

RED-ACT Report

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

Apr. 28, M5.6 Japan Tokachi-chiho Nambu Earthquake

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Acknowledgments and Disclaimer

The authors are grateful for the data provided by K-NET and KiK-net. 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/software/Real-Time Report.pdf

1. Introduction to the earthquake event

At 02:25 28 Apr 2019 (Local Time, UTC +9), an M 5.6 (JMA) earthquake occurred in Japan Tokachi-chiho Nambu. The epicenter was located at 142.9 42.5, with a depth of 110.0 km.

2. Recorded ground motions

33 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 126 cm/s/s. The corresponding response spectra in comparison with the design spectra specified in the Chinese Code for Seismic Design of Buildings are shown in Figure 1.





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 (see the Appendix of this report)**, the damage ratios of buildings located in different places can be obtained. The building damage distribution and the human uncomfortableness distribution near to different stations is 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 uncomfortableness 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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No.	Station Name	Longitude	Latitude
1	AOM01020190428022531	141.142	40.8721
2	HKD07120190428022526	145.26	43.2326
3	HKD07520190428022522	145.029	43.1309
4	HKD07820190428022456	144.498	43.1486
5	HKD08520190428022453	144.07	42.9581
6	HKD08920190428022452	143.554	43.2436
7	HKD09020190428022451	143.618	43.1213
8	HKD09120190428022450	143.659	42.8087
9	HKD09220190428022451	143.448	42.9283
10	HKD09520190428022448	143.214	42.9311
11	HKD09620190428022449	143.136	42.6975
12	HKD09720190428022448	143.421	42.6181
13	HKD09820190428022448	143.279	42.4984
14	HKD09920190428022453	142.839	43.0736
15	HKD10020190428022448	143.312	42.2864
16	HKD10320190428022455	142.297	42.7275

Table 1 Names and locations of the strong motion stations

17	HKD10420190428022449	142.131	42.5886
18	HKD10520190428022449	142.054	42.4825
19	HKD10620190428022452	142.369	42.3414
20	HKD10820190428022448	142.564	42.2528
21	HKD10920190428022448	142.767	42.1678
22	HKD11320190428022449	143.315	42.1287
23	HKD12120190428022454	141.855	43.3332
24	HKD12520190428022450	142.135	42.7608
25	HKD12620190428022451	141.928	42.575
26	HKD12720190428022451	141.82	42.8741
27	HKD12820190428022451	141.822	42.7655
28	HKD12920190428022508	141.606	42.6344
29	HKD15820190428022457	141.141	41.8345
30	HKD18120190428022454	141.546	43.1161
31	HKD18220190428022454	141.552	42.9925
32	HKD18420190428022452	141.601	42.79
33	HKD18520190428022453	141.402	42.7755