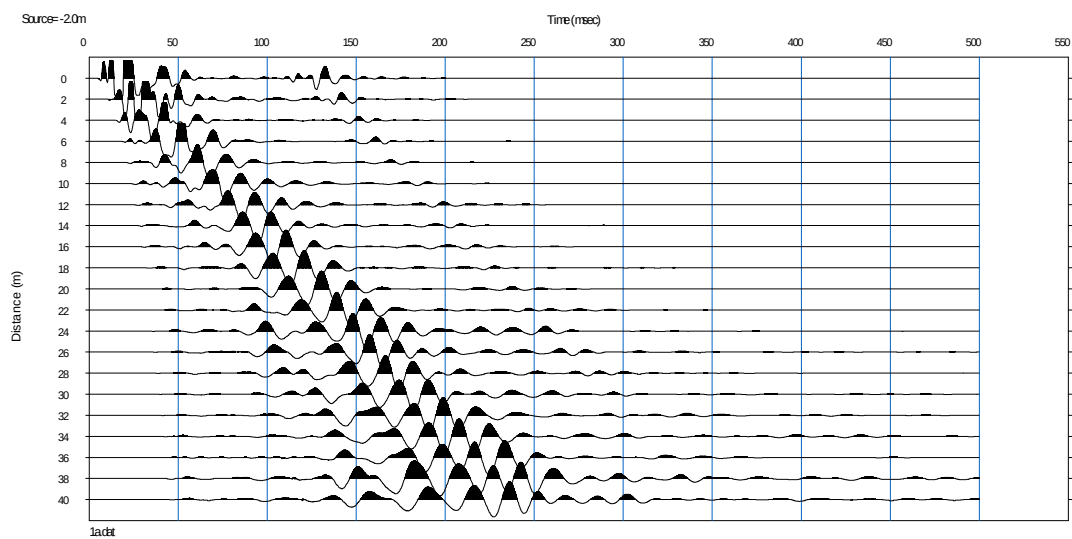


Figure 12. Waveform of the acquired data due to shot-1 at Una-4

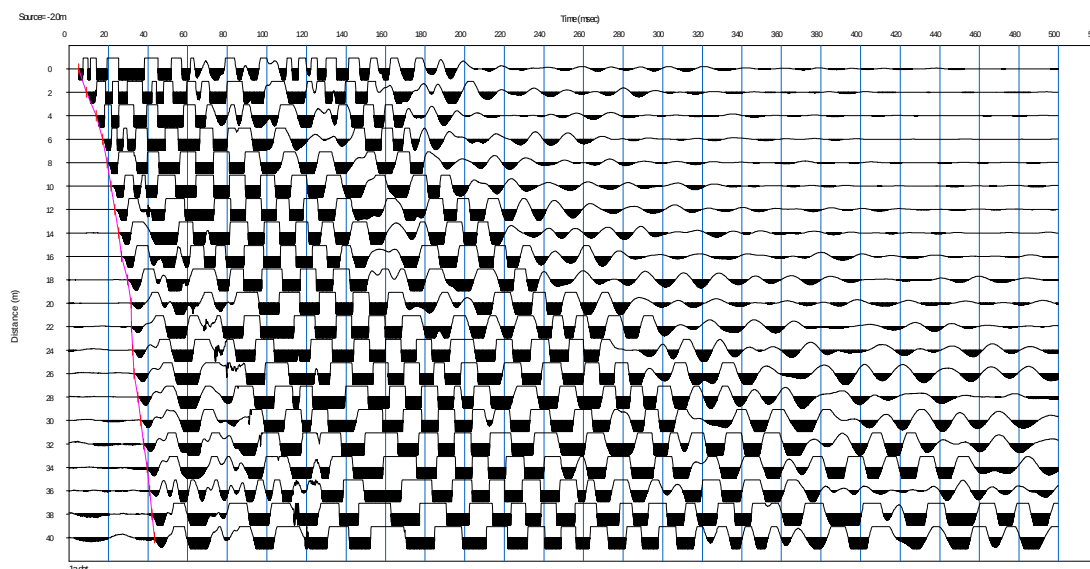


Figure 13. Picking the first breaks after increasing display gain and using display clipping

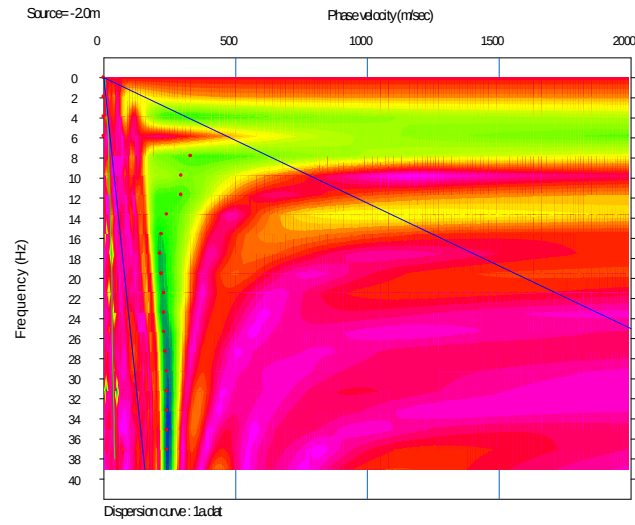


Figure 14. Dispersion plot of the frequency against phase velocity

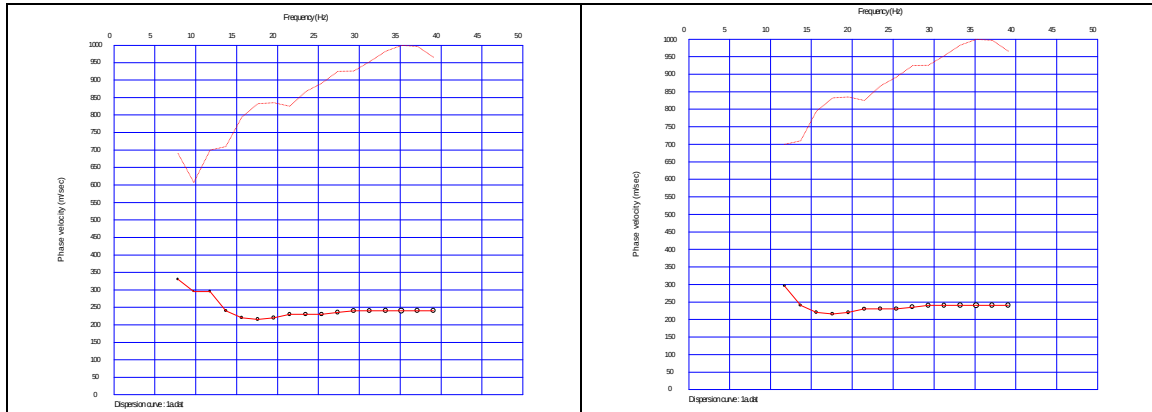


Figure 15. a. Dispersion curve, b. Dispersion curve after removing low quality data

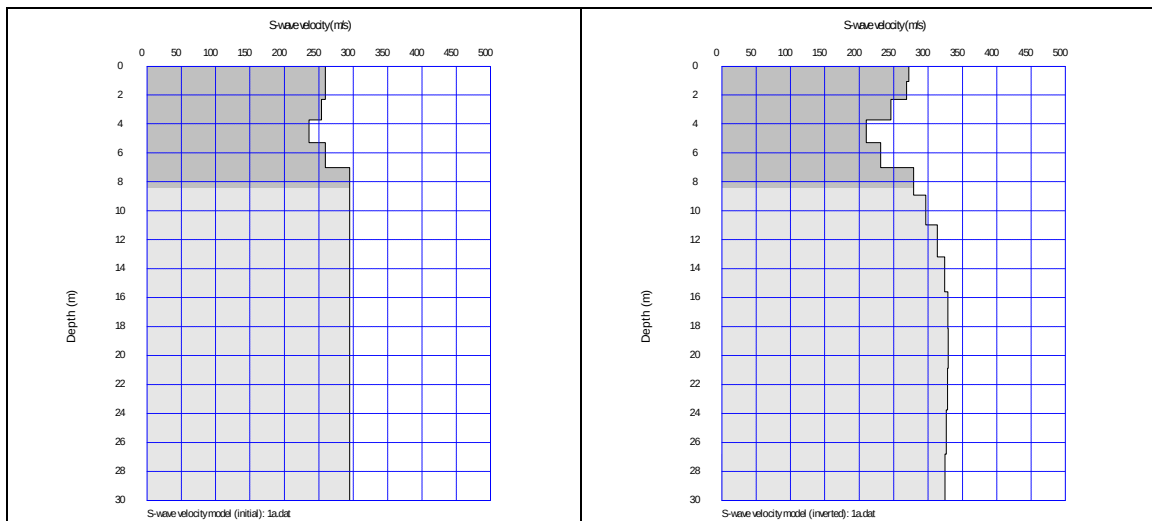


Figure 16. a. Initial shear wave velocity model, b. Final shear wave velocity model after performing inversion

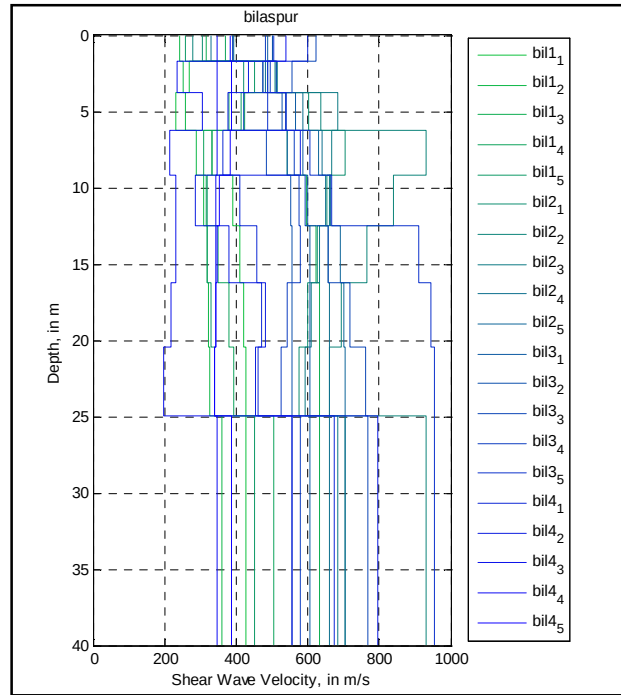


Figure 17.1. Shear wave profiles of all the test sites in Bilaspur

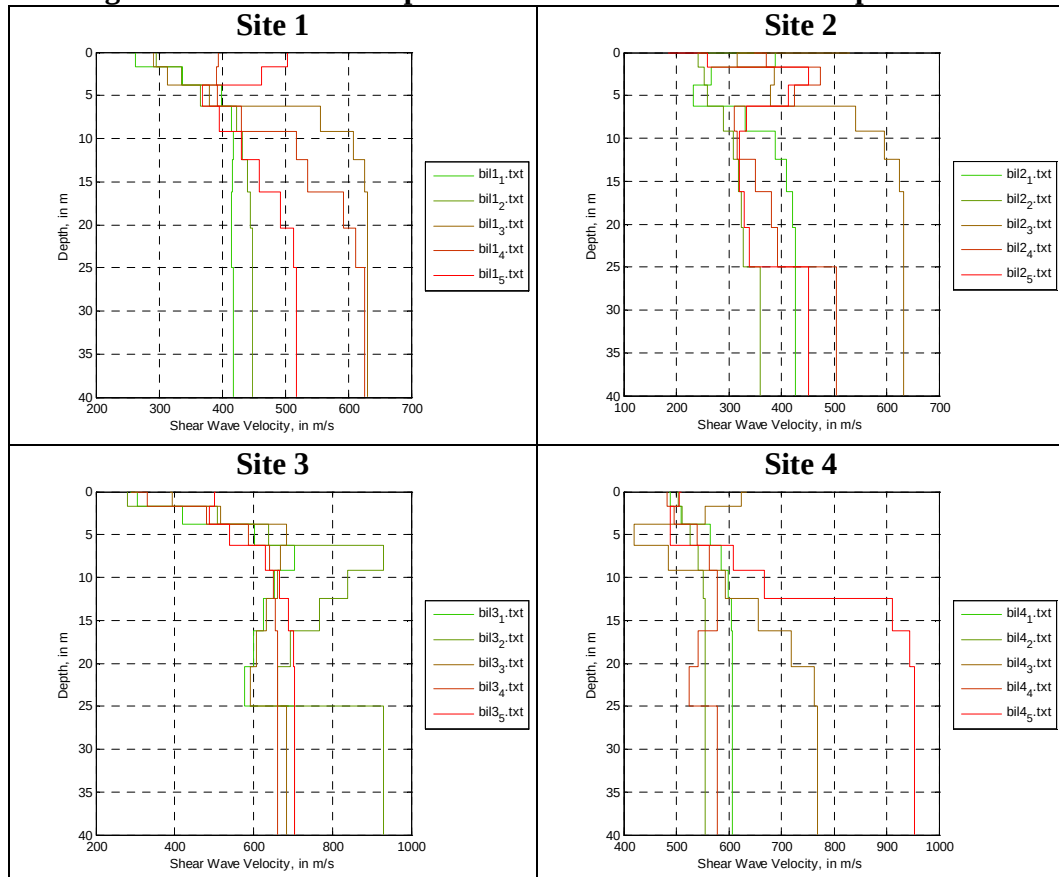


Figure 17.2. Shear wave velocity profile at Sites 1 to 5 in Bilaspur

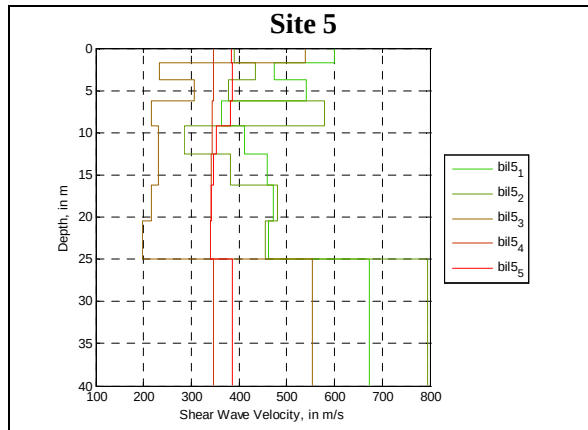


Figure 17.2. Continued

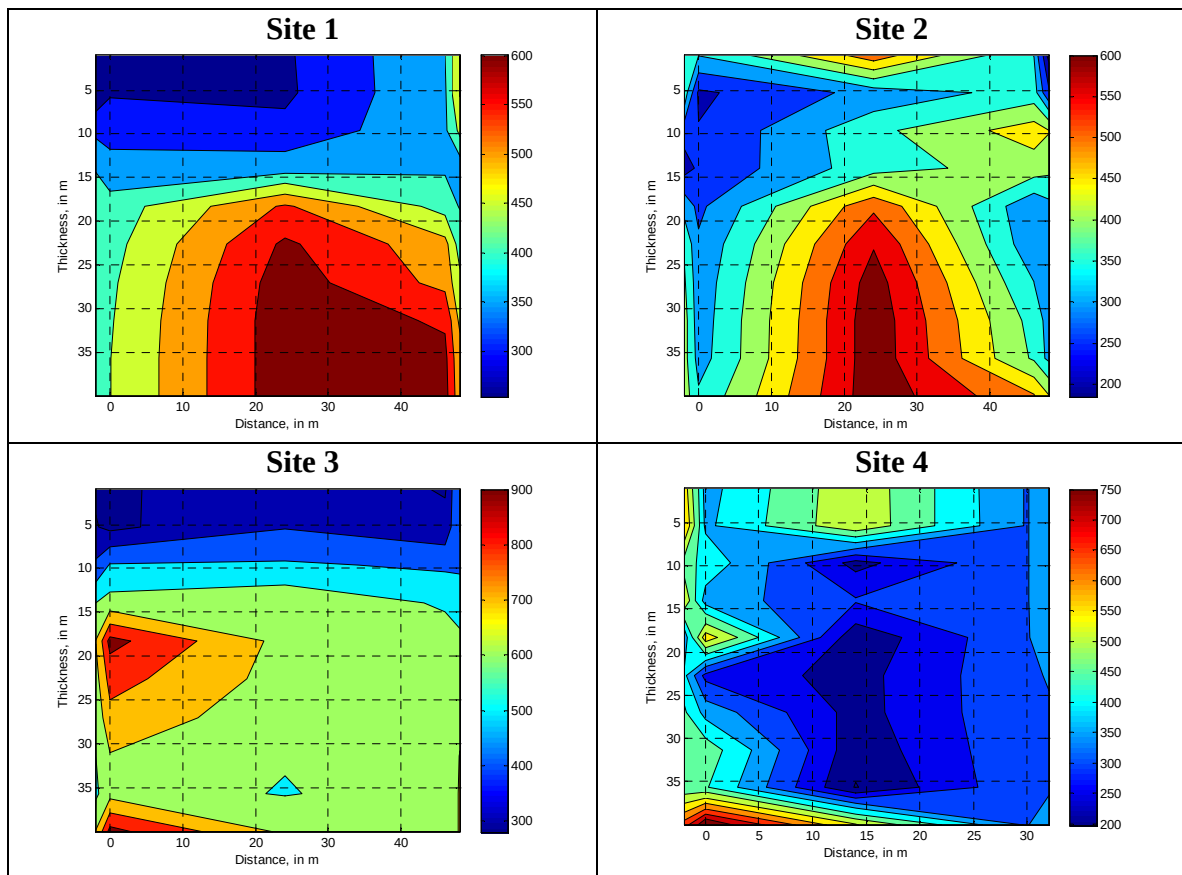


Figure 17.3. Interpolated 2d shear wave velocity profile for sites 1 to 5 in Bilaspur

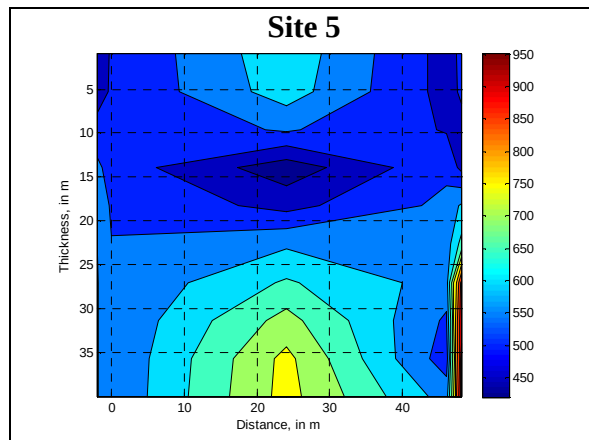


Figure 17.3. Continued



Figure 17.4. a. Soil c/s in Bilaspur between test sites 1& 2, b. Soil c/s near test site 5 in Bilaspur

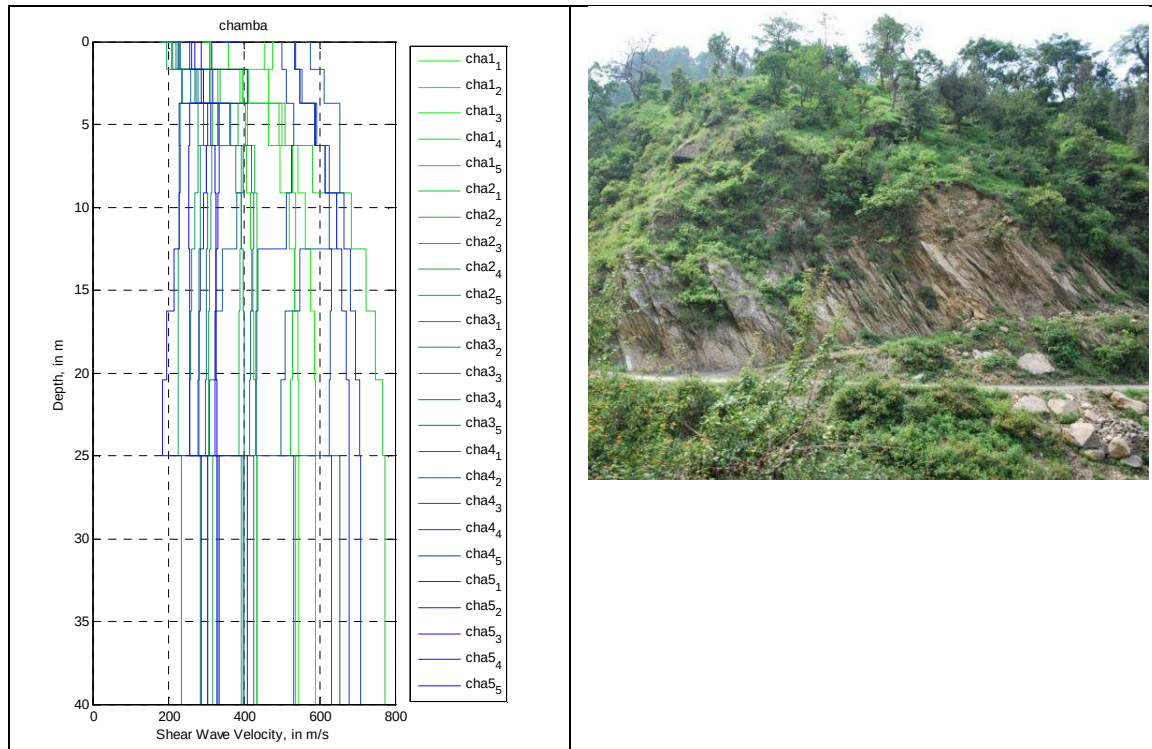


Figure 18.1. a. Shear wave velocity profiles of all the test sites in Chamba, b. Soil c/s near a test site

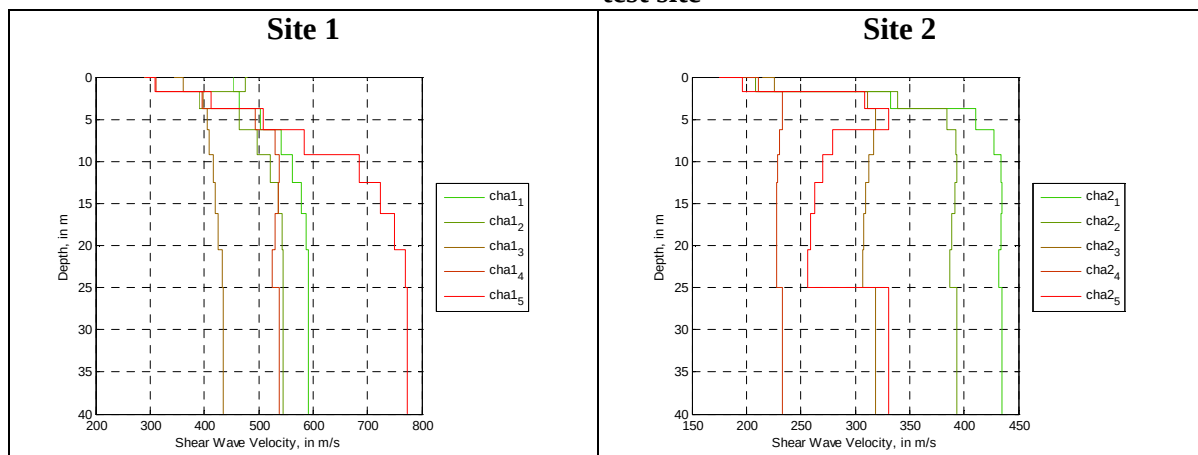


Figure 18.2. Shear wave velocity profile at Sites 1 to 5 in Chamba

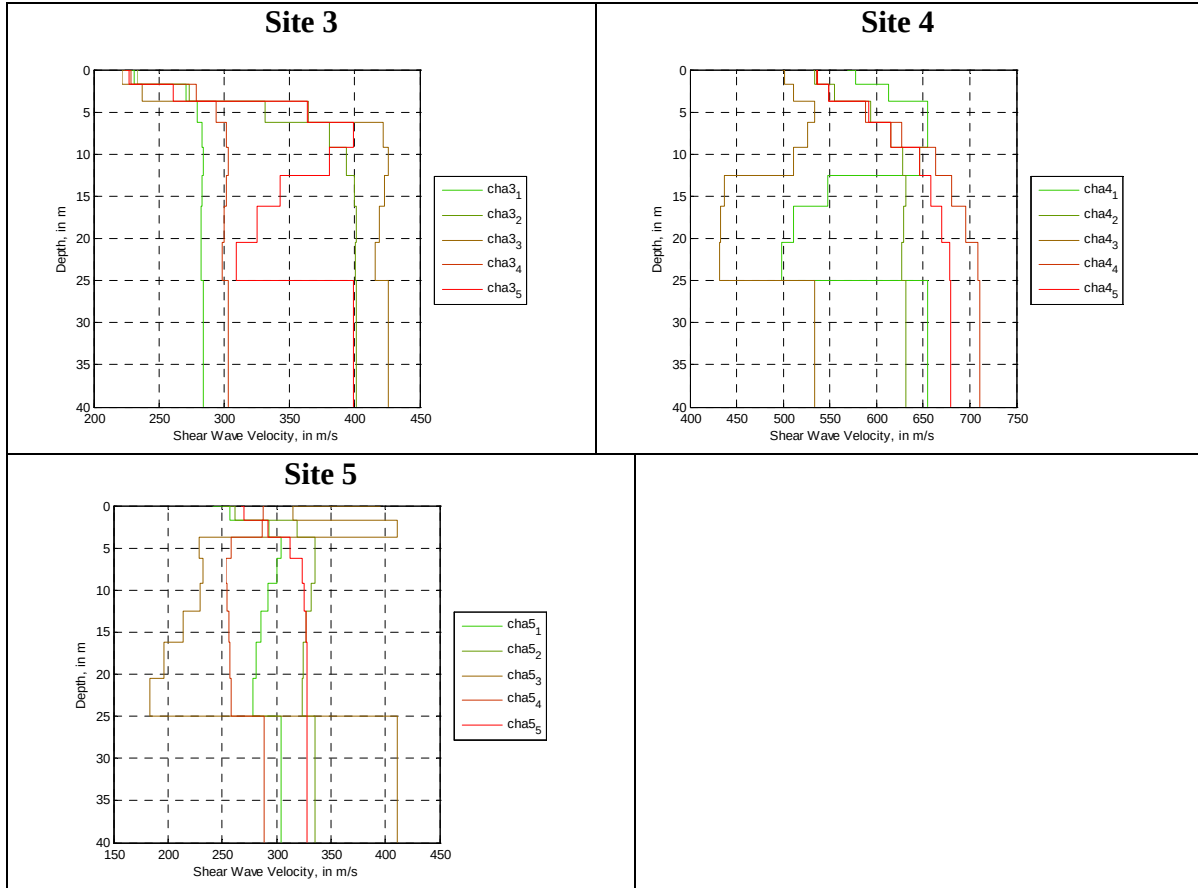


Figure 18.2. Continued

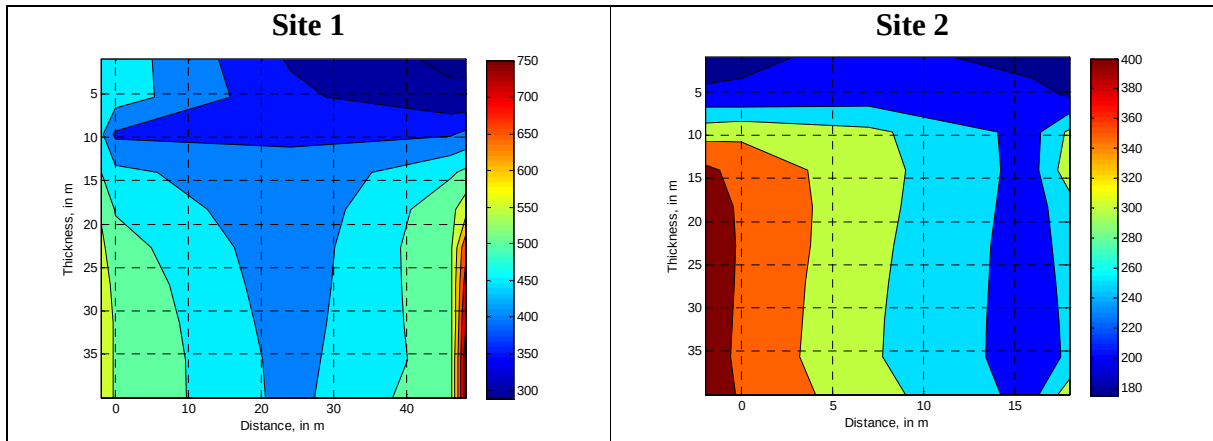


Figure 18.3. Interpolated 2d shear wave velocity profile for sites 1 to 5 in Chamba

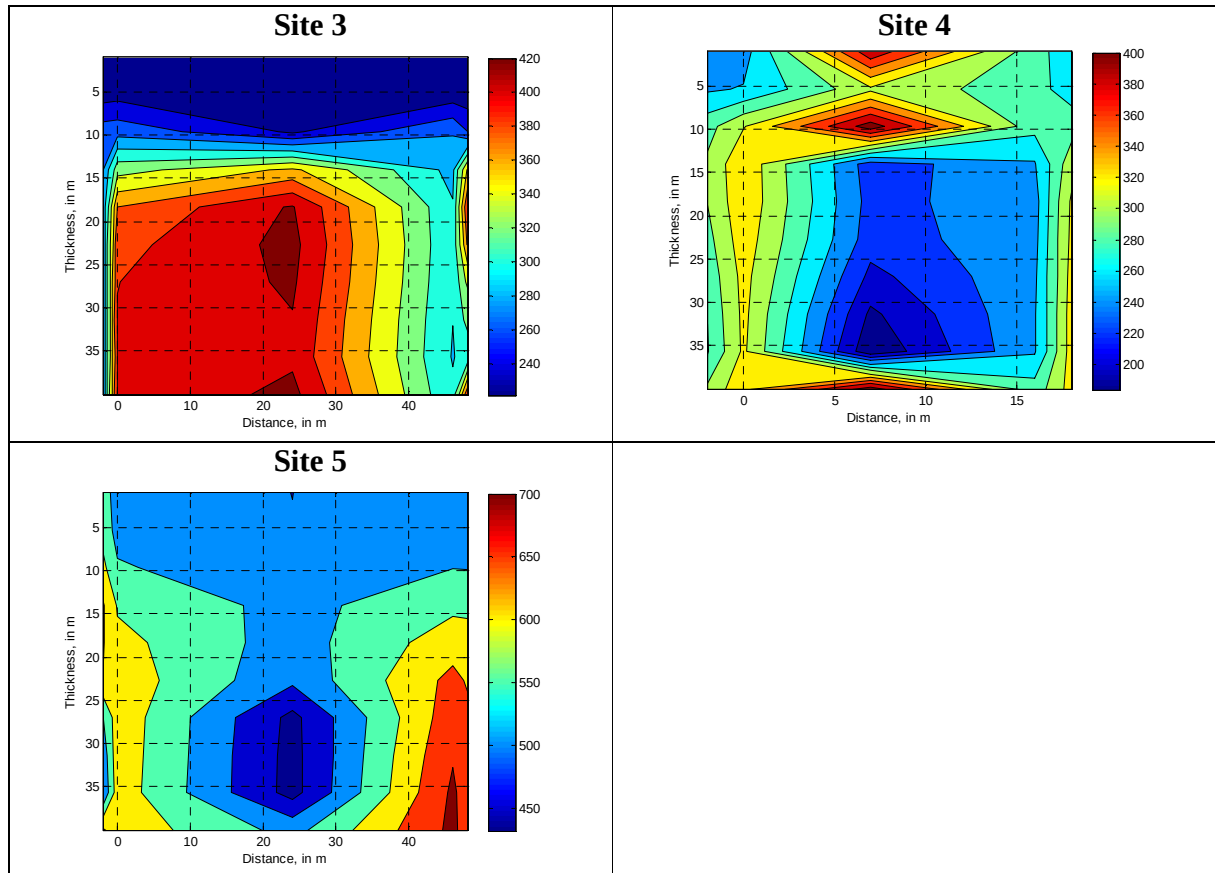


Figure 18.3. Continued



Figure 19.1. a. Soil formation at Dhankar, b. Test site located outside the Monastery

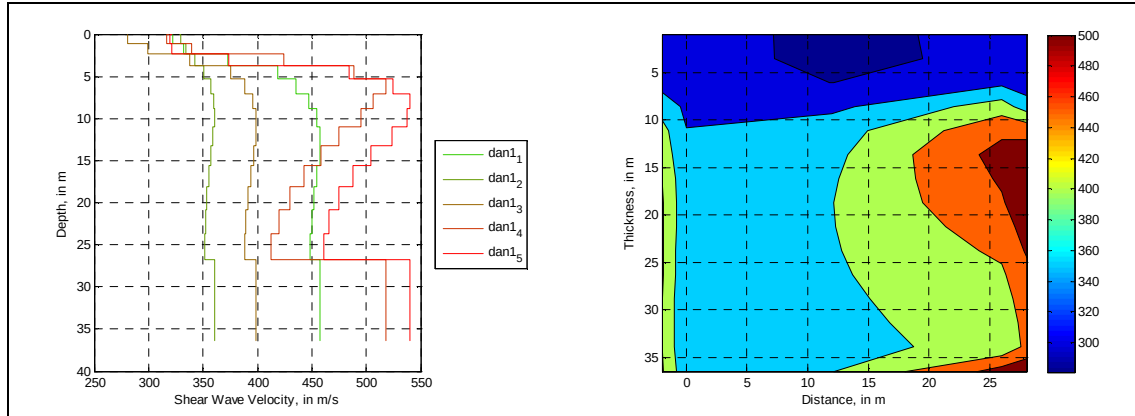


Figure 19.2. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Dhankar

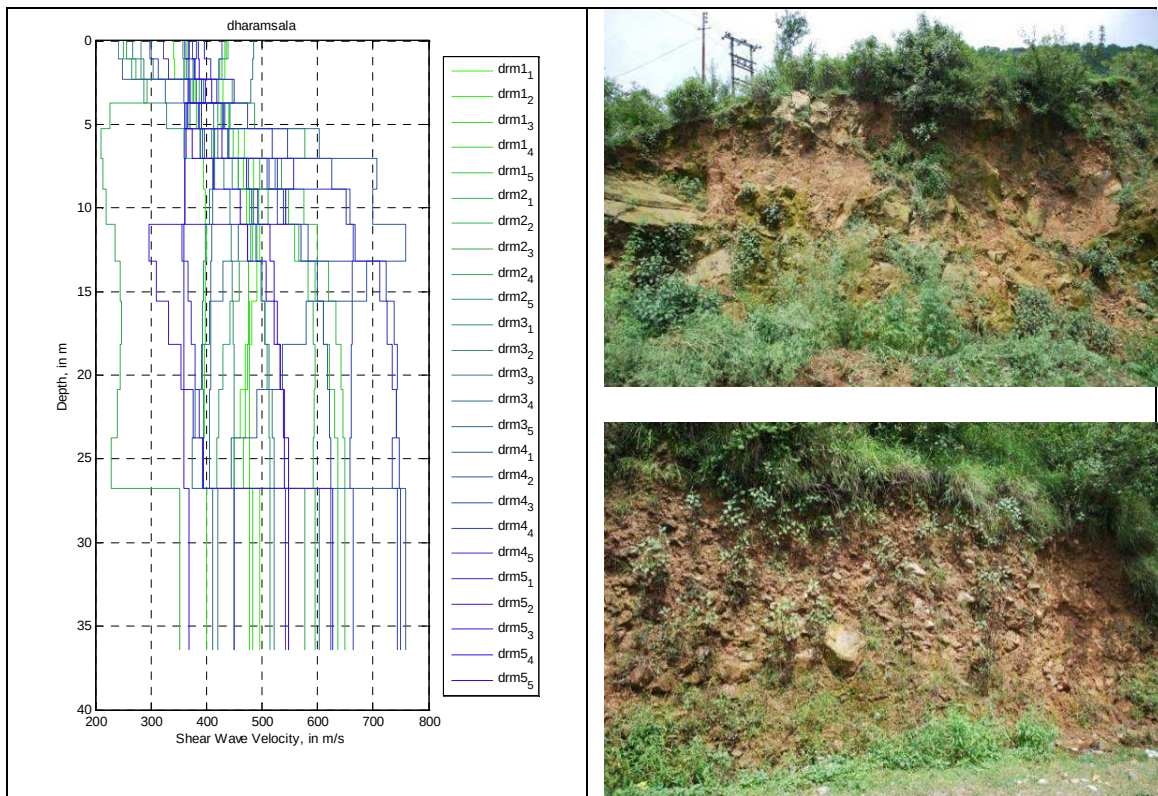


Figure 20.1. a. Shear wave profiles of all the test sites in Dhramshala, b. Soil c/s near site4, c. b. Soil c/s near site 5

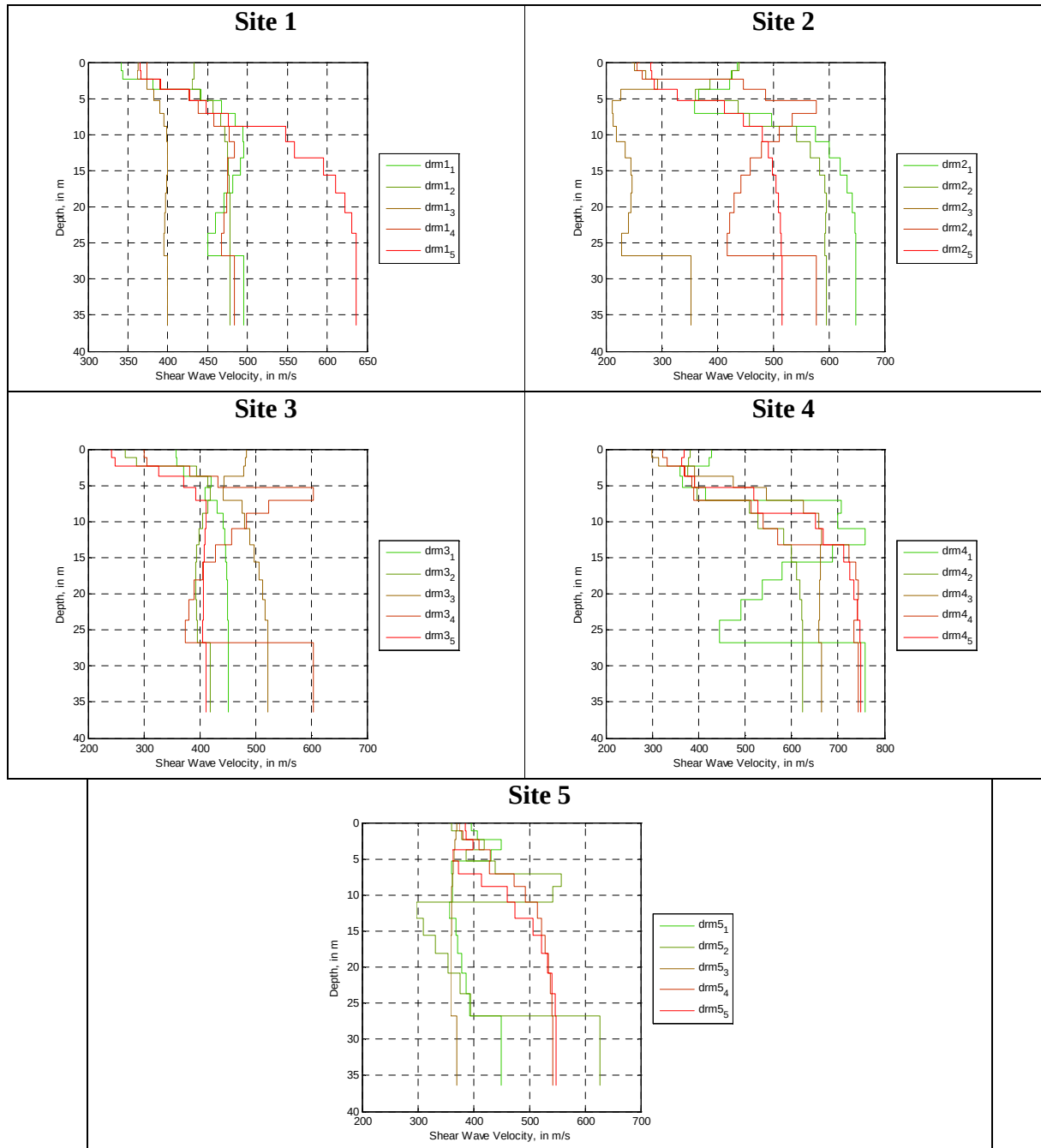


Figure 20.2. Shear wave velocity profile at Sites 1 to 5 in Dhramshala

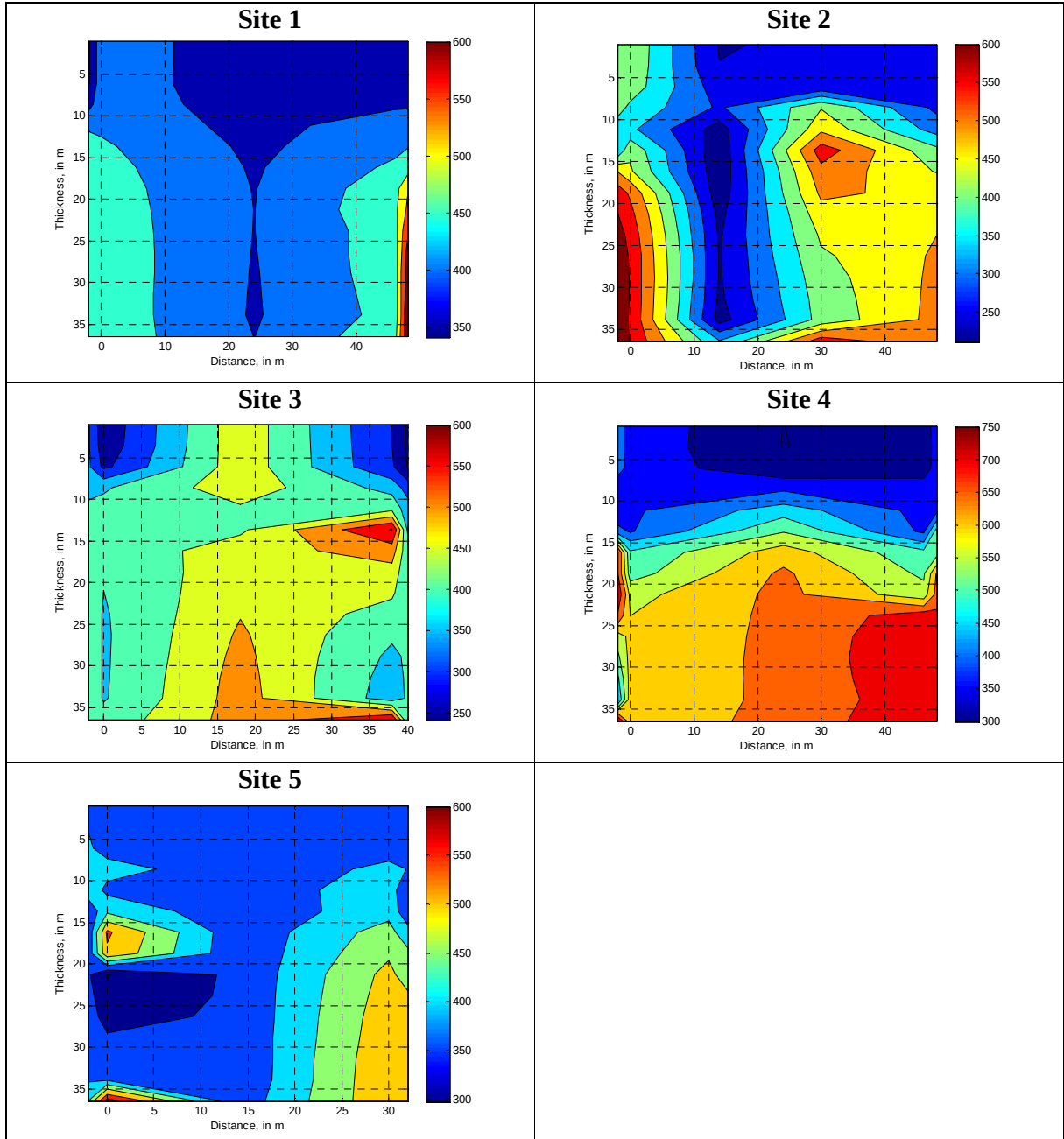


Figure 20.3. Interpolated 2d shear wave velocity profile for sites 1 to 5 in Dhramshala

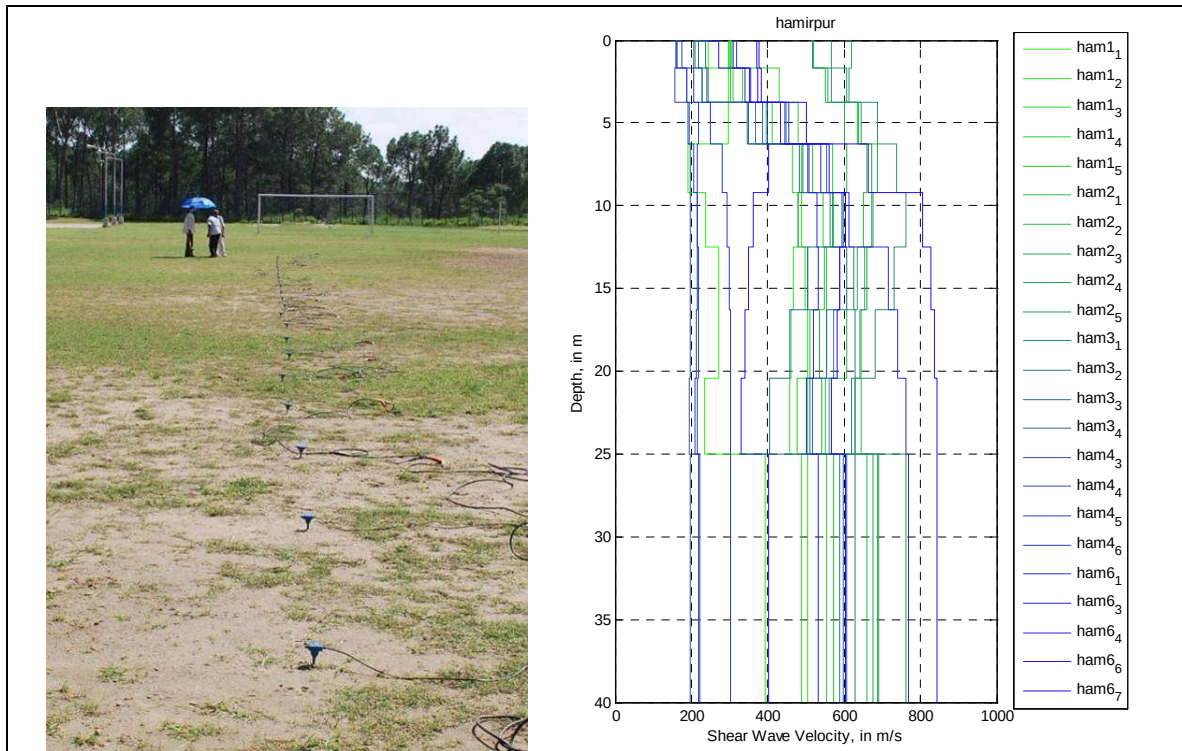


Figure 21.1. a. Test site, b. Shear wave profiles of all the test sites in Hamirpur

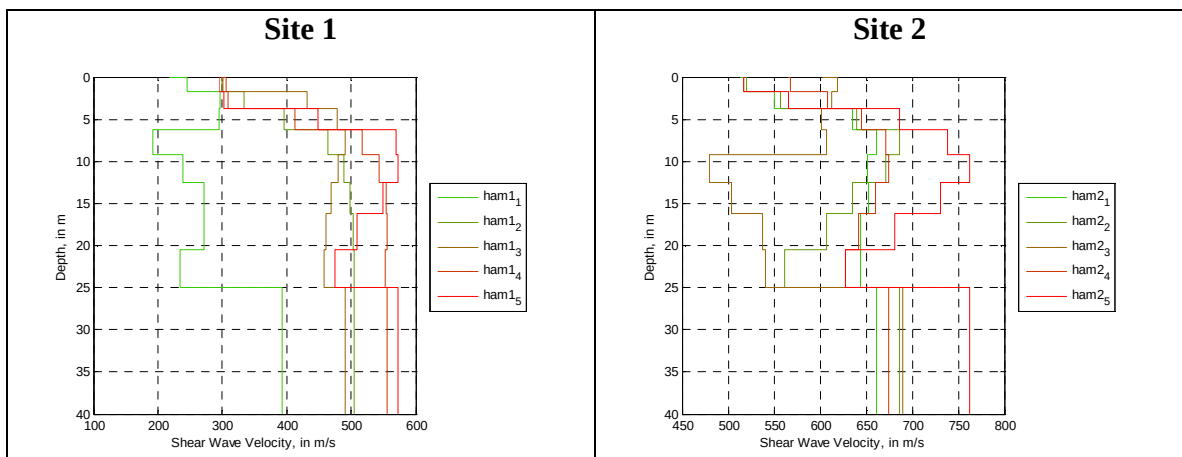


Figure 21.2. Shear wave velocity profile at Sites 1 to 5 in Hamirpur

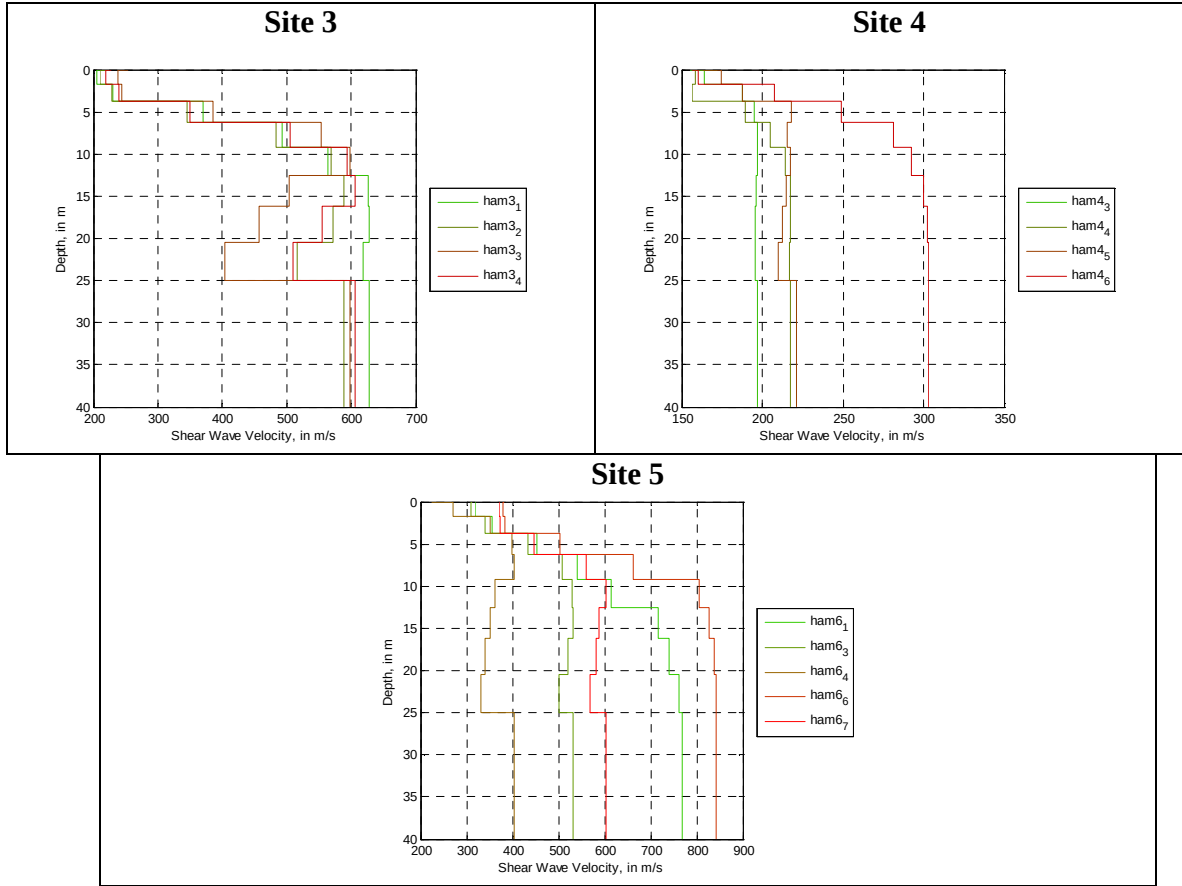


Figure 21.2. Continued

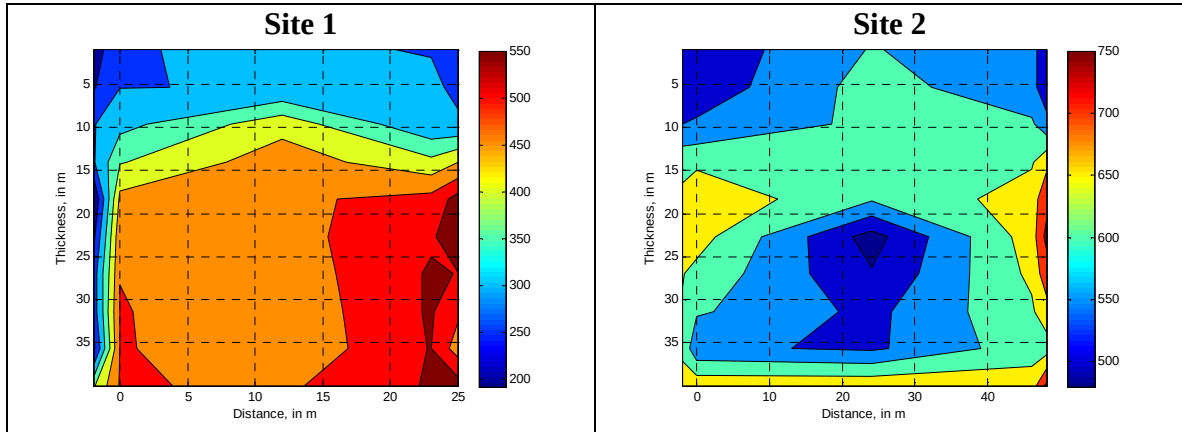


Figure 21.3. Interpolated 2d shear wave velocity profile for sites 1 to 5 in Hamirpur

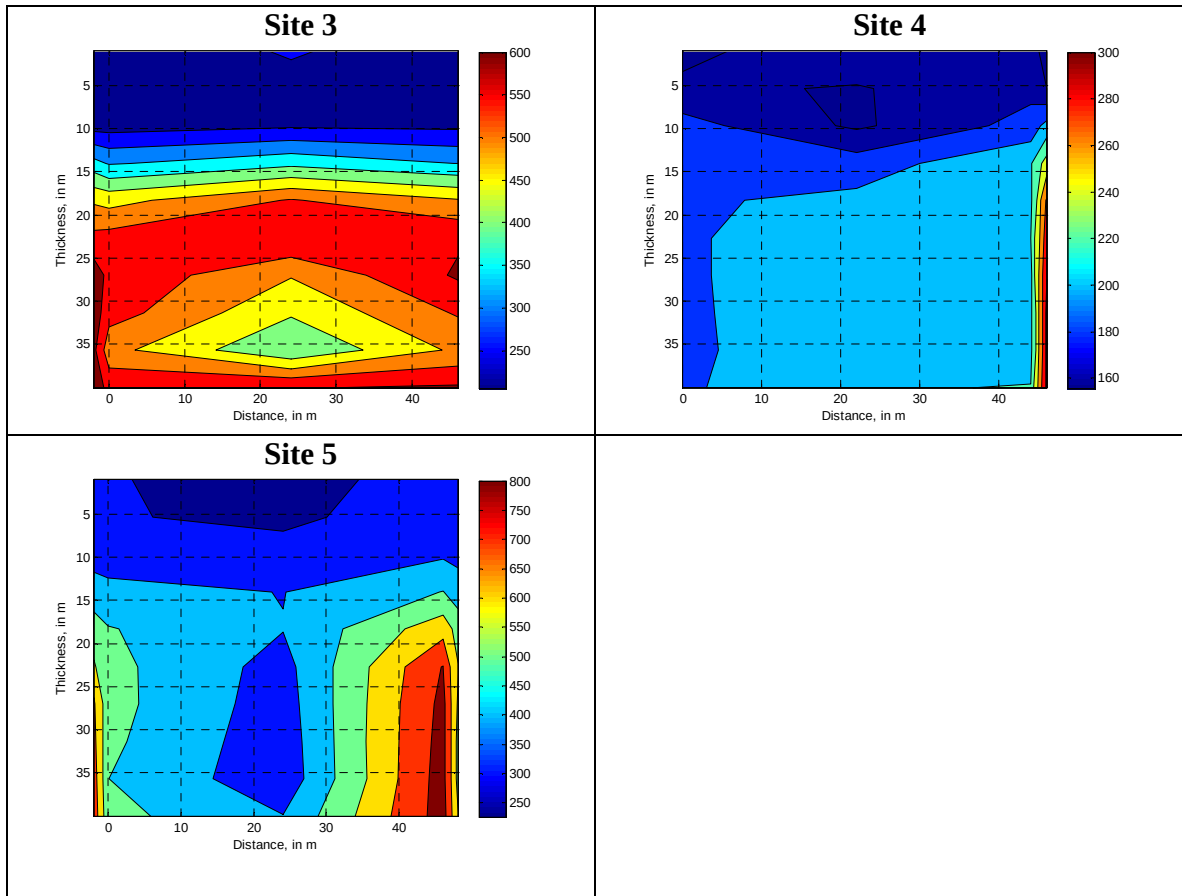


Figure 21.3. Continued



Figure 22.1. a. Test site in Kalpa

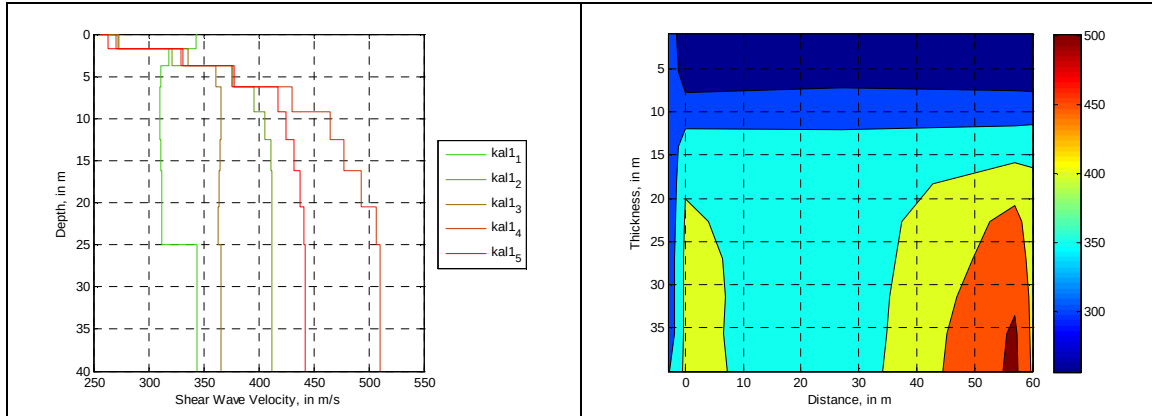


Figure 22.2. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Kalpa



Figure 23.1. a. Test site in Kangra

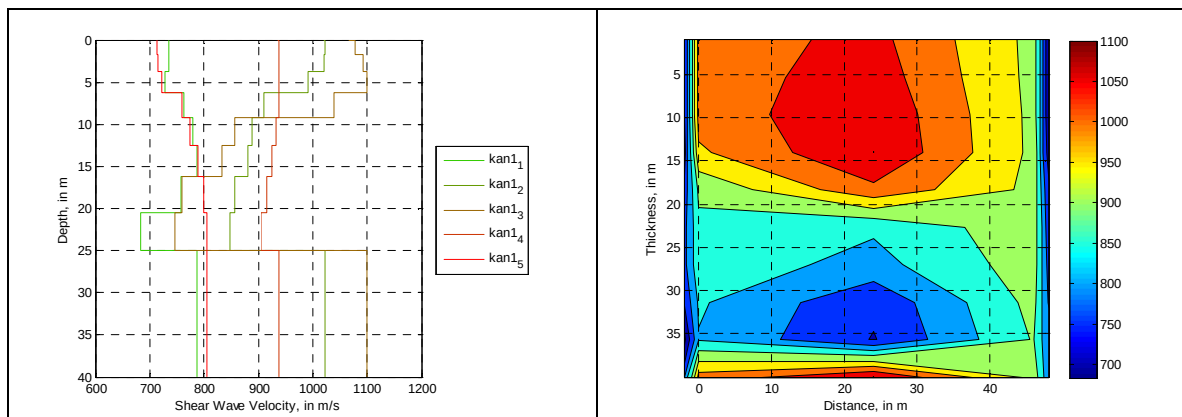


Figure 23.2. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Kangra

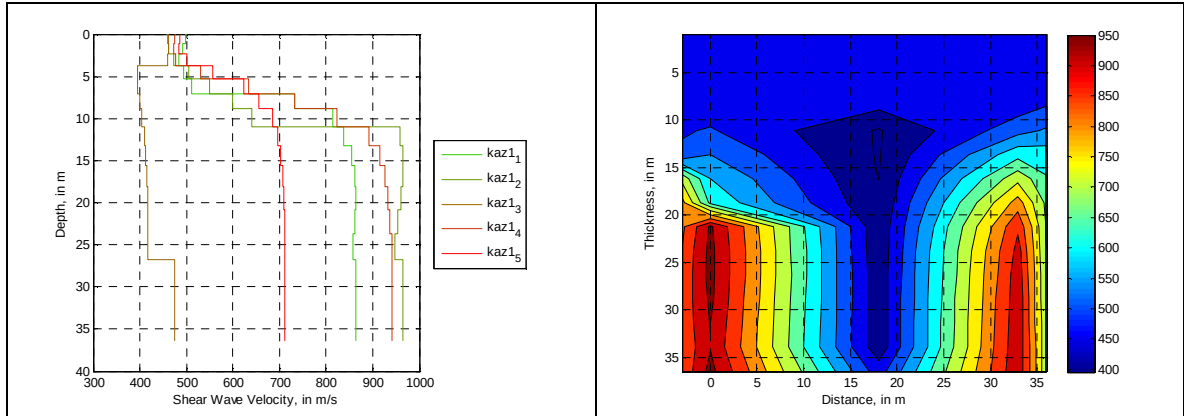


Figure 24. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Kaza



Figure 25.1. Soil type around Key Gompa

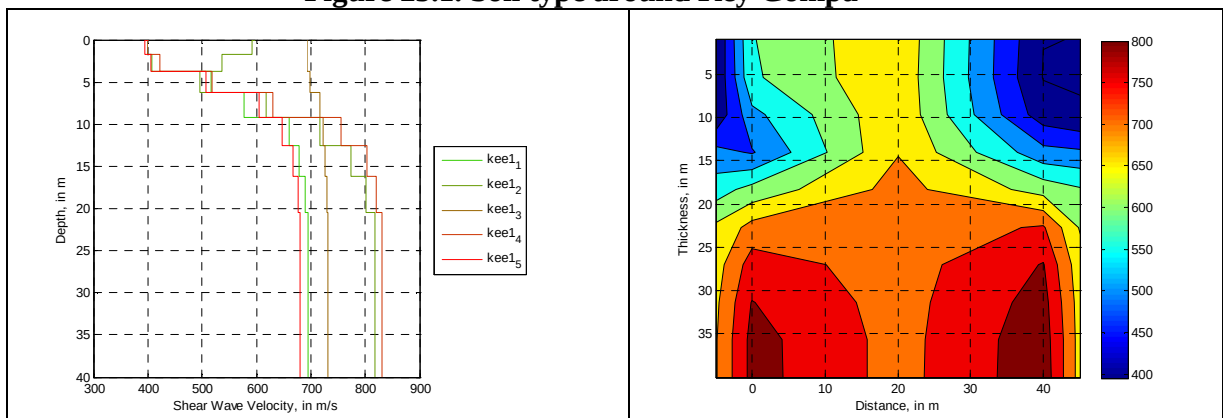


Figure 25.2. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Key Monastery

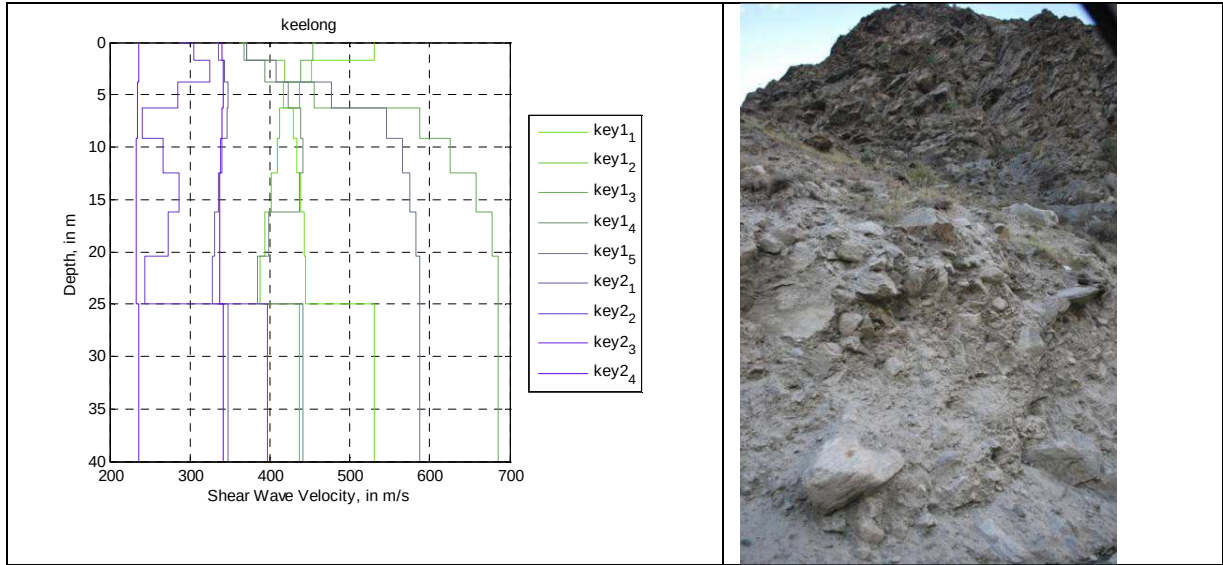


Figure 26.1. a. Shear wave profiles of all the test sites in Keylong, b. Soil c/s near site-1

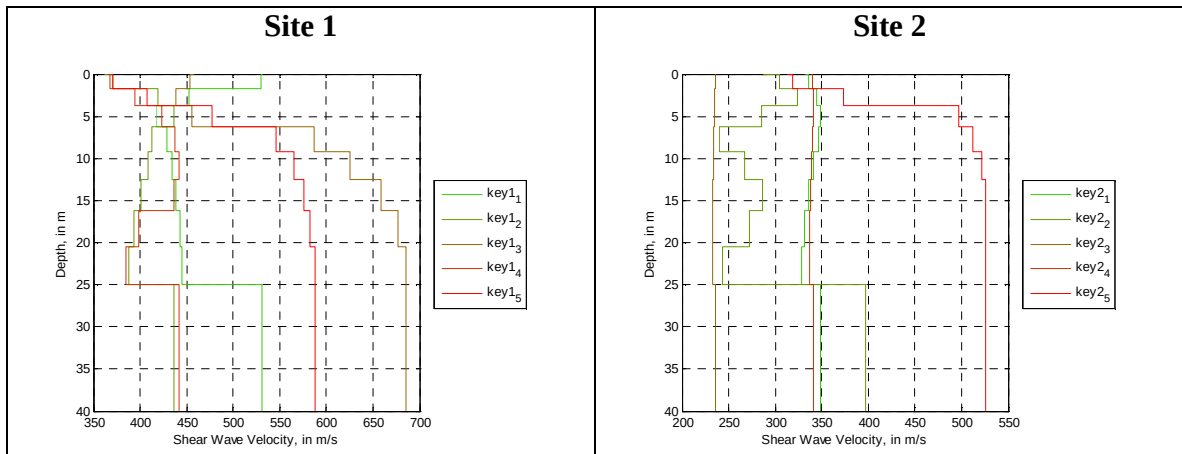


Figure 26.2. Shear wave velocity profile at Sites in Keylong

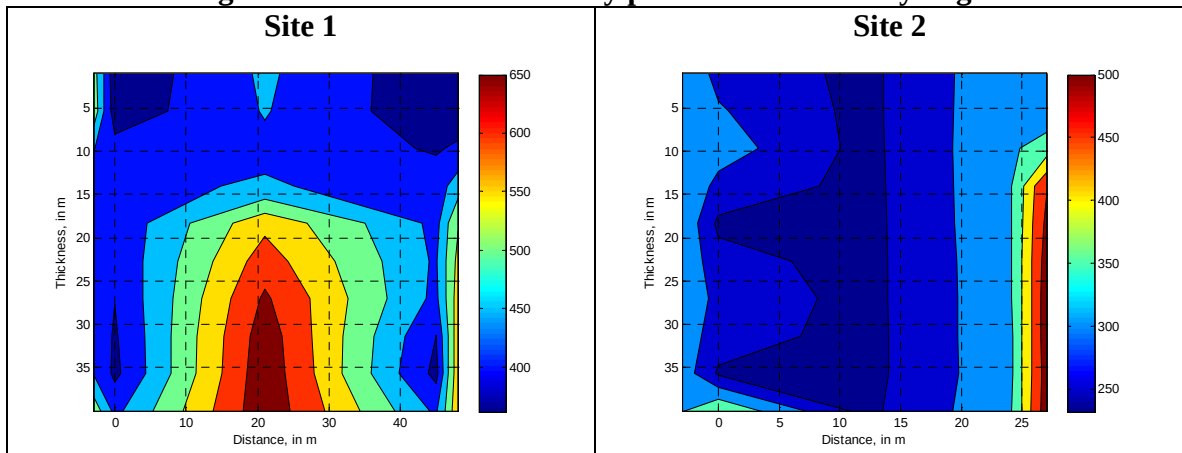


Figure 26.3. Interpolated 2d shear wave velocity profile for sites in Keylong

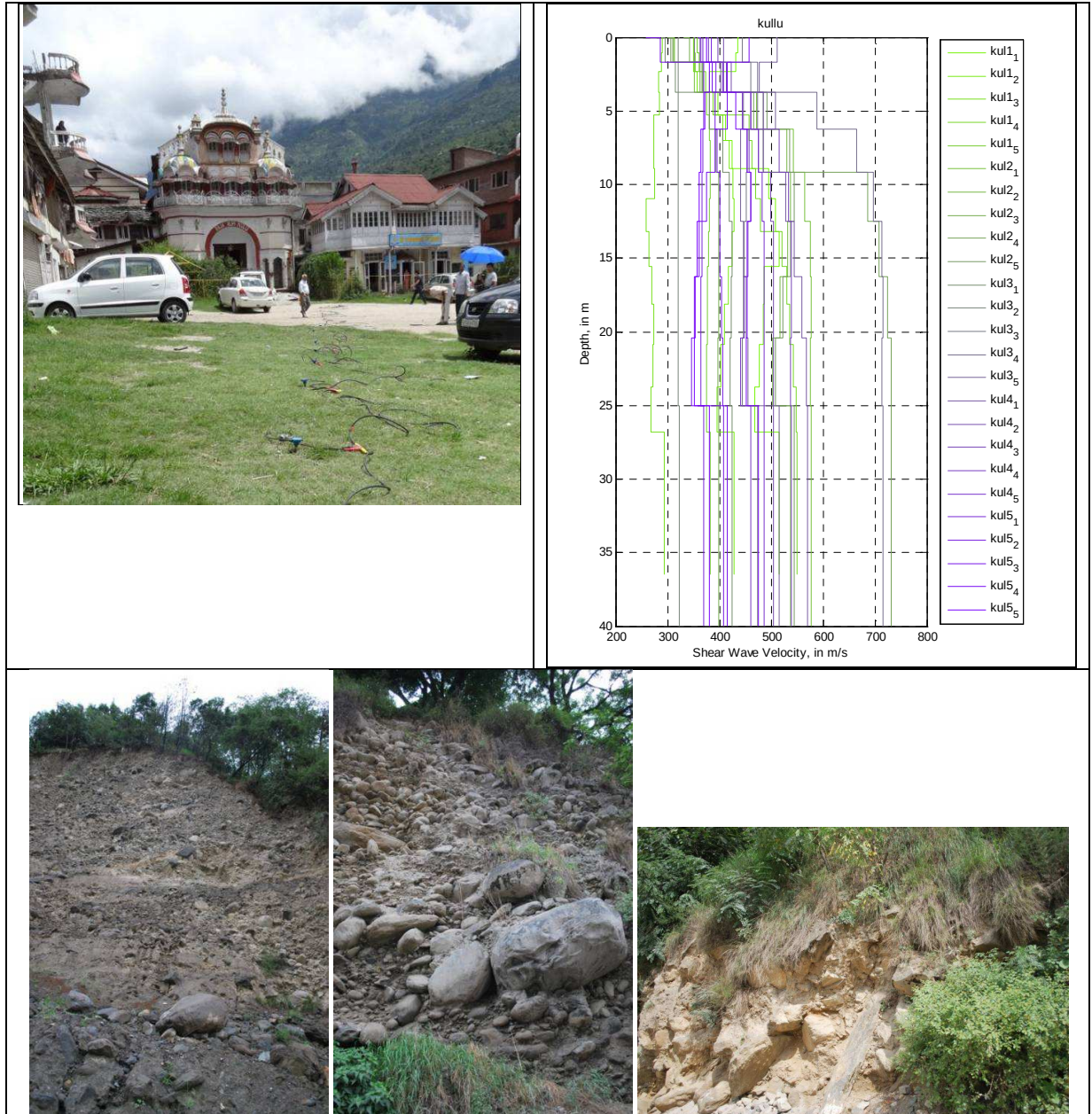


Figure 27.1. a. Test site, b. Shear wave profiles of all the test sites in Kullu, c. Soil c/s near site-3, d. Soil c/s near site-5, e. Soil c/s near site -4

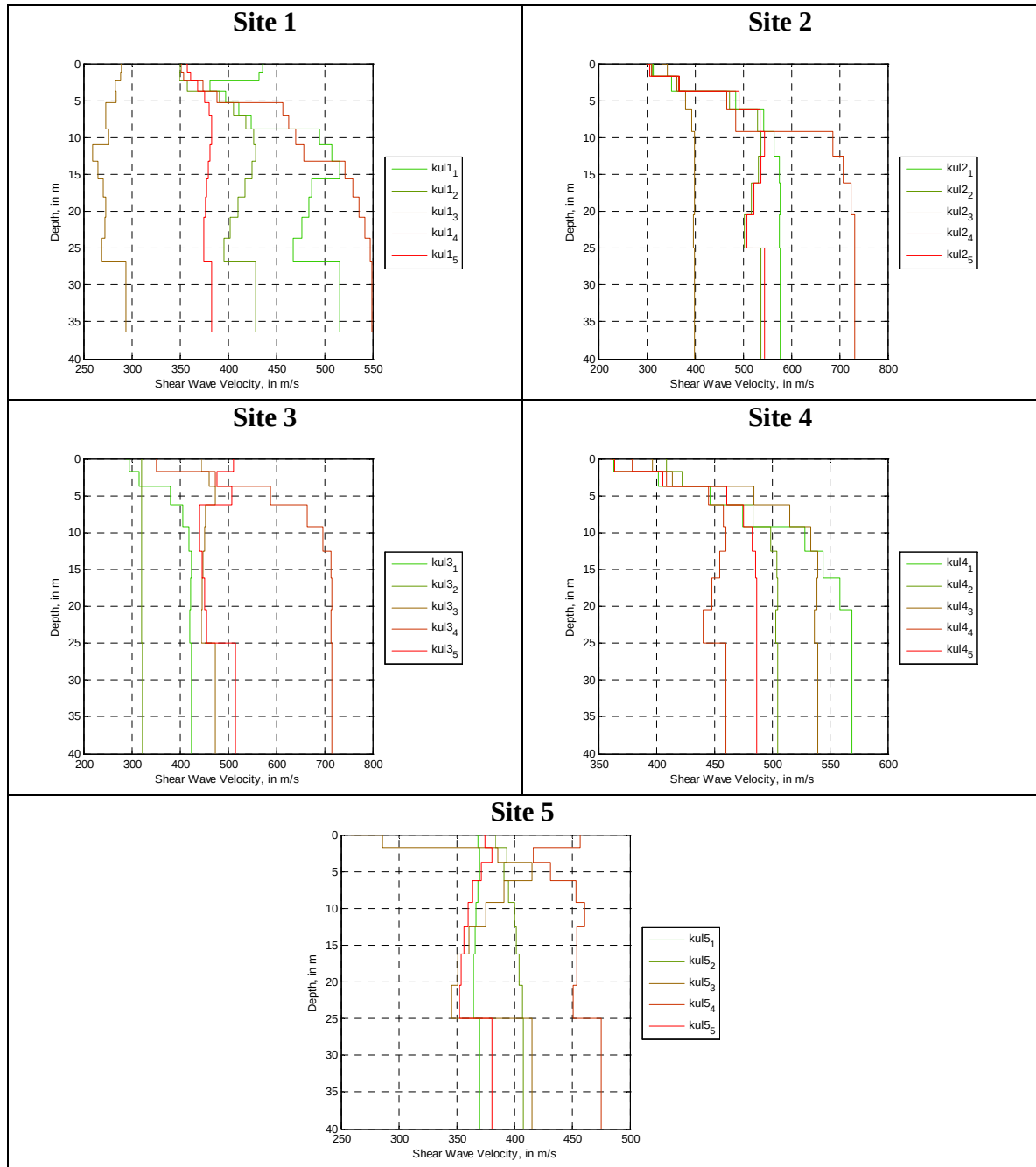


Figure 27.2. Shear wave velocity profile at the test sites in Kullu

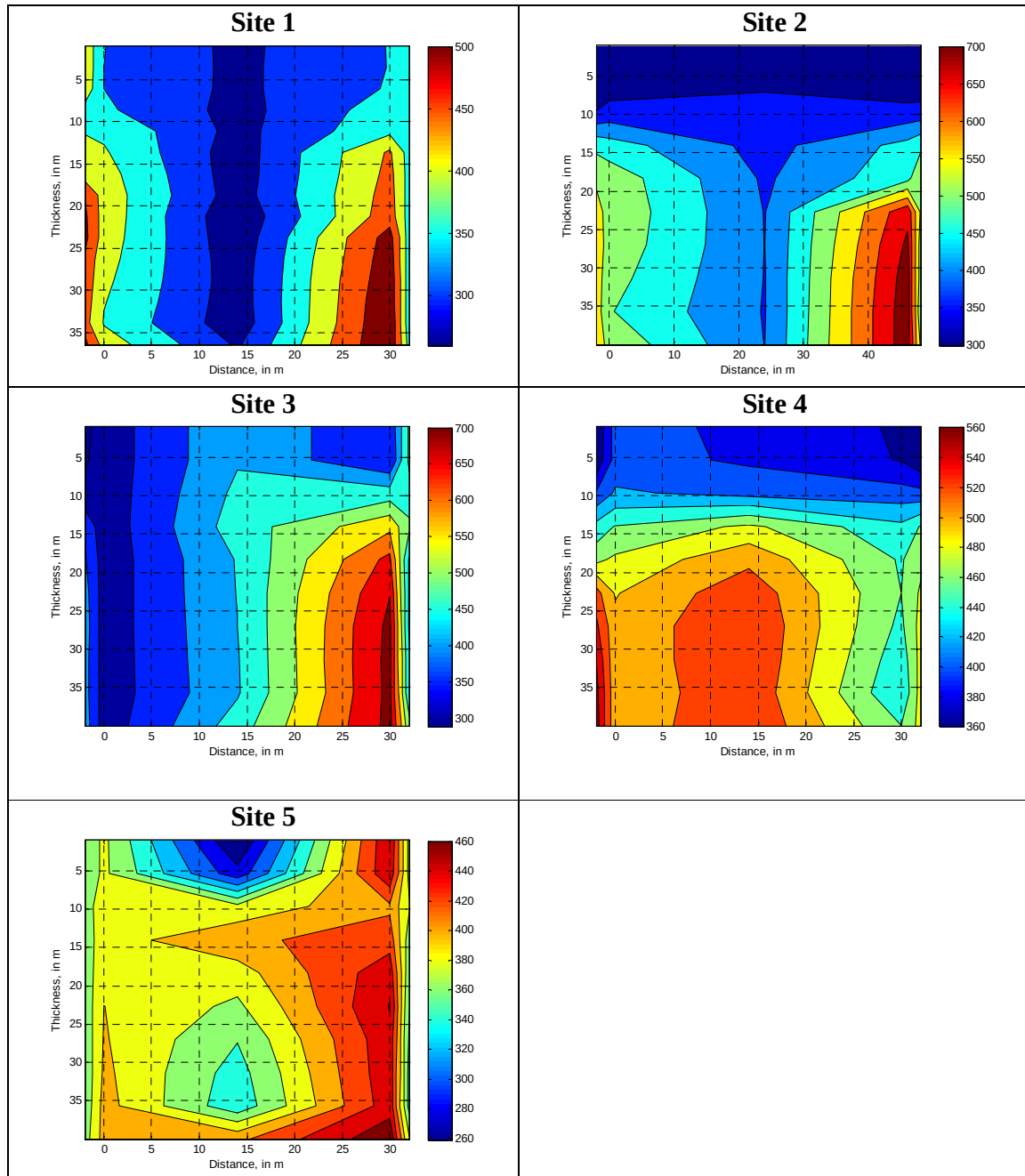


Figure 27.3. Interpolated 2d shear wave velocity profile at the test sites in Kullu

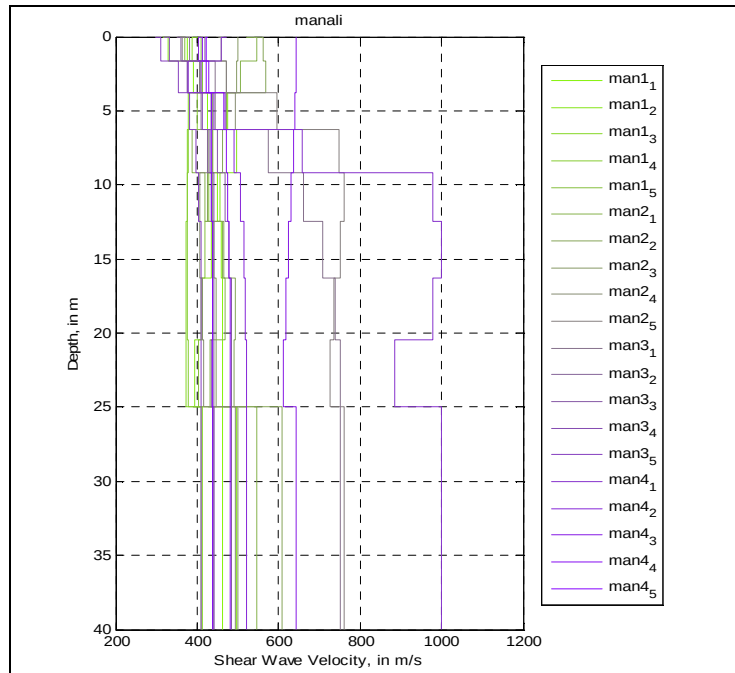


Figure 28.1. Shear wave profiles of all the test sites in Manali

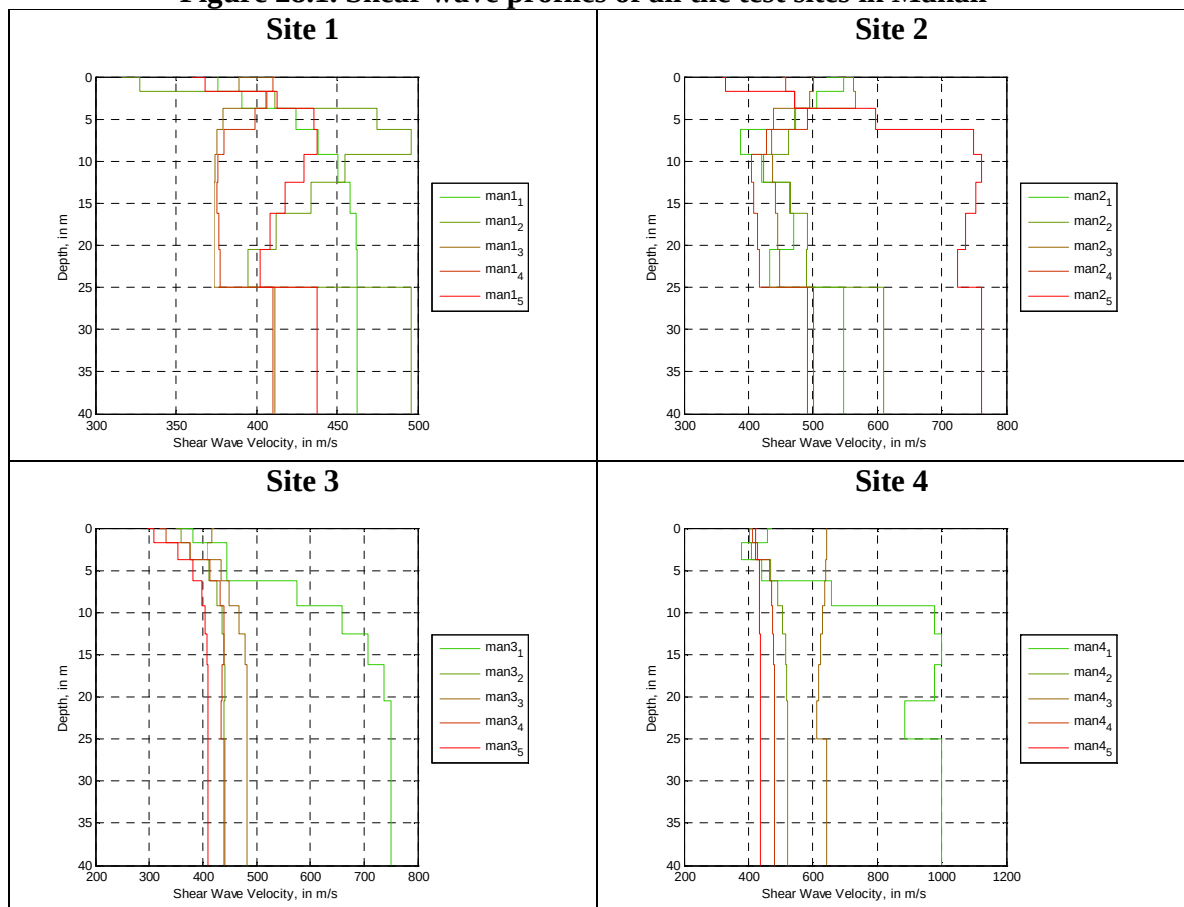


Figure 28.2. Shear wave velocity profile for the test sites in Manali

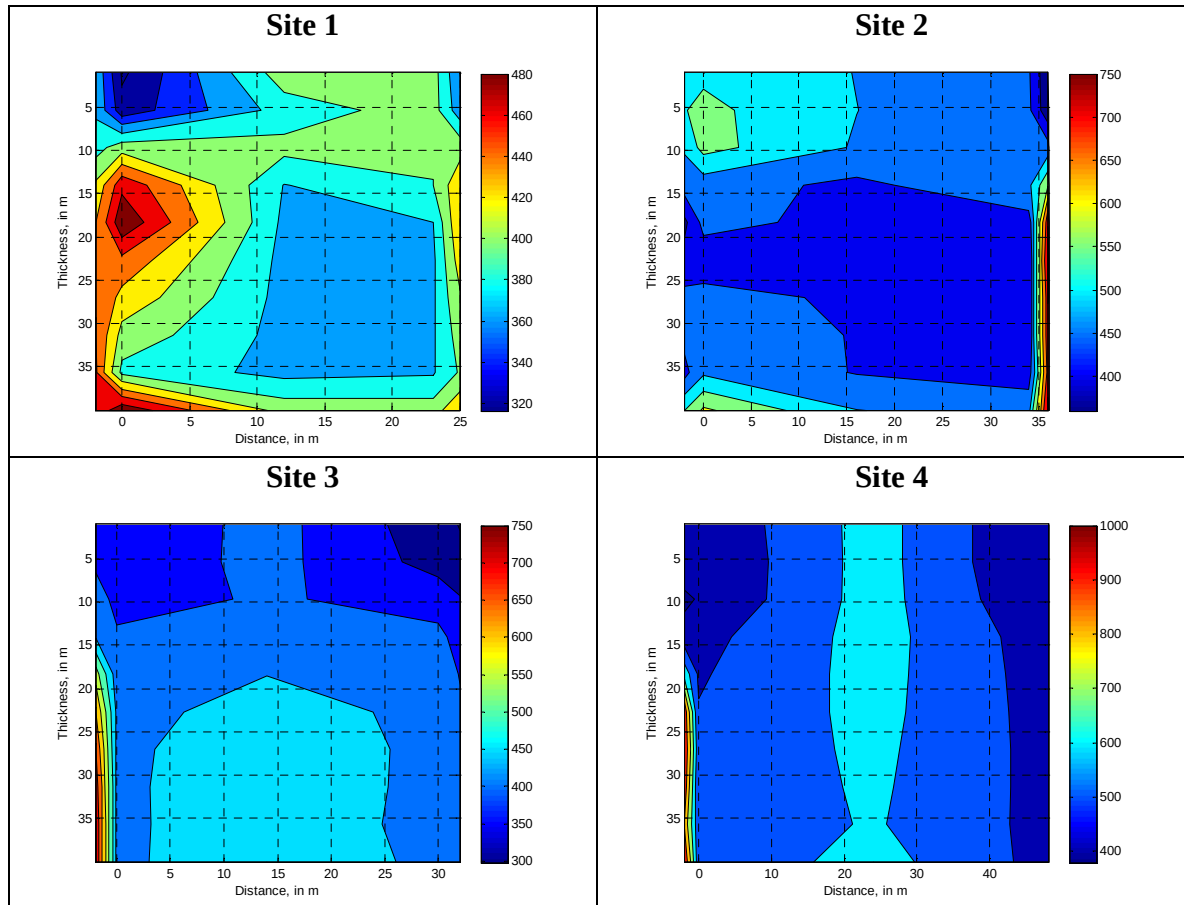


Figure 28.3. Interpolated 2d shear wave velocity profile for the test sites in Manali



Figure 29.1. a. Site no. 1, b. Site no. 3, c. Site no. 4, d. Site no. 5, e. Shear wave profiles of all the test sites in Mandi

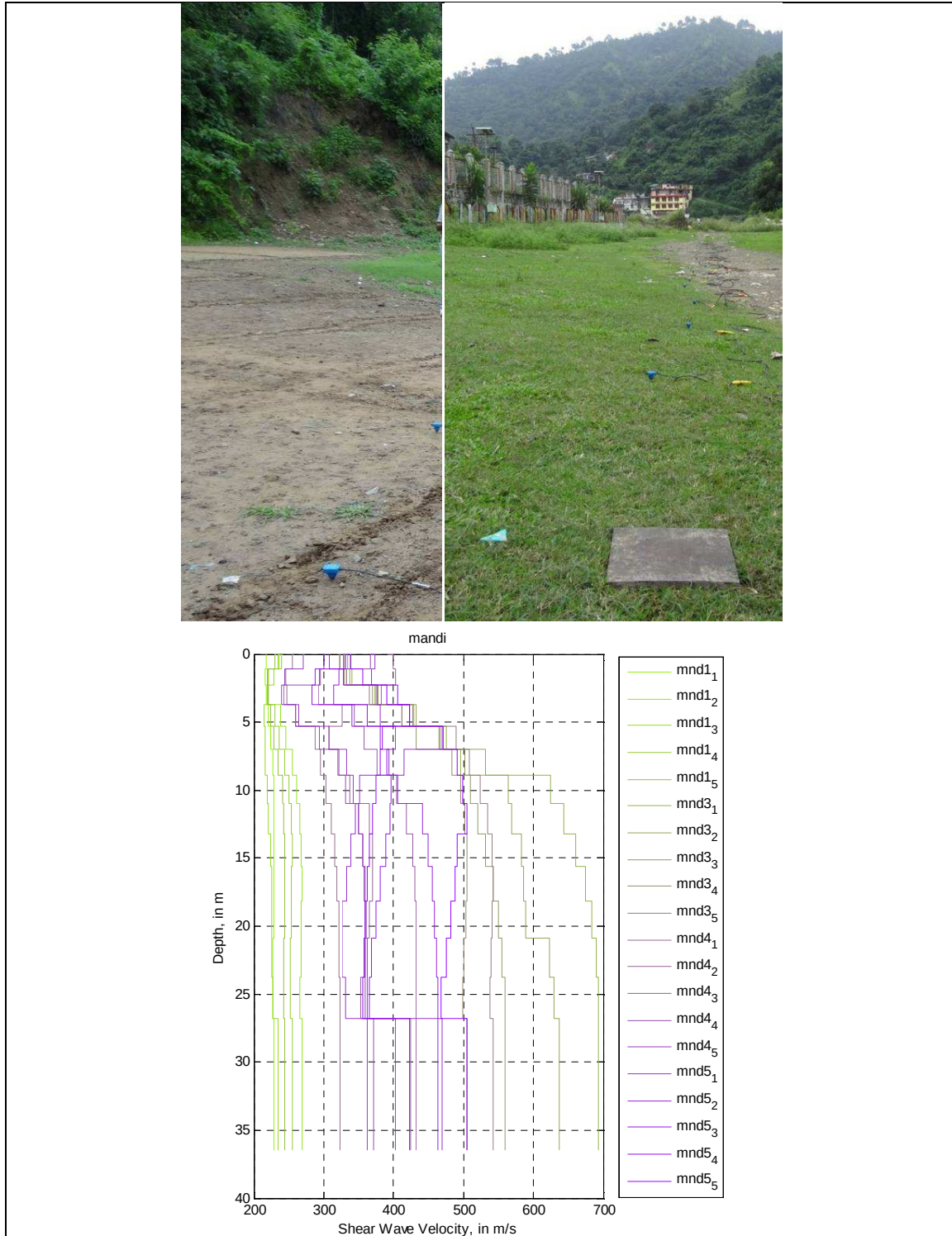


Figure 29.1. Continued

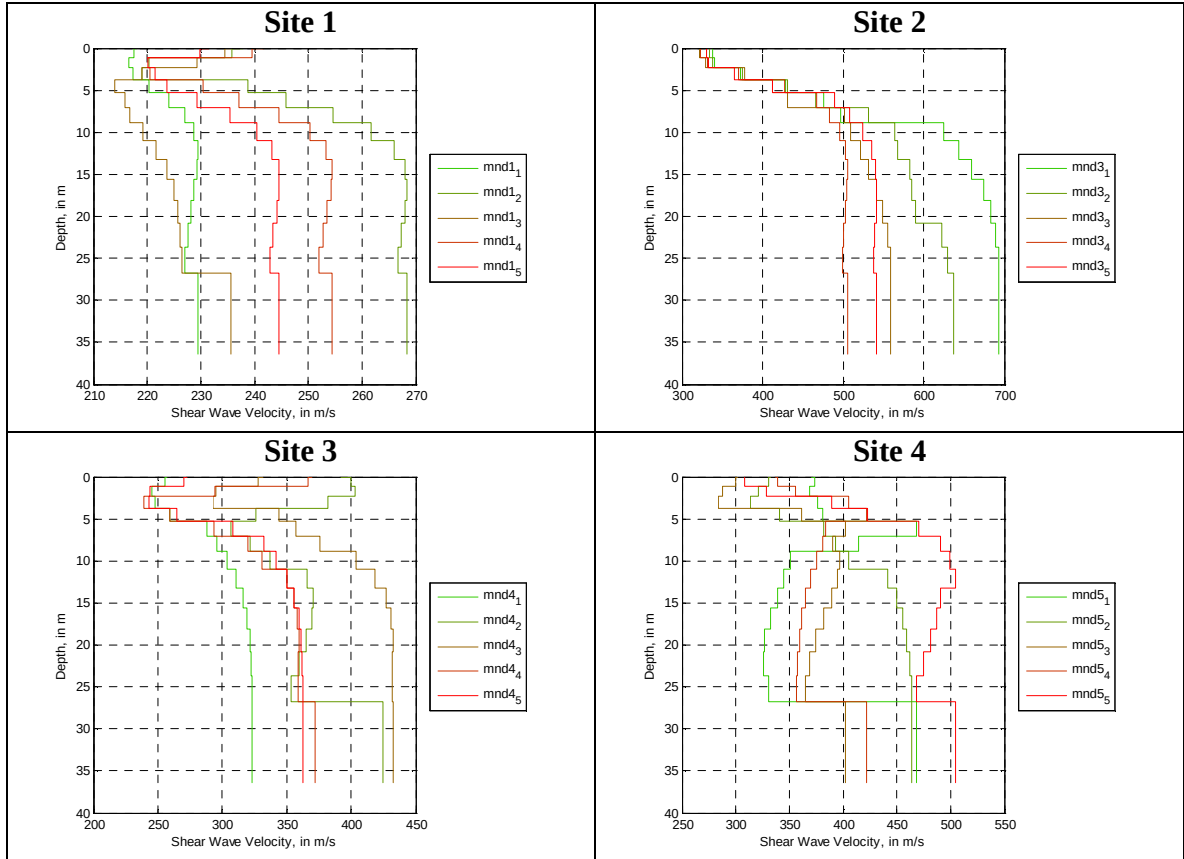


Figure 29.2. Shear wave velocity profile for the test sites in Mandi

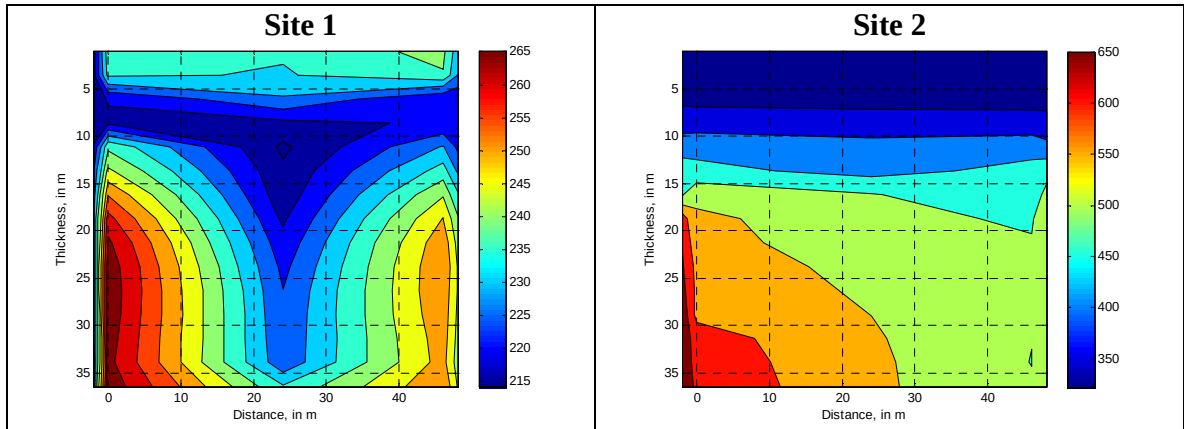


Figure 29.3. Interpolated 2d shear wave velocity profile for the test sites in Mandi

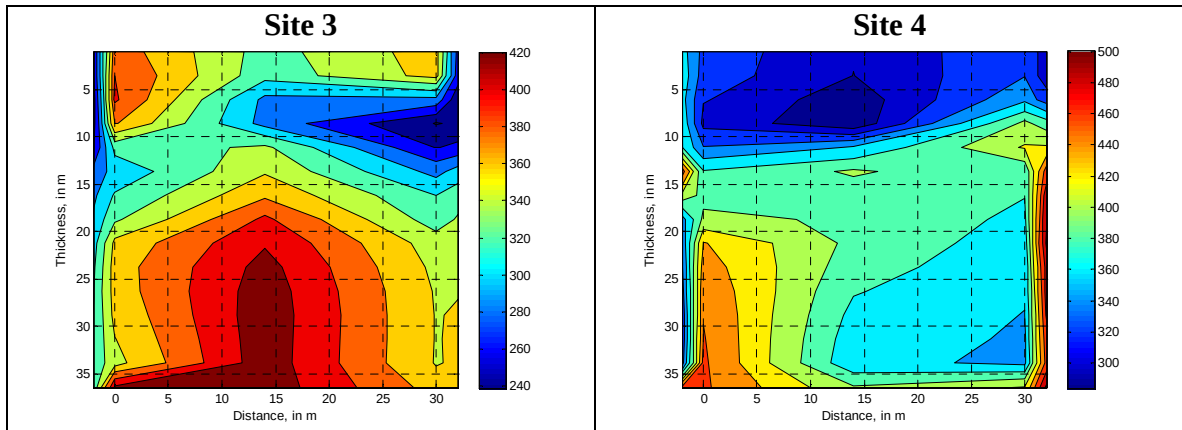


Figure 29.3. Continued

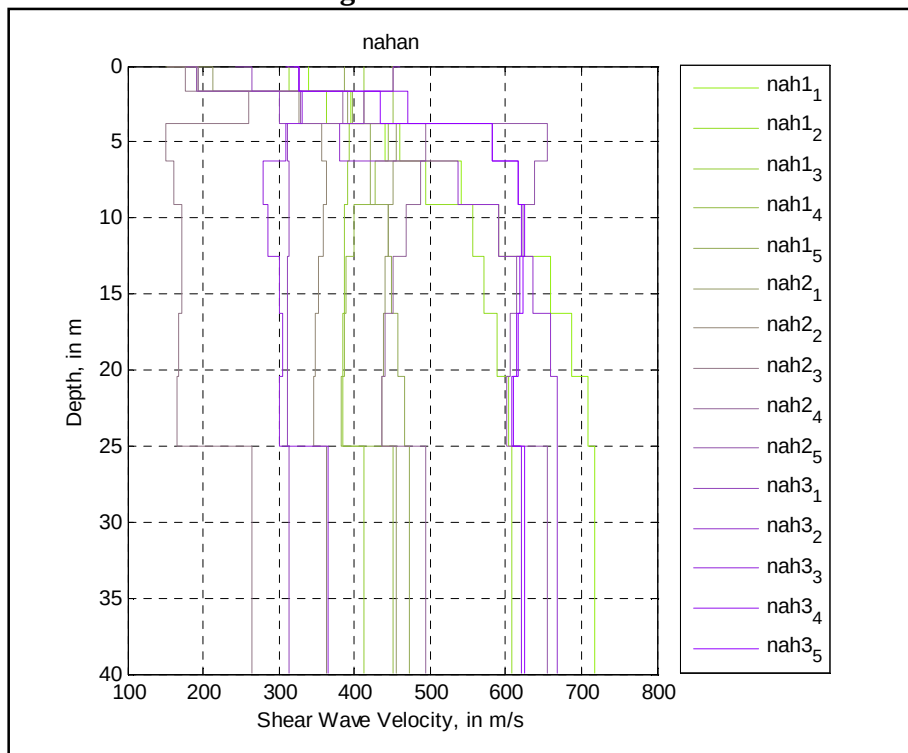


Figure 30.1 – a. Shear wave profiles of all the test sites in Nahan, b. Typical soil profile in Nahan, c. Site 2 , d. Site 3



Figure 30.1. Continued

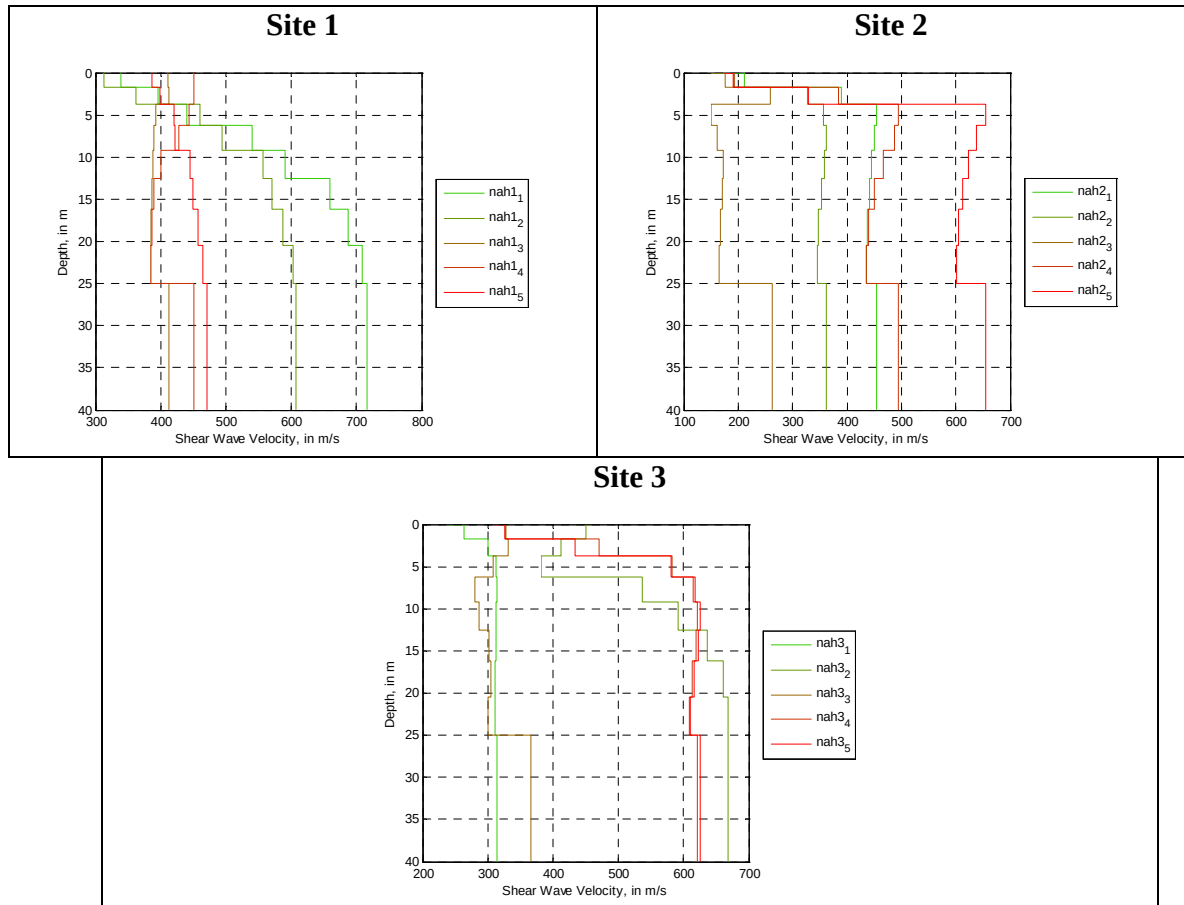


Figure 30.2. Shear wave velocity profile for the test sites in Nahan

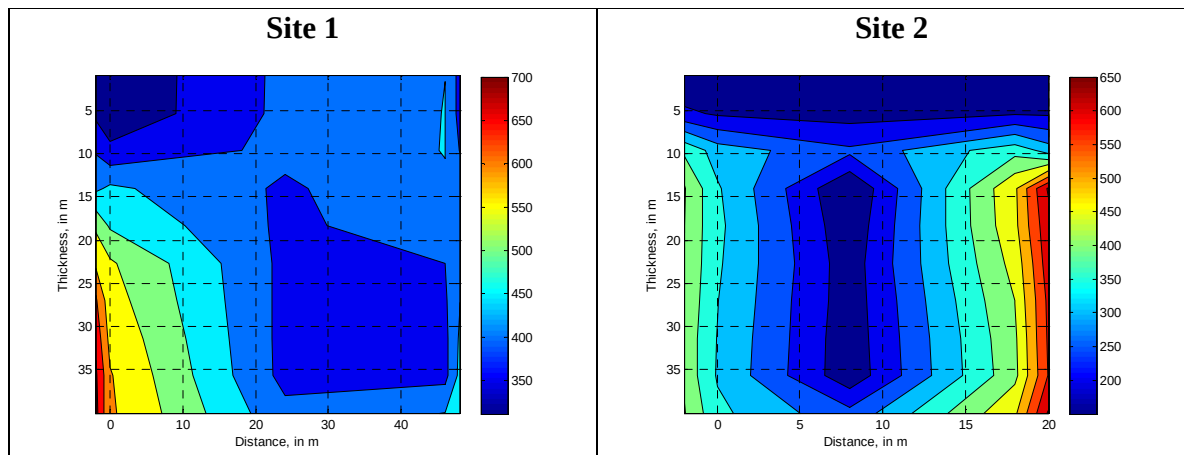


Figure 30.3. Interpolated 2d shear wave velocity profile for the test sites in Nahan

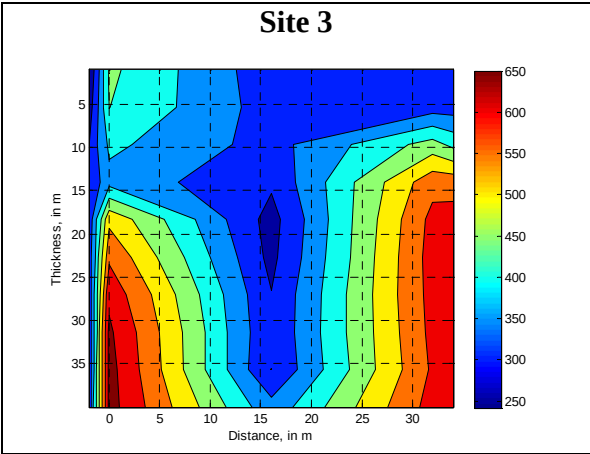


Figure 30.3. Continued



Figure 31.1 – Test site in Nako

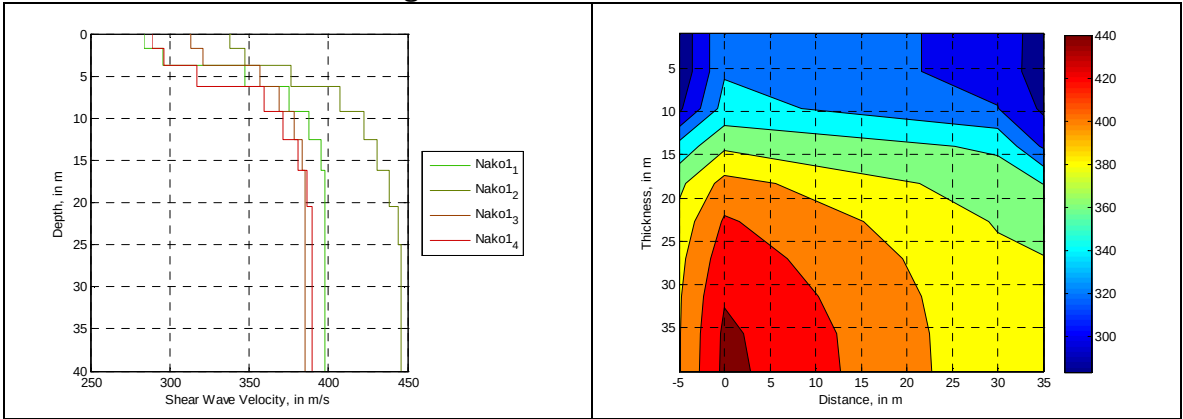


Figure 31.2 - a. Shear wave velocity profile at site1, b. interpolated 2d shear wave velocity profile for the test site in Nako

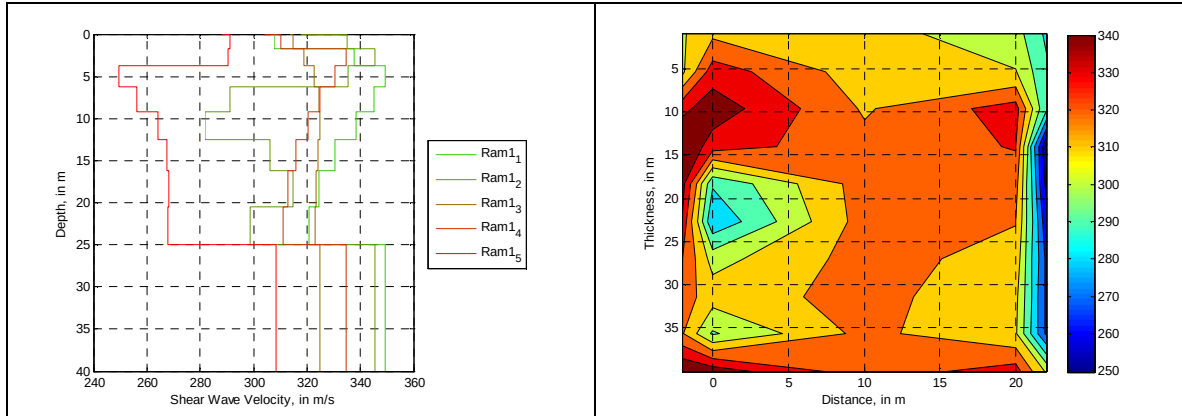


Figure 32. a. Shear wave velocity profile at Site1, interpolated 2d shear wave velocity profile for the test site in Rampur

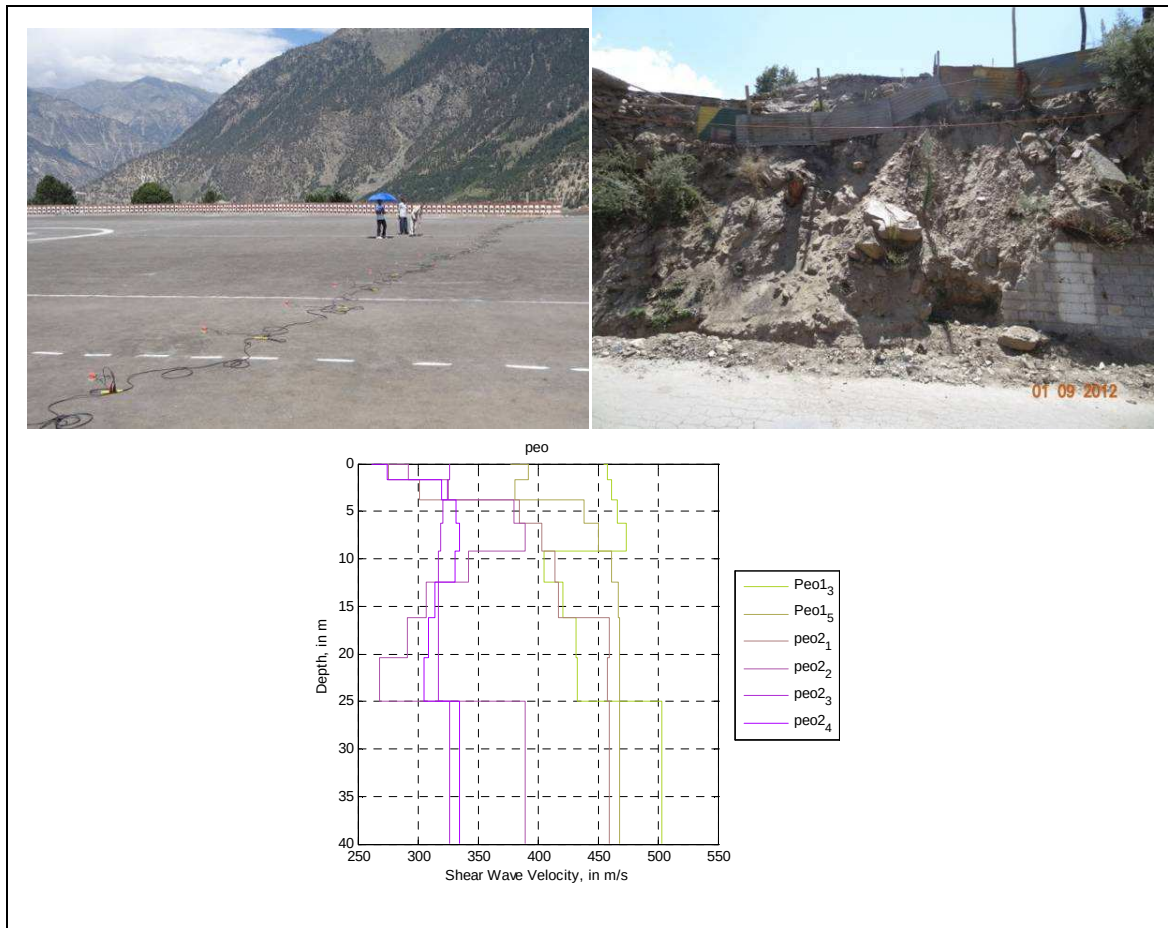


Figure 33.1. a. Reckong Peo test site, b. Soil c/s at test site2, c. Shear wave profiles of all the test sites in Reckong Peo

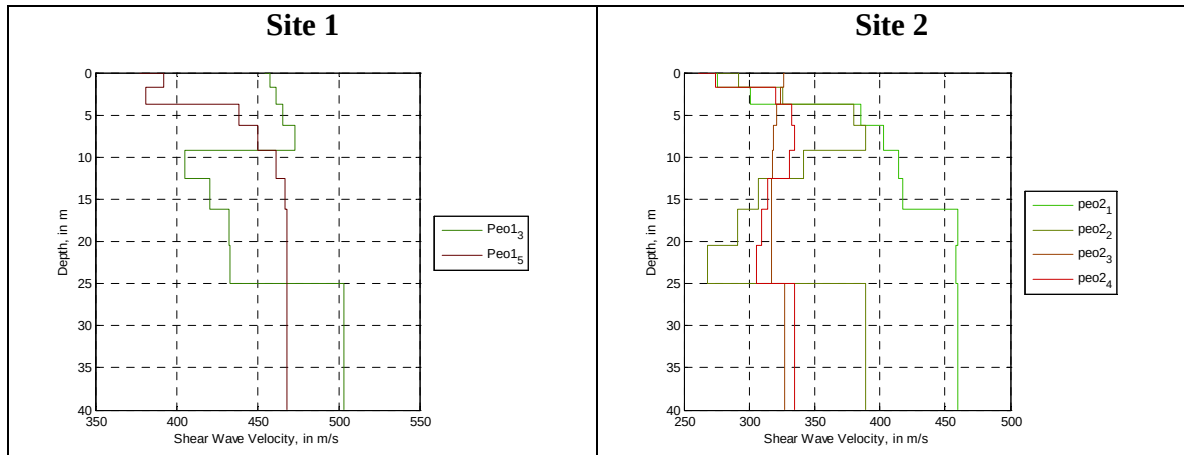


Figure 33.2. Shear wave velocity profile for the test sites in Reckong Peo

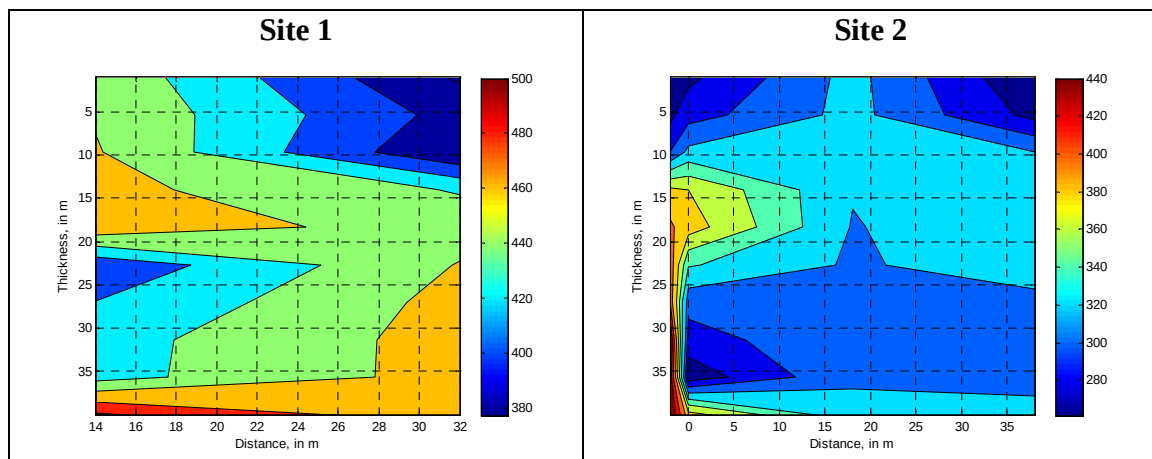


Figure 33.3. Interpolated 2d shear wave velocity profile for the test sites in Reckong Peo

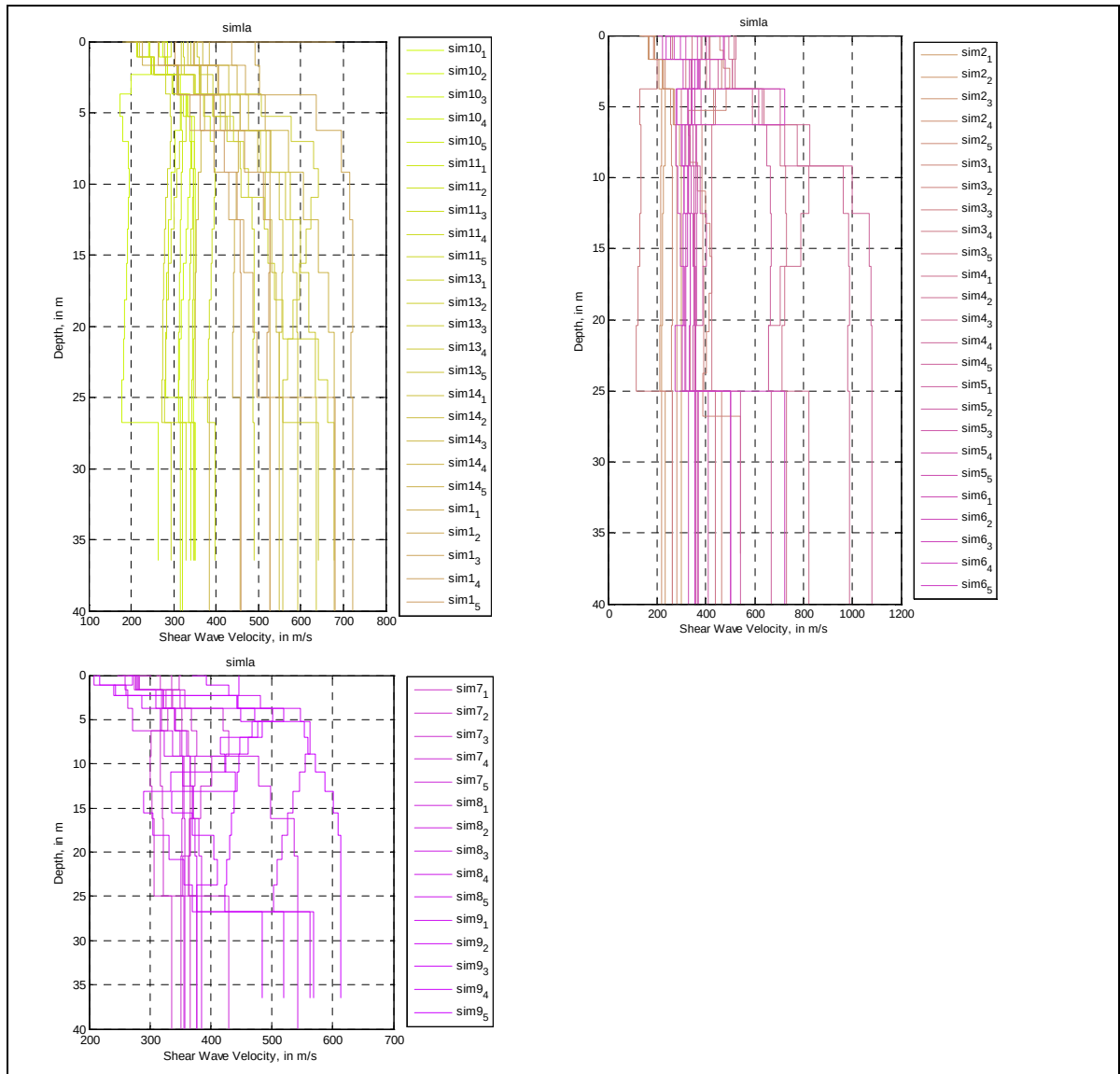


Figure 34.1 – Shear wave profiles of all the test sites in Shimla

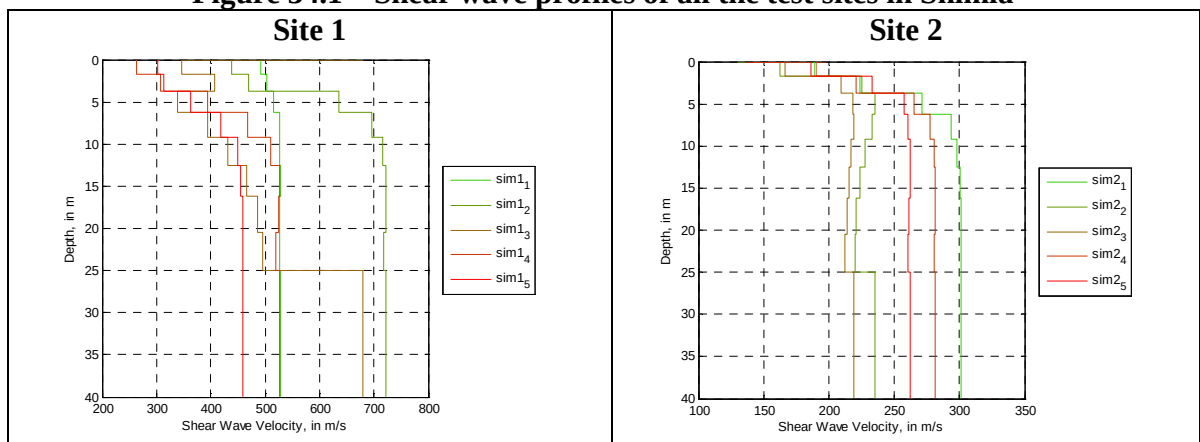


Figure 34.2. Shear wave velocity profile for the test sites in Shimla

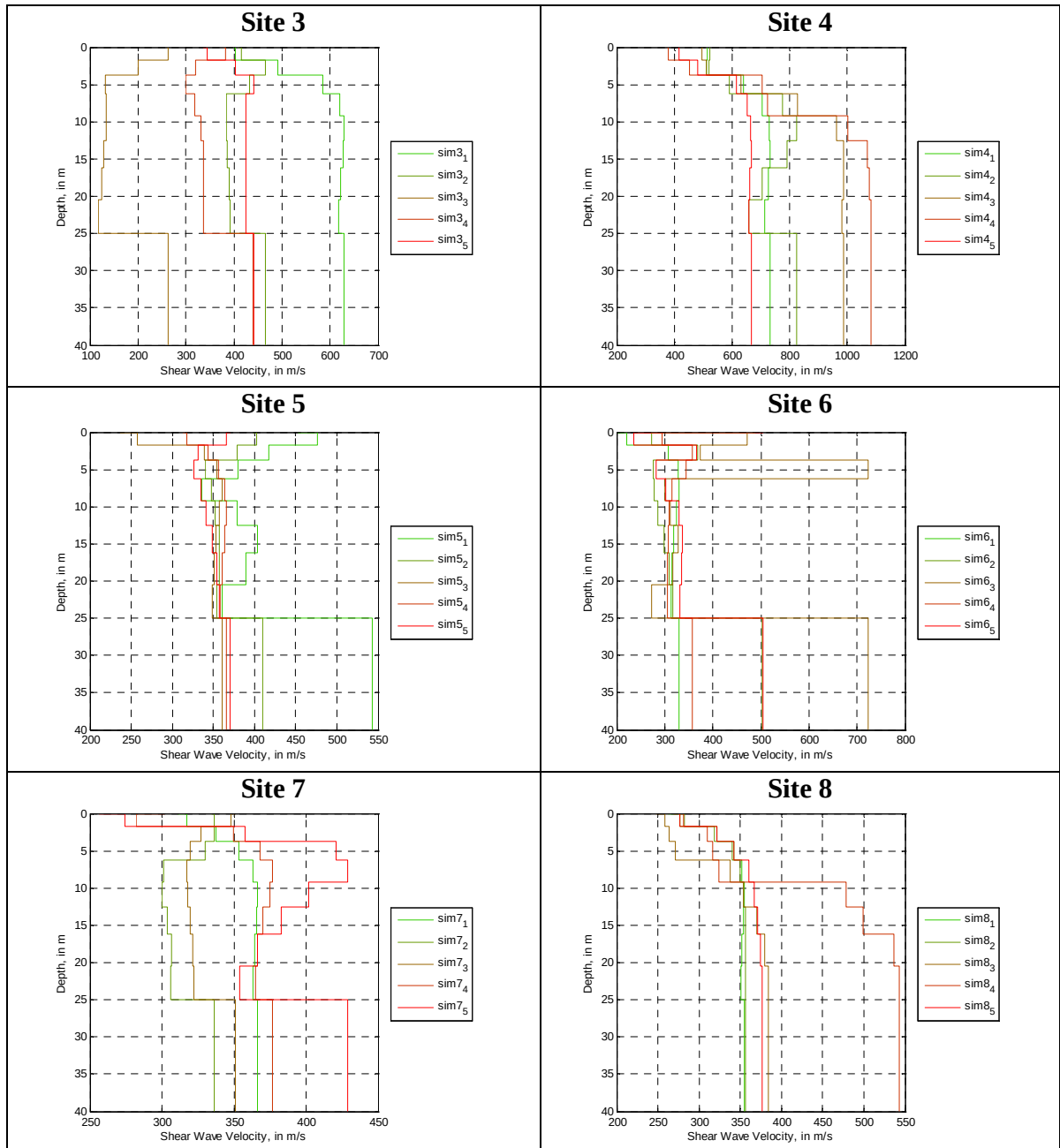


Figure 34.2. Continued

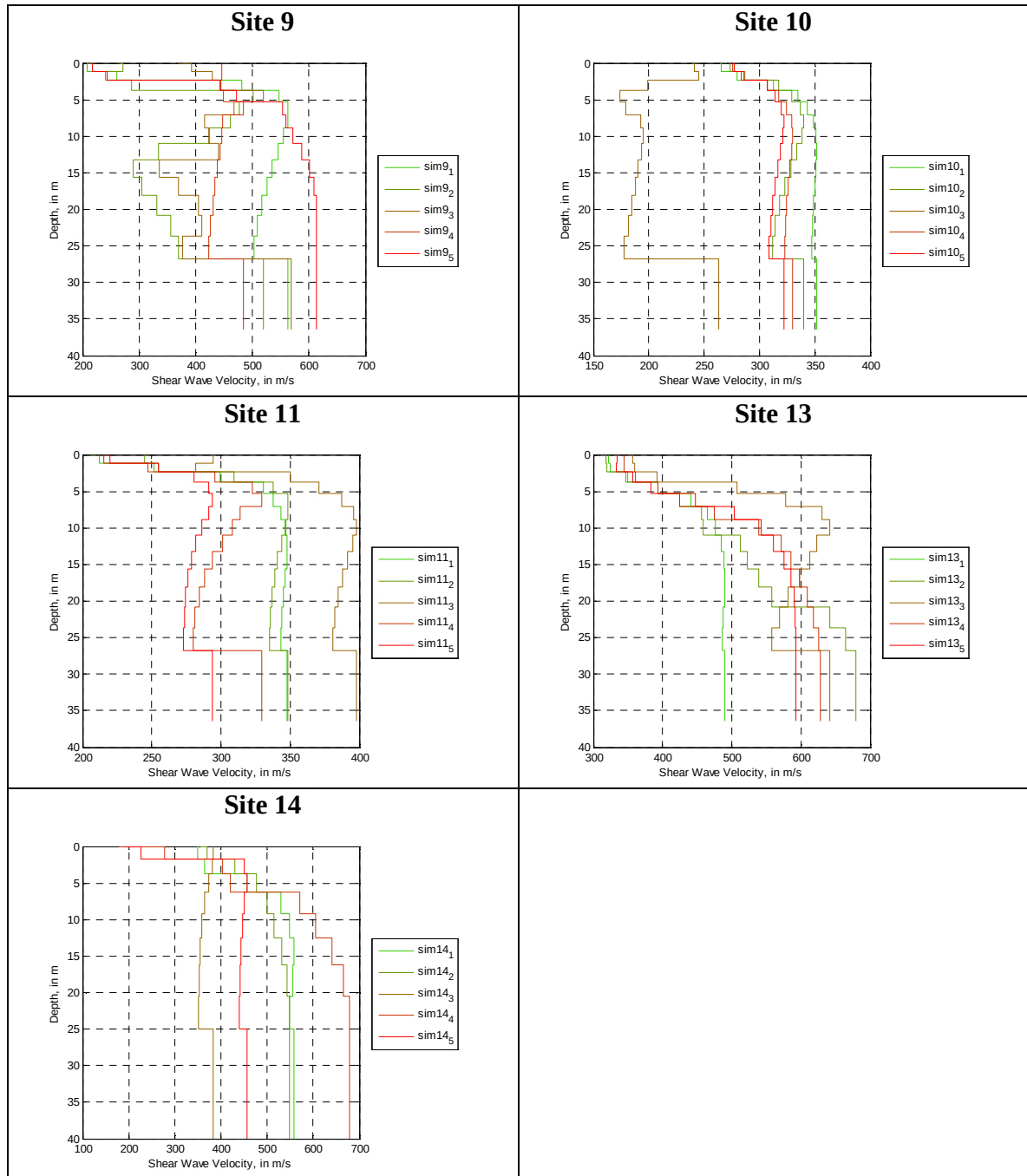


Figure 34.2. Continued

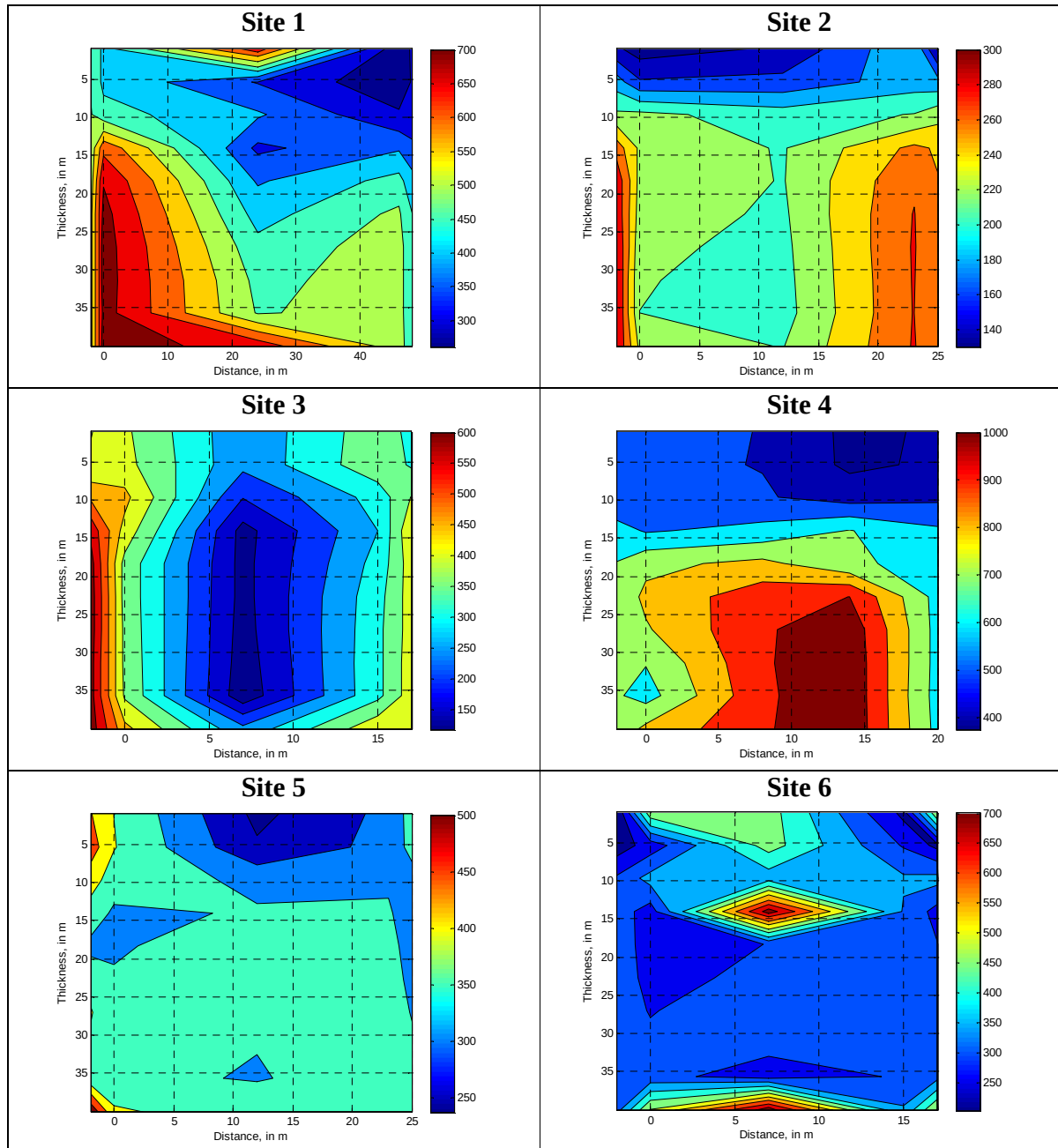


Figure 34.3 - Interpolated 2d shear wave velocity profile for the test sites in Shimla

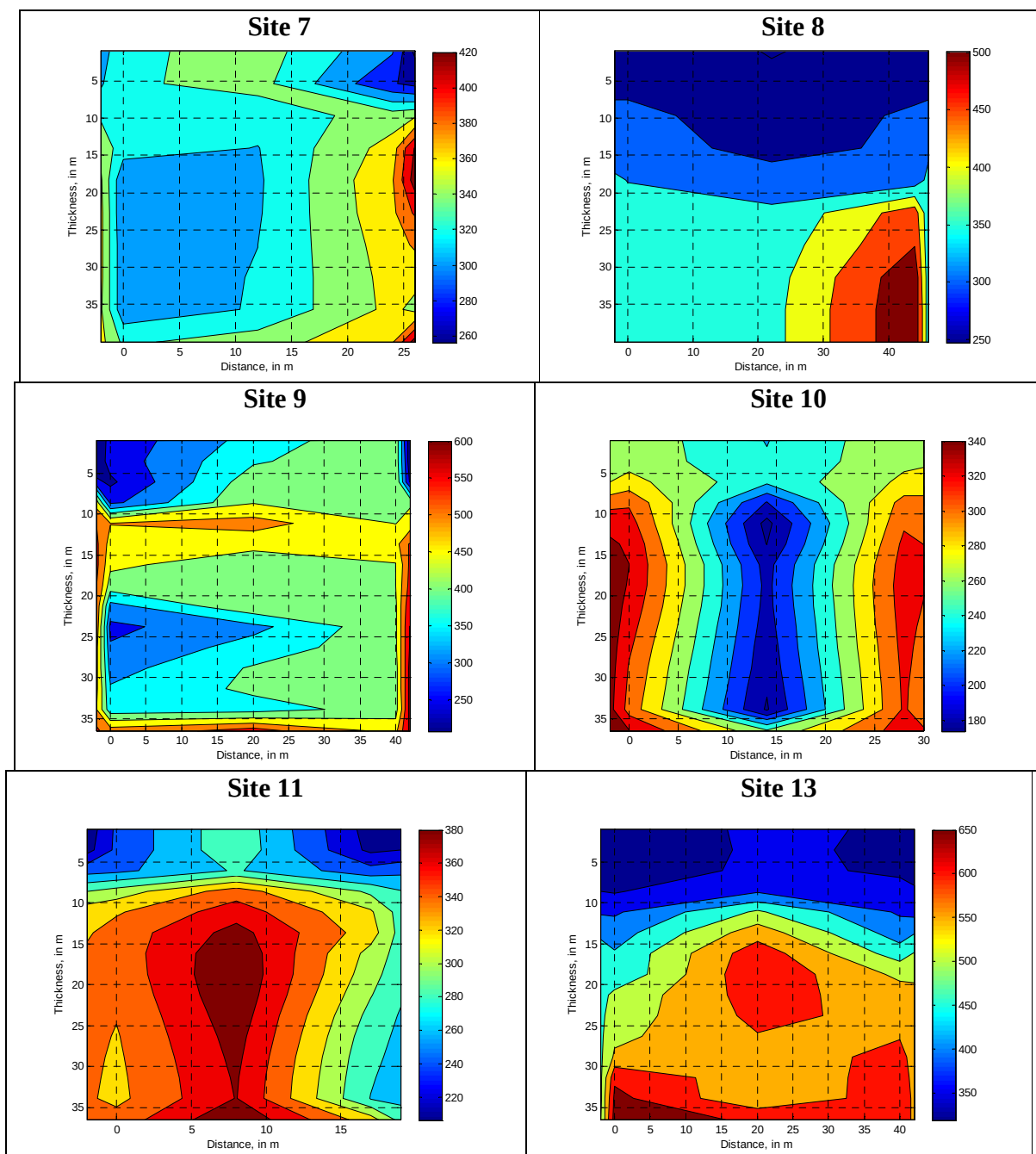


Figure 34.3. Continued

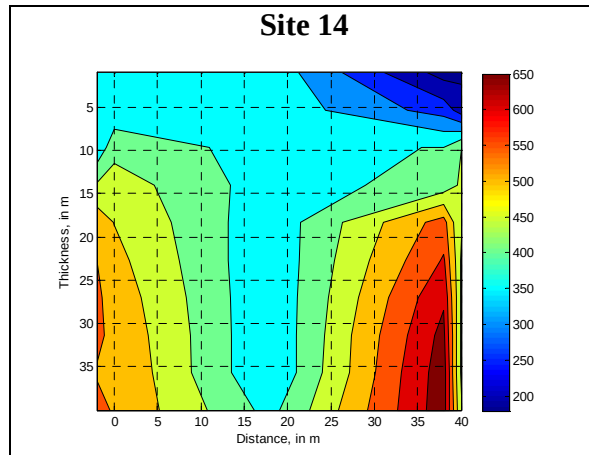


Figure 34.4 – a. Site 1, b. Site 2, c. Site 3, d. Soil c/s near site 3, e. Soil c/s at site 4, f. soil c/s at site 5, g. Site 6, h. Site 7, i. Site 8, j. Site 9, k. Site 10, l. soil c/s near site 11, m. Site 14



Figure 34.4. Continued



Figure 34.3. Continued



Figure 35.1. a. Soil c/s near site 1, b. soil c/s near site 4, c. Shear wave profiles of all the test sites in Solan

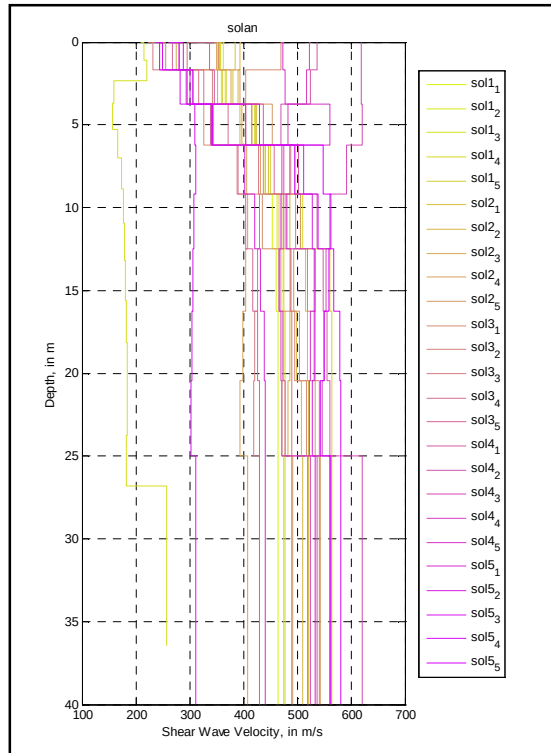


Figure 35.1 Continued

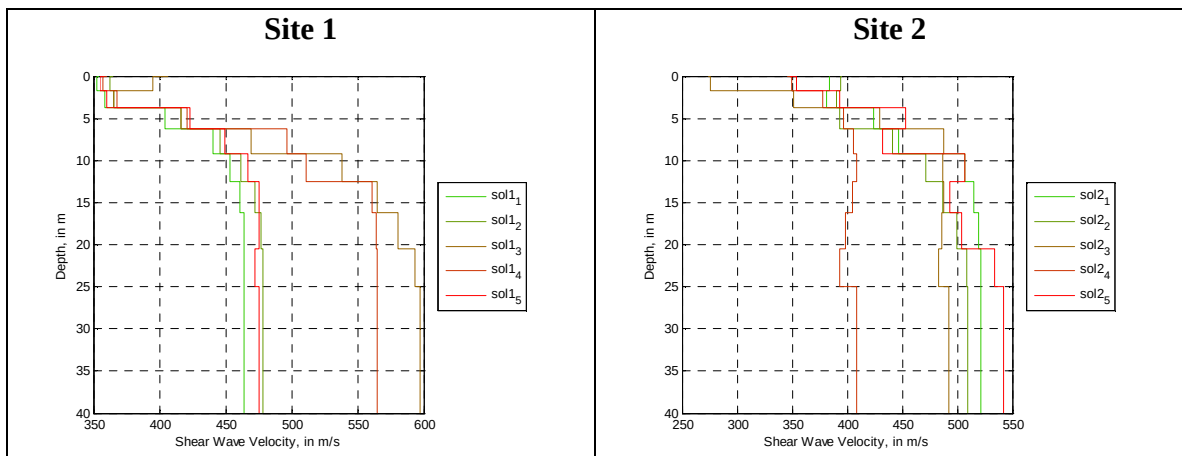


Figure 35.2. Shear wave velocity profile for the test sites in Solan

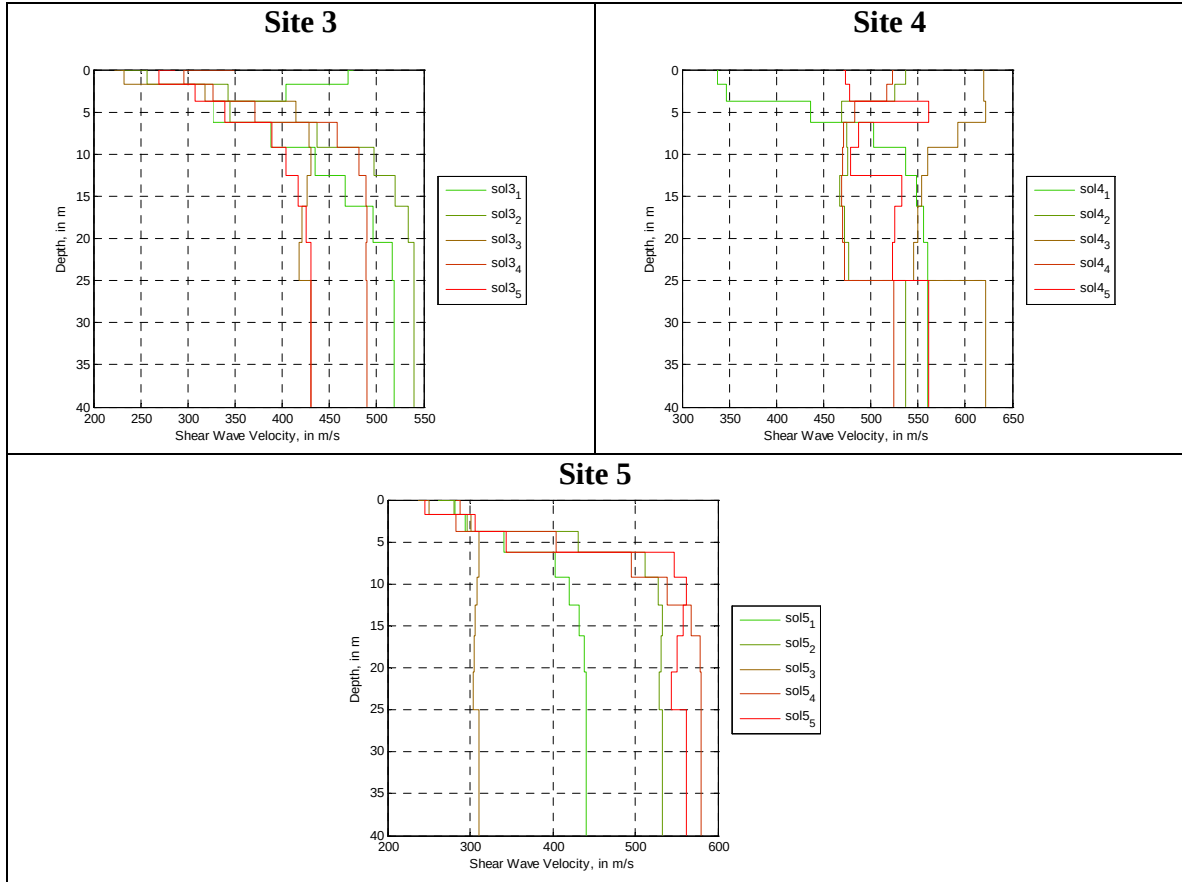


Figure 35.2. Continued

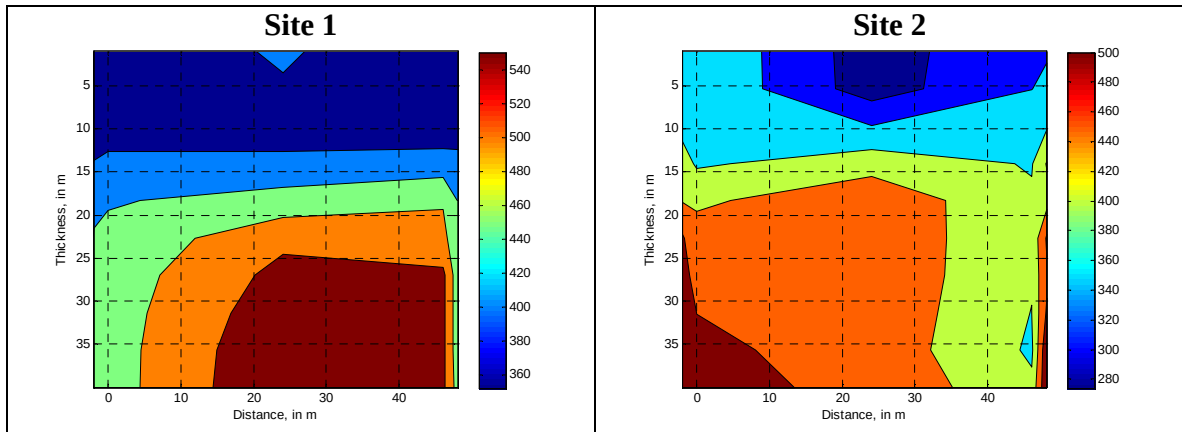


Figure 35.3. Interpolated 2d shear wave velocity profile for the test sites in Solan

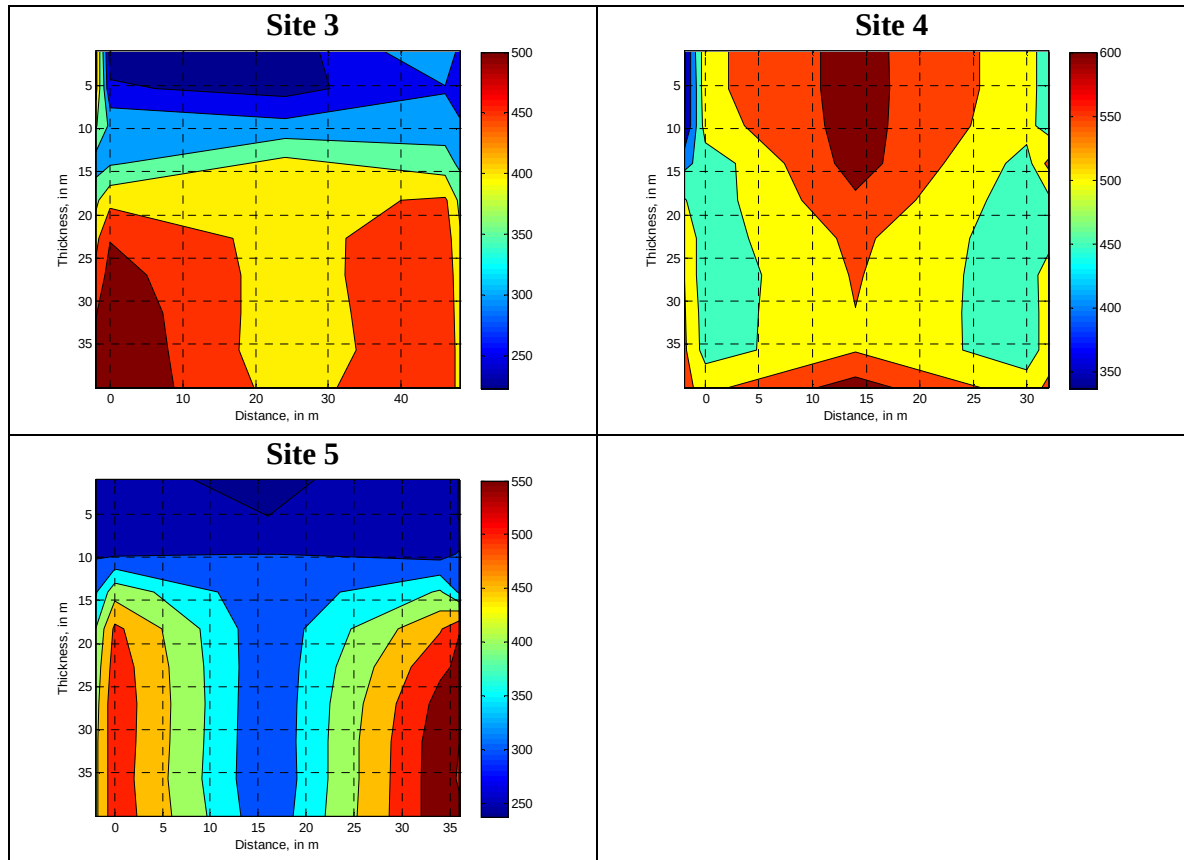


Figure 35.3. Continued



Figure 36.1. a. Test site 1, b. Test site 2, c. Shear wave profiles of all the test sites in Sundernagar

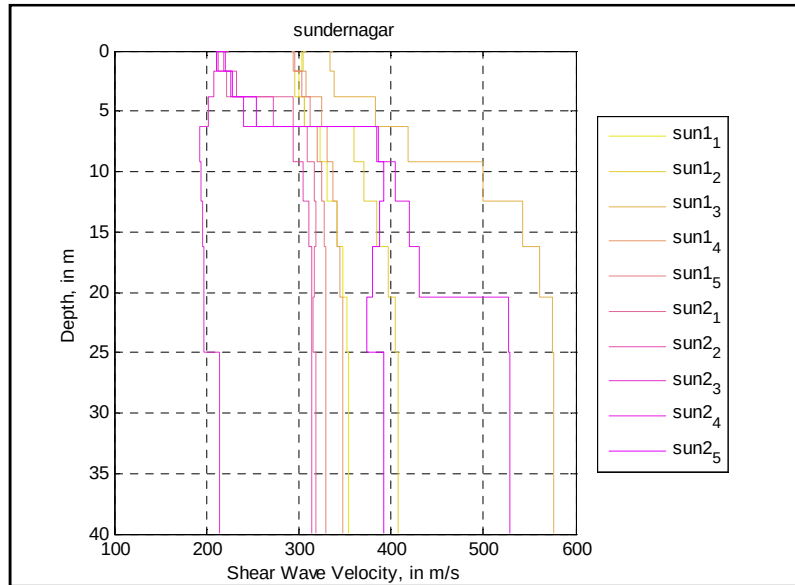


Figure 36.1 Continued

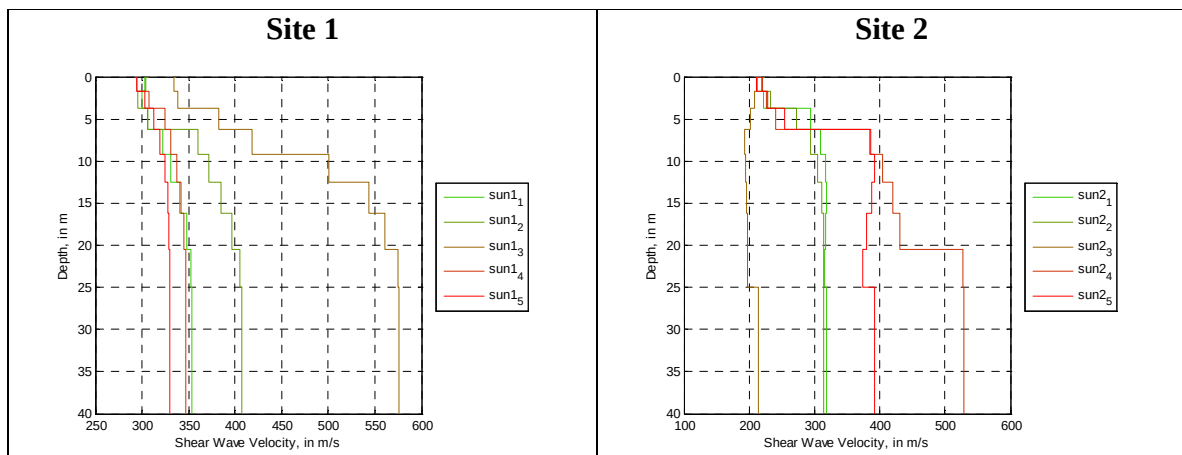


Figure 36.2. Shear wave velocity profile for the test sites in Sundernagar

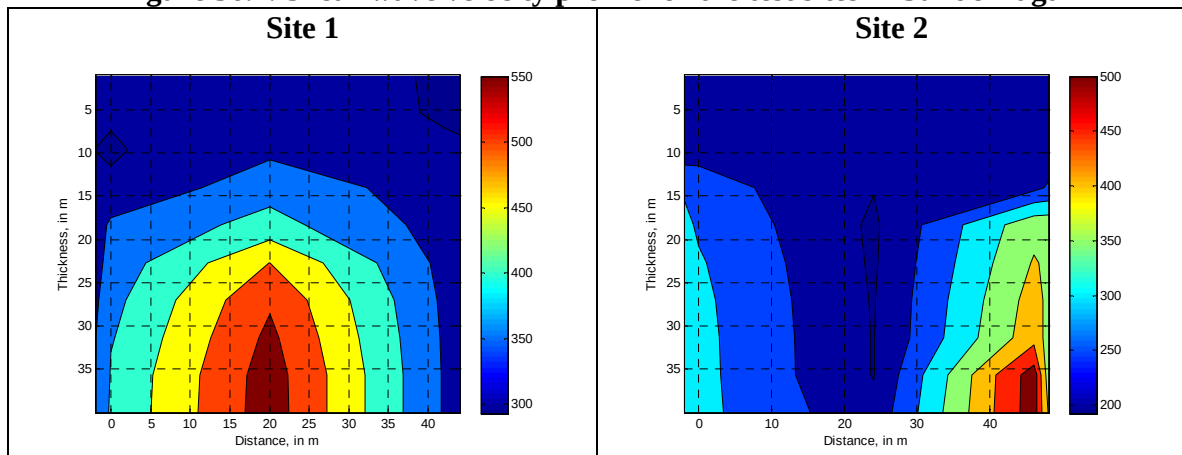


Figure 36.3. Interpolated 2d shear wave velocity profile for the test sites in Sundernagar



Figure 37.1. a. Test site in Tabo

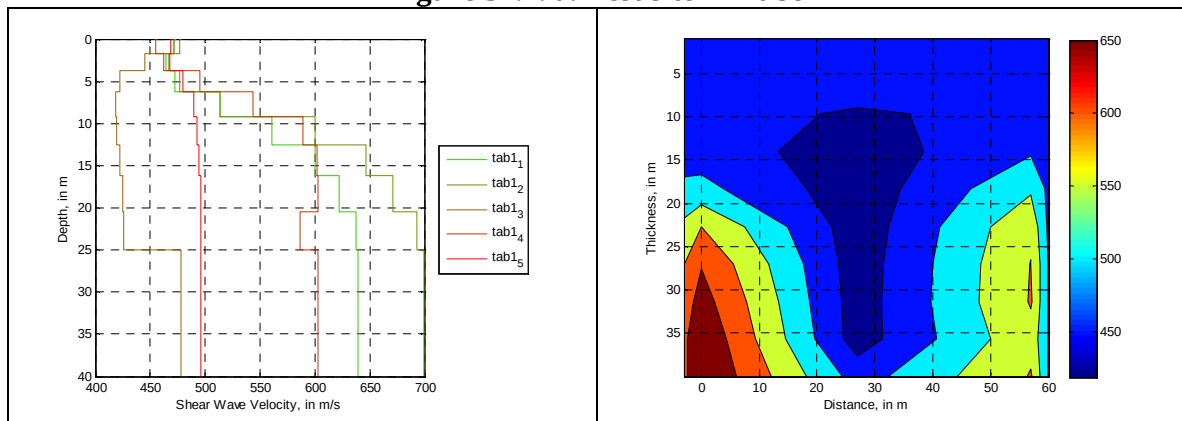
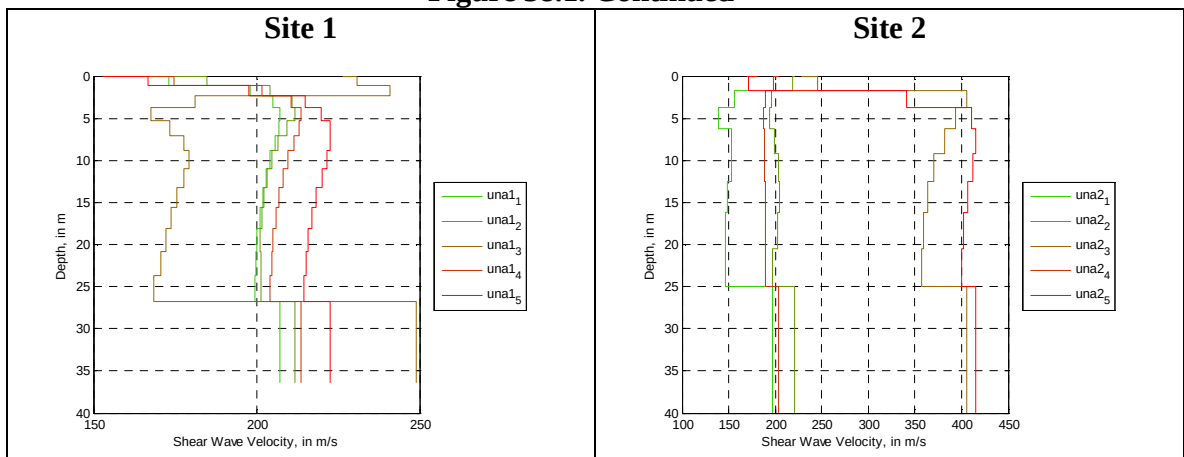
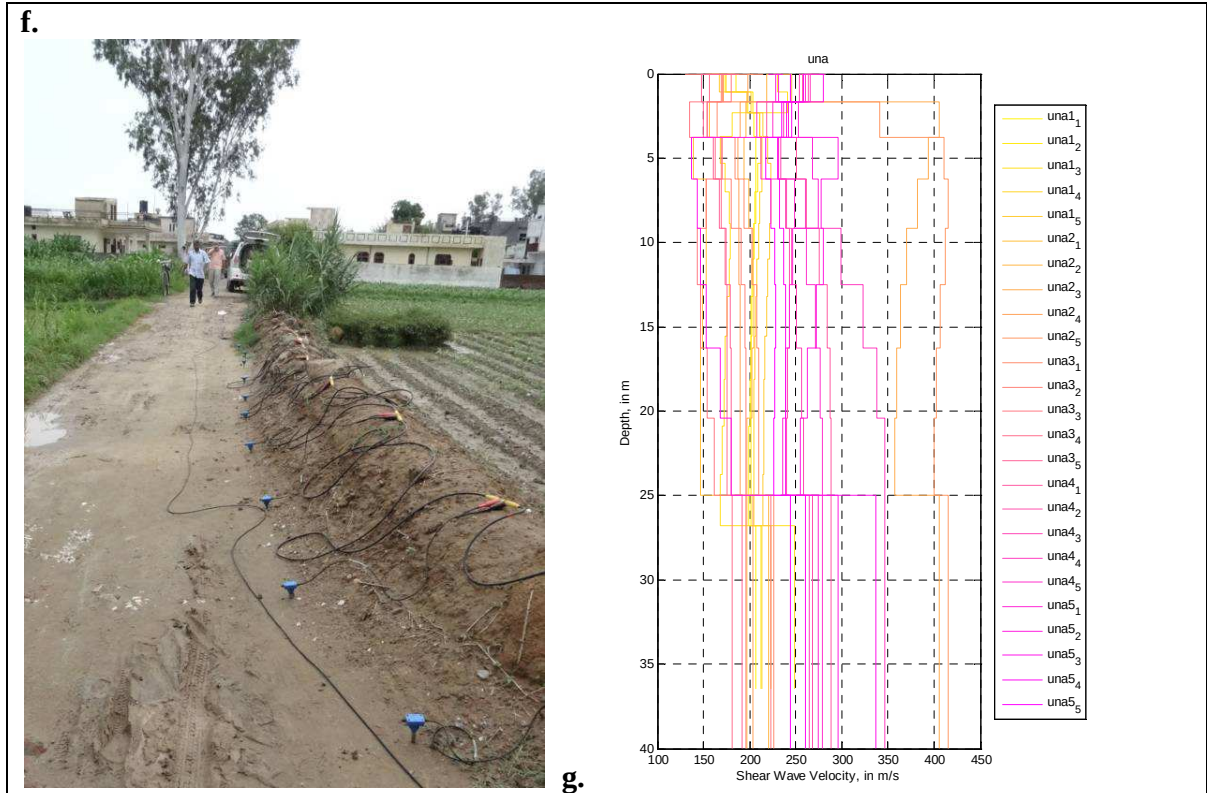


Figure 37.2. a. Shear wave velocity profile at Site1, b. interpolated 2d shear wave velocity profile for the test site in Tabo



Figure 38.1. a. Test site 1 in Una, b. Soil profile near site 1, c. Soil profile near site 2, d. Soil profile near site 5, e. Site 4 with soil profile in the right, f. Site 3, g. Shear wave profiles of all the test sites in Una



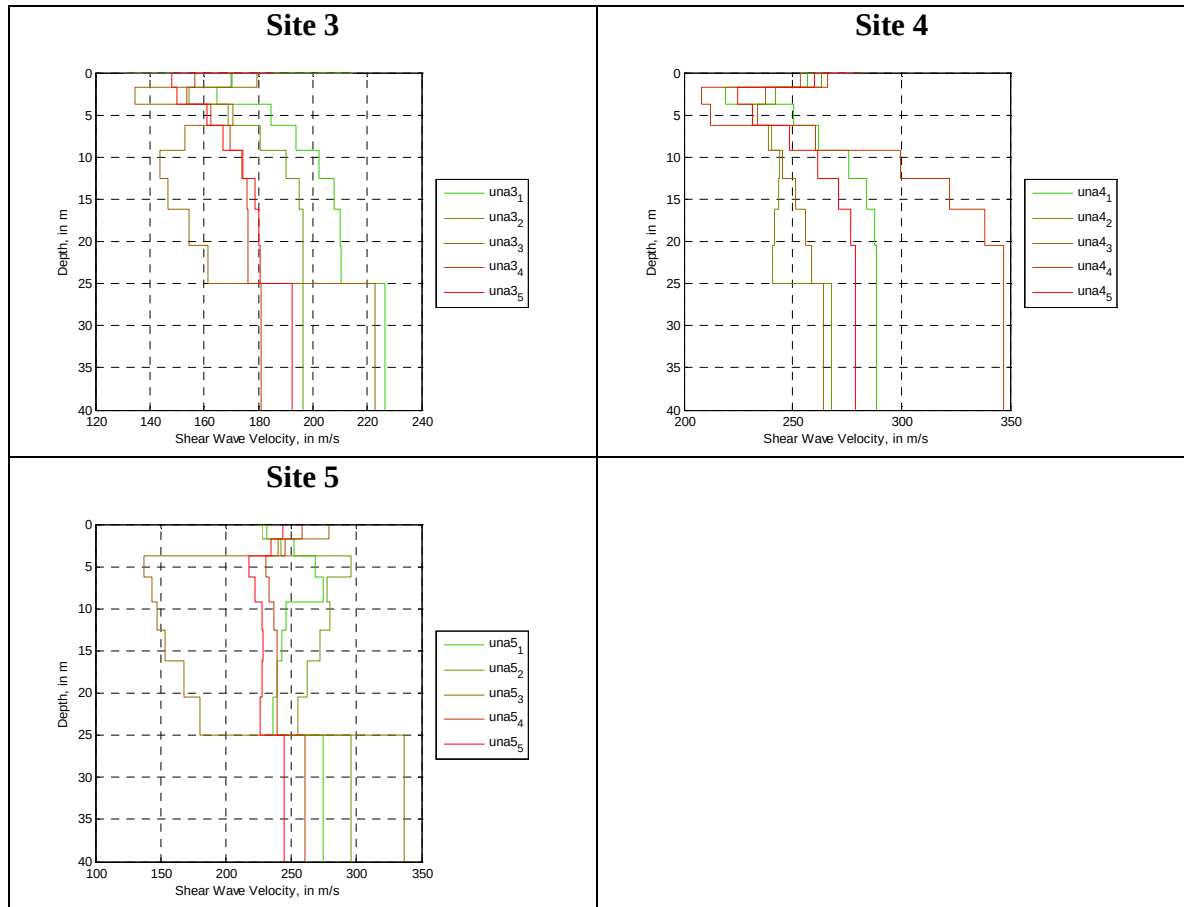


Figure 38.2. Continued

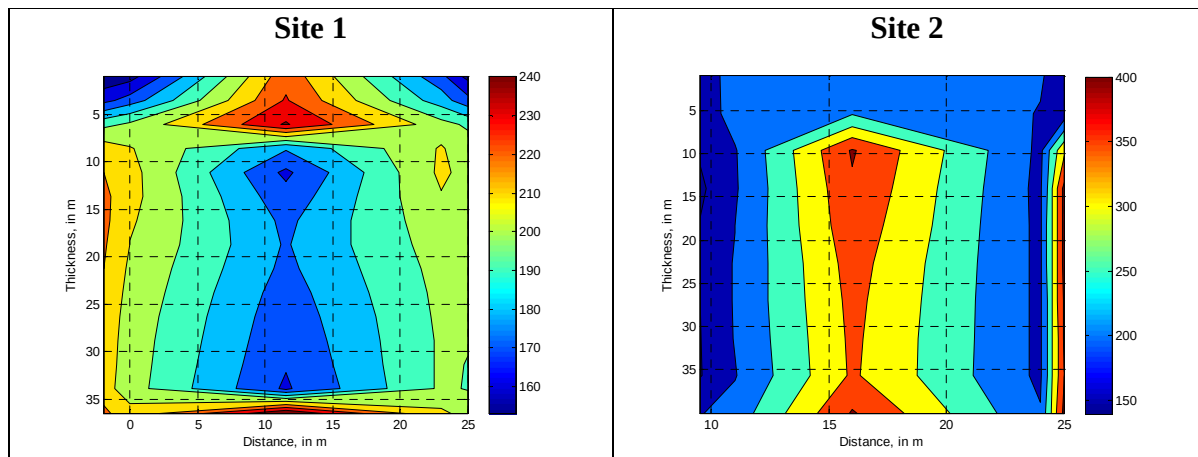


Figure 38.3. Interpolated 2d shear wave velocity profile for the test sites in Una

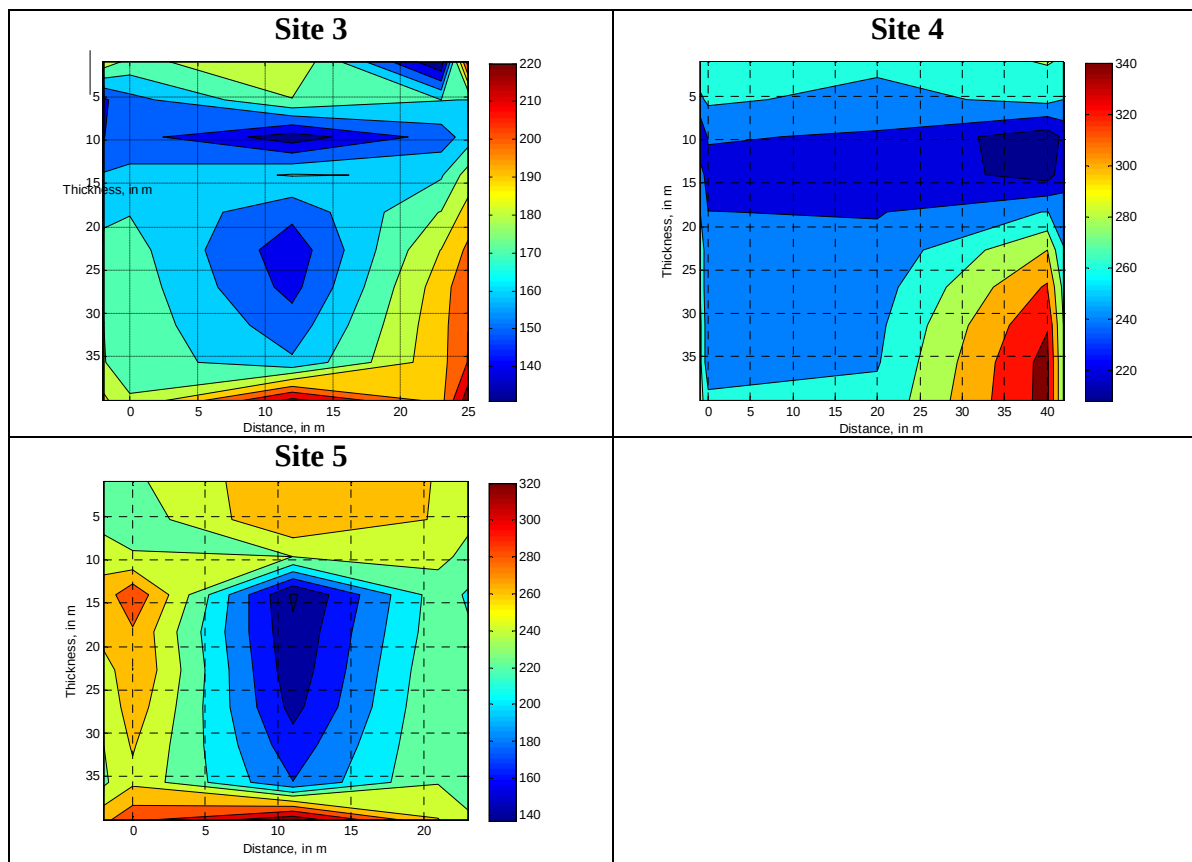


Figure 38.3. Continued

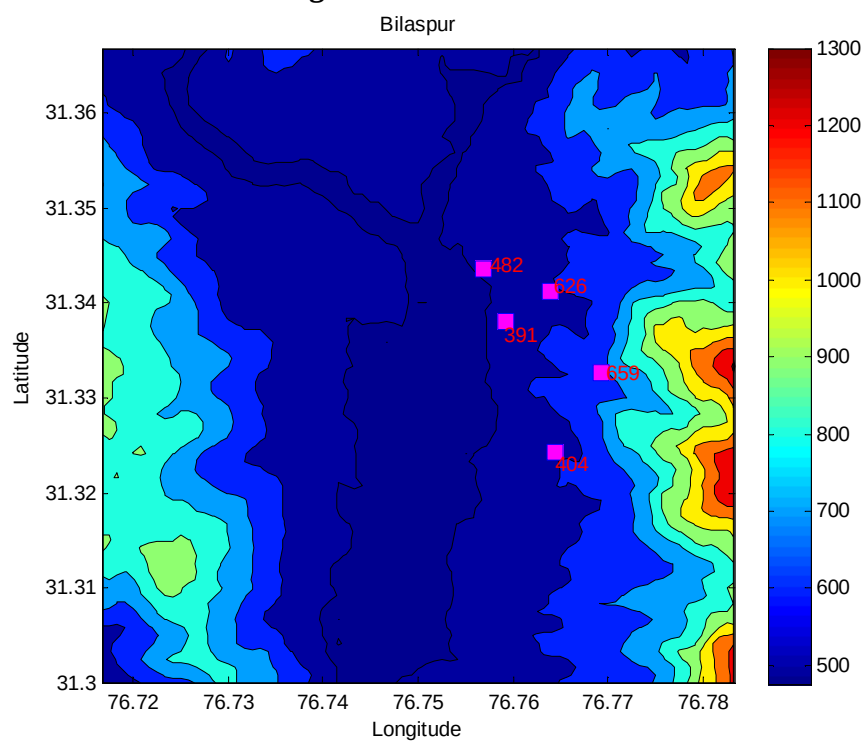


Figure 39. V_{s30} values on the topography map of Bilaspur

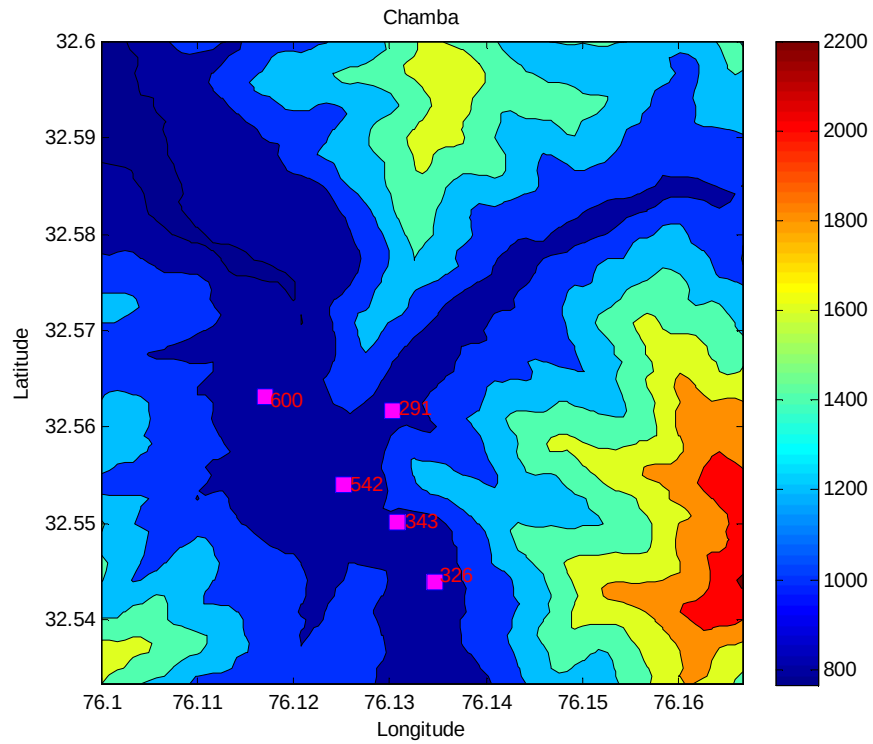


Figure 40. V_{s30} values on the topography map of Chamba

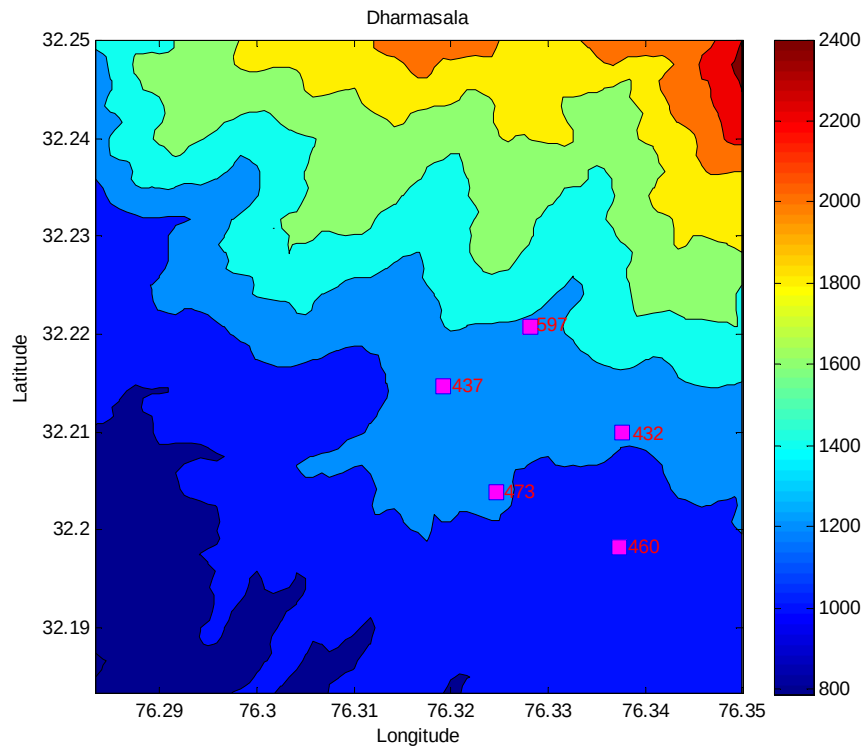


Figure 41. V_{s30} values on the topography map of Dharmasala

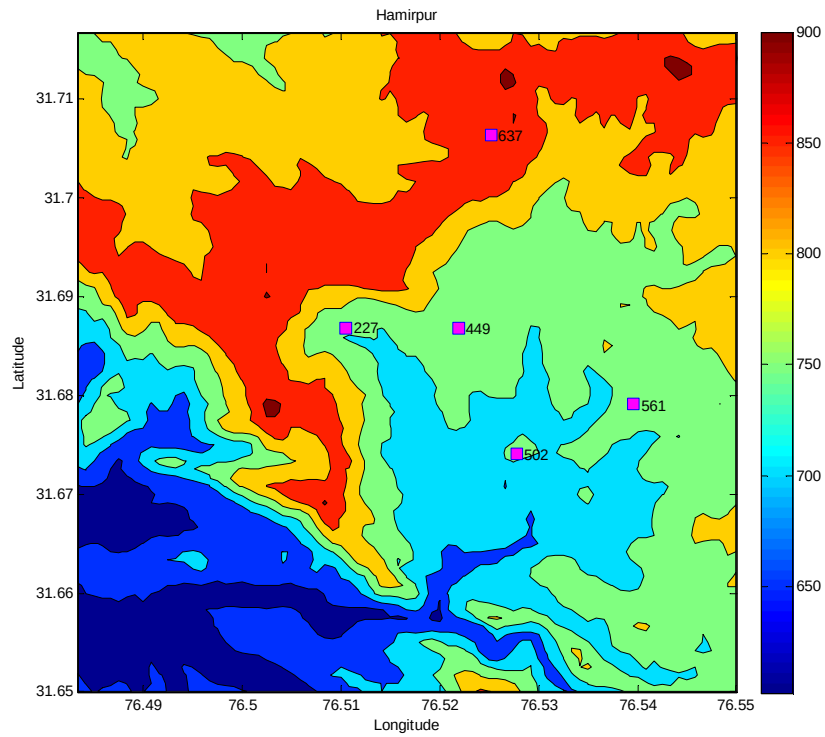


Figure 42. V_{s30} values on the topography map of Hamirpur

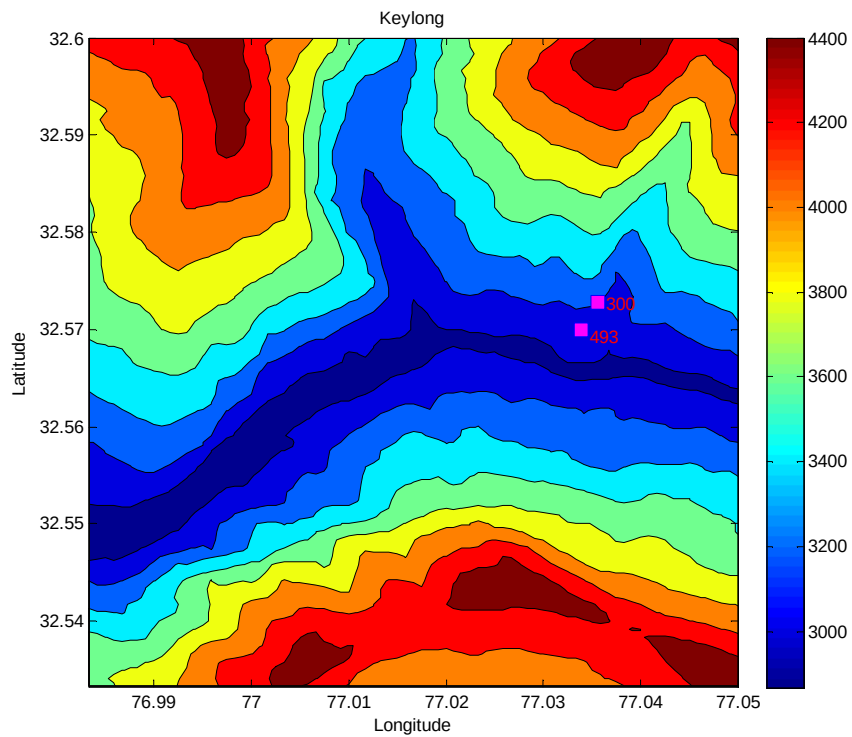


Figure 43. V_{s30} values on the topography map of Keylong

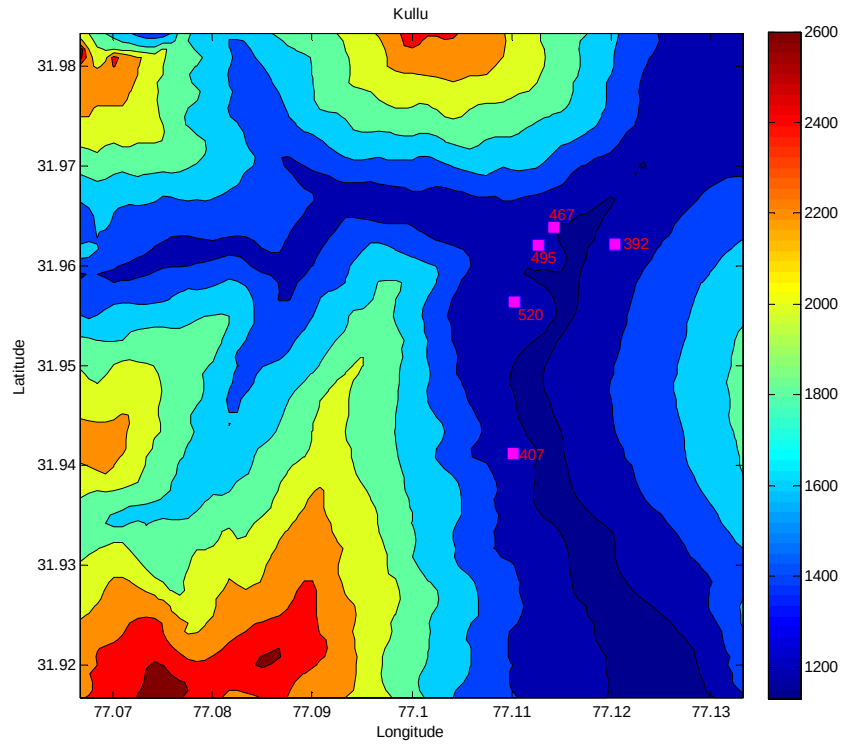


Figure 44. V_{s30} values on the topography map of Kullu

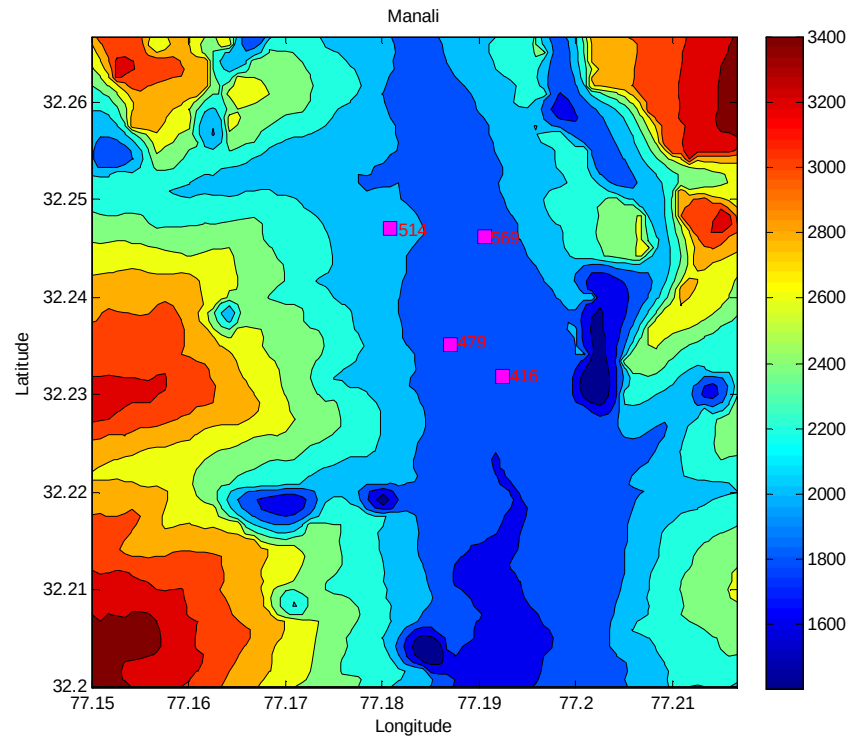


Figure 45. V_{s30} values on the topography map of Manali

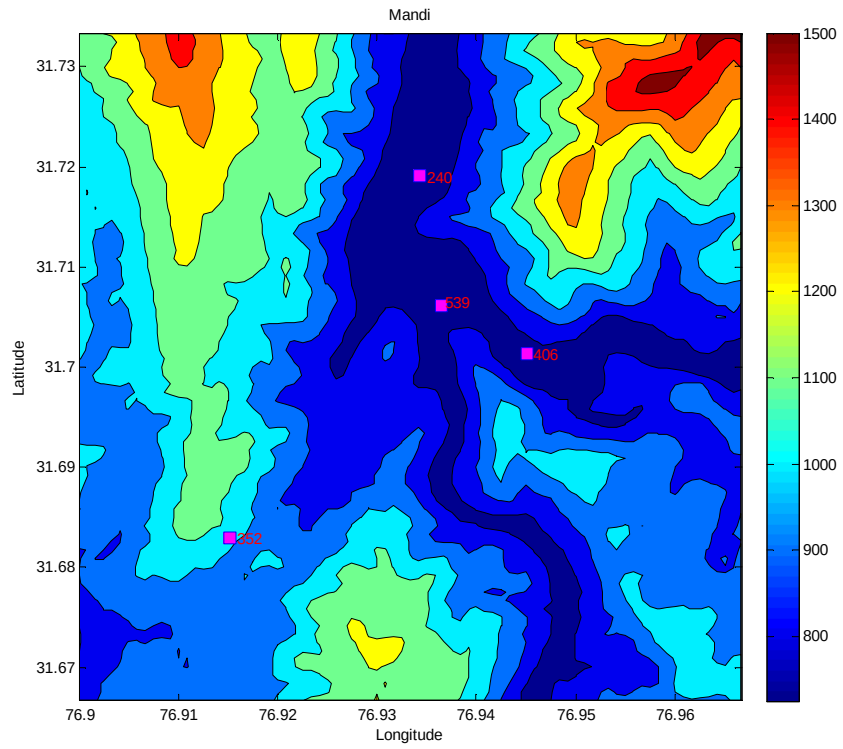


Figure 46. V_{s30} values on the topography map of Mandi

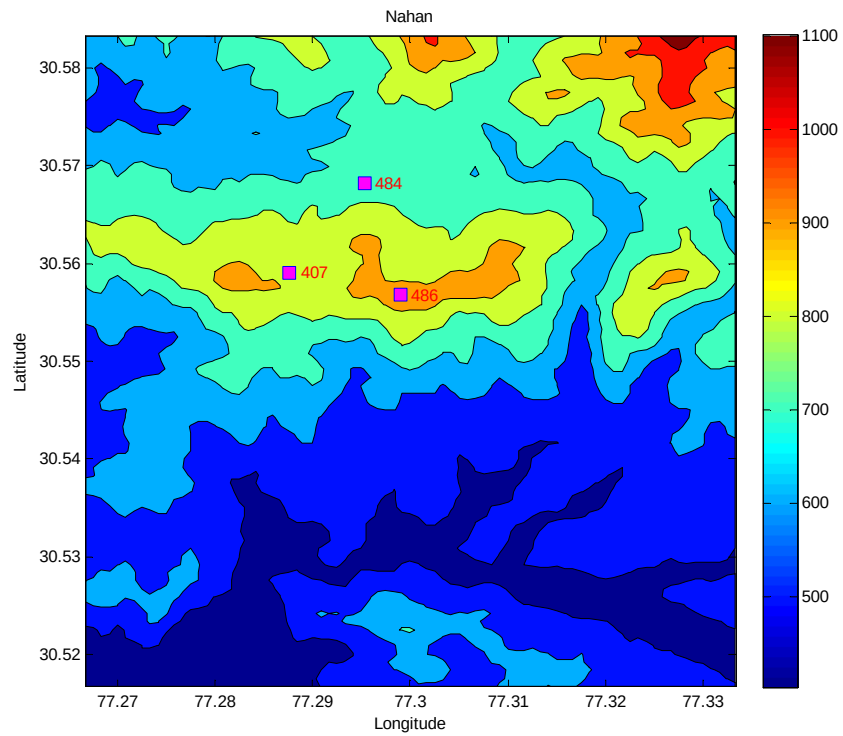


Figure 47. V_{s30} values on the topography map of Nahan

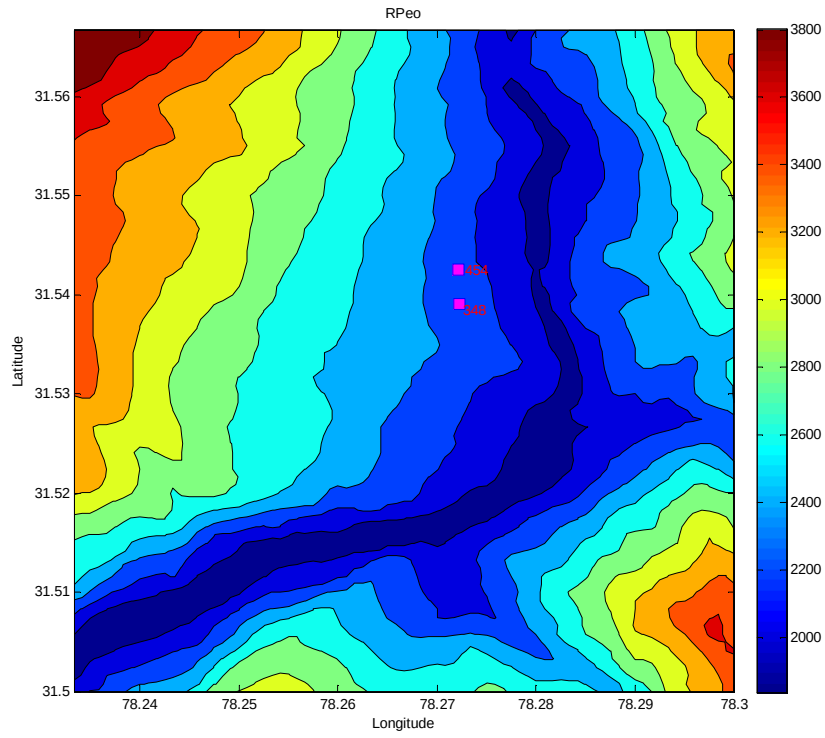


Figure 48. V_{s30} values on the topography map of Reckong Peo

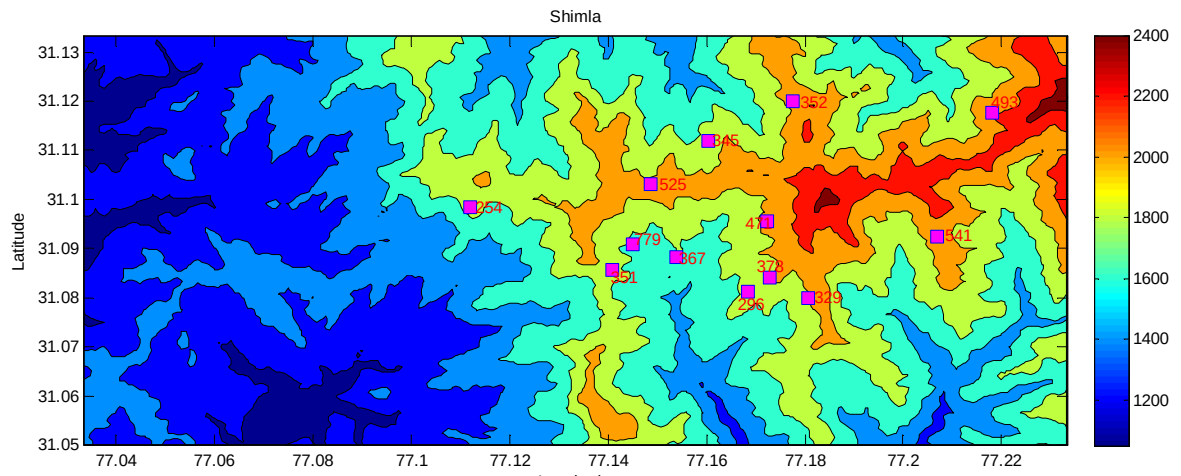


Figure 49. V_{s30} values on the topography map of Shimla

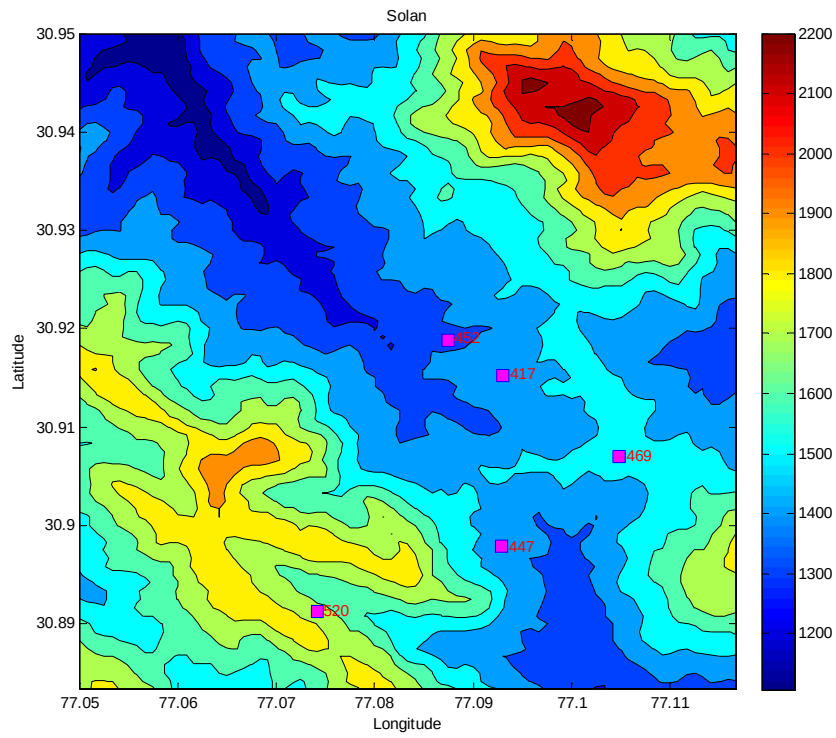


Figure 50. V_{s30} values on the topography map of Solan

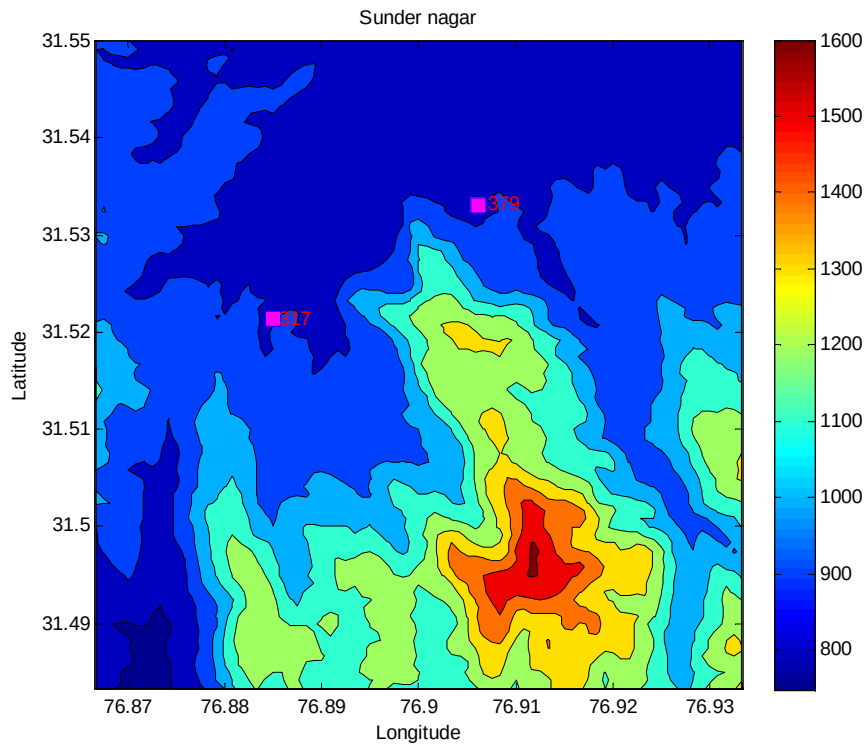


Figure 51. V_{s30} values on the topography map of Sundernagar

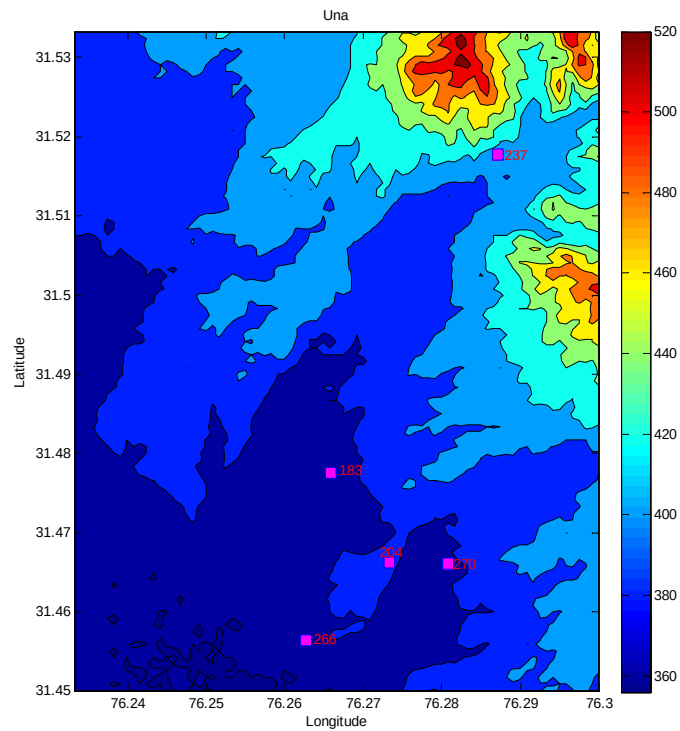


Figure 52. V_{s30} values on the topography map of Una

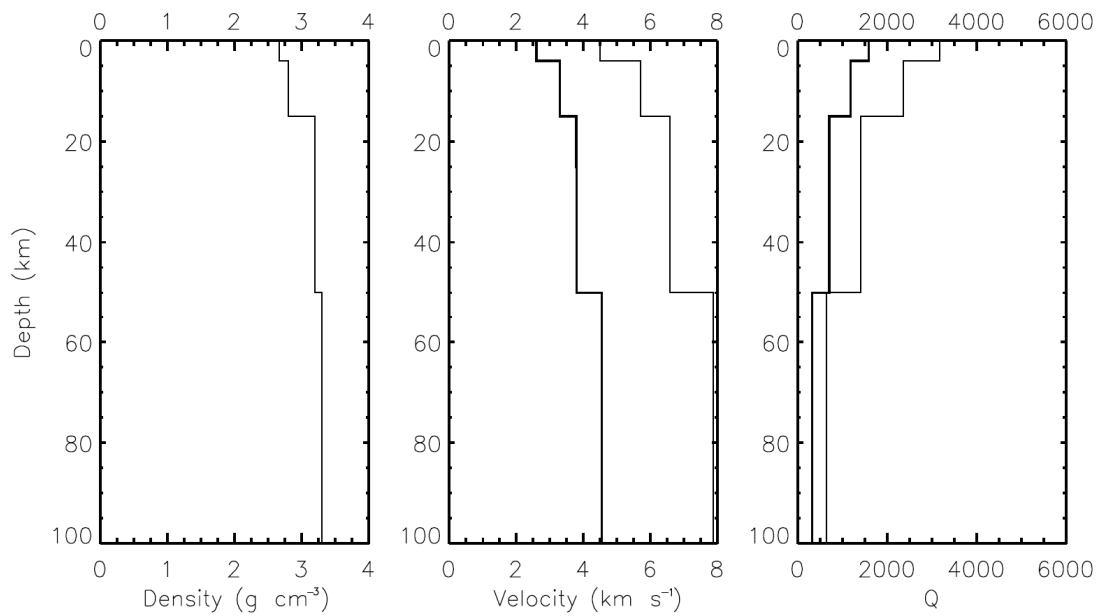


Figure 53. Density in g cm^{-3} , P - and S -wave velocities in km s^{-1} , and the corresponding quality factor (thick line for S waves and thin for P waves) .

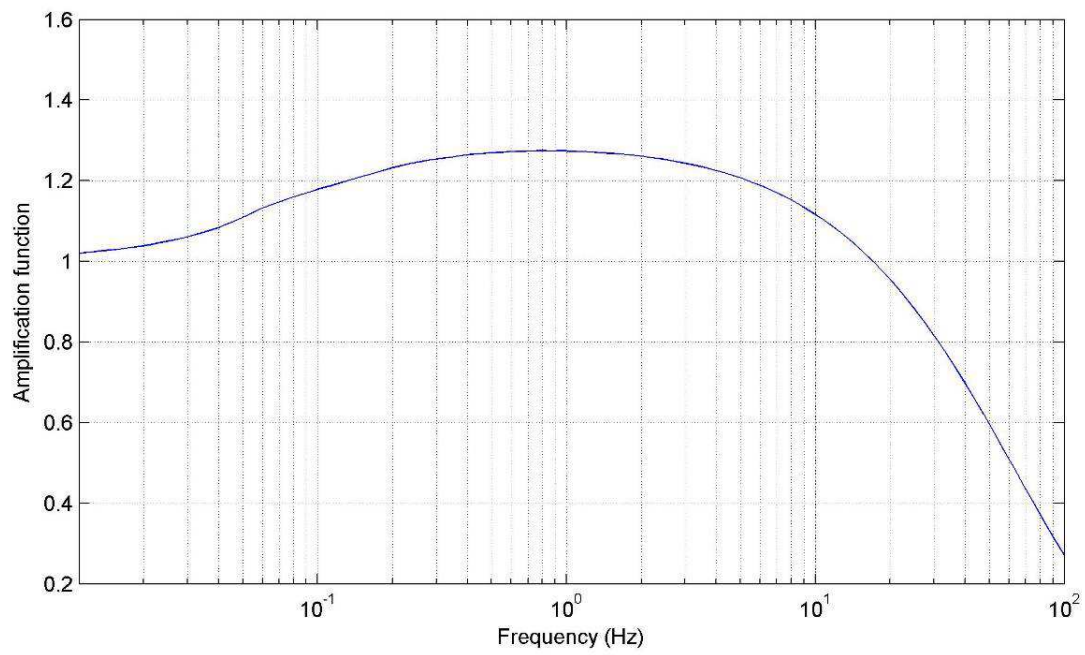


Figure 54. Amplification function for A-type site in HP

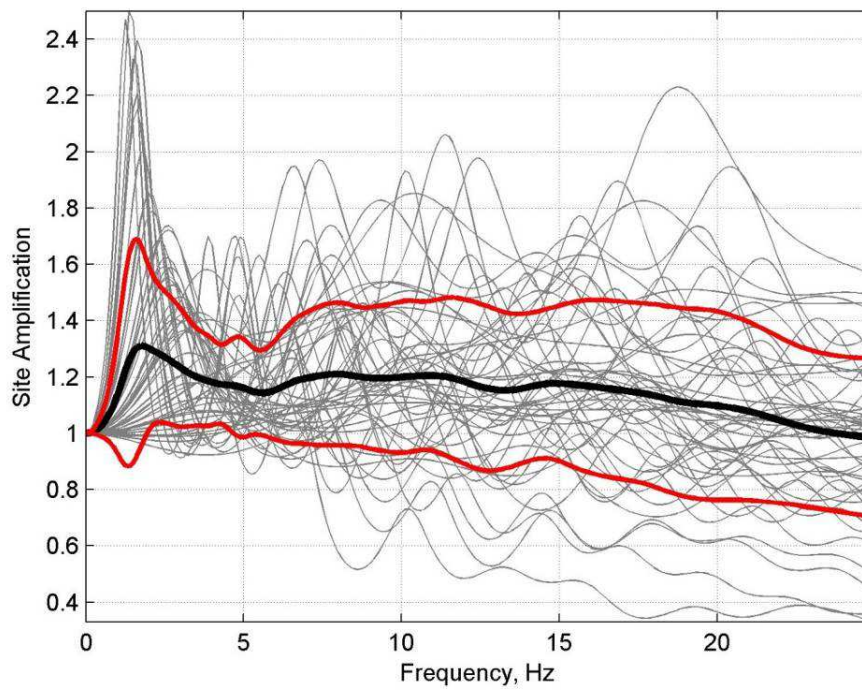


Figure 55. Mean frequency response function of site amplification for 50 C-type test sites

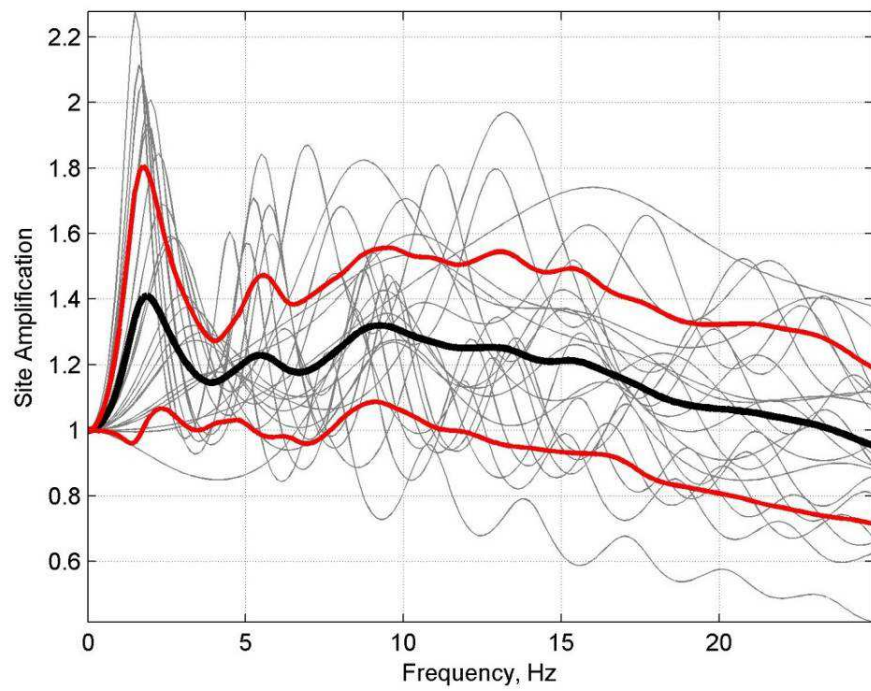


Figure 56. Mean frequency response function of site amplification for 21 D-type test

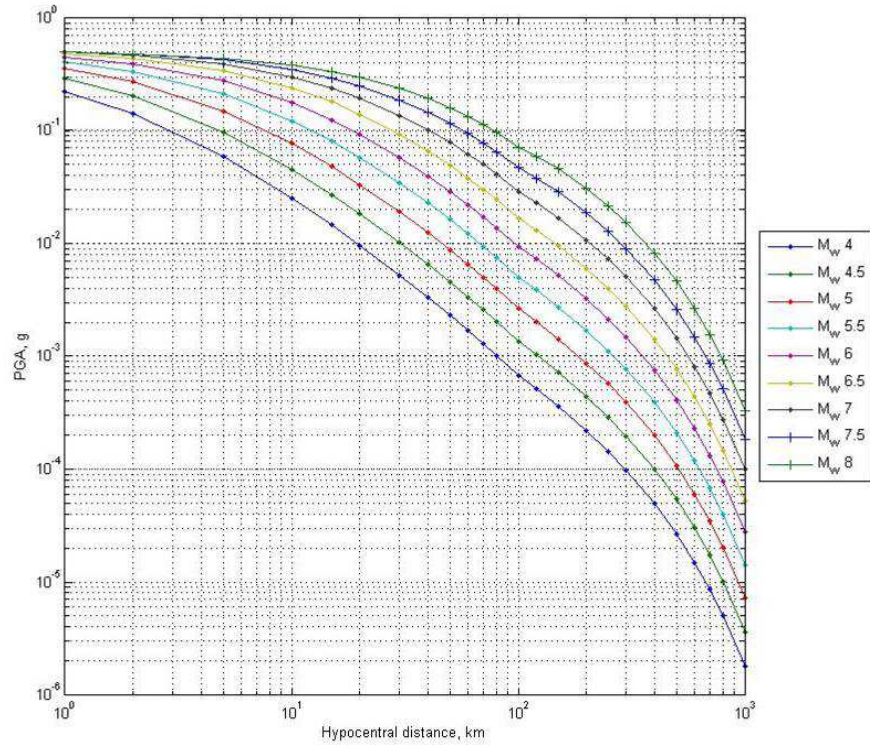


Figure 57. Attenuation of PGA (g) with Hypocentral distance at Type-C sites in the Himalayan region

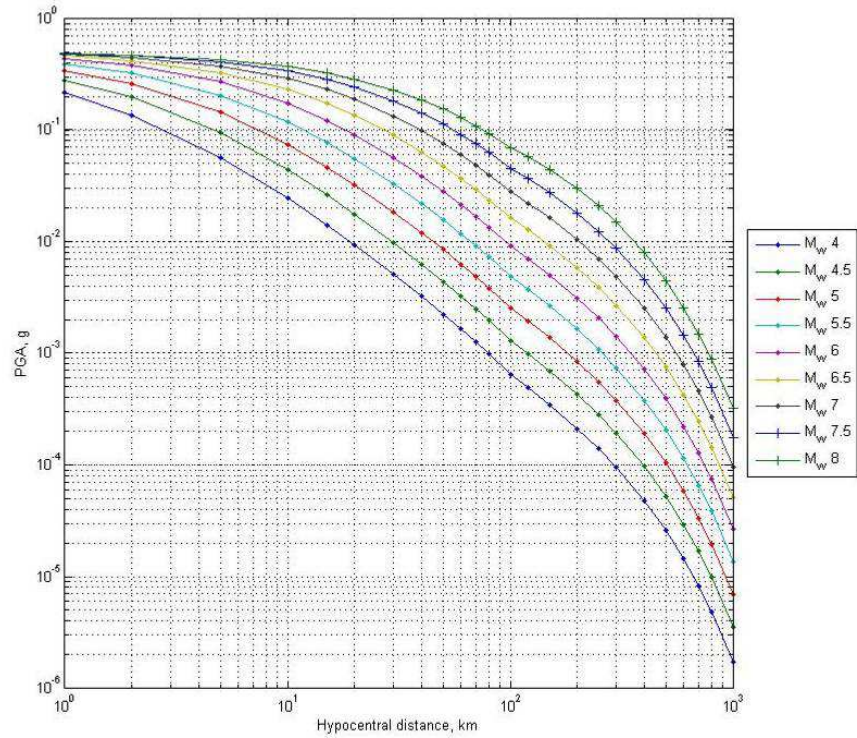


Figure 58. Attenuation of PGA (g) with Hypocentral distance at Type-D sites in the Himalayan region

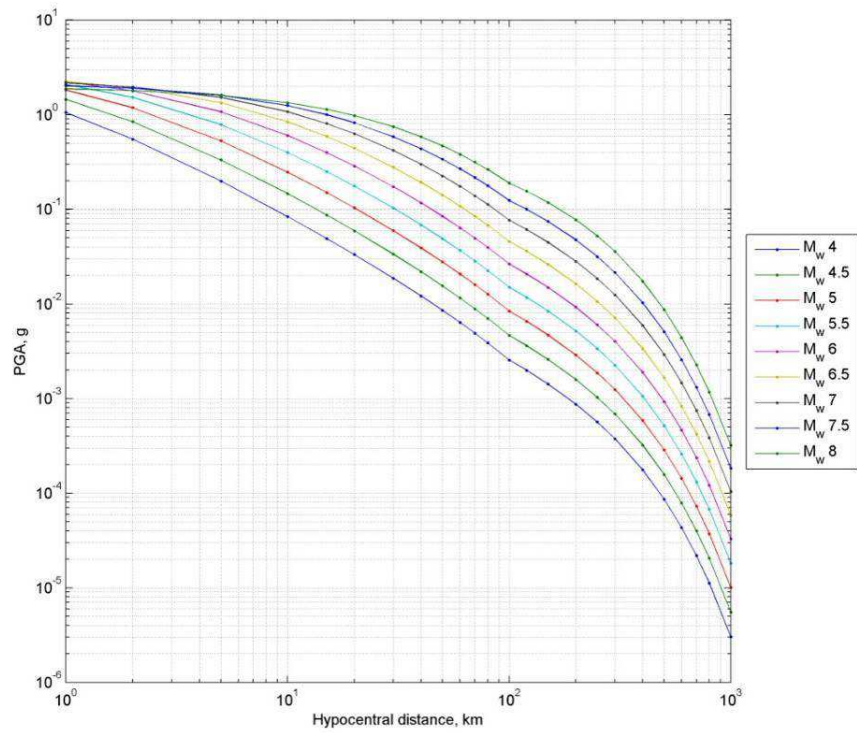


Figure 59. Attenuation of PGA (g) with Hypocentral distance at Type-C sites in the Indo-Gangetic region

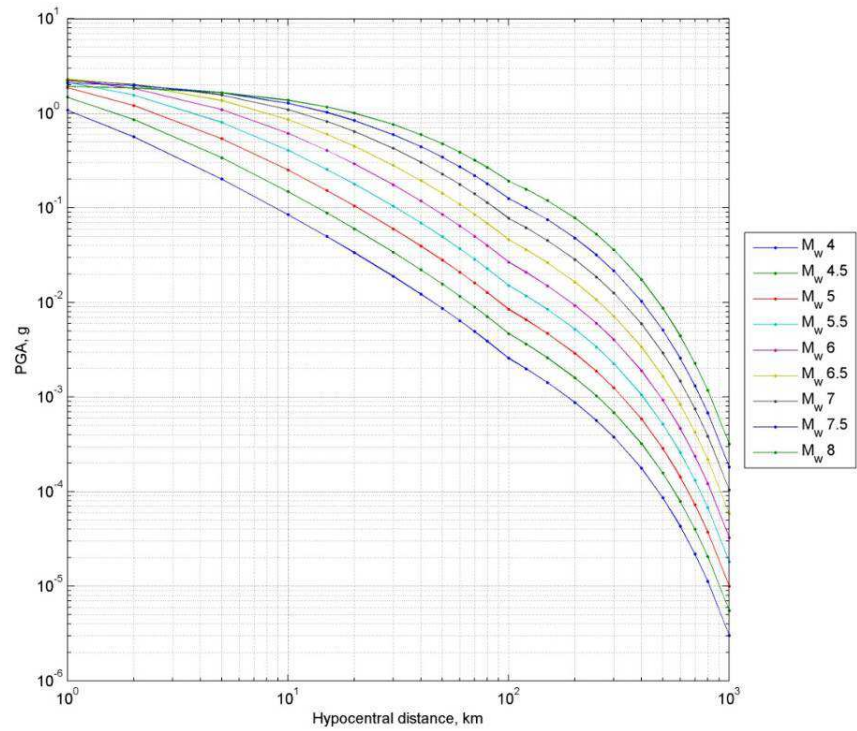


Figure 60. Attenuation of PGA (g) with Hypocentral distance at Type-C sites in the Indo-Gangetic region

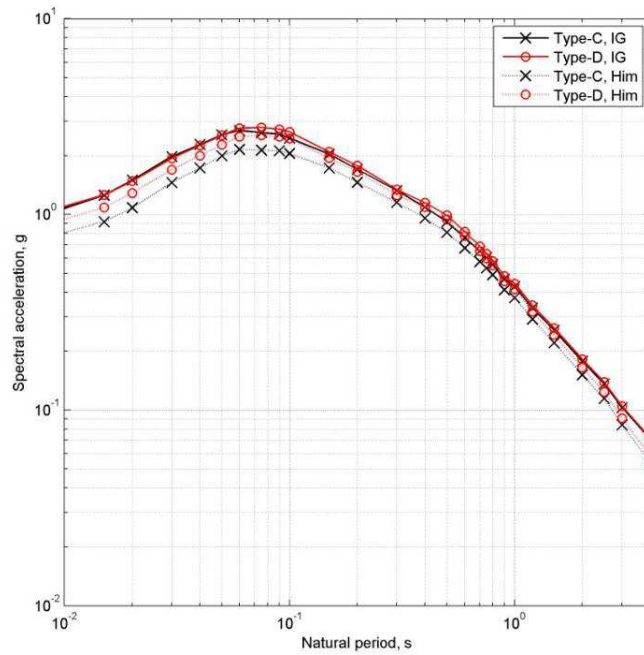


Figure 61. Comparison of the spectral acceleration plots for a M_w 7 event at a hypocentral distance of 10 km for Type-C & -D sites in the two active regions¹

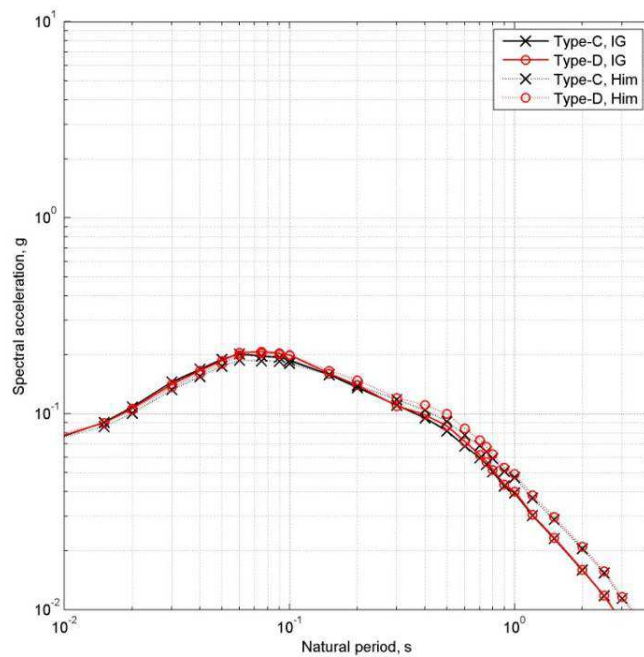


Figure 62. Comparison of the spectral acceleration plots for a M_w 7 event at a hypocentral distance of 100 km for Type-C & -D sites in the two active regions¹

¹ Note: IG - Indo-Gangetic region, Him - Himalayan region

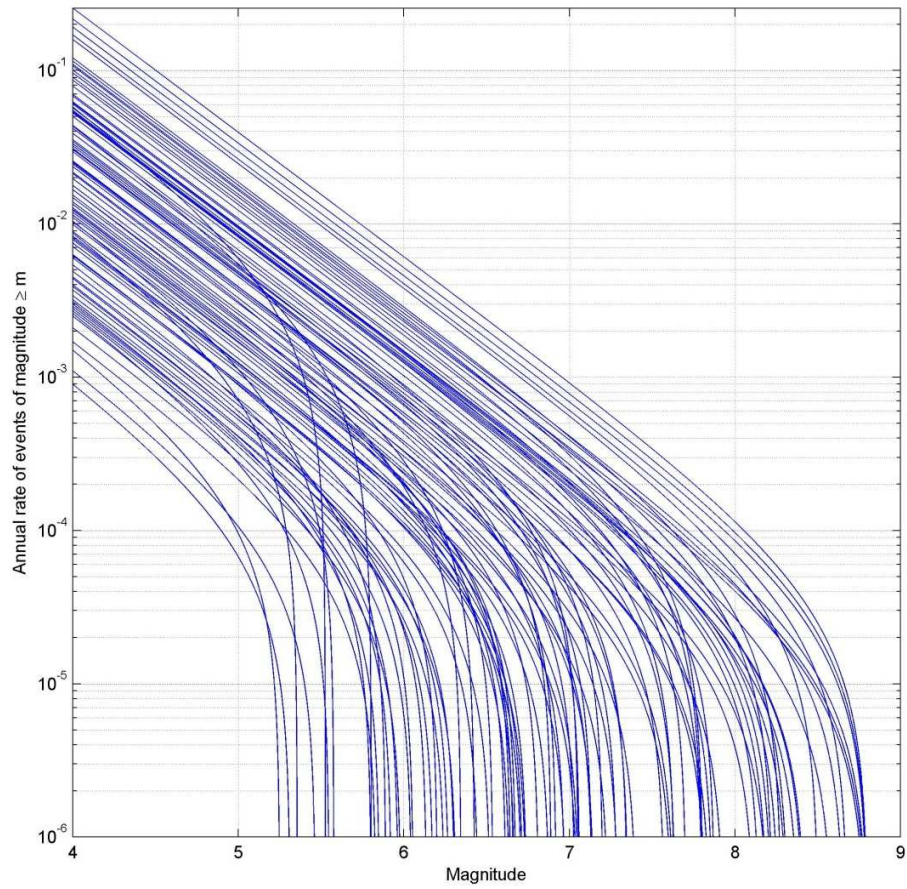


Figure 63. Fault level recurrence relation for seismogenic zone 1

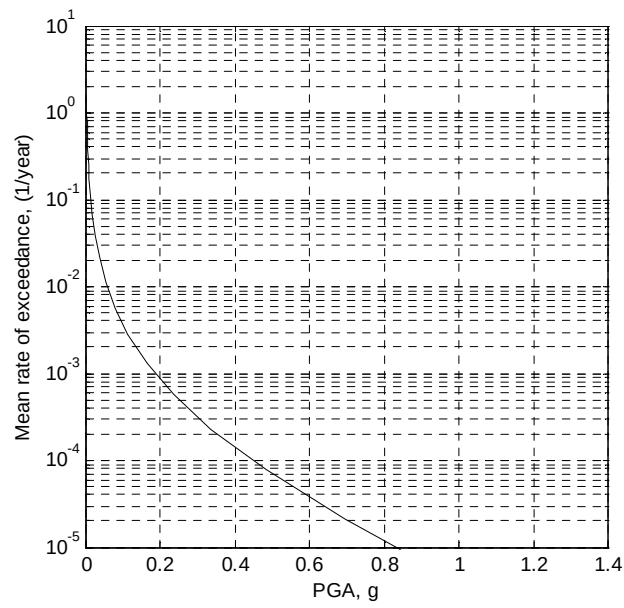


Figure 64. Seismic Hazard curve for Bilaspur (Site Type: C)

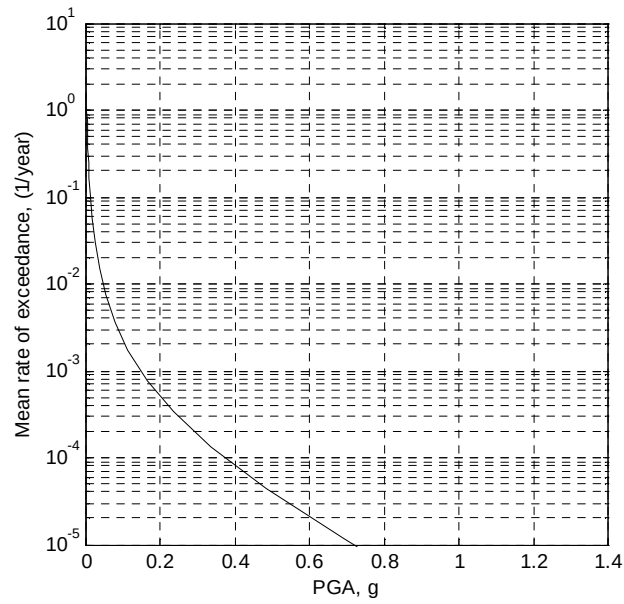


Figure 65. Seismic Hazard curve for Chamba (Site Type: C)

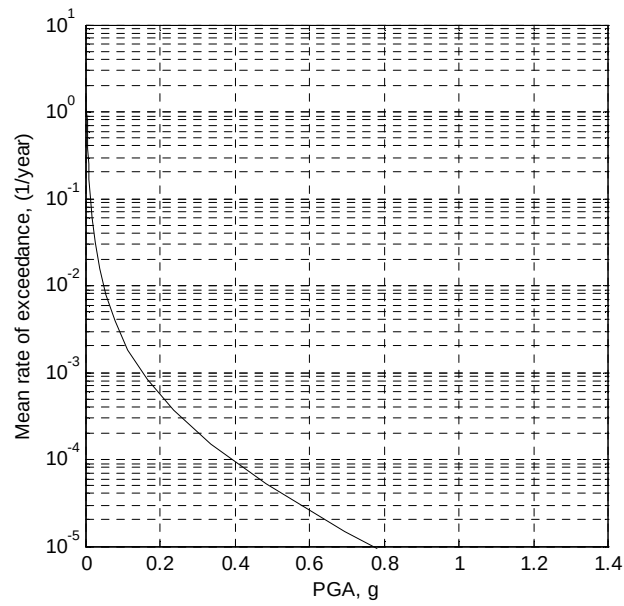


Figure 66. Seismic Hazard curve for Chamba (Site Type: D)

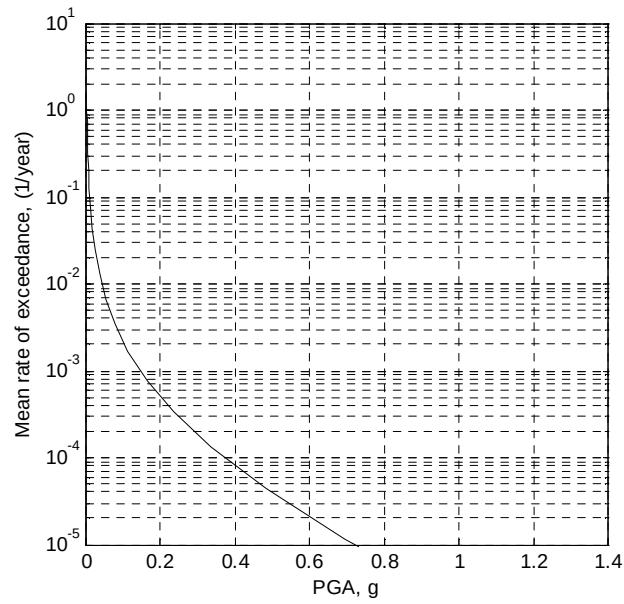


Figure 67. Seismic Hazard curve for Dhramshala (Site Type: C)

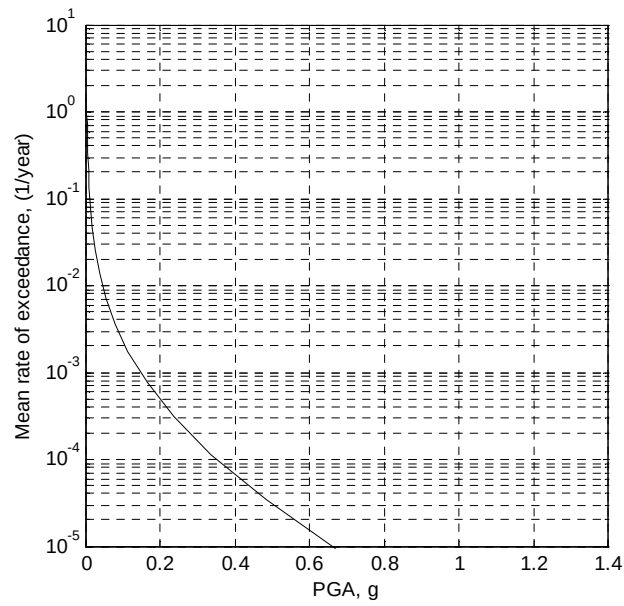


Figure 68. Seismic Hazard curve for Hamirpur (Site Type: C)

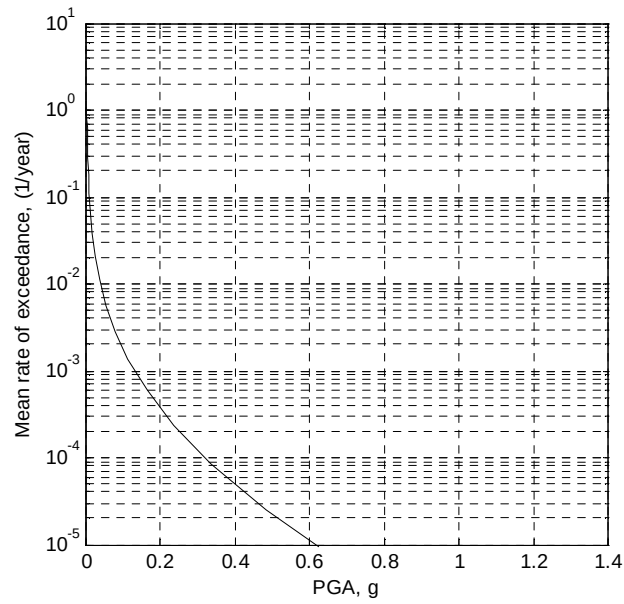


Figure 69. Seismic Hazard curve for Hamirpur (Site Type: D)

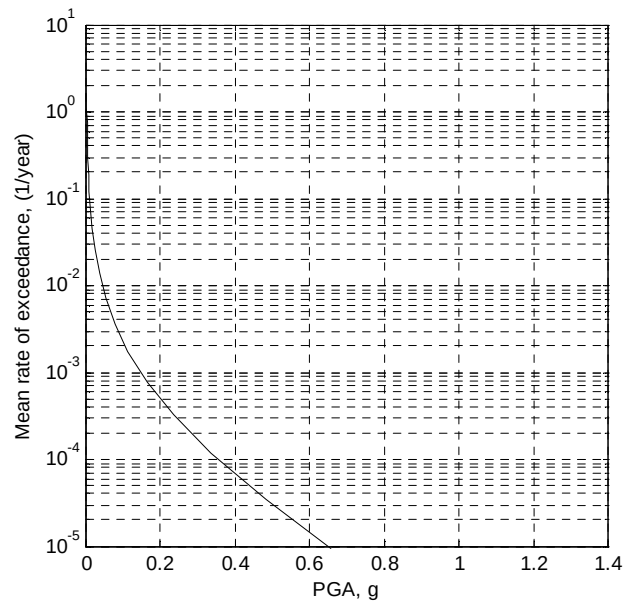


Figure 70. Seismic Hazard curve for Keylong (Site Type: C)

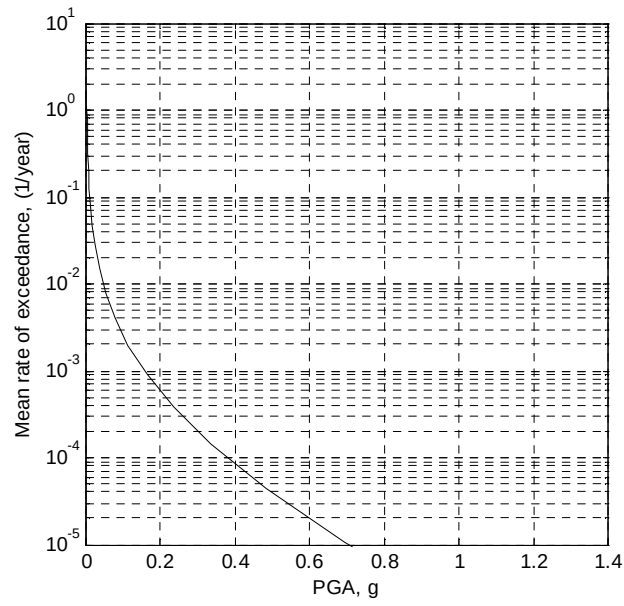


Figure 71. Seismic Hazard curve for Keylong (Site Type: D)

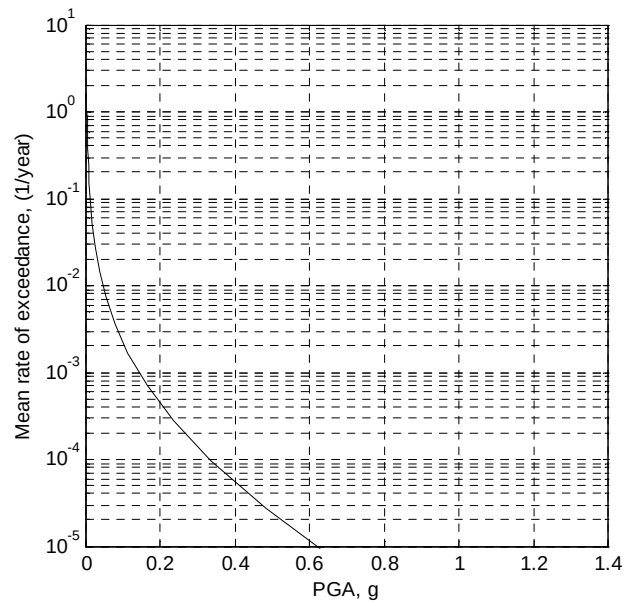


Figure 72. Seismic Hazard curve for Kullu (Site Type: C)

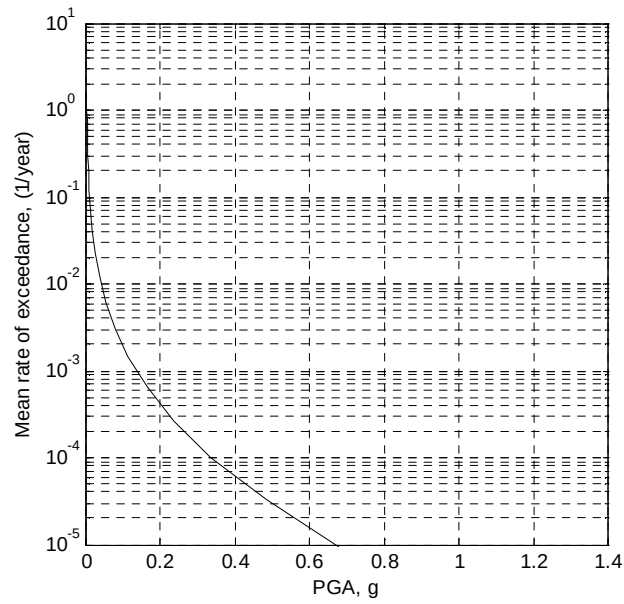


Figure 73. Seismic Hazard curve for Manali (Site Type: C)

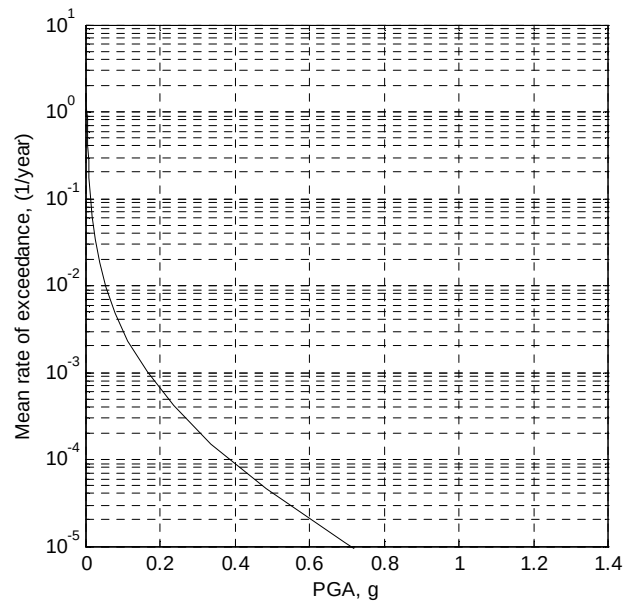


Figure 74. Seismic Hazard curve for Mandi (Site Type: C)

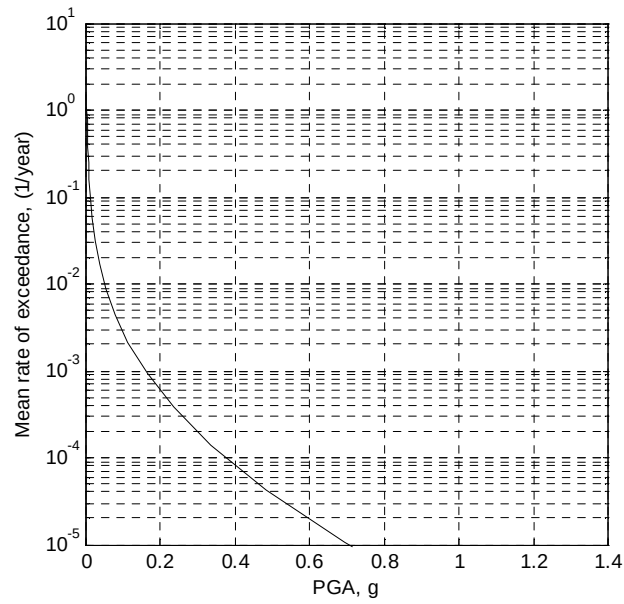


Figure 75. Seismic Hazard curve for Mandi (Site Type: D)

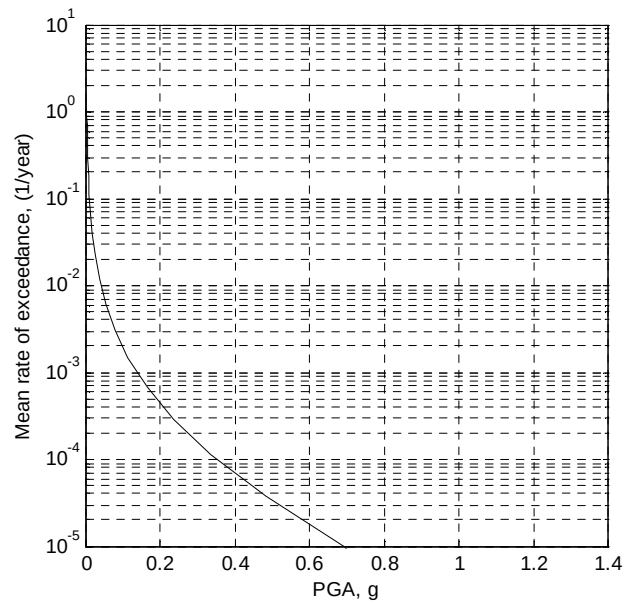


Figure 76. Seismic Hazard curve for Nahan (Site Type: C)

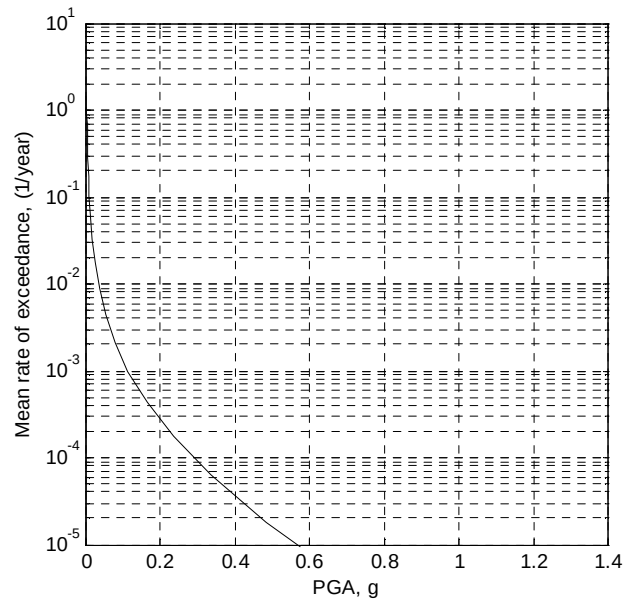


Figure 77. Seismic Hazard curve for Reckong Peo (Site Type: C)

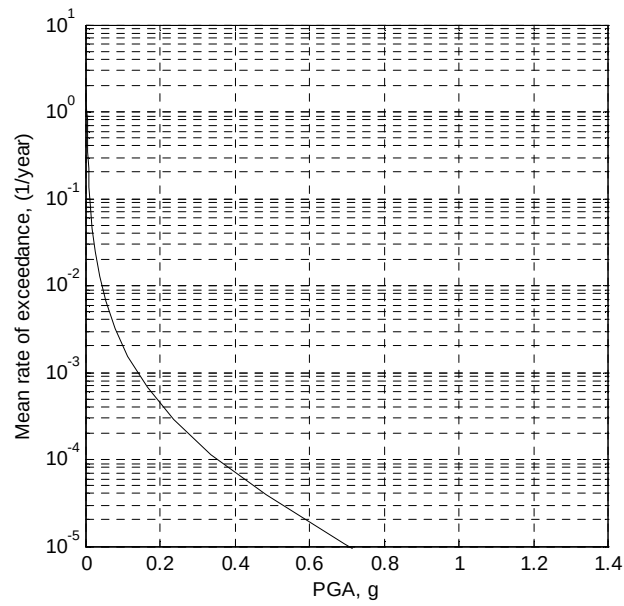


Figure 78. Seismic Hazard curve for Reckong Peo (Site Type: D)

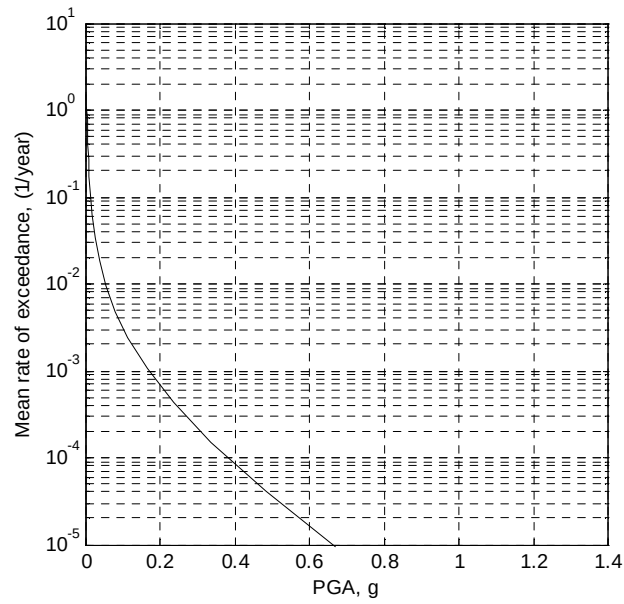


Figure 79. Seismic Hazard curve for Shimla (Site Type: C)

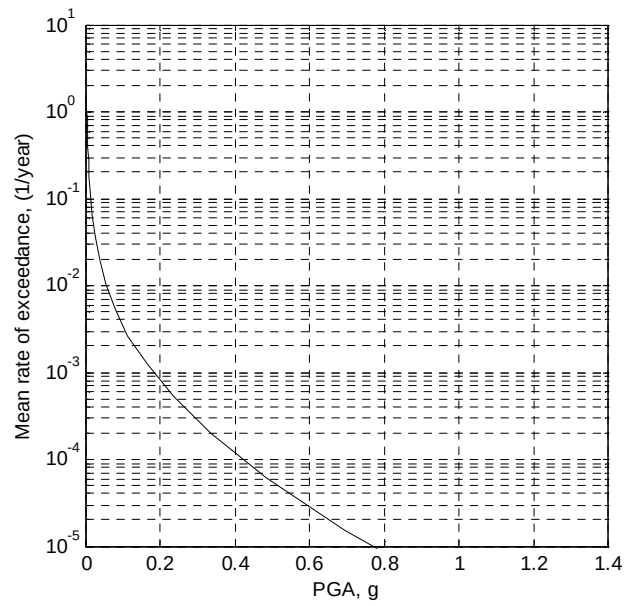


Figure 80. Seismic Hazard curve for Shimla (Site Type: D)

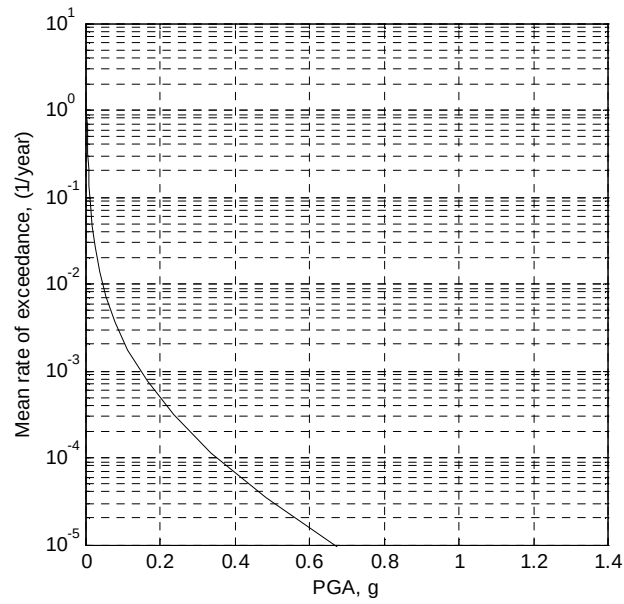


Figure 81. Seismic Hazard curve for Solan (Site Type: C)

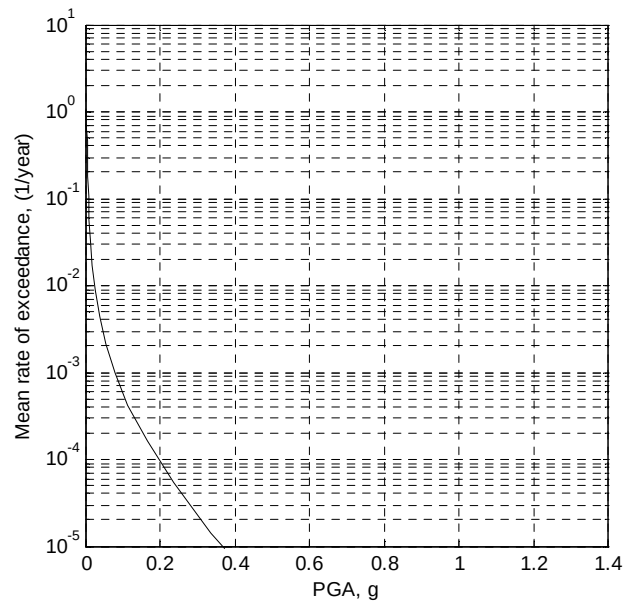


Figure 82. Seismic Hazard curve for Una (Site Type: D)

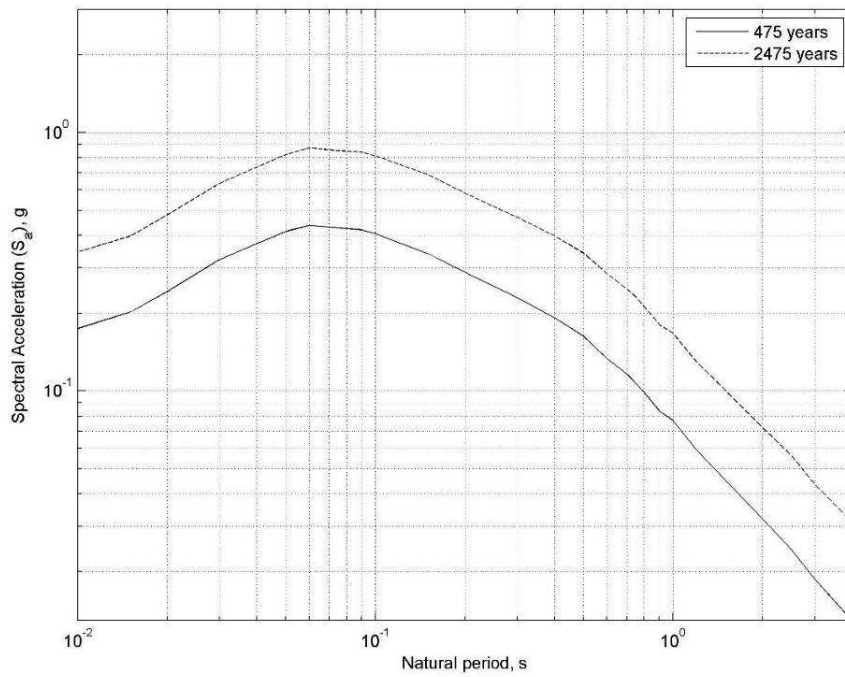


Figure 83. Uniform Hazard Response Spectra at Bilaspur (Site Type: C)

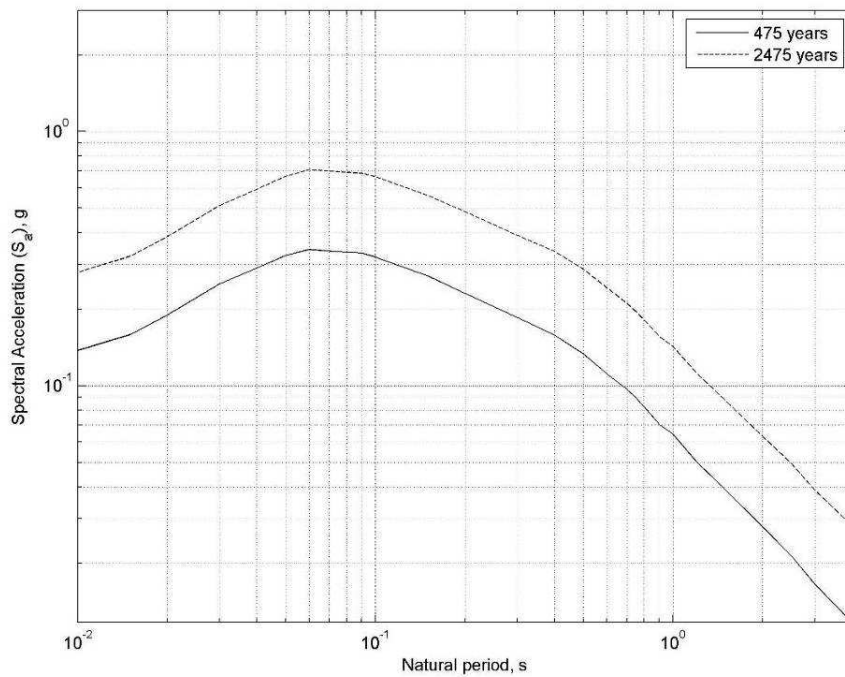


Figure 84. Uniform Hazard Response Spectra at Chamba (Site Type: C)

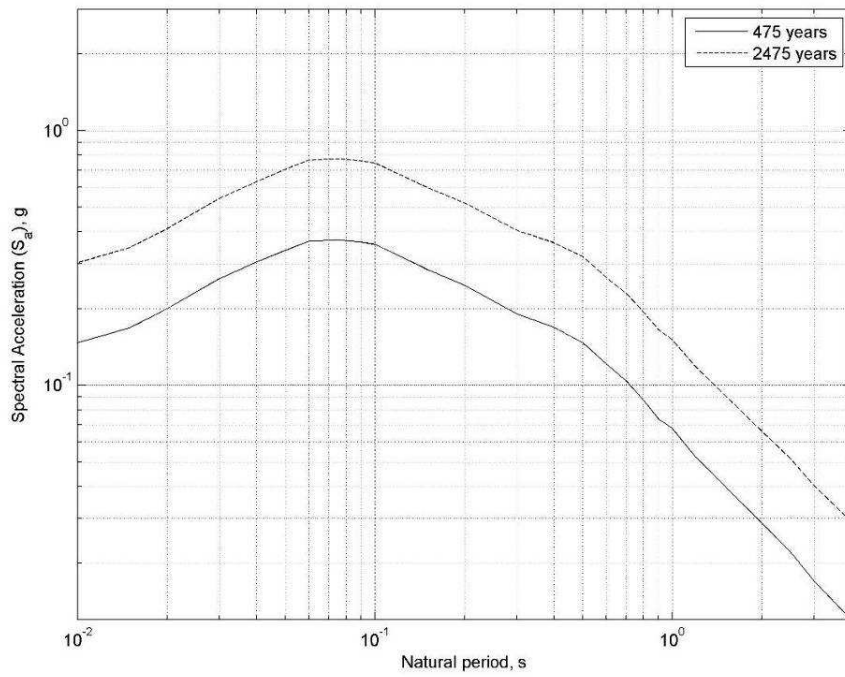


Figure 85. Uniform Hazard Response Spectra at Uniform Hazard Response Spectra at Chamba (Site Type: D)

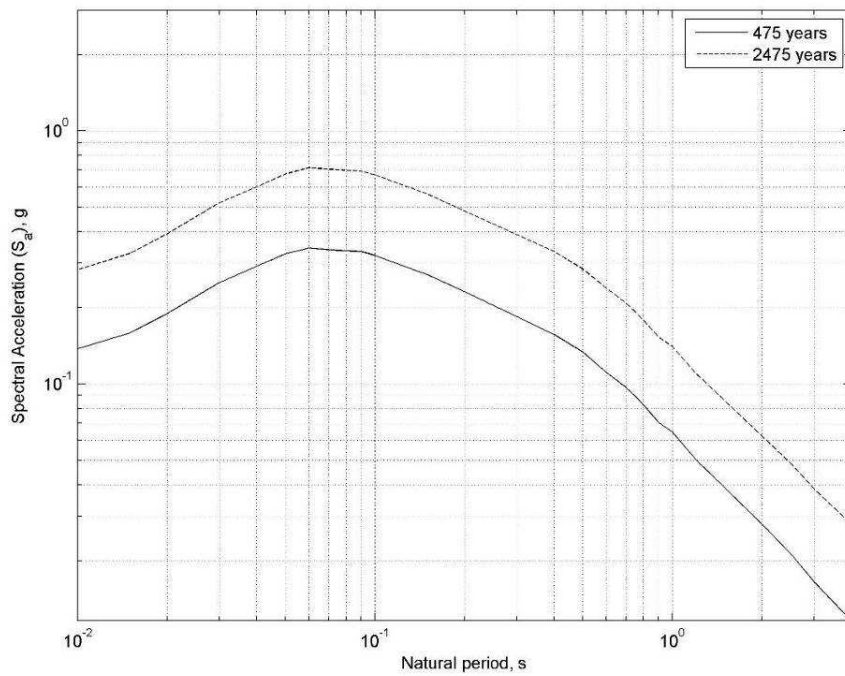


Figure 86. Uniform Hazard Response Spectra at Uniform Hazard Response Spectra at Dhramshala (Site Type: C)

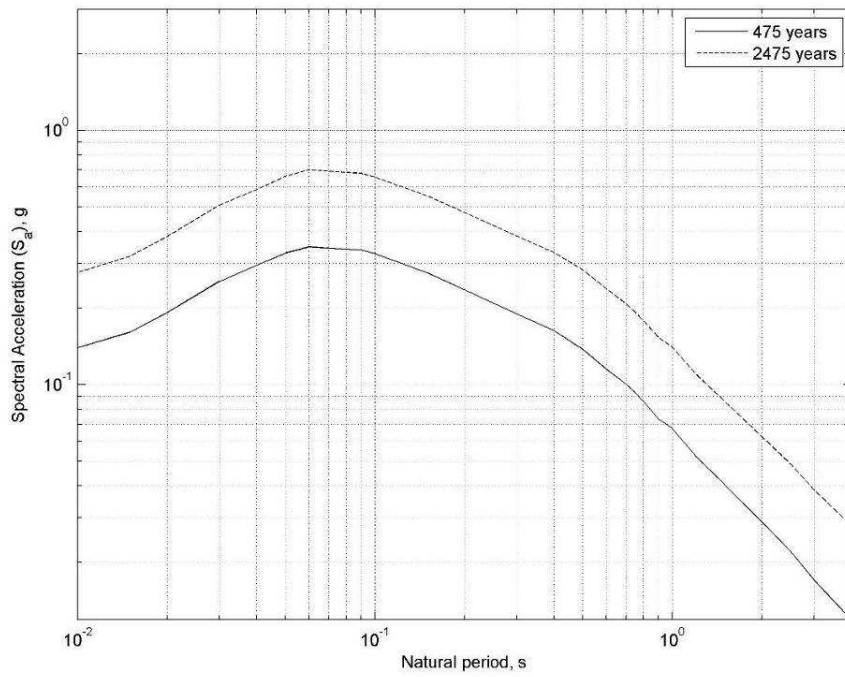


Figure 87. Uniform Hazard Response Spectra at Hamirpur (Site Type: C)

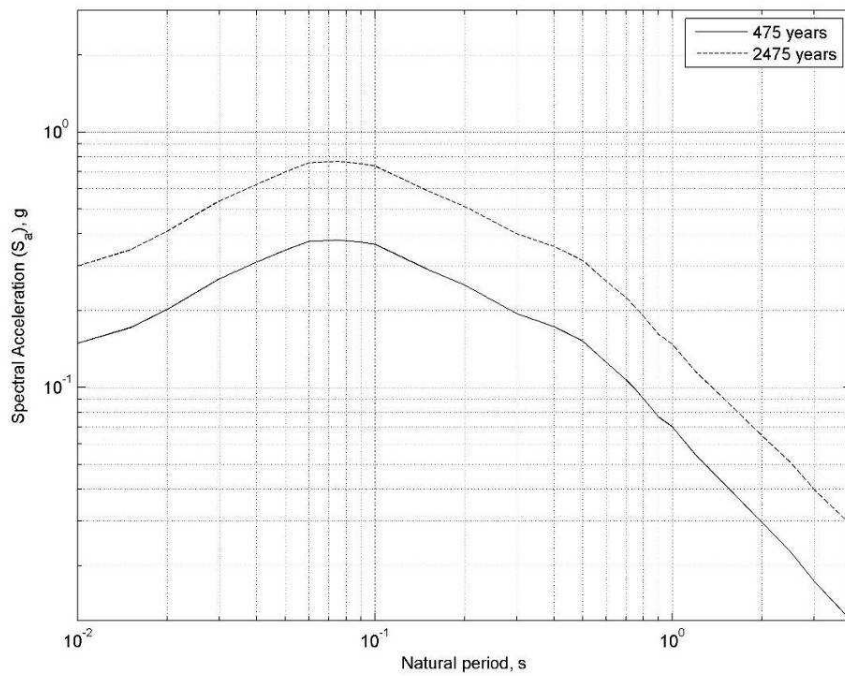


Figure 88. Uniform Hazard Response Spectra at Hamirpur (Site Type: D)

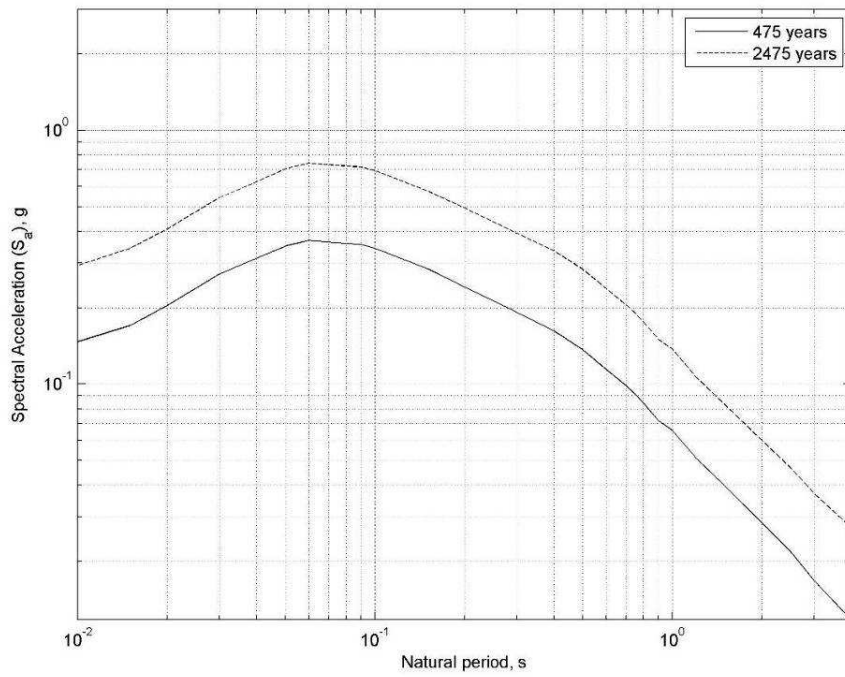


Figure 89. Uniform Hazard Response Spectra at Keylong (Site Type: C)

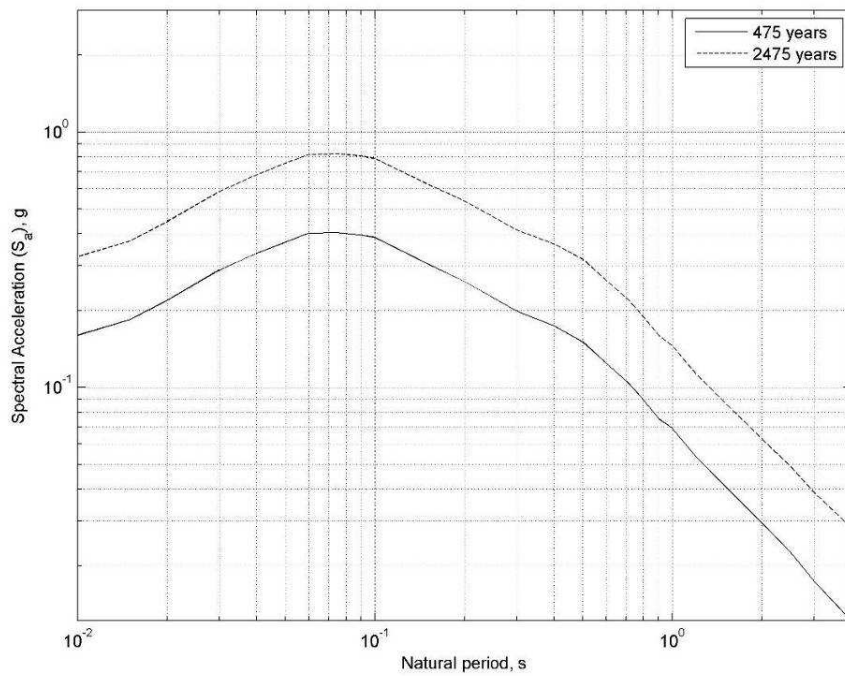


Figure 90. Uniform Hazard Response Spectra at Keylong (Site Type: D)

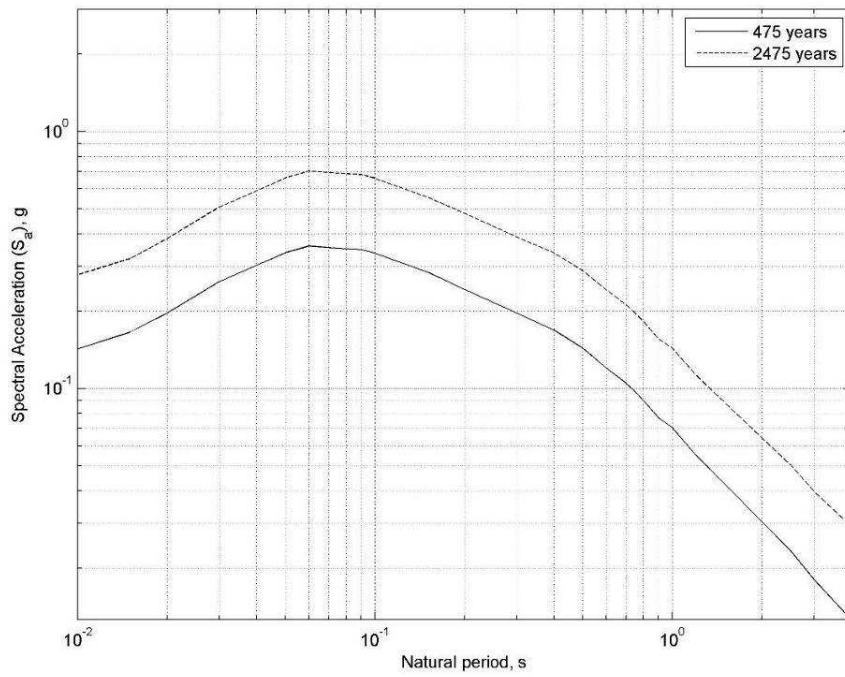


Figure 91. Uniform Hazard Response Spectra at Kullu (Site Type: C)

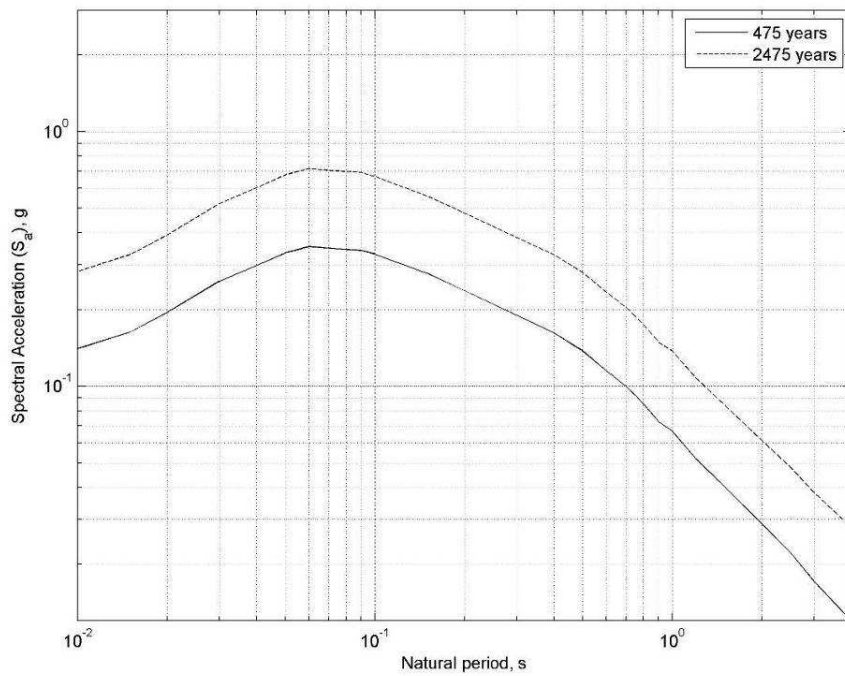


Figure 92. Uniform Hazard Response Spectra at Manali (Site Type: C)

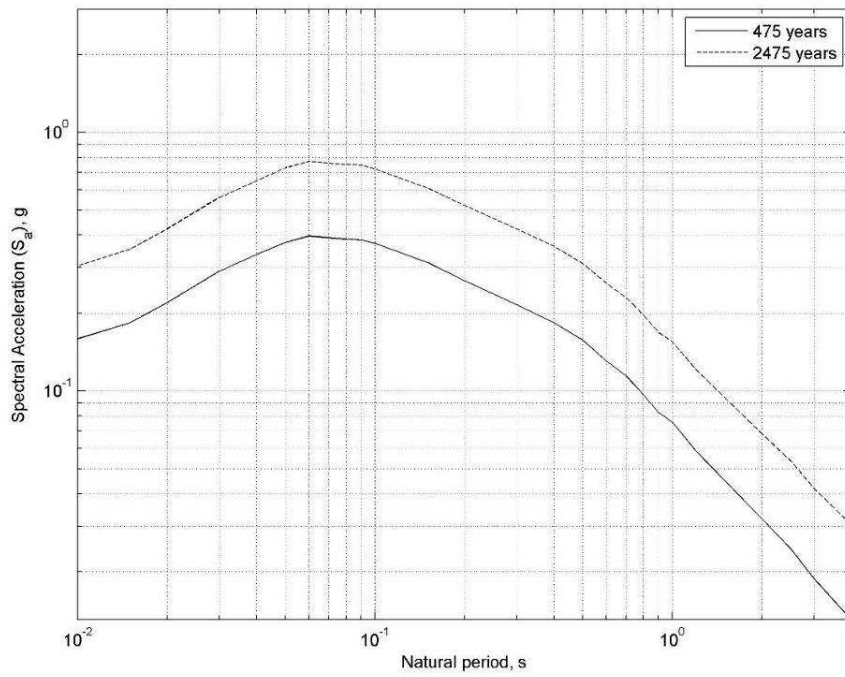


Figure 93. Uniform Hazard Response Spectra at Mandi (Site Type: C)

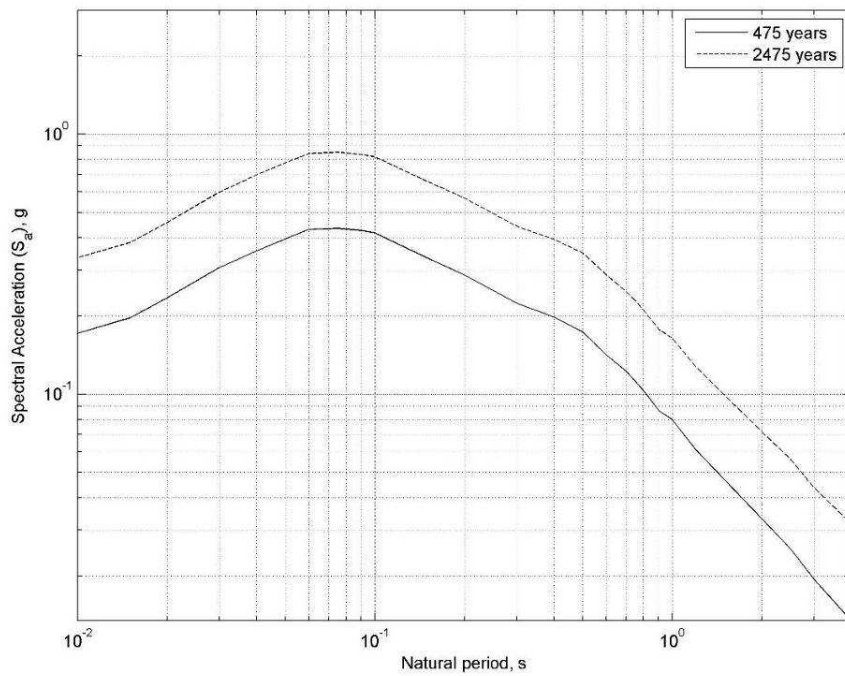


Figure 94. Uniform Hazard Response Spectra at Mandi (Site Type: D)

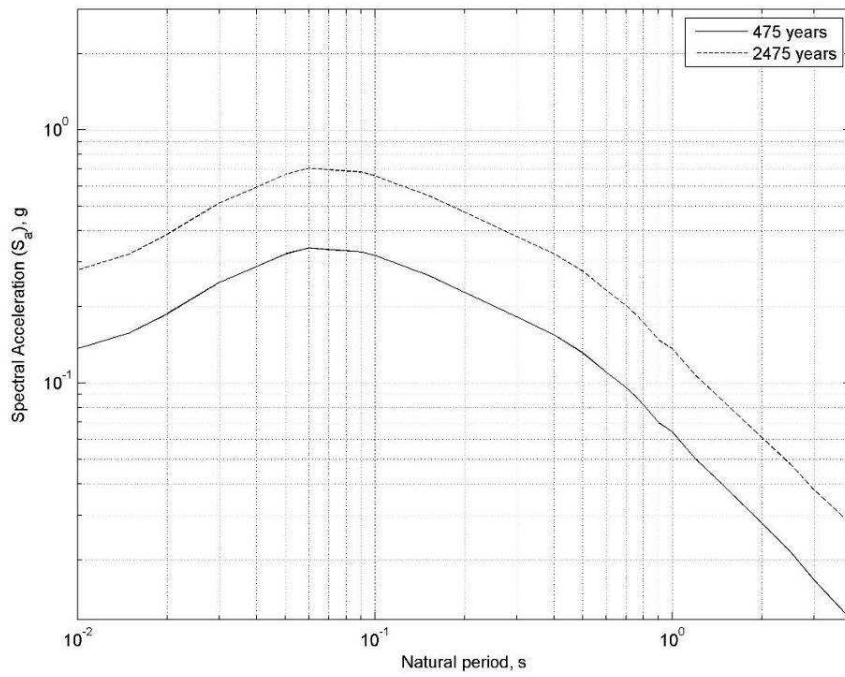


Figure 95. Uniform Hazard Response Spectra at Nahan (Site Type: C)

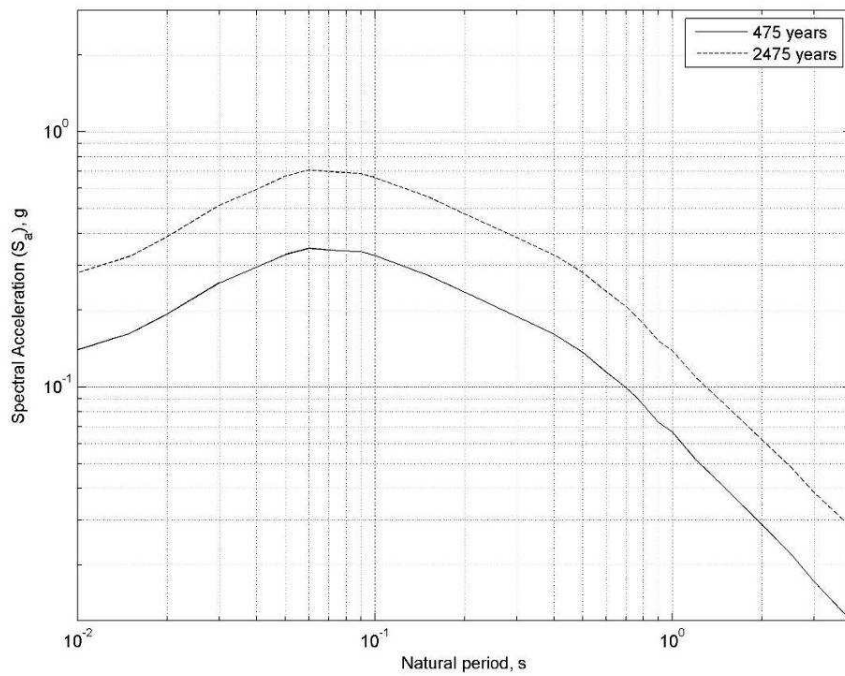


Figure 96. Uniform Hazard Response Spectra at Reckong Peo (Site Type: C)

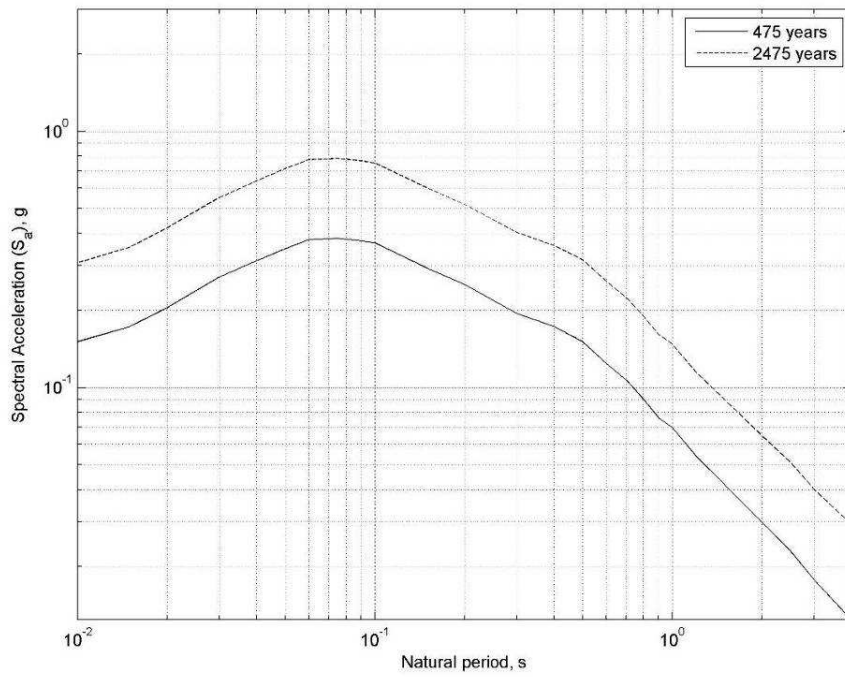


Figure 97. Uniform Hazard Response Spectra at Reckong Peo (Site Type: D)

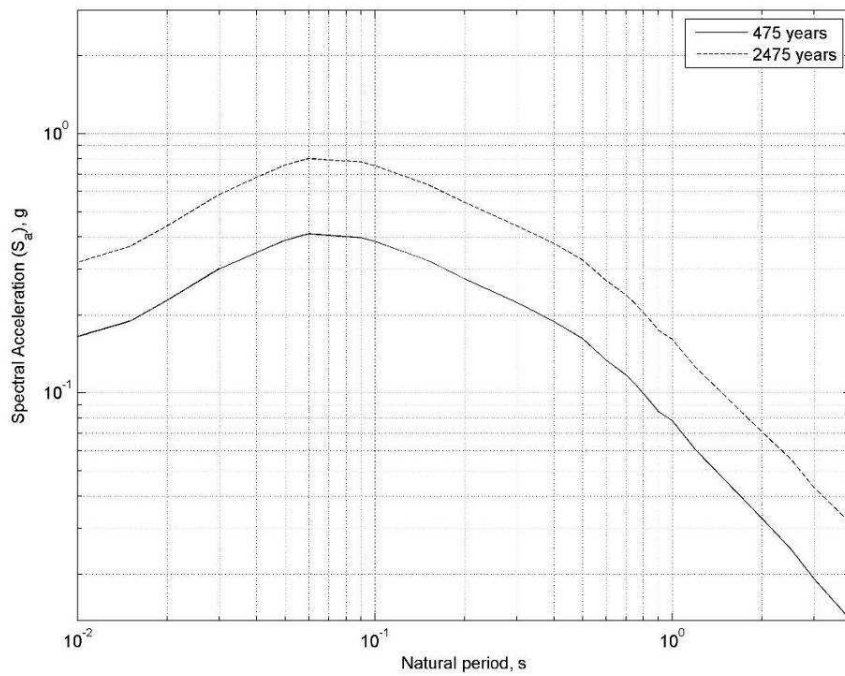


Figure 98. Uniform Hazard Response Spectra at Shimla (Site Type: C)

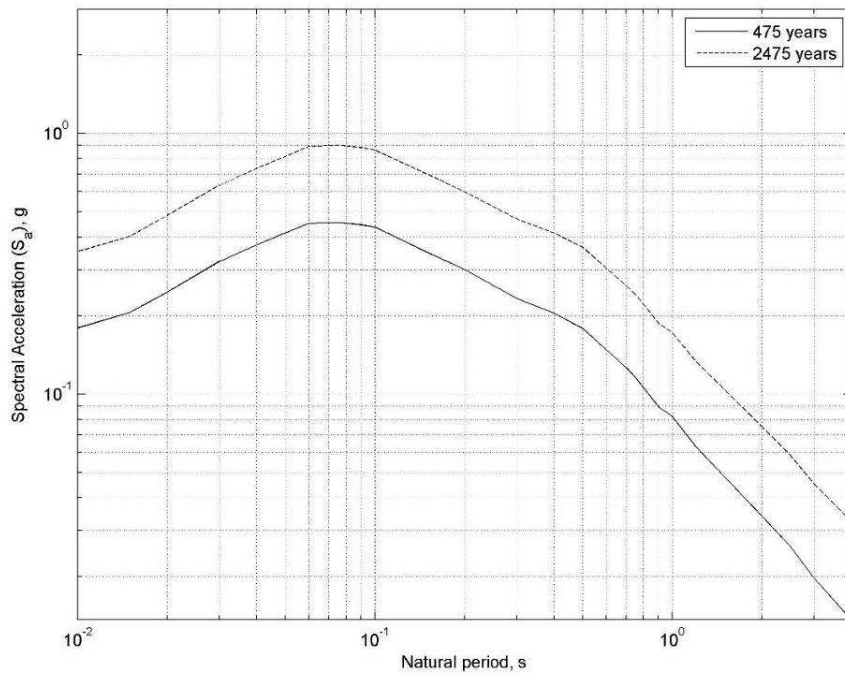


Figure 99. Uniform Hazard Response Spectra at Shimla (Site Type: D)

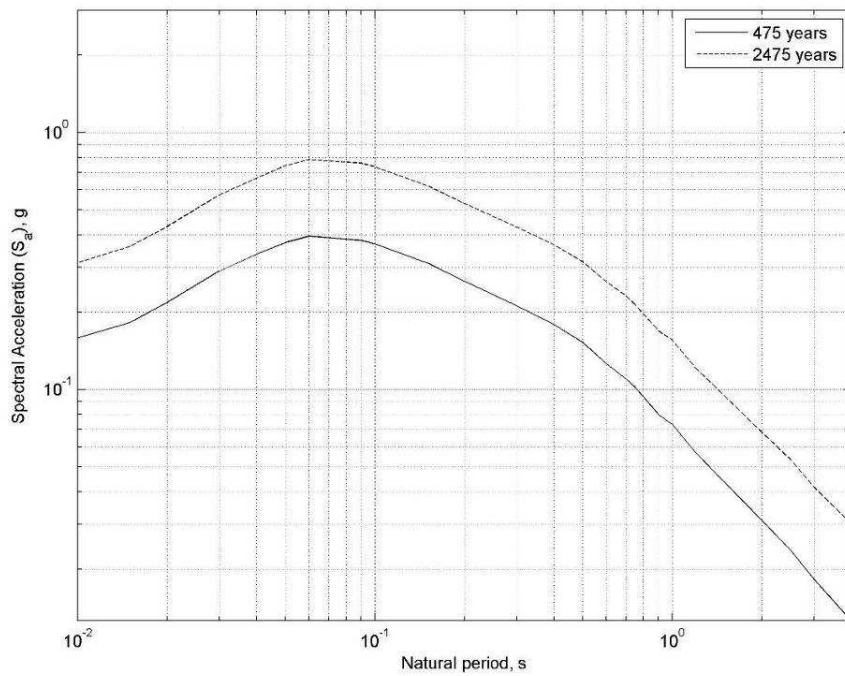


Figure 100. Uniform Hazard Response Spectra at Solan (Site Type: C)

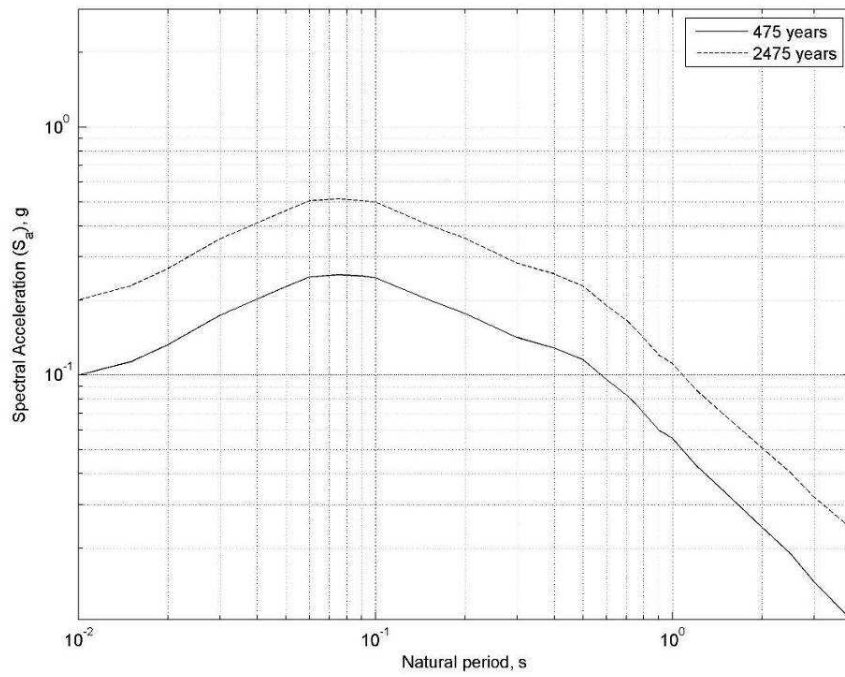


Figure 101. Uniform Hazard Response Spectra at Uniform Hazard Response Spectra at Una (Site Type: D)

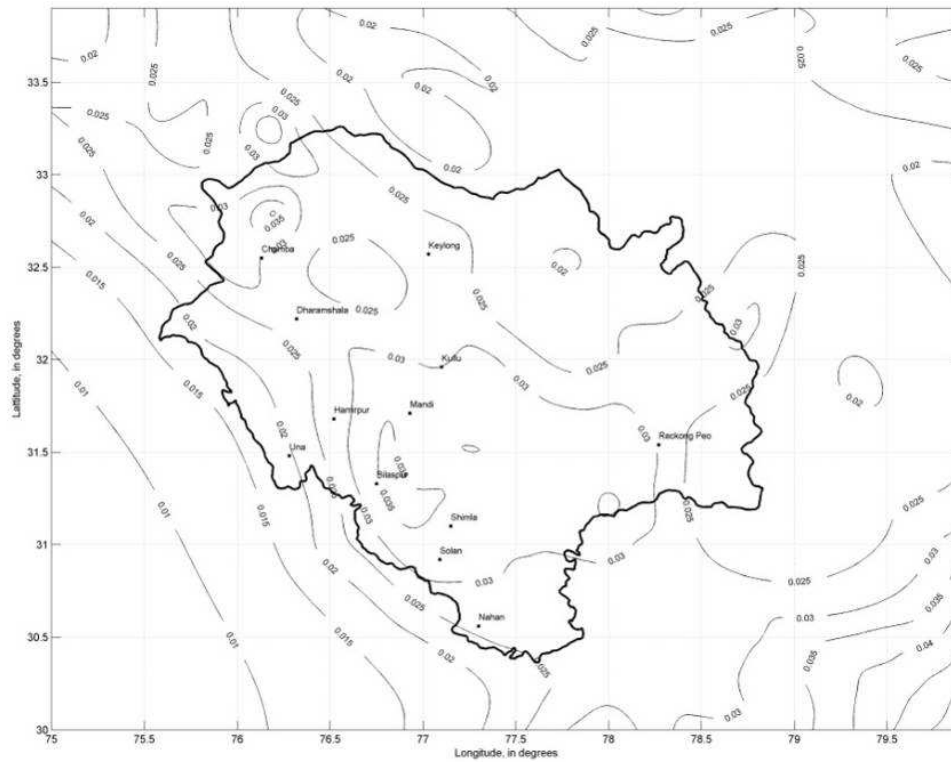


Figure 102. PGA contours with a return period of 25 years for C-Type sites

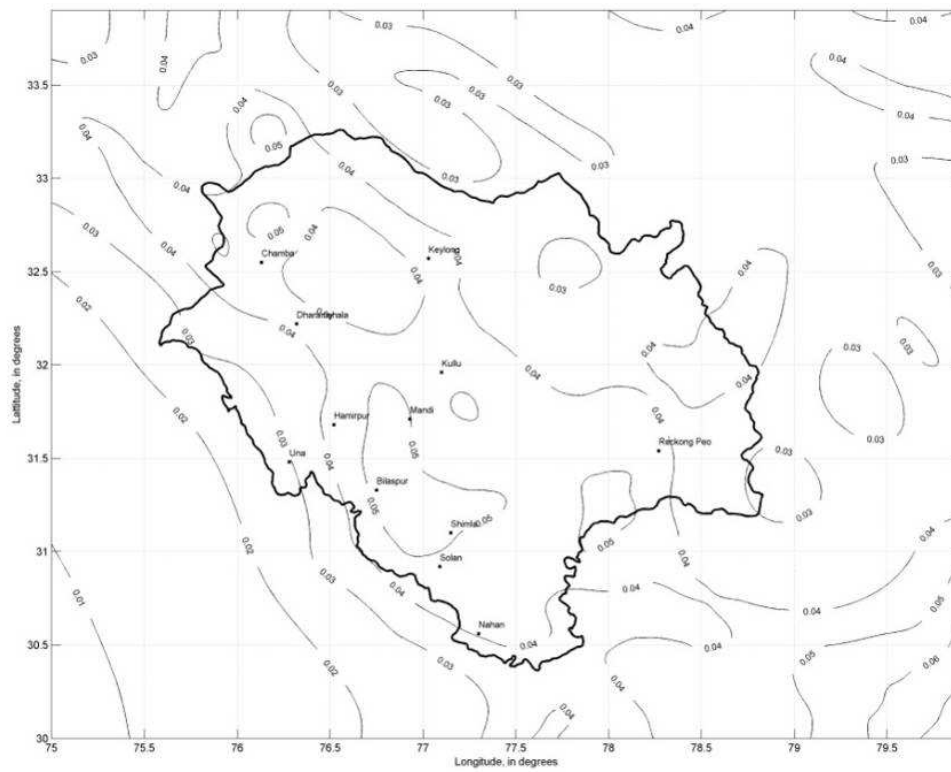


Figure 103. PGA contours with a return period of 50 years for C-Type sites

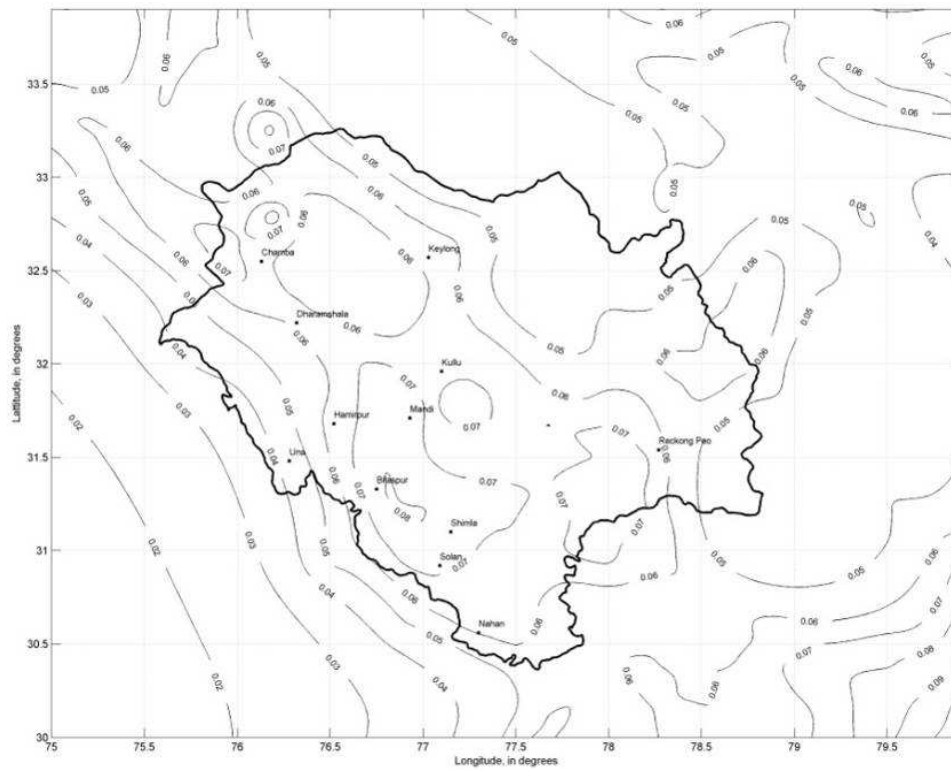


Figure 104. PGA contours with a return period of 100 years for C-Type sites

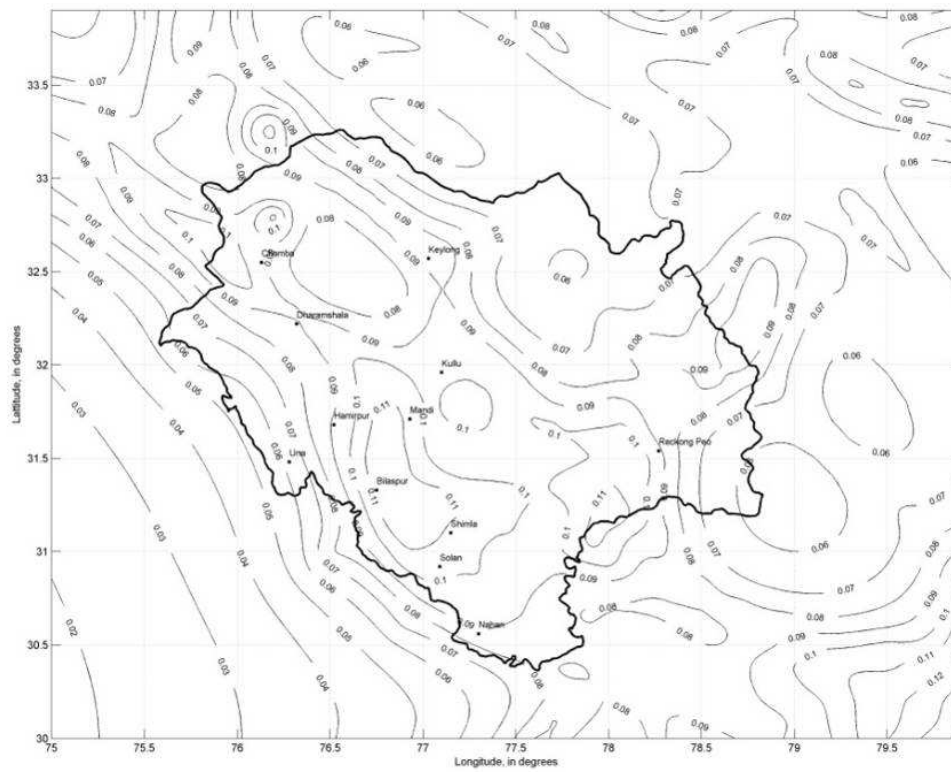


Figure 105. PGA contours with a return period of 200 years for C-Type sites

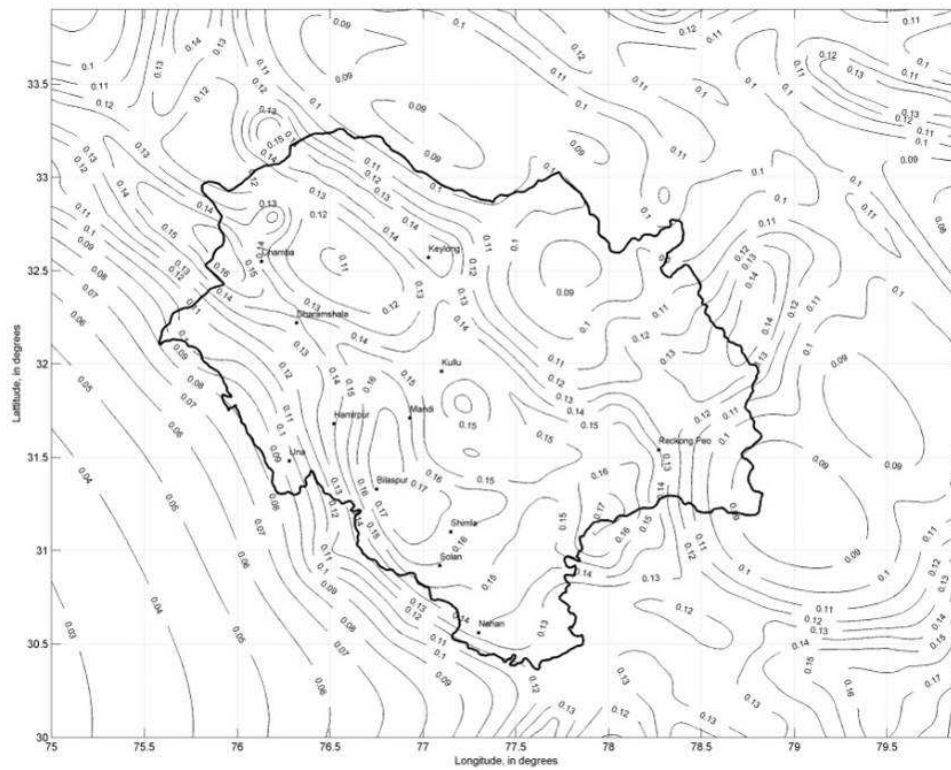


Figure 106. PGA contours with a return period of 475 years for C-Type sites

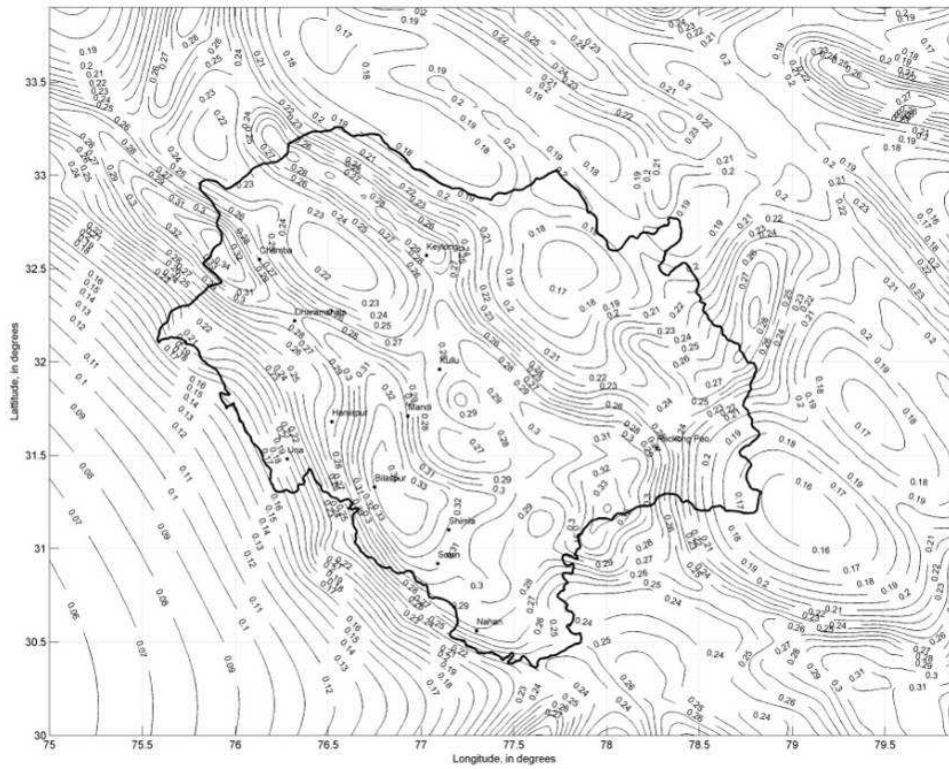


Figure 107. PGA contours with a return period of 2475 years for C-Type sites

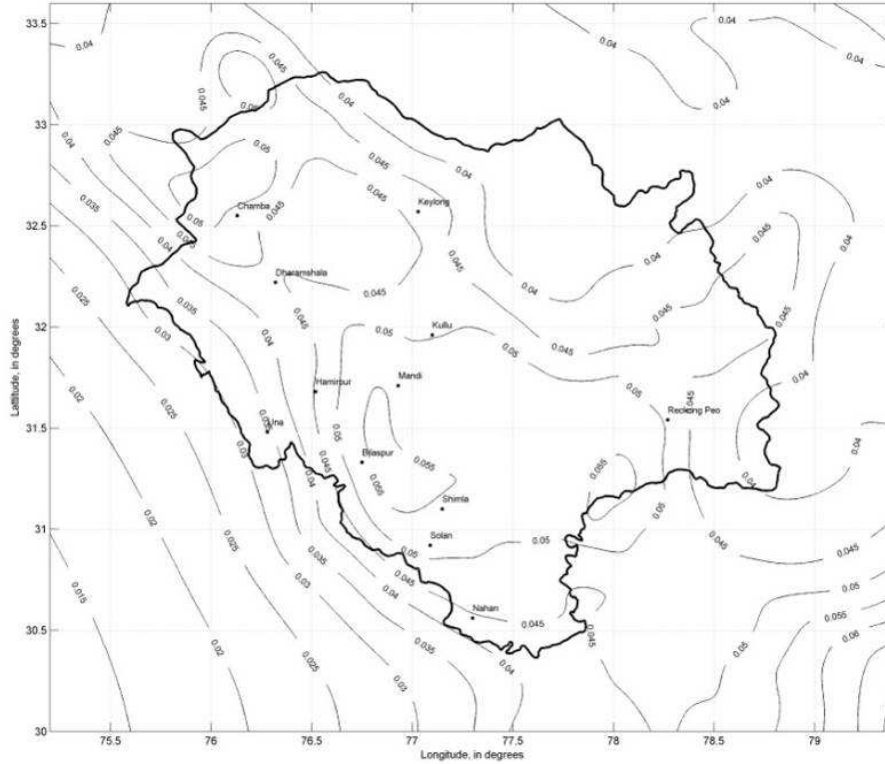


Figure 108. $S_{a0.2s}$ contours with a return period of 25 years for C-Type sites

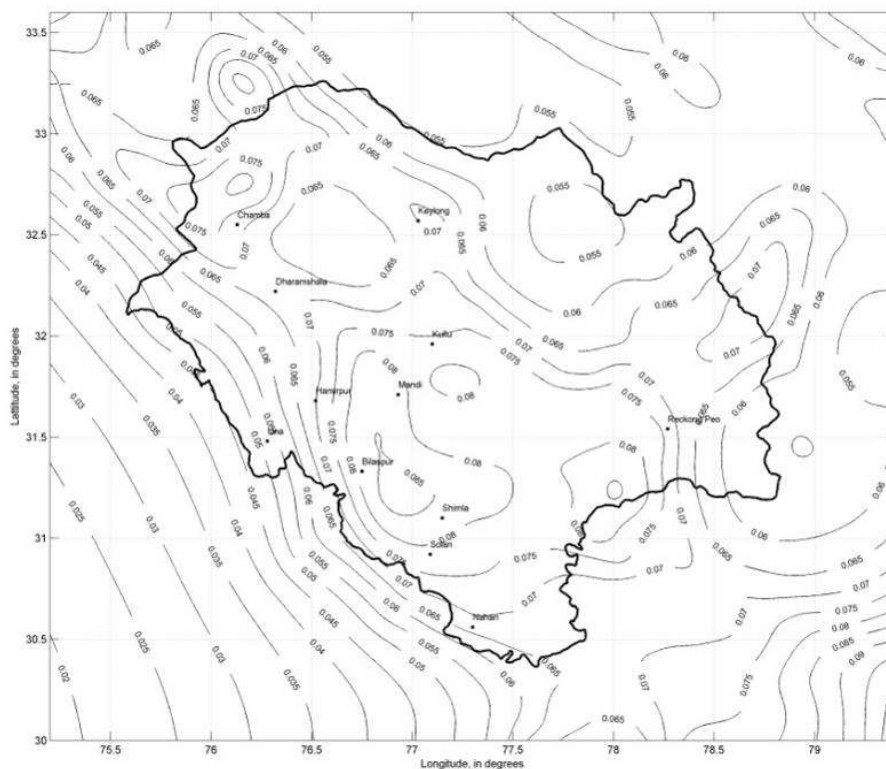


Figure 109. $Sa_{0.2s}$ contours with a return period of 50 years for C-Type sites

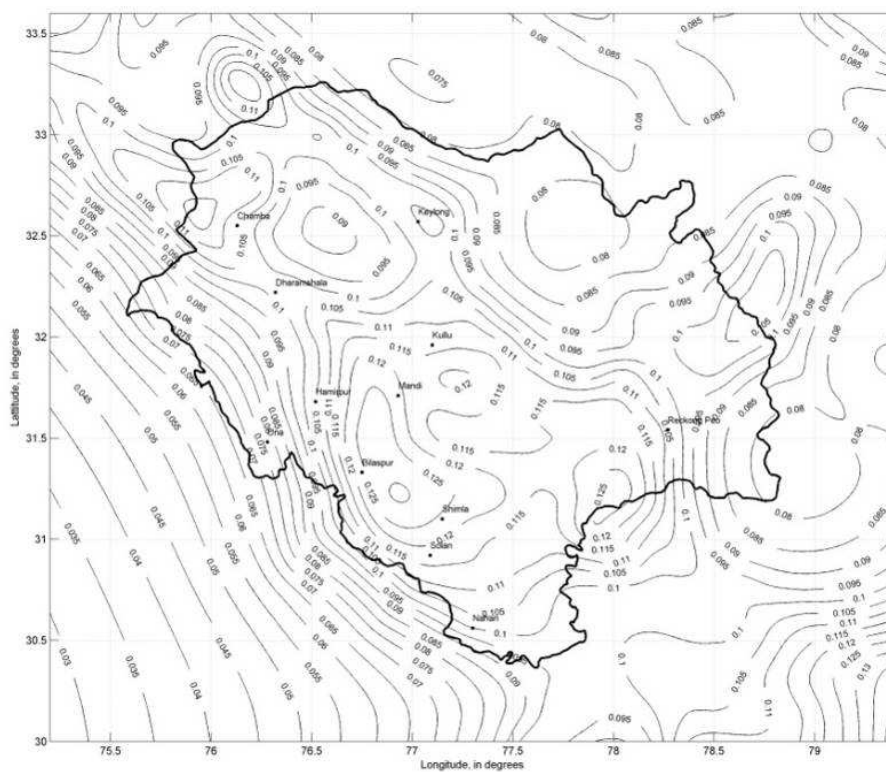


Figure 110. $Sa_{0.2s}$ contours with a return period of 100 years for C-Type sites

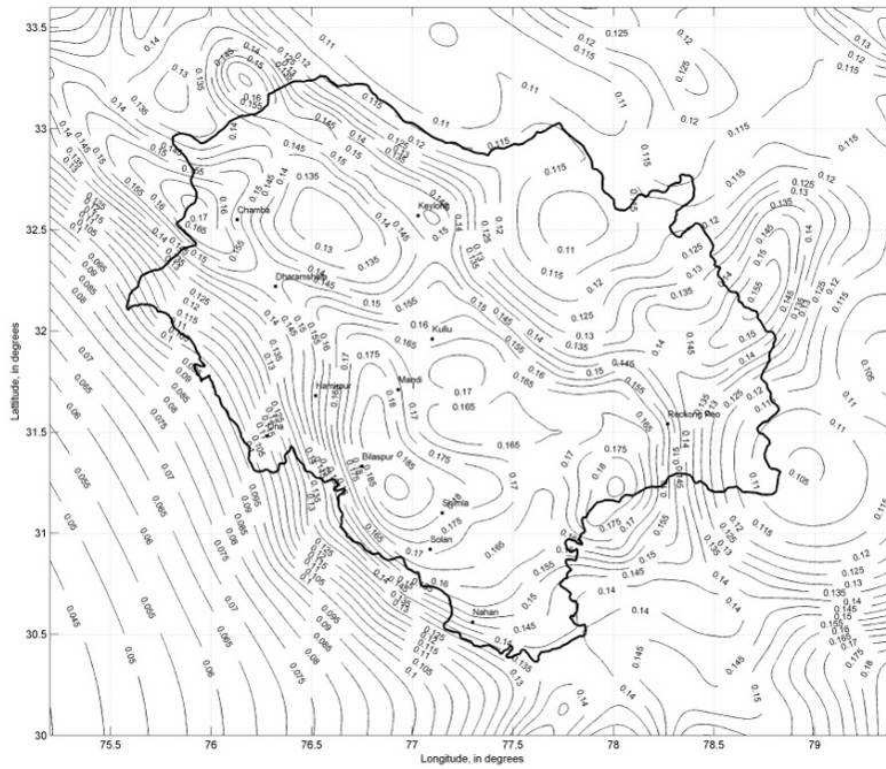


Figure 111. $Sa_{0.2s}$ contours with a return period of 200 years for C-Type sites

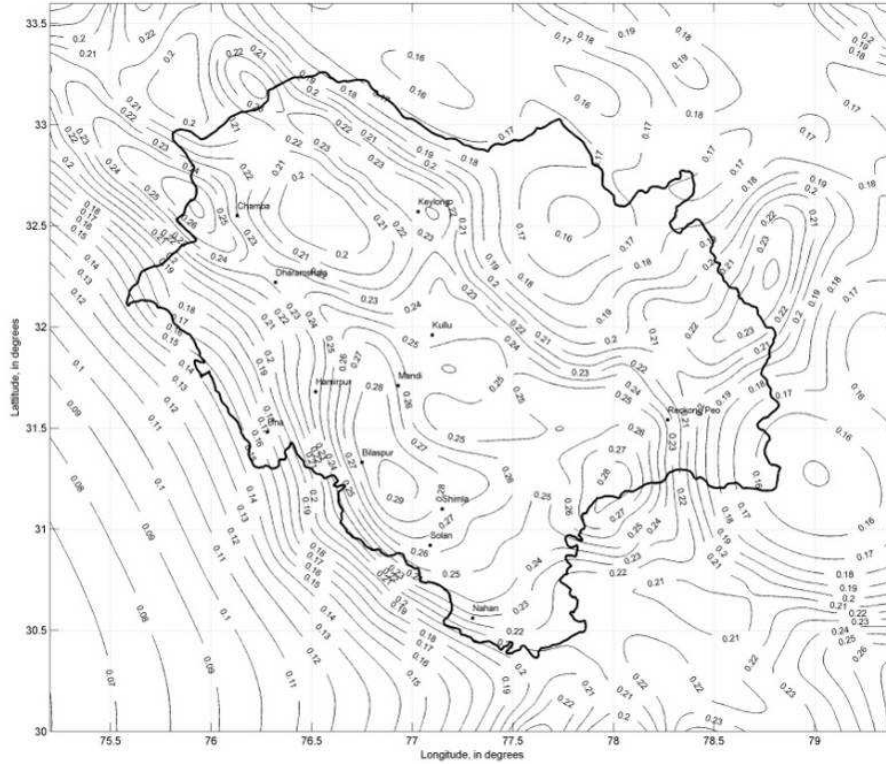


Figure 112. $Sa_{0.2s}$ contours with a return period of 475 years for C-Type sites

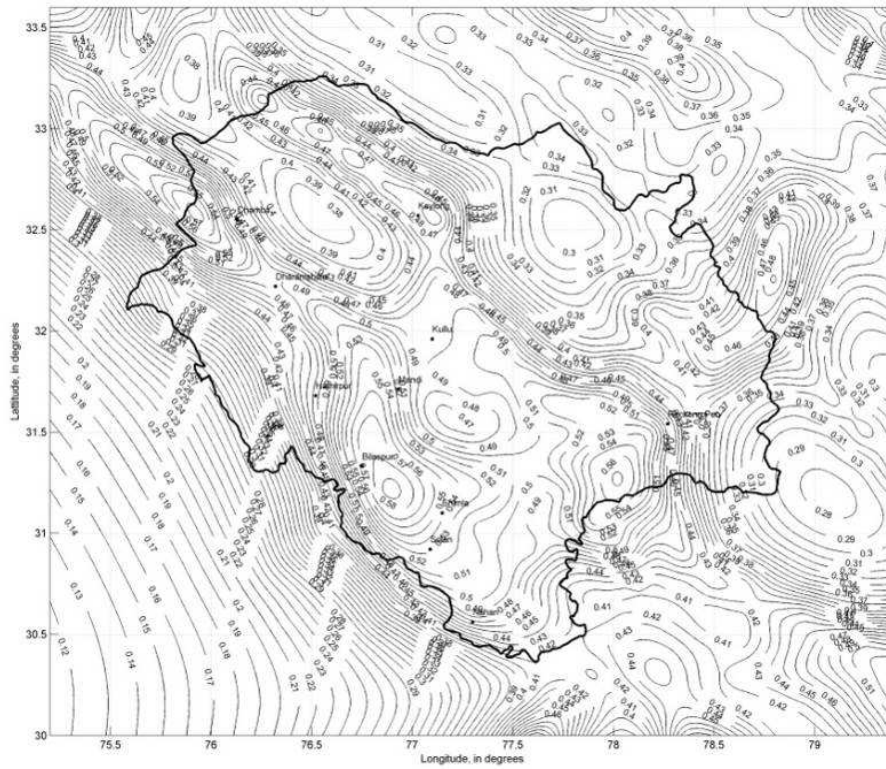


Figure 113. $Sa_{0.2s}$ contours with a return period of 2475 years for C-Type sites

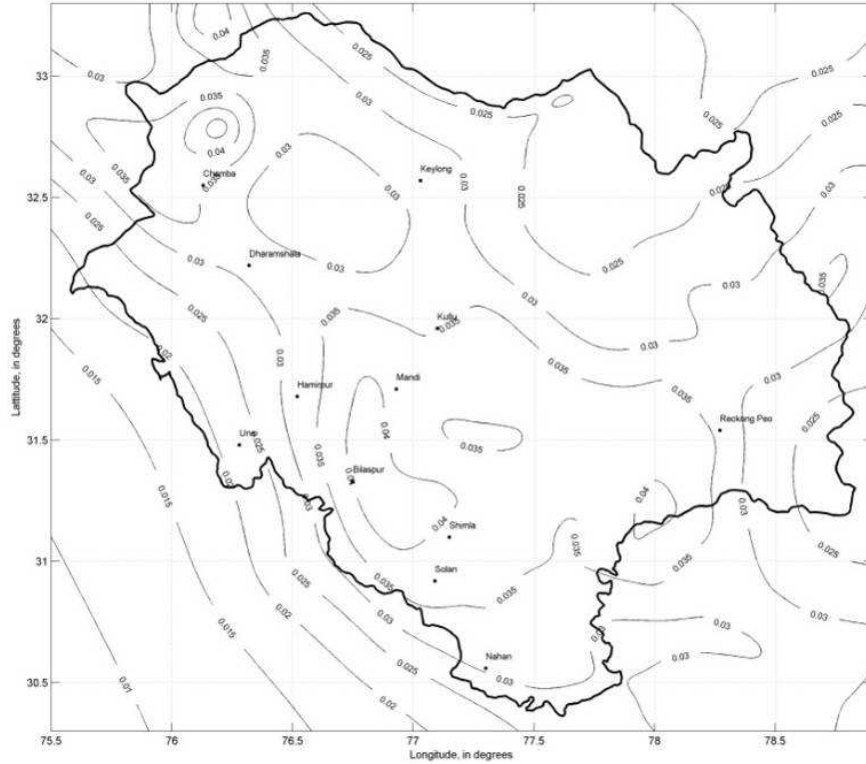


Figure 114. $Sa_{1.0s}$ contours with a return period of 25 years for C-Type sites

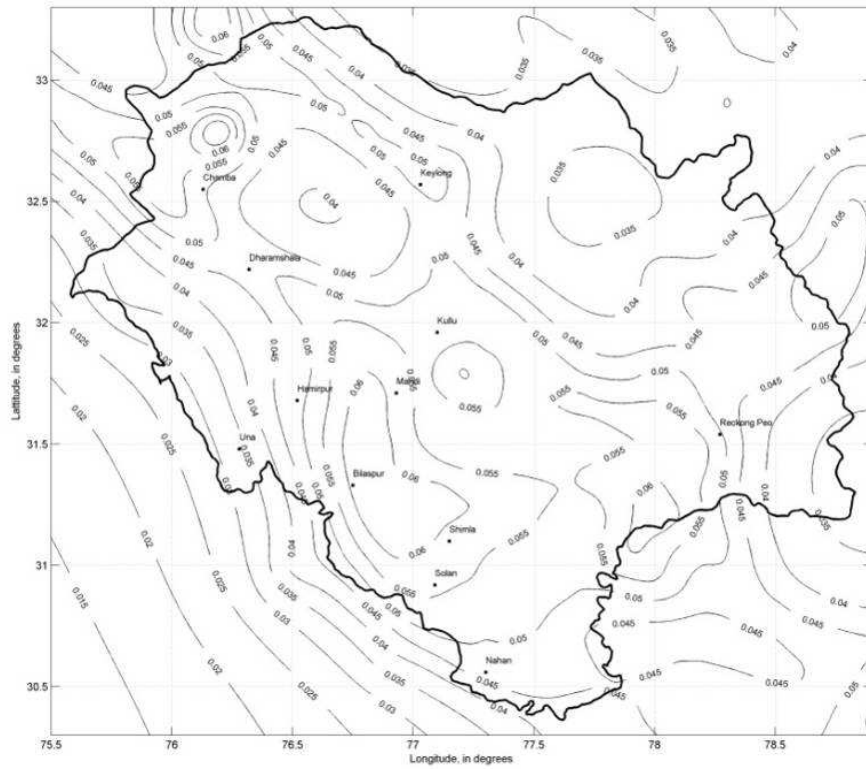


Figure 115. $Sa_{1.0s}$ contours with a return period of 50 years for C-Type sites

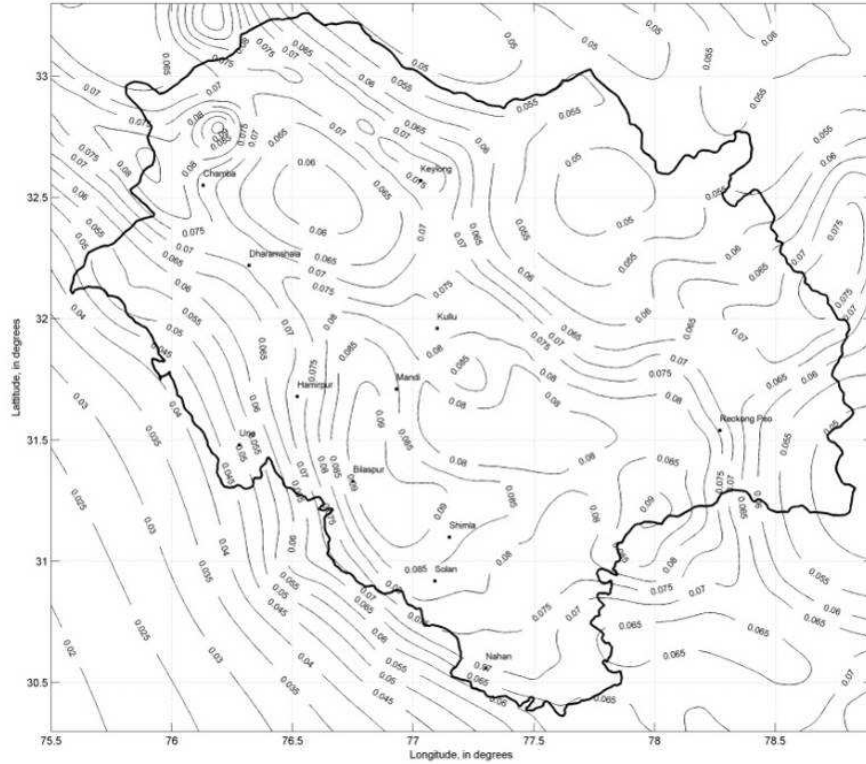


Figure 116. $Sa_{1.0s}$ contours with a return period of 100 years for C-Type sites

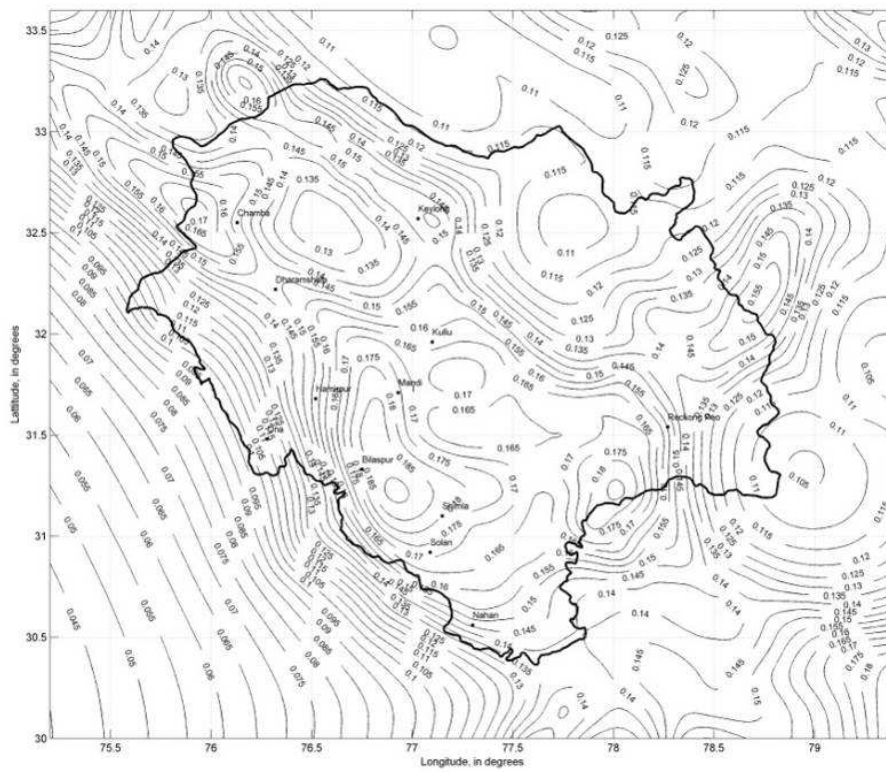


Figure 117. $Sa_{1.0s}$ contours with a return period of 200 years for C-Type sites

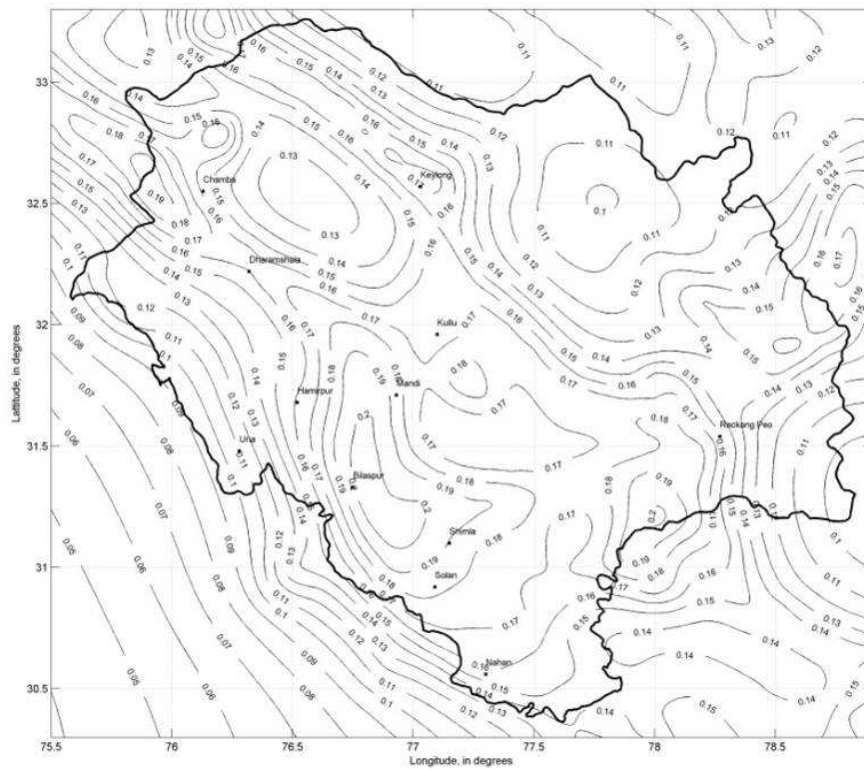


Figure 118. $Sa_{1.0s}$ contours with a return period of 475 years for C-Type sites

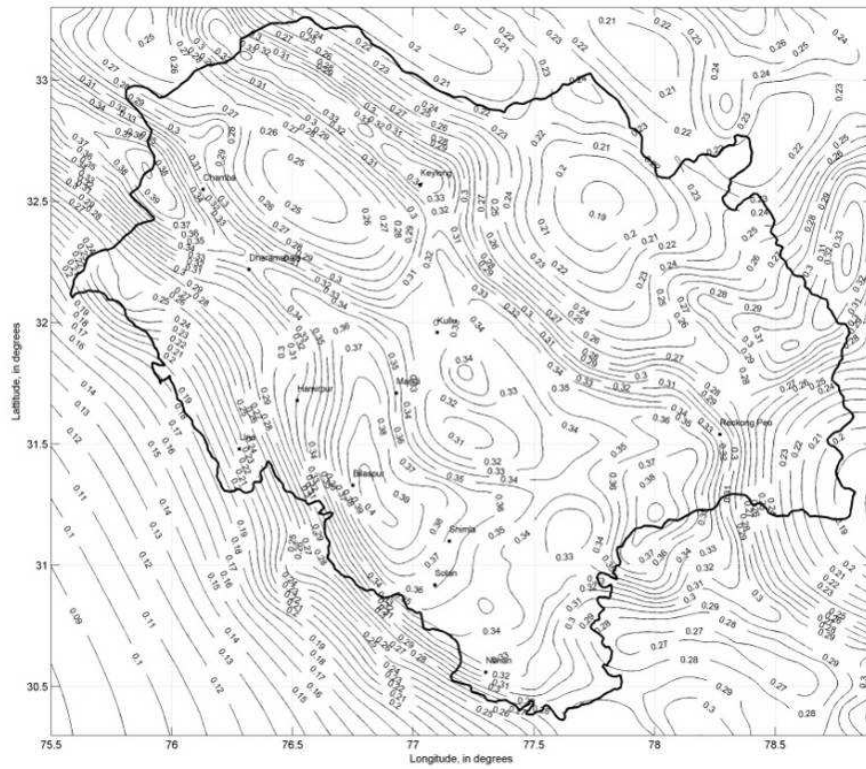


Figure 119. $Sa_{1.0s}$ contours with a return period of 2475 years for C-Type sites

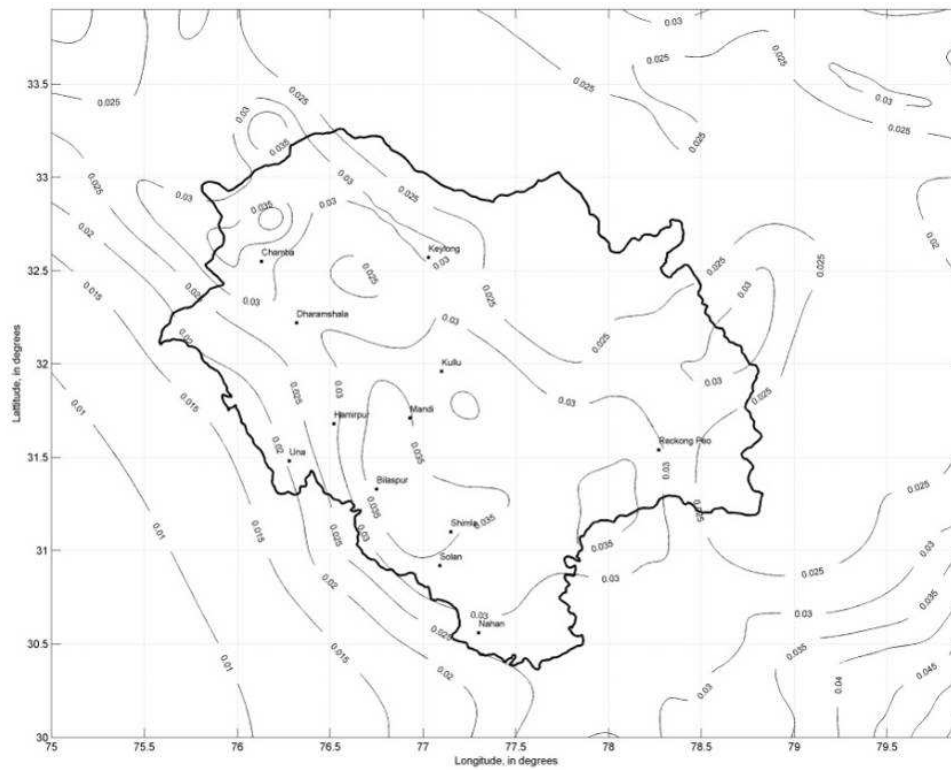


Figure 120. PGA contours with a return period of 25 years for D-Type sites

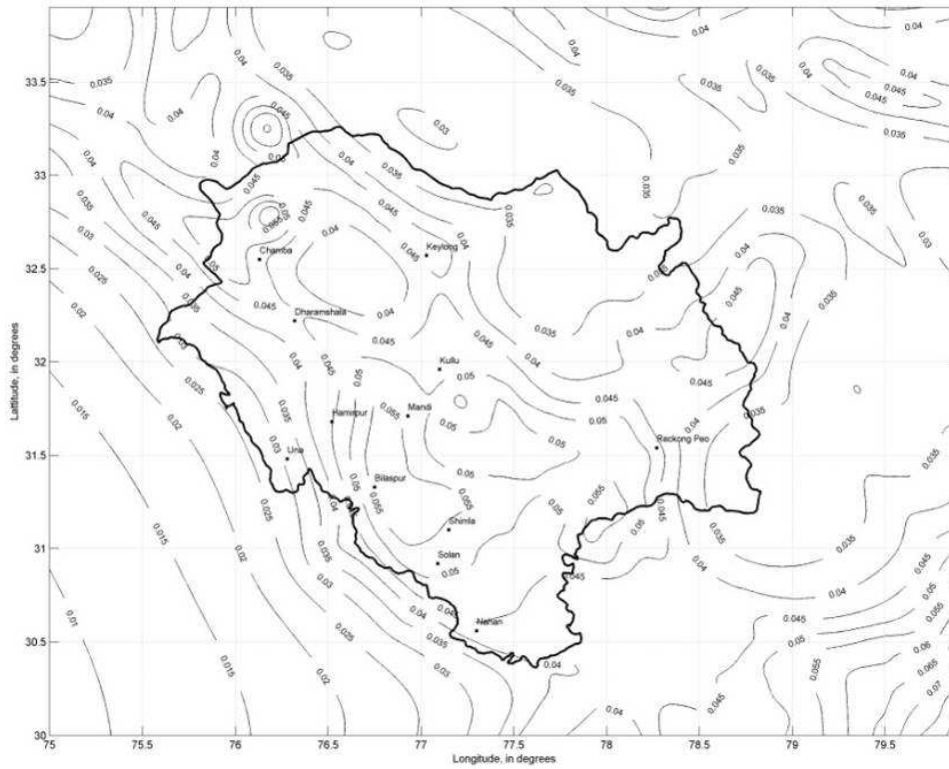


Figure 121. PGA contours with a return period of 50 years for D-Type sites

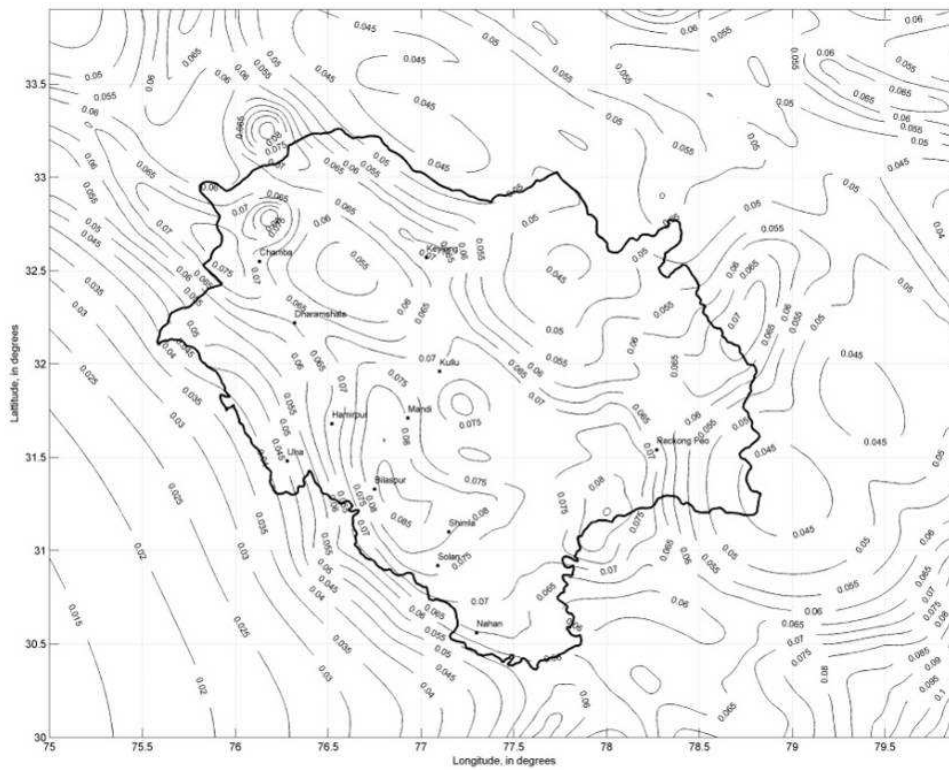


Figure 122. PGA contours with a return period of 100 years for D-Type sites

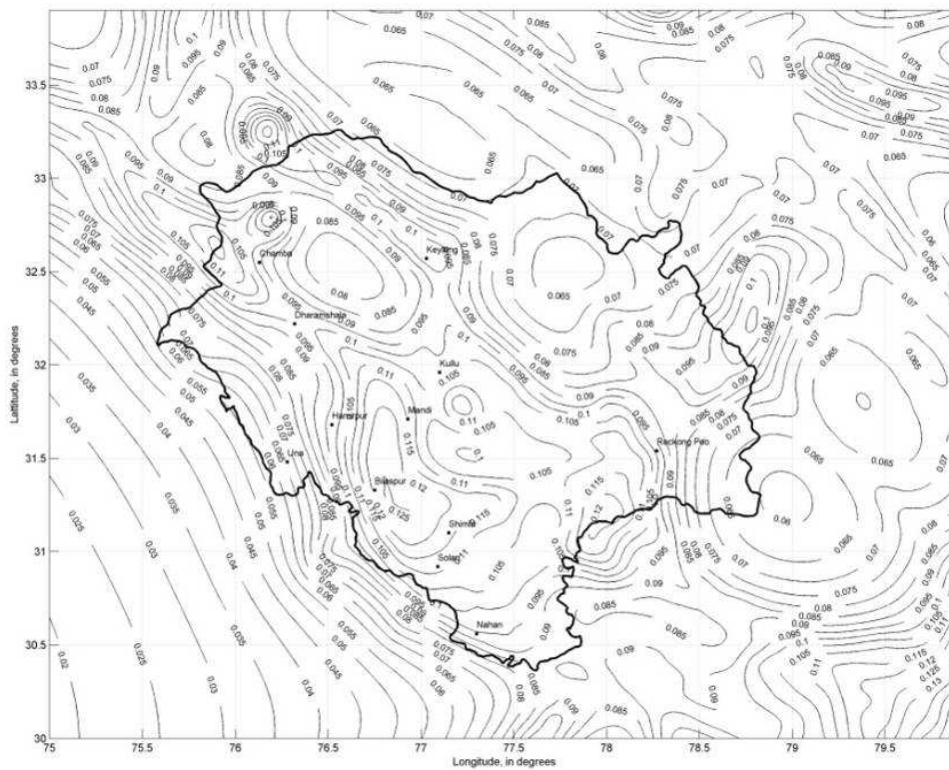


Figure 123. PGA contours with a return period of 200 years for D-Type sites

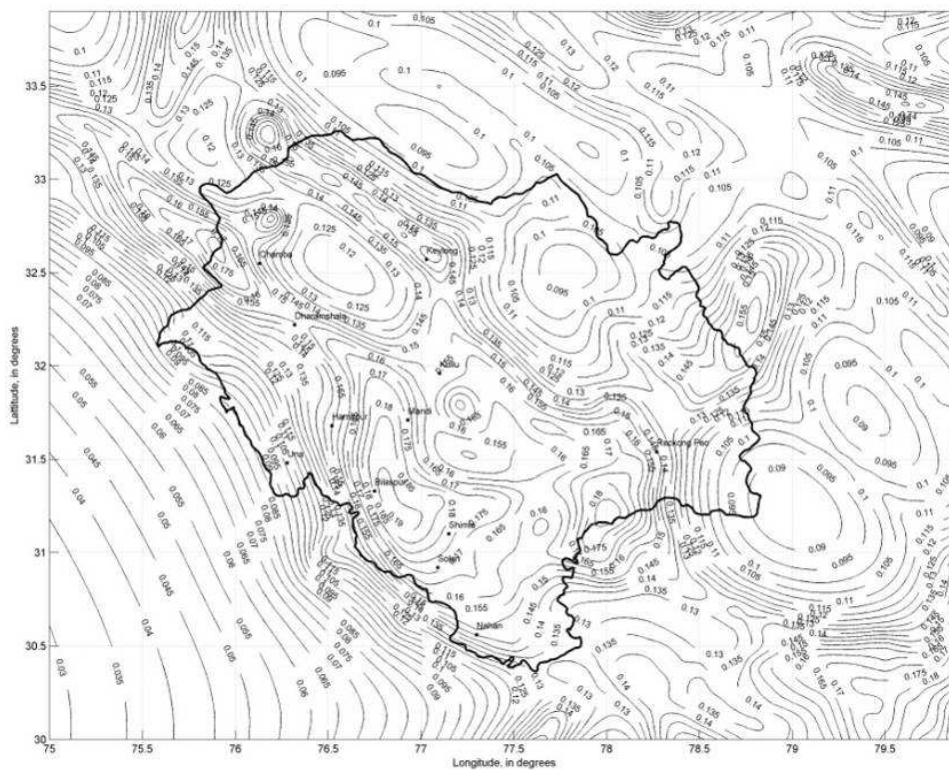


Figure 124. PGA contours with a return period of 475 years for D-Type sites

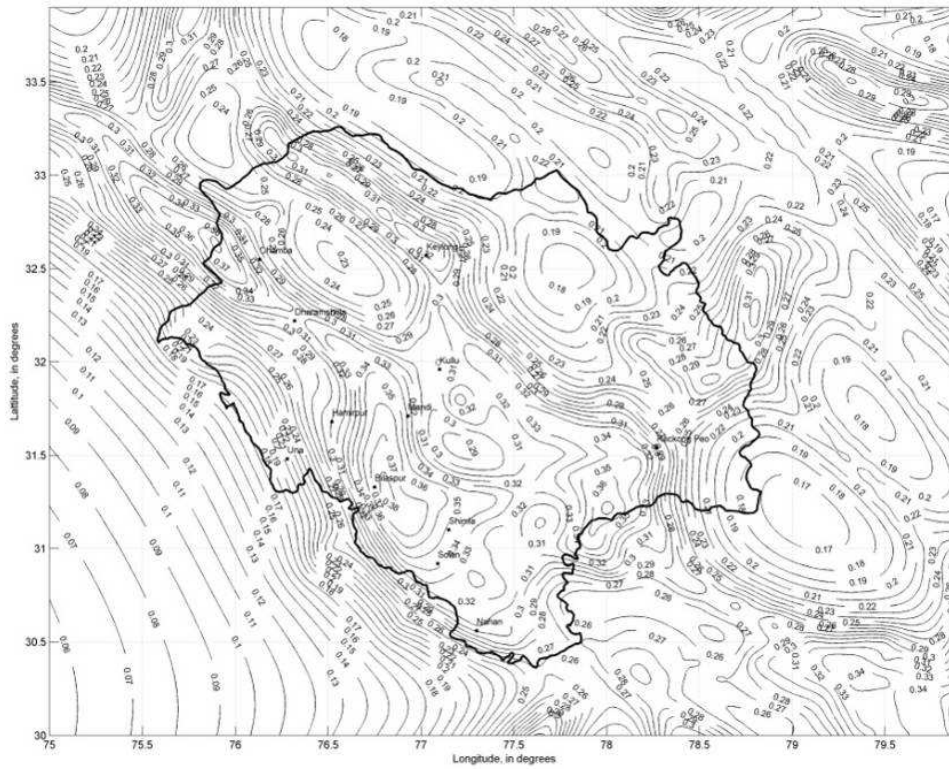


Figure 125. PGA contours with a return period of 2475 years for D-Type sites

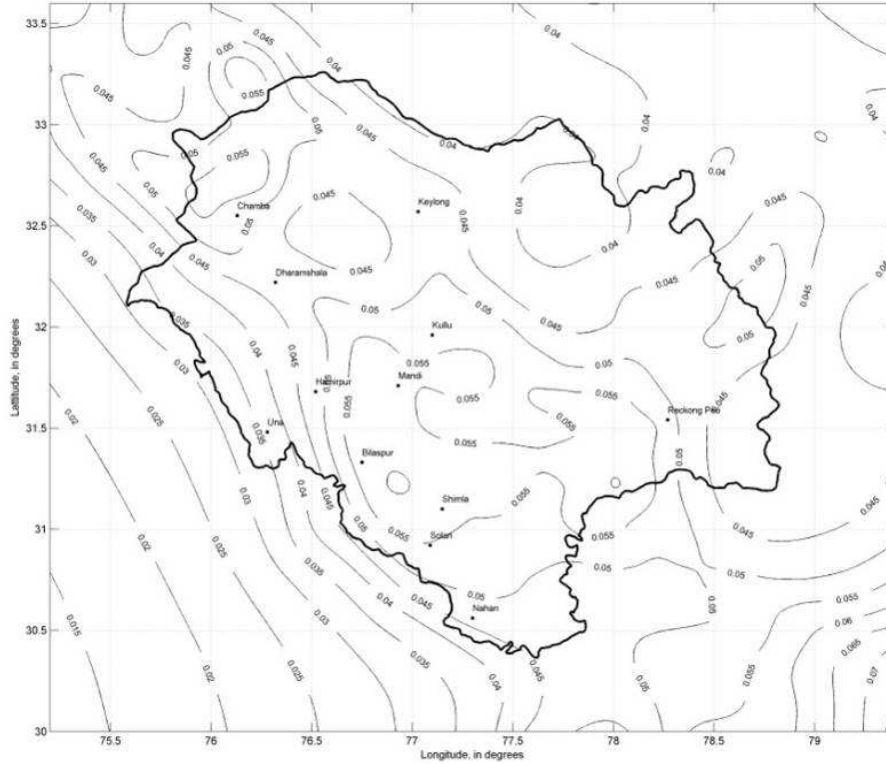


Figure 126. $Sa_{0.2s}$ contours with a return period of 25 years for D-Type sites

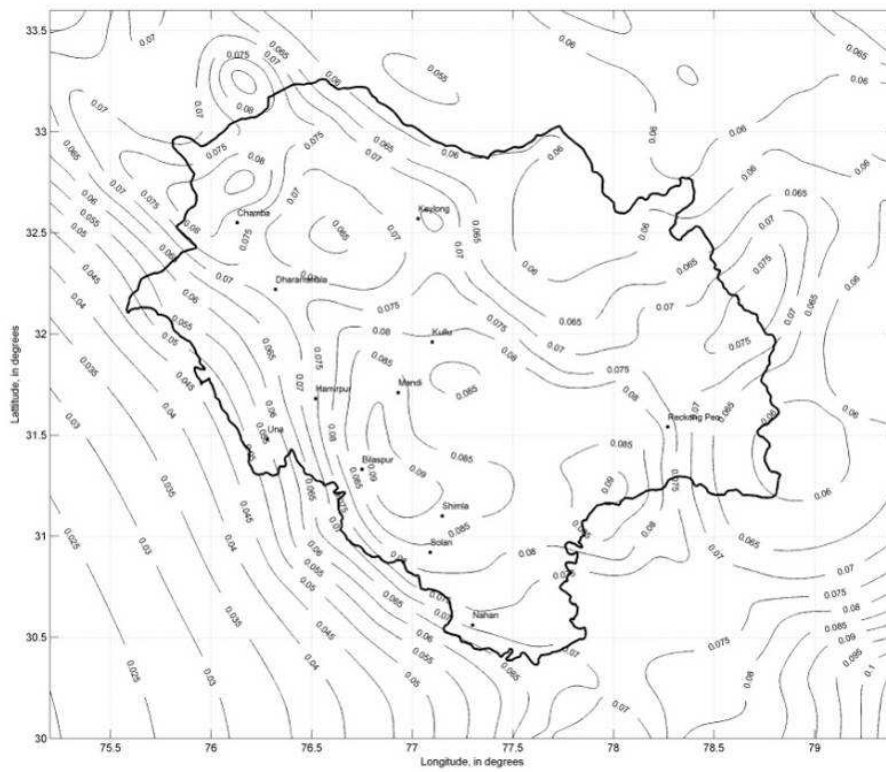


Figure 127. $Sa_{0.2s}$ contours with a return period of 50 years for D-Type sites

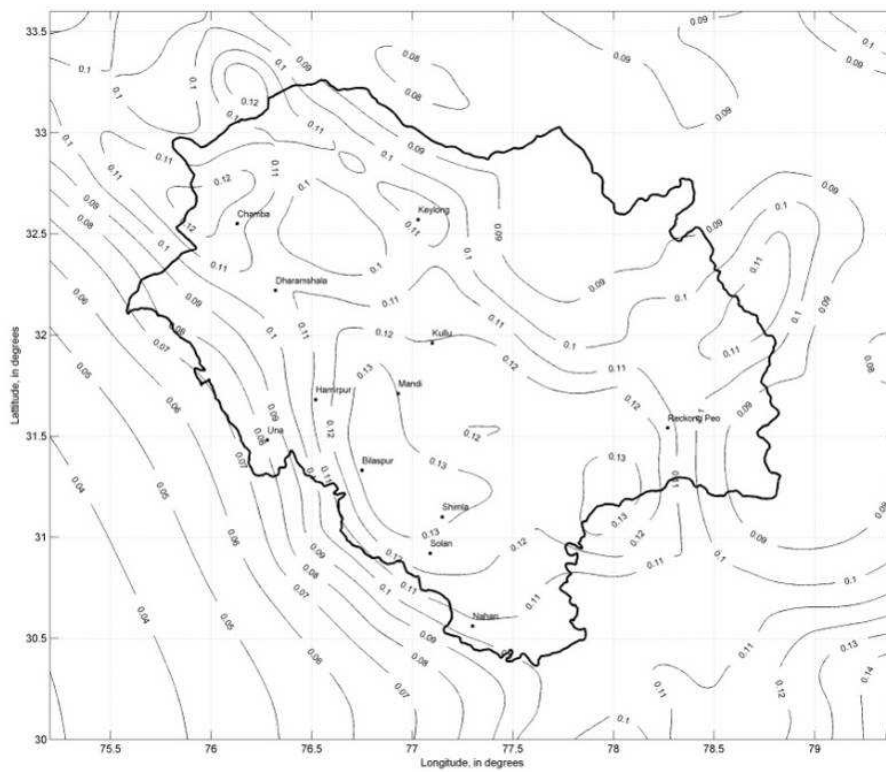


Figure 128. $Sa_{0.2s}$ contours with a return period of 100 years for D-Type sites

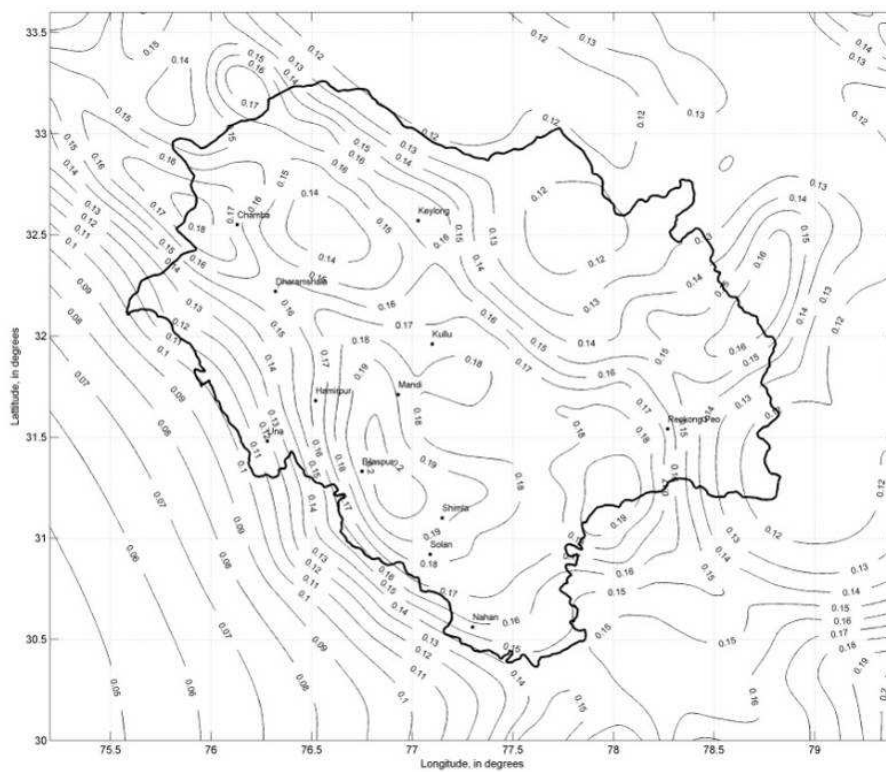


Figure 129. $Sa_{0.2s}$ contours with a return period of 200 years for D-Type sites

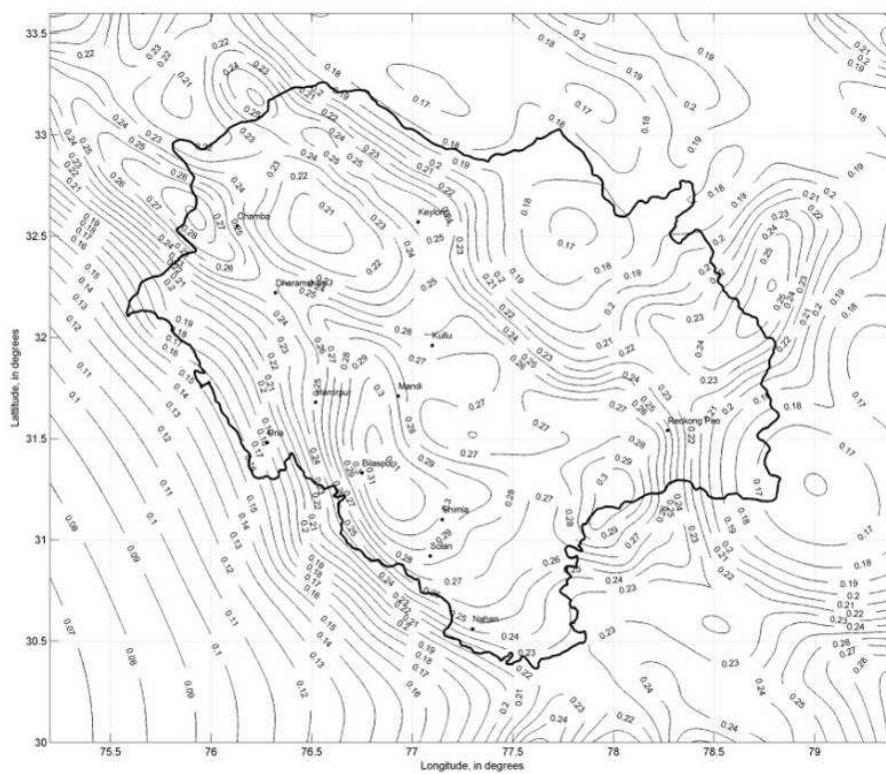


Figure 130. $Sa_{0.2s}$ contours with a return period of 475 years for D-Type sites

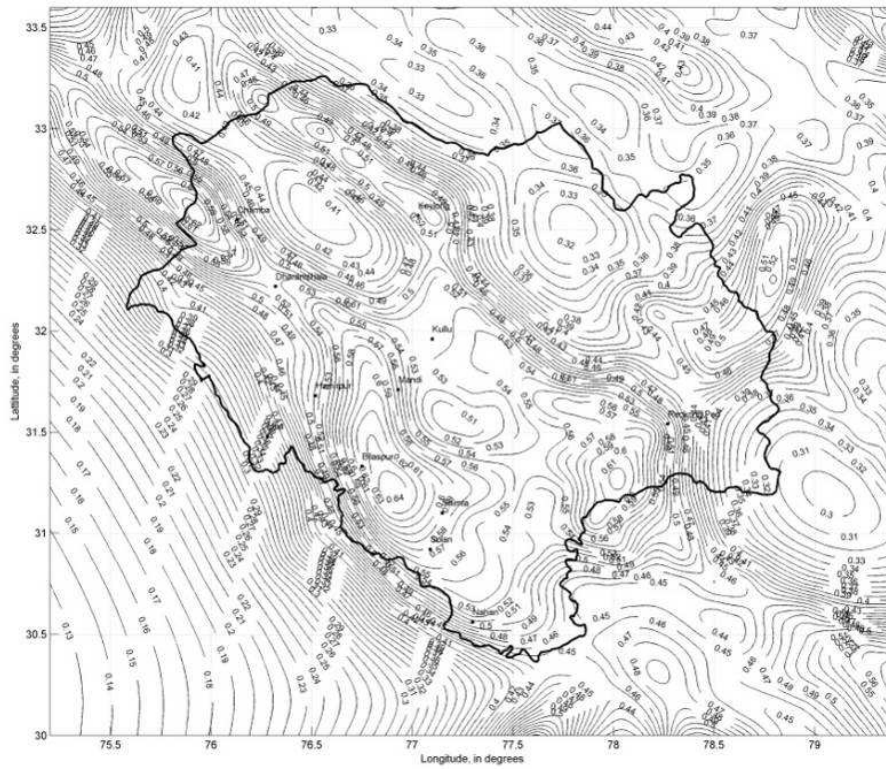


Figure 131. $Sa_{0.2s}$ contours with a return period of 2475 years for D-Type sites

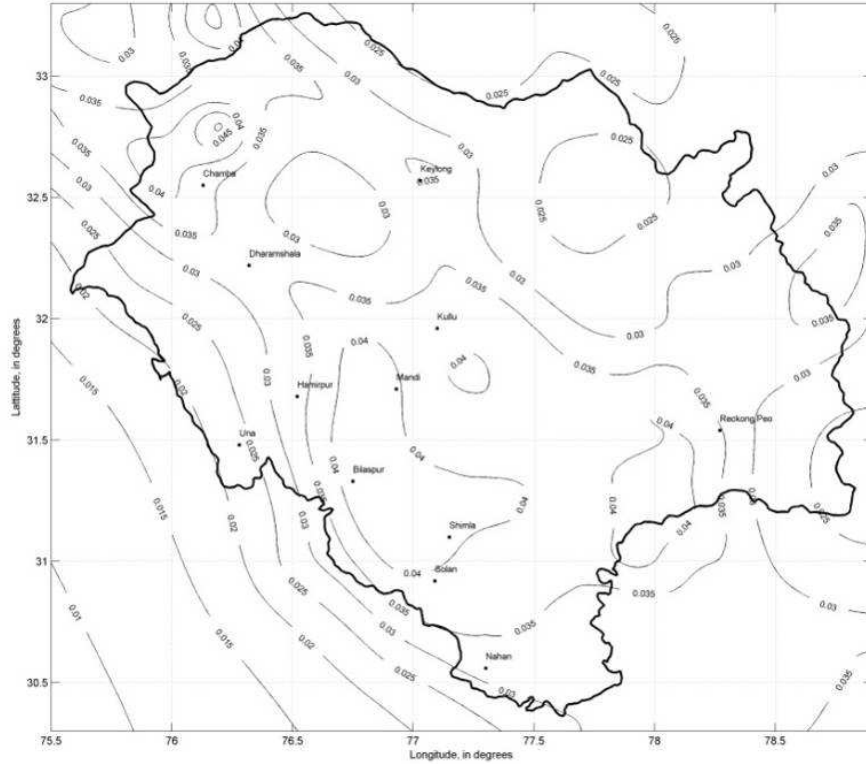


Figure 132. $Sa_{1.0s}$ contours with a return period of 25 years for D-Type sites

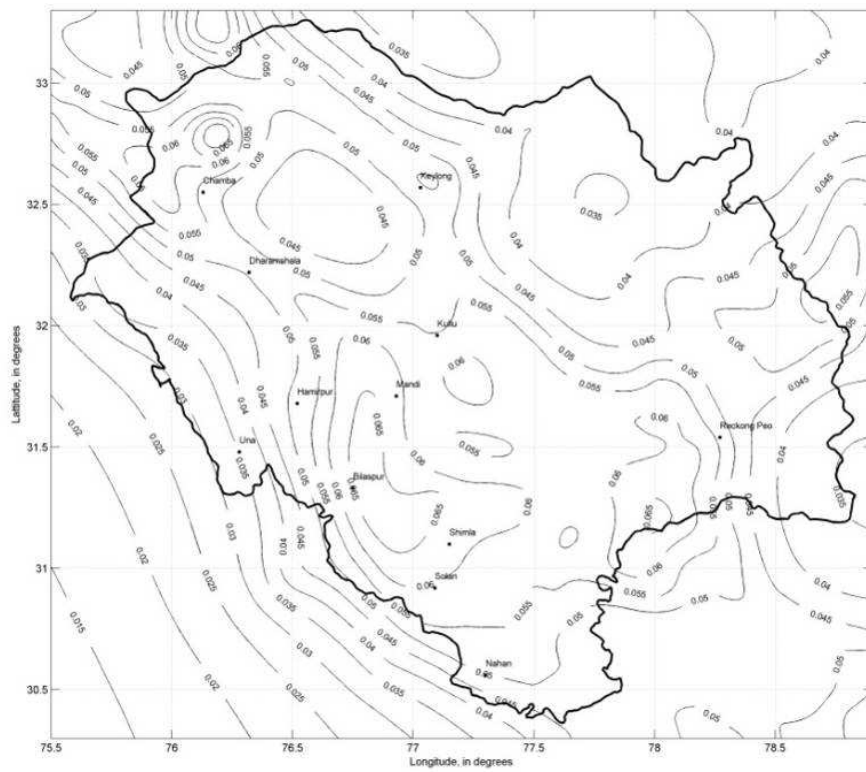


Figure 133. $Sa_{1.0s}$ contours with a return period of 50 years for D-Type sites

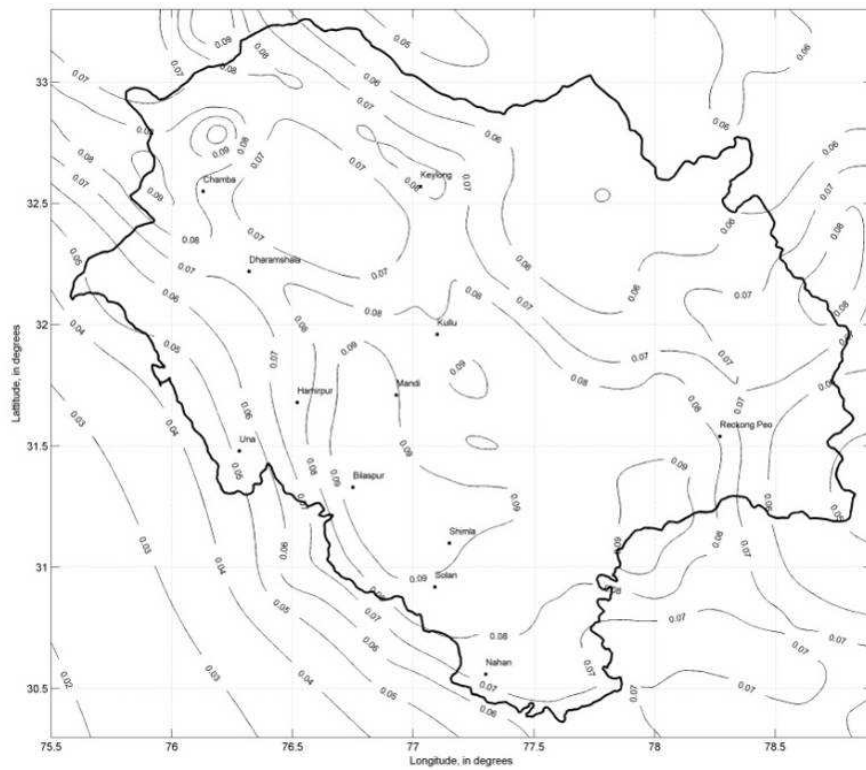


Figure 134. $Sa_{1.0s}$ contours with a return period of 100 years for D-Type sites

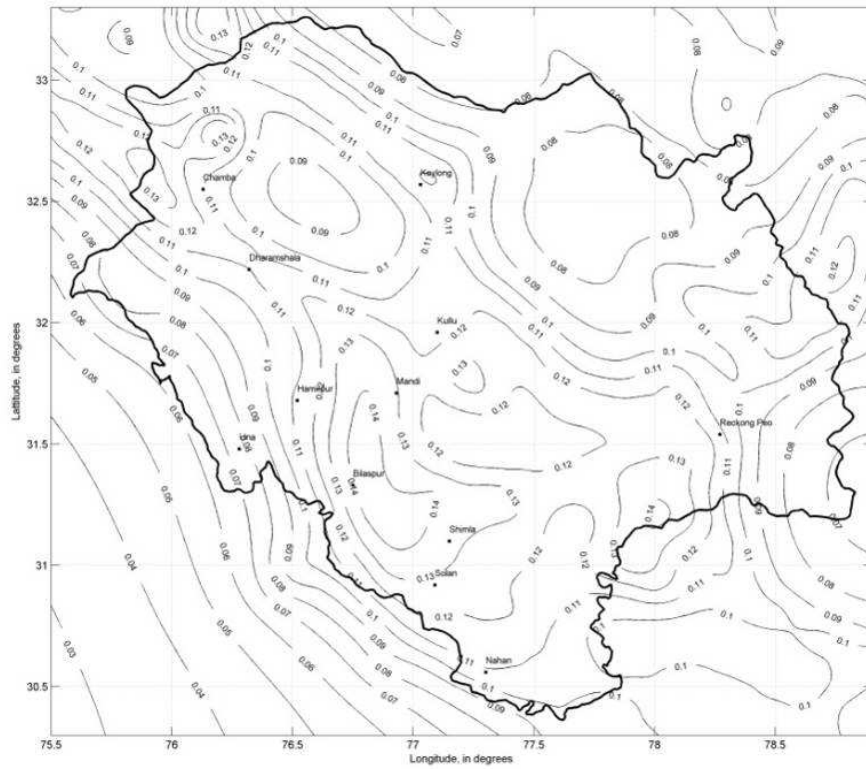


Figure 135. $Sa_{1.0s}$ contours with a return period of 200 years for D-Type sites

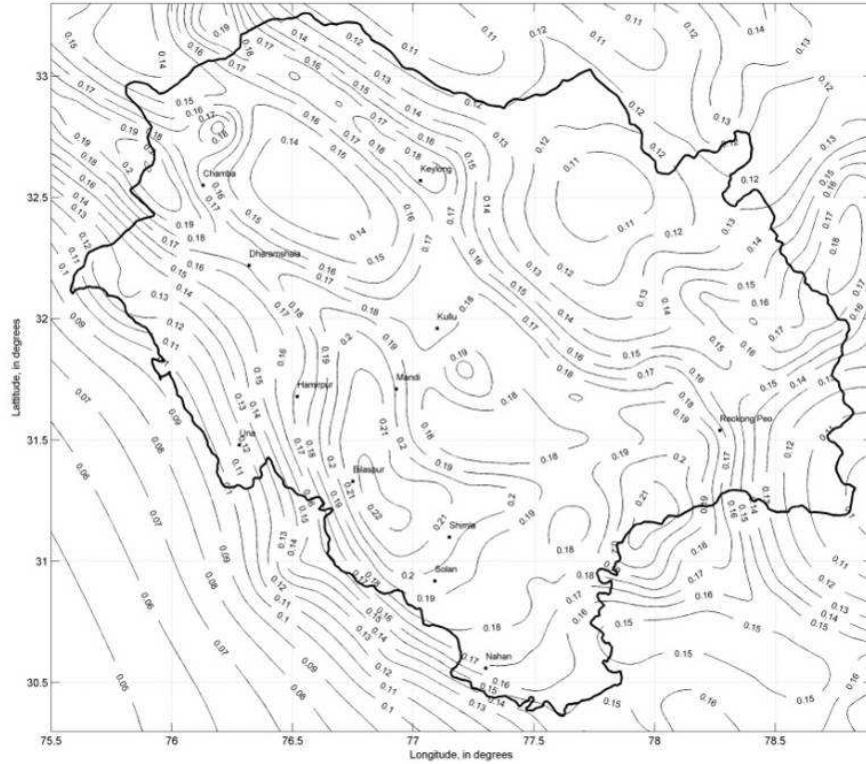


Figure 136. $Sa_{1.0s}$ contours with a return period of 475 years for D-Type sites

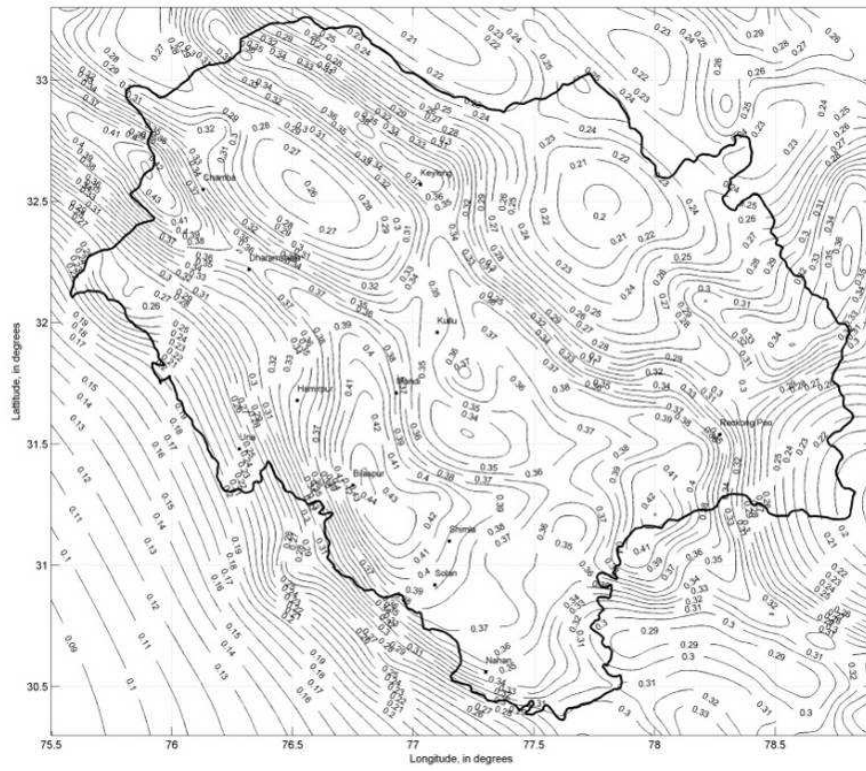


Figure 137. $Sa_{1.0s}$ contours with a return period of 2475 years for D-Type sites