Tohoku Chapter, Architectural Institute of Japan

Reconnaissance Report (14) on Tsunami Damage in Kesen-numa City
The 2011 off the Pacific Coast of Tohoku Earthquake

Released on April 9, 2011

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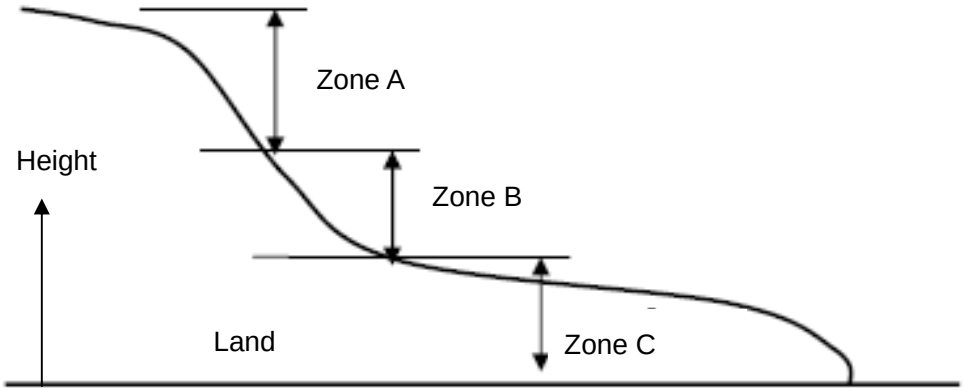
This report describes the damage in Kesen-numa City, Miyagi Prefecture, with emphasis on the damage of buildings in relation to the altitude of the construction site. The same figure used in Report (12) is quoted herein;



Zone A: Houses on the hill, no damage from tsunami nor by ground shaking;

Zone B: Houses where tsunami wave reached as high as 1 to 3 m, but some did and others did not suffer damage from tsunami wave; and

Zone C: Houses could not resist tsunami wave attacks and were completely destructed and washed away.

Fig. 1 : Tsunami Damage Zones

According to IOC (Intergovernmental Oceanographic Commission)/UNESCO Bulletin No. 17, as of April 5, 2011, tsunami height in Kesen-numa City was reported by Waseda University, Port and Airport Research Institute and Kagoshima University;

Karakuwa-machi: 13.64 m

Motoyoshi-machi: 9.19 m

Oisehama beach, Motoyoshi: 14.5 - 14.7 m

Ohtani beach, Motoyoshi: 11 m

Motoyoshi-machi, Koizumi: 13.0 m

Hill of the shrine: 11.98 m

667 were confirmed to be dead, and 1,505 are missing out of the population of 73,239 in Kesen-numa City.

http://itic.ioc-unesco.org/images/docs/no._17_ioc_unesco_bulletin_5_apr.doc

Buildings at higher altitude did not suffer damage, and those at low land suffered damage. Those timber houses designed in accordance with the Building Standard Law showed different degrees of damage depending on the location. The design requirements should consider the effect of tsunami in the coastal region. The location in this report is shown in Fig. 2 (Route Map).

The approach to Kesen-num City (No. 1 in Fig. 2) is located at higher altitude, and no damage was observed in this area (Photos 1 to 3), but damage could be seen below the national route (Photos 4 and 5, No. 2 in Fig. 2).

Photo 1: Approach to Kesen-numa City lies at higher altitude, and no damage was observed.

Photo 2: No damage was seen in all directions near the approach to the city (1).

Photo 3: No damage was seen in all directions near the approach to the city (2).

Photo 4: Damage was observed in the area lower than the route.

Photo 5: Washed away houses and rubbish.

The central part of Kesen-numa City is also located at higher altitude. Commercial buildings in Mikka-machi area (Photos 6 and 7, No. 3 in Fig. 2)) and Kesen-numa City Municipal Building (Photos 8 and 9, No. 4 in Fig, 2) on high land suffered no damage. The list of missing persons and message for search (Photo 10) is displayed in the municipal office; the list indicates that many people were lost in the city.

Photo 6: Commercial buildings in Mikka-machi (1)

Photo 7: Commercial buildings in Mikka-machi (2)

Photo 8: Kesen-numa City Municipal Building (1)

Photo 9: Kesen-numa City Municipal Building (2)

Photo 10: List of missing people and messages for search.

Tsunami flowed upstream in the river, and houses on both sides of the river suffered heavy damage. View from Kesen-numa Bridge is shown in Photos 11 and 12 (No. 5 in Fig. 2).

Photo 11: Damage of houses on both sides of the river (1)

Photo 12: Damage of houses on both sides of the river (2)

A house was found to flow in the river (Photo 13). Many cars were found in the river bed (Photo 14).

Photo 13: A house flows in the river.

Photo 14: A car sank in the river.

Tsunami crossed the railway (the Kesen-numa line, No. 6 in Fig. 2). A car is left on the railway (Photos 15 and 16). Many rubbish items were flowed across the railway (Photo 17).

Photo 15: Tsunami crossed the railway.

Photo 16: A car was left on the rail.

Photo 17: Rubbish was brought across the railway.

Damage observed along the railway is shown in Photos 18 to 24 (No. 7 in Fig. 2). The damage in this area was caused by tsunami flowed upstream in the river and also tsunami from the coast line. Roads were filled with debris and were not possible to walk.

Photo 18: Damage in Kesen-numa City (1)

Photo 19: Damage in Kesen-numa City (2)

Photo 20: Damage in Kesen-numa City (3)

Photo 21: Damage in Kesen-numa City (4)

Photo 22: Damage in Kesen-numa City (5)

Photo 23: Damage in Kesen-numa City (6)

Photo 24: Damage in Kesen-numa City (7)

The view of the port is shown in Photo 25. Looking at the sea, it is not possible to imagine the severity of the damage on the land.

Photo 25: View of Kesen-numa Port

Photo 26 shows the “Sight-seeing Pier Building (ocean view building)” 150 m from the port; the building is of three-story reinforced concrete construction. Damage even cracking could not be observed in this building. Tsunami water reached to the second floor. A three-story reinforced concrete parking garage building is seen at the further end; no damage was observed. The conditions of the first story of the are shown in Photos 27 and 28 (No. 8 in Fig. 2). Window glasses were broken by tsunami wave. The glass in the first story door was broken. The stair case leading the second floor was covered with soil, showing the tsunami trace. Window glasses and hand rails in the second story were broken. The height of tsunami wave is estimated to be 5 to 6 m in the port.

Photo 26: Sight-seeing Pier Building.

Photo 27: Glasses in the first story door were broken by tsunami wave.

	
Photo 28: Stairs leading to the second floor were covered with soil.	Photo 29: Window glasses and hand rail in the second story were broken.

Timber houses in the port were totally lost above the foundation (Photo 30).

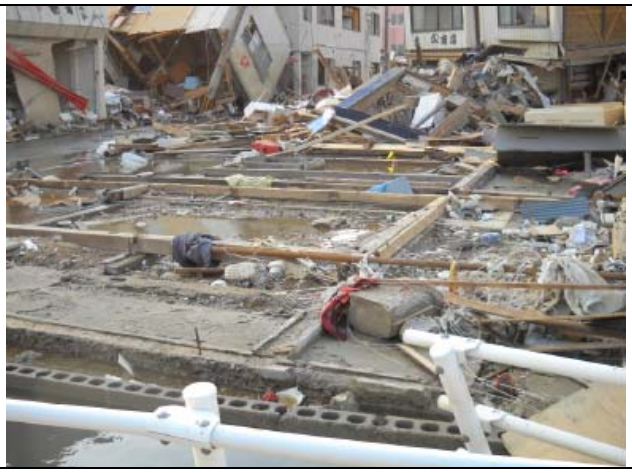


Photo 30: Total loss of timber houses above the foundation in the port area.	

A fire station building (three-story reinforced concrete), near the Kesen-numa harbor, was not structurally damaged, but the content in the first story was severely damaged by tsunami (Photo 31). A one-story reinforced concrete building adjacent to the fire station was also undamaged (Photo 32).

Photo 31: Overall view of the fire station building, no structural damage.

Photo 32: The first story of the fire station building (content was severely damaged).

There is a hill near the port. Tsunami did not hit this hill zone. Most timber houses were undamaged (Photos 33 to 35, No. 9 in Fig. 2), but old traditional houses were damaged due to ground shaking (Photo 36).

Photo 33: Houses on a hill side near the port (1).

Photo 34: Houses on a hill side near the port (2).

Photo 35: Houses on a hill side near the port (3).

Photo 36: A collapsed traditional timber house due to ground shaking.

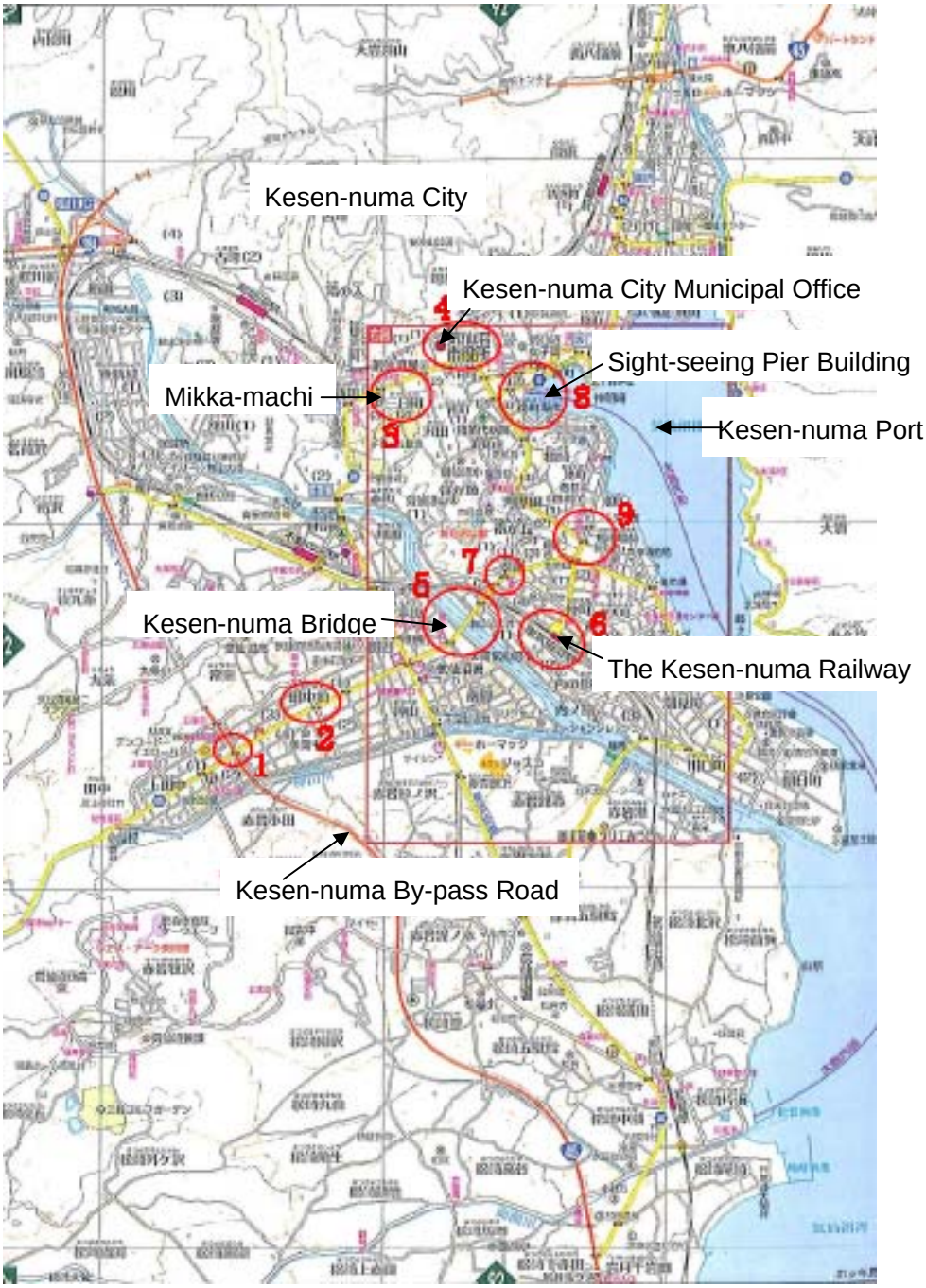


Fig. 2: Route Map