Structural Response Monitoring Networks at Dalian，P.R.China

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The earthquake Engineering Research Institute, Dalian University of Technology, is completing the installation of a set of seismic networks for monitoring the response of structures to earthquake induced strong motions in the Dalian region. The installation of the networks began in 2005, which consist of 40 three-component accelerographs that are installing step by step on buildings with different structural characters in campus and the city center. The instruments for the network completed to date were provided as a cooperative “SAFER Cities Project” with the Consortium of Strong-Motion Observation Systems (COSMOS) and the World Seismic Safety Initiative (WSSI).

Dalian is situated in a seismic region in northeastern China with active faults passing through the city. This city has suffered many earthquake affections in history. The famous Haicheng earthquake (Ms 7.3, 1975) occurred at about 200km away from the city and caused some structural damage (MM intensity Ⅵ), but no deaths and injuries because of the successful prediction. The seismic zonation map of China, compiled in 1990, indicates that the upper earthquake magnitude is 6.5 and MM intensity is VII with exceeding probability of 10% in 50 years in Dalian region.

Dalian is a modern tourist city in China with a population near 2.6 million. The city has a rich history with structures of many designs from different cultures, like traditional Chinese, Japanese, Russian, and European. So the city government has invested more funds to protect these valuable structures and make both of these old and new constructions be more safety during possible future earthquakes. The more important work we should do now is installing more accelerographs on these buildings to monitor their earthquake responses and then improving aseismic design by accumulating more experience.

The seismicity in the Dalian region (Figure 1) is monitored by the local seismological network installed in 1984, and figure 2 shows the seismicity recorded by this network. Figure 3 indicates the geographic distribution of earthquake epicenters in 2001, 2002, 2003 and 2004 respectively. Current earthquake predictions indicate that this region may be affected by a strong earthquake with magnitude 5 or larger in the mid-term. The seismicity and high potential earthquake risk in this region emphasizes the necessary to mitigate the possible earthquake risk by different ways.

At present, three seismic networks for monitoring structural response have been or will be

installed in Dalian region. One of them is installed in the 12-story International Conference Center (ICC) of DUT (Figure 4). The network consists of 7 three-component accelerographs installed on different stories of this building (figure 5). Instrument locations in the building were selected by optimal decision based on modal analysis shown in Figure 6. The instrument housing on free field near the ICC building is shown in Figure 7.

A second network is planned for the 5-story administration hall of the DUT Civil Engineering Department shown in Figure 8. Construction of the hall was completed in 2005. This network will consist of about 5 three-component accelerographs installed on the ground, third and roof levels.

A third network is planned for the No.1 laboratory building on the DUT campus shown in Figure 9. Five accelerographs will be installed for this building.

Another high-rise structure (about 340m high; see Figure 10) is being negotiated for a possible network. And now we have finished the modal analysis of optimal selection for accelerograph positing on this building, and probably 15 instruments will be installed on different stories. Figure 11 shows its 3D Finite Element (FE) analytical model and the ichnography of the top story.

We expect these networks could play an important role in disaster mitigation and reduction for the city development.

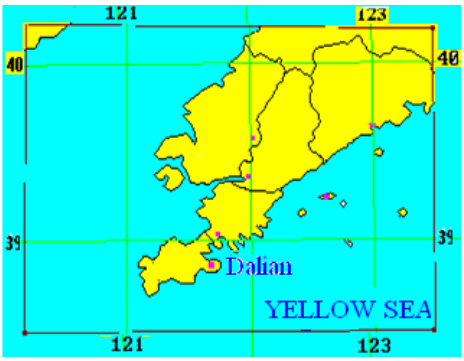


Fig.1 Dalian reagion

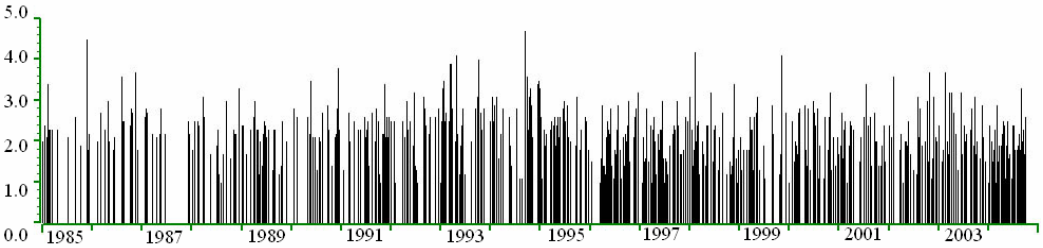
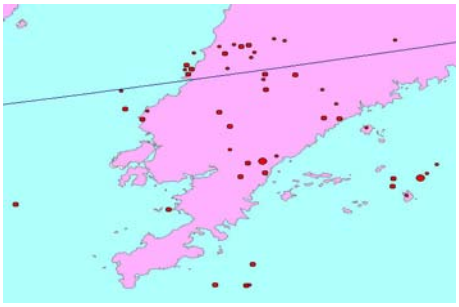
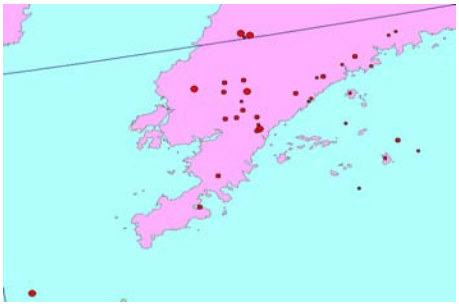


Fig.2 Seismic activity in Dalian region shown in top map since 1984



2001

2002



2003

2004

Fig.3 Seismic distribution in Dalian region

Fig. 4 International Conference Center of DUT

Fig. 5 Some accelerographs installed on different stories in ICC

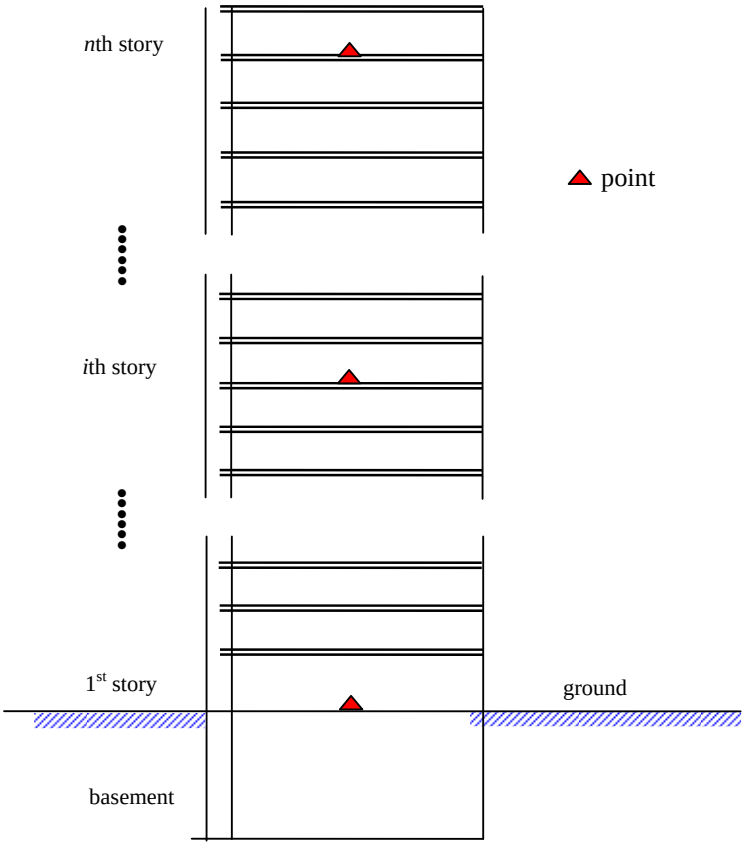


Fig.6 Analysis model of ICC

Fig.7 Installation of the instrument housing on free field site in the front of ICC

Fig, 8 Administration hall of Civil Engineering Department

Fig.9 No.1 laboratory building in DUT

Fig.10 Impression of the highest rise building in Dalian

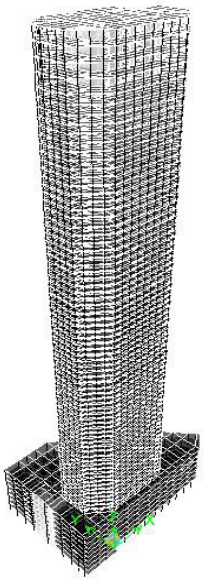


Fig. 11. (a) Structural three-dimensional FE diagram

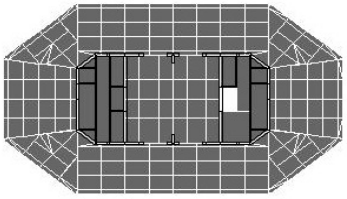


Fig.11. (b) Plane diagram of structural top floor