
Survey of Damage to Road Bridges by the Bohol Island Earthquake in the Philippines

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1. Introduction

An earthquake of M7.2 occurred on Bohol Island, Philippines, on October 15, 2013. It caused serious damage and resulted in 222 deaths, 8 missing persons, and 796 injured (as of the end of October). Since road bridges also suffered serious damage including collapse from this earthquake, the Department of Public Works and Highways of the Philippines Government requested technical assistance for road bridge restoration to the Japan International Cooperation Agency ("JICA") hereafter). As requested by JICA, I was dispatched to the Philippines as a short-term expert to survey the damage to road bridges from November 18 to 22, together with Junichi Hoshikuma, senior researcher of the Center for Advanced Engineering Structural Assessment and Research (CAESAR), Public Works Research Institute, and Toru Tsuchihashi of the Planning / Coordination Division, Economic Infrastructure Development Department, JICA.

Note that, on November 4 to 11, 20 days after this earthquake, Typhoon No. 30 ("Haiyan") passed through an area about 140 km north of Bohol Island and caused enormous damage to Leyte and Samal Islands, but no further serious damage to the road bridges on Bohol Island, which was just a short distance away.

2. Outline of the Philippines Bohol Island Earthquake

The earthquake struck at 8:15 a.m (local time), on October 15 (Wed.), 2013 with an epicenter in Sagbayan Town (north latitude 9.86°, east longitude 124.07°). It had a magnitude of 7.2 and focal depth of 12 km, according to the announcements of the Philippine Institute of Volcanology and Seismology.

On the Island, a reverse fault, which is a concealed fault different from the existing fault (Bohol Fault), was found and named the "Northern Bohol Fault."

The maximum seismic intensity was 7 on the 12-stage seismic intensity scale of the Philippine, which is

equivalent to about an upper 5 on the Japanese intensity scale.

3. Damage to road bridges

Damage to road bridges occurred on the west side of the roads running around Bohol Island. We investigated 16 bridges during the survey period. The photo shows the collapsed Moalong Bridge. The deformation in the surrounding ground caused the abutment and intermediate abutment to tilt. The bridge girder then collapsed because of the shortened girder seating. In many other affected bridges, damage resulting from the movement of the abutment due to the subsidence of surrounding ground was seen.

Such form of damage was also seen in the 1990 Luzon Earthquake¹⁾. It is, therefore, necessary to take seismic improvement measures including the seismic design of substructure, and bridge collapse prevention measures, according to ground conditions.

4. Conclusions

We promptly reported the survey results to the Department of Public Works and Highways of the Philippines Government, and introduced the seismic measures in Japan in consideration of the type of damage to the road bridges in the Philippines. The geographical environment of the Philippines is similar to Japan and likely to suffer disasters from earthquakes and typhoons. We hope that this survey will contribute to the development of disaster-resistant roads in the Philippines.

[Reference]

"Report on the 1990 Philippines Luzon Earthquake Damage Survey," edited by the Japan Society of Civil Engineers (Earthquake Damage Survey Series 1)



Photo: Damage to Moalong Bridge (Built in 1982)