

RED-ACT Report

Real-time Earthquake Damage Assessment using City-scale Time-history analysis

Dec. 05, M4.5 China Tangshan Earthquake

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Acknowledgments and Disclaimer

The authors are grateful for the data provided by **China Earthquake Network Center (CENC)**. This analysis is for research only. The actual damage resulting from the earthquake should be determined according to the site investigation.

Scientific background of this report can be found at: <http://www.luxinzheng.net/rr.htm>

1. Introduction to the earthquake event

At 8:2 Dec. 05 2019 (Local Time, UTC +8), an M 4.5 earthquake occurred in Tangshan City, Hebei Province. The epicenter was located at 118.04 39.31, with a depth of 10.0 km.

2. Recorded ground motions

50 ground motions near to epicenter of this earthquake were analyzed. The names and locations of the stations can be found Table 1. The maximal recorded peak ground acceleration (PGA) is 273.6 cm/s/s. The waveform and corresponding response spectra in comparison with the design spectra specified in the Chinese Code for Seismic Design of Buildings are shown in Figure 1.

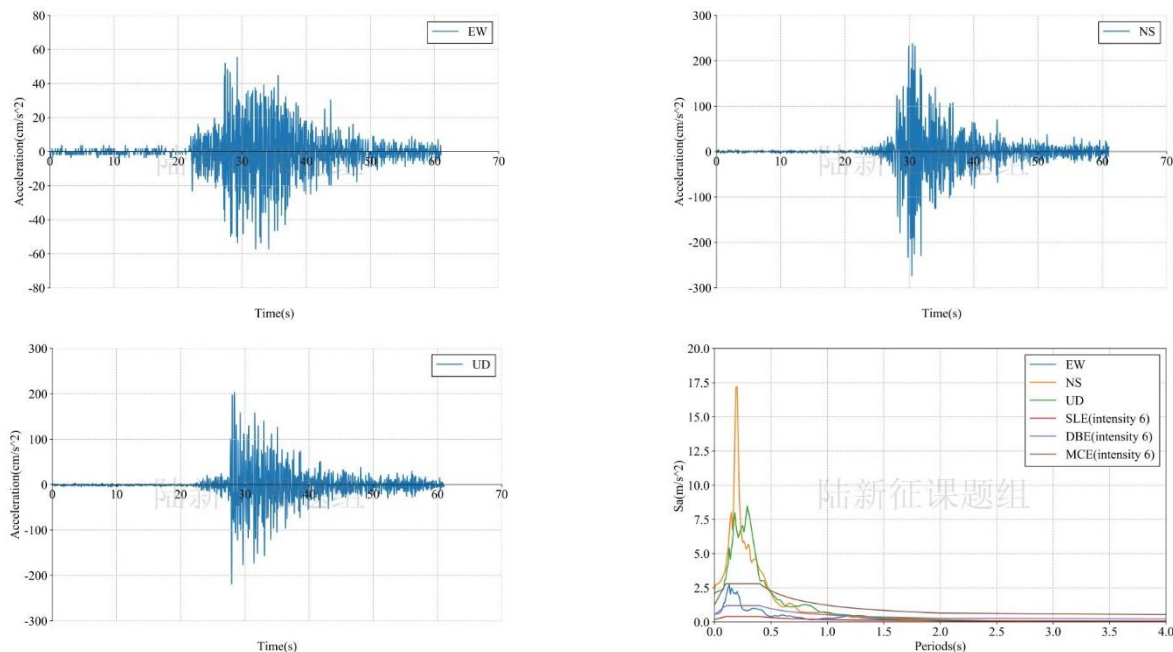


Figure 1 Waveform and response spectra of the recorded ground motions with maximal destructive capacity

3. Damage analysis of the target region subjected to the recorded ground motions

Using the real-time ground motions obtained from the strong motion networks and the **city-scale nonlinear time-history analysis**, the damage ratios of buildings located in different places can be obtained. The building damage distribution and the human feeling distribution near to different stations are shown in Figure 2 and Figure 3, respectively. These outcomes can provide a reference for post-earthquake rescue work

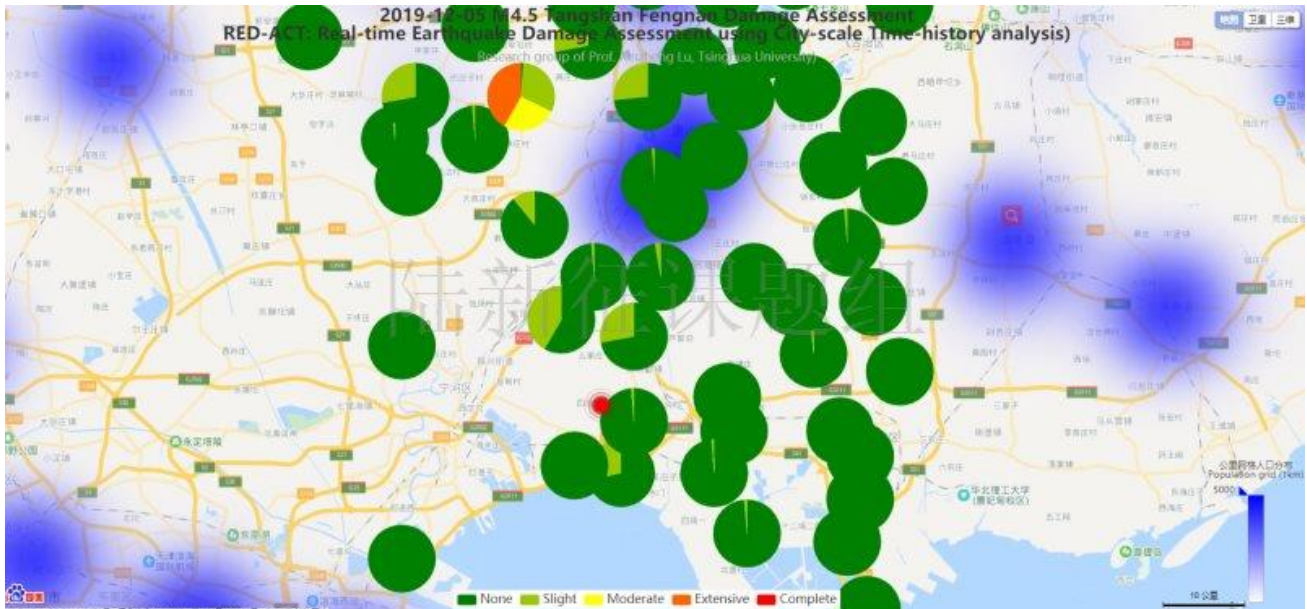


Figure 2 Damage ratio distribution of the buildings near to different stations

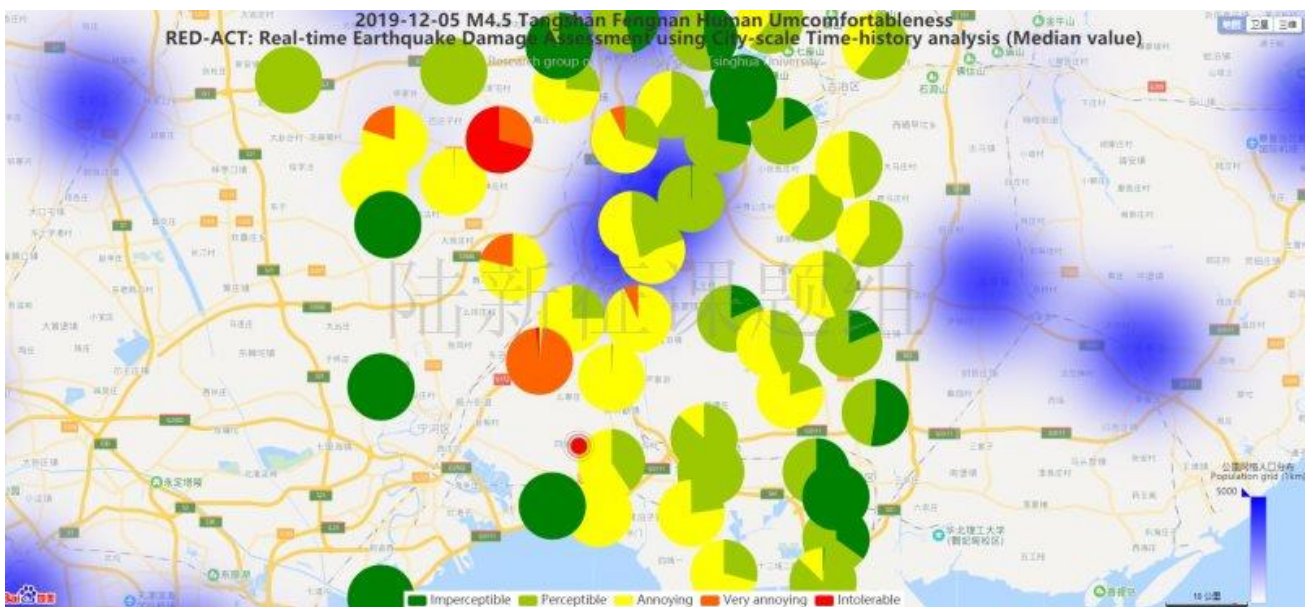


Figure 3 Human feeling distribution near to different stations

4. Earthquake-induced landslide of the target region subjected to the recorded ground motions

According to local topographic data, lithology data and ground motion records, the distribution of earthquake-induced landslide near to different stations under the different proportions of the landslide slab thickness that is saturated can be calculated, as shown in Figure 4. The basemap shows the distribution of the local

slope. The number in the circle represents the critical slope of the landslide. The earthquake-induced landslide tends to occur with a higher probability when the slope is larger than this threshold value.



(a) The proportion of the landslide slab thickness that is saturated equals 0%



(b) The proportion of the landslide slab thickness that is saturated equals 50%



(c) The proportion of the landslide slab thickness that is saturated equals 90%
 Figure 4 Distribution of earthquake-induced landslide near to different stations

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Table 1 Names and locations of the strong motion stations

No.	Station Name	Longitude	Latitude
1	HBB0002	118.44	39.07
2	HBB0003	118.24	39.28
3	HBB0004	118.03	39.46
4	HBB0005	118.39	39.59
5	HBB0006	118.07	39.23
6	HBB0008	118.09	39.29
7	HBB0011	118.13	39.46
8	HBB0012	117.94	39.52
9	HBB0013	118.36	39.37
10	HBB0014	117.98	39.41
11	HBB0015	118.27	39.46
12	HBB0017	118.15	39.54
13	HBB0018	118.23	39.79
14	HBB0020	117.85	39.62
15	HBB0021	118.11	39.81
16	HBB0022	118.02	39.73
17	HBB0024	117.92	39.67
18	HBB0025	118.01	39.78

19	HBB0028	118.49	39.78
20	HBB0029	118.45	39.64
21	HBB0030	118.35	39.68
22	HBB0031	118.25	39.67
23	HBB0032	118.45	39.43
24	HBB0034	118.49	39.35
25	HBB0035	118.48	39.56
26	HBB0043	118.41	39.5
27	HBB0062	118.33	39.81
28	HBB0072	118.26	39.16
29	HBB0073	118.21	39.23
30	HBB0098	118.21	39.6
31	HBB0100	118.18	39.71
32	HBB0101	118.11	39.67
33	HBB0102	118.23	39.32
34	HBB0105	118.4	39.28
35	HBB0106	118.43	39.2
36	HBB0107	118.41	39.15
37	HBB0109	117.85	39.75
38	HBB0115	117.6	39.74
39	HBB1001	118.33	39.43
40	HBB1002	118.09	39.39
41	HBB1003	118.12	39.57
42	HBB1006	118.29	39.73
43	HBB1007	117.73	39.62
44	HBB1009	117.76	39.67
45	TJTAH	118.43	39.25
46	TJBET	117.74	39.13
47	TJDAG	117.70	38.98
48	TJFTZ	117.75	39.57
49	TJLUT	117.74	39.38
50	TJSJT	118.00	39.24