Tohoku Chapter, Architectural Institute of Japan

Reconnaissance Report (11) on Building Damage in Kurihara City The 2011 off the Pacific Coast of Tohoku Earthquake

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1. Investigator

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2. Schedule

March 25 (Friday), 2011

3. Investigation Route (Fig. 1)

Disaster Relief Headquarter, Kurihara City
Tsukidate Municipal Gymnasium Center
Kurihara City Municipal Tsukidate Junior High School
Shiwahime Branch Municipal Office of Kurihara City and its Neighborhood
Wakayanagi-Naka-machi
Kurihara City Municipal Wakayanagi Elementary School

The JMA seismic intensity was estimated to be 7, the highest intensity of the JMA scale. The Tsukidate station of K-NET, Kurihara City, recorded 2,700 Gal in the north-south direction. Therefore, the investigator studied the damage in Kurihara City to correlate the observed ground motion intensity and the damage in the area.

Fig. 1: Route Map

4. Observed Damage

4.1 Disaster Relief Headquarter, and Kurihara City Municipal Office Building

The data on the damage on cultural heritage buildings in Kurihara City were obtained from the emergency control officer of the Disaster Relief Headquarter of Kurihara City. The officer explained the distribution of the damage in the city. As of March 25, 5 houses were completely lost, 15 houses were half lost and 132 houses were partially damaged; the damage was relatively light for an area which JMA seismic intensity was estimated to be 7 (K-NET strong motion measurement at Tsukidate recorded 2,700 Gal in the north-south, 1,268 Gal in the east-west, and 1,880 Gal in the up-down directions). Small damage may be attributed to the fact that the ground motion was dominated by short period components less than 0.3 sec.

The 2008 Iwate-Miyagi Inland Earthquake caused damage in the western part of the city including Ichihazama District and also in the south east part of the city such as Wakayanagi District.

In the Kurihara City Municipal Office Building (4-story reinforced concrete building), the ceiling of City Municipal Assembly Hall fell in the fourth floor and finishing tiles on a reinforced concrete column fell; no structural damage was observed (Photo 1).

(a) Overall view of the Kurihara City Municipal Office Building

(b) Fall of ceiling of Municipal Assembly Hall (1)

(c) Fall of finishing tiles on a column

(d) Fall of ceiling of Municipal Assembly Hall (2)

Photo 1: Kurihara City Municipal Office Building and non-structural damage

4.2 Kurihara City Municipal Tsukidate Junior High School and Tsukidate Gymnasium Center

Two buildings near the K-NET Tsukidate station were selected for the damage investigation; Kurihara City Municipal Tsukidate Junior High School (new construction, Photo 2) and Kurihara City Municipal Tsukidate Gymnasium Center Building (Photo 3), the latter suffered non-structural damage during the 2008 Iwate-Miyagi Inland Earthquake. No damage was observed in both buildings.


Photo 2: Tsukidate Junior High School Building with minor non-structural damage


Photo 3: Tsukidate Gymnasium Center Building with minor non-structural damage

4.3 Shiwahime Municipal Branch of Kurihara City Office

Soil liquefaction phenomena were observed on the road to National Route 398 in Shiwahime District; i.e., a man hole was lifted (Photo 4). Fall of masonry walls along the plot periphery was seen in several locations (Photo 5). Concrete block walls did not fall, but heavy masonry walls fell down (Photo 6). When the investigator asked an old man at a parking lot near Shiwahime Municipal Branch how he compared the intensities of ground motion of the 2011 Tohoku earthquake and the 1978 Miyagi-ken Oki Earthquake, he said “the ground motion intensity of this earthquake was larger and the duration was longer. Compared with the 2008 Iwate-Miyagi Inland Earthquake, the ground motion intensity of this earthquake was larger.”

Photo 4: Lifting of a man hole due to soil liquefaction near Shiwahime

Photo 5: Fall of masonry walls

Photo 6: Undamaged concrete block walls and damaged masonry walls

4.4 Urban area of Wakayanagi-machi

Along the Hazama River in Wakayanagi-machi, the damage of old timber houses was observed (Photo 7) Mud exterior finishing fell from old traditional ware houses (Photo 8)

Photo 7: Damage of houses in urban area of Wakayanagi-machi


Photo 8: Fall of exterior mud finishing of traditional ware house walls

4.5 Kurihara City Municipal Wakayanagi Elementary School and neighborhood

No damage was observed in the two story reinforced concrete Kurihara City Municipal Wakayanagi Elementary School Building, supported by pile foundation. Due to the soil settlement, 20 cm deep opening was observed (Photos 9 and 10). A statute fell down (Photo 11). The school master said “the large motion was felt in the east-west direction. The length of piles was told to be 30 m.” The gateposts of the Kanro-ji temple fell to the west near the school (Photo 12), and a large masonry lantern fell in a similar manner. The dominant frequency of the (H/V) ratio of horizontal to vertical spectra of micro tremor measurements at the Wakayanagi Elementary School after the 2008 Iwate-Miyagi Inland Earthquake was observed to be 0.8 Hz. In the neighborhood of the school, utility poles were tilted (Photo 13), cracking on the road, severe tilting of a timber house (Photo 14) in the second story were observed,

Photo 9: Overall view of Kurihara City Municipal Wakayanagi Elementary School

Photo 10: Ground settlement at the elementary school

Photo 11: Fall of a statute

Photo 12: Fall down of two gateposts of the Kanro-ji temple to west

	
Photo 13: Tilting of utility poles	Photo 14: Tiling of the second story of a timber house