

Report on Building Damage in Central Ibaraki Prefecture by
The 2011 off the Pacific Coast of Tohoku Earthquake
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Dr. Toshiyuki Kanakubo,
Department of Engineering Mechanics and Energy
Graduate School of Systems and Information Engineering,
University of Tsukuba
Dr. Juan Jose Castro
Center for International Education and Exchange, Osaka University
(Translated by Shunsuke Otani, University of Tokyo)

1. Reconnaissance Team Members

Toshiyuki Kanakubo, Associate Professor
Department of Engineering Mechanics and Energy
Graduate School of Systems and Information Engineering,
University of Tsukuba
Dr. Juan Jose Castro, Associate Professor
Center for International Education and Exchange, Osaka University

2. Schedule and Visiting Sites (see Route Map)

March 28, 2011

Hitachi-Ohta City Municipal Office
Hitachi-Ohta City Municipal Gundo Elementary School ((1) in Fig. 1)
Nakano-machi, Hitachi-Ohta City ((2) in Fig. 1)
Fujita-machi, Hitachi-Ohta City ((3) in Fig. 1)
Hitachi-Ohta City Municipal Kanasago Elementary School ((4) in Fig. 1)
Hitachi-Ohta City Exchange Center ((5) in Fig. 1)
Naka City Municipal Office
] Naka City Municipal Godai Elementary School ((6) in Fig. 2)
Hitachi-Naka City Municipal Office ((7) in Fig. 3)
Naka-Minato Port ((8) in Fig. 3)
Hitachi-Naka City Kaimon-machi ((9) in Fig. 3)
Oharai Port ((10) in Fig. 3)



Fig. 1: Route Map in Hitachi-Ohta City



Fig. 2: Route Map in Naka City



Fig. 1: Route Map in Hitachi-Naka City and Oharai Port

3. Observed Damage

3.1 Hitachi-Ohta City

Urban Planning Department of Construction Division, Hitachi-Ohta City Municipal Office, reported that quick damage inspection of 1,400 buildings was carried out on March 13 to 18; most buildings, judged to be dangerous, were due to the fall of roof tiles, tilting of warehouse and storage and damage in foundation. Falls of Ohya tuff masonry walls along lot periphery and warehouses were observed in many places. Damage of houses was seen in Nakano-machi, Kume-machi and Takagaki-machi. Heavy damage was reported in the Gymnasium Building of Municipal Kanasago Elementary School, Kanasago Municipal Branch Building, and Municipal Exchange Center Building.

(1) Hitachi-Ohta City Municipal Gundo Elementary School ((1) in Fig. 1)

The school building for special education is two-story reinforced concrete construction and was constructed after the 1981 revision of Building Standard Law Enforcement Order (New Seismic Design Provisions). Flexural cracks were observed in columns and walls of Special Class Building (Photo 1). A reinforced concrete building for normal classes was constructed before the enforcement of New Seismic Design Provisions, and was not retrofitted at the time of the earthquake, but no damage was observed. In the neighborhood of the school, the overturning of tomb stones (Photo 2) and damage on masonry warehouses were observed (Photo 3).



Photo 1: Flexural cracks in columns in a building in accordance with the New Seismic Design Provisions



Photo 2: Overturning of tomb stones near the Gundo Elementary School



Photo 3: Damage of Masonry Warehouses near Gundo Elementary School

(2) Nakano-machi ((2) in Fig. 1)

There are more rich farming houses in Nakano-machi: in each lot, there are a residential house, a barn, a warehouse and a storage. A guardian dog masonry statue of a shrine fell to the foot of stairs (Photo 4). Concrete block walls along a plot fell down (Photo 4). Damage of roof tiles was seen many places (Photo 6).



Photo 4: Fall of a guardian dog statue and also concrete block walls along a lot



Photo 5: Collapse of timber barns



Photo 6: Damage on roof tiles and a tilted traditional barn

(3) Fujita-machi ((3) in Fig. 1)

Damage similar to those observed in Nakano-machi was seen in Fujita-machi. In a house lot, exterior wall finishing fell from the house, roof tiles were damaged and a barn collapsed (Photo 7).



Photo 7: Fall of exterior wall finishing of a house and collapse of a timber traditional barn

(4) Hitachi-Ohta City Municipal Kanasago Elementary School ((4) in Fig. 1)

The Kanasago Elementary School is located on a hill, The gymnasium (Photo 8) was constructed in 1987; the first story is reinforced concrete and the second story is steel frame construction; there are vertical brace members in the end walls. In the gymnasium building, glass panes of the second story came off (Photo 8) and the deformation of ceiling brace members were observed (Photos 9 and 10). No damage was observed in the vertical brace members in the end wall and the first-story reinforced concrete columns (Photo 11).



Photo 8: Overall view of the gymnasium



Photo 9: Fall of glass panes and cracking at the base of a steel column



Photo 10: Deformation of ceiling brace members



Photo 11: Vertical brace members in the end wall and first-story reinforced concrete column were undamaged.

A special visual and audio education building was constructed in 2003; two-stories reinforced concrete moment-resisting frame building with 2 bays in longitudinal direction and one span in the transverse direction. Horizontal cracks in a girder, breakage of glasses (Photo 13), a diagonal crack and spalling of concrete at the top and bottom of a first story column were observed (Photo 14). Cracking does not seem to be caused by the horizontal ground shaking, there could be some effect of vertical ground shaking or uneven settlement.



Photo 12: Overall view of a visual and audio education building.

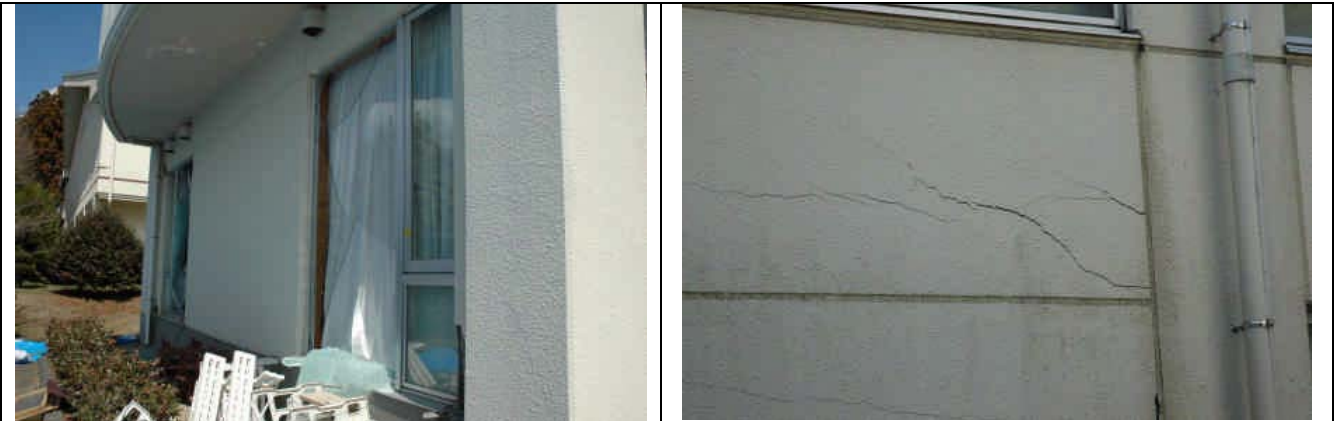


Photo 13: Breakage of glasses and horizontal cracks in the girder



Photo 14: Diagonal crack at the top and crack at the base of a first-story column

(5) Municipal Exchange Center ((5) in Fig. 1)

The Municipal Exchange Center building (Photo 15) is located on the same hill as the Kanasago Elementary School. The two-story reinforced concrete building was completed in 1997. The main hall is two-story open ceiling and one quarter of ceiling panels fell down (Photo 16, left). Spalling of concrete was observed in the long span girder above the stage presumably caused by out-of-plane bending (Photo 16, right). The concrete spalling was observed at mid-height of a tall column of the entrance hall; horizontal cracks were observed in other columns at about same height, these cracks may be associated with concrete placement joint.



Photo 15: Overall view of the Municipal Exchange Center Building

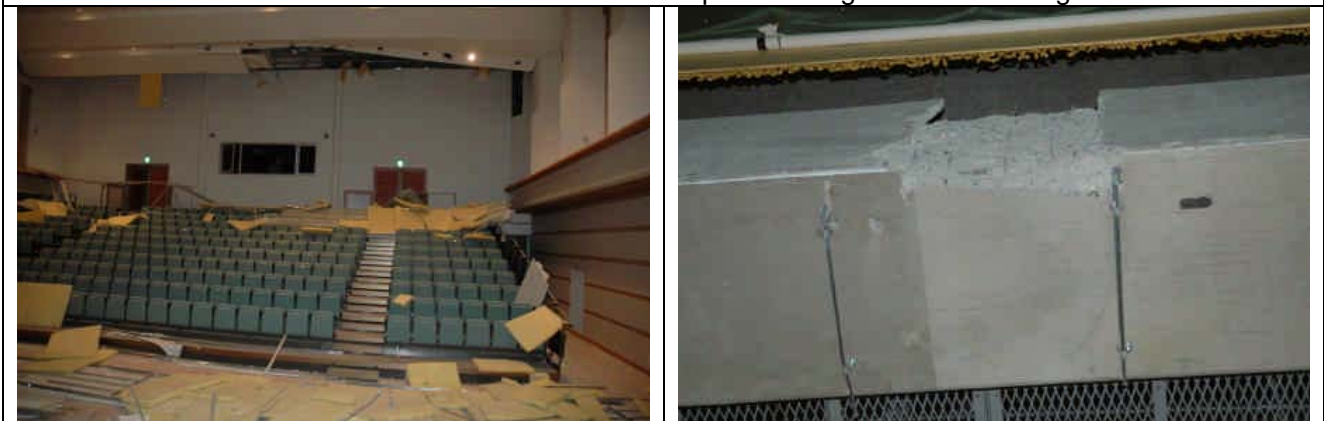


Photo 16: Fall of ceiling panels (left) and damage in the girder above the stage (right).



Photo 17: Damage of tall columns in the entrance hall

3.2 Naka City

Building Guidance Department of Construction Division, Naka Municipal Office, reported that 5 houses were completely lost in Ibaraki Prefecture, but the Naka City had not confirmed the damage. The city carried out quick inspection of buildings (houses) in designated areas along the Kuji River. Most red stickers (dangerous) were placed in barns and Ohya tuff masonry warehouses. Soil liquefaction was reported. There were many damaged buildings from light damage, but the city did not collect all the information; questionnaires about damage were sent out to all household owners, and will be collected at the end of April. In public buildings, ceiling panels dropped in the swimming pool room at the integrated

sport park

(1) Naka City Municipal Godai Elementary School ((6) in Fig. 2)

The Godai School three-story reinforced concrete building (Photo 18) was constructed before the enforcement of New Seismic Design provisions (1981). The building was retrofitted in 2006. No serious damage was observed in the structure, the penthouse (moment resisting frames in X-direction and walls in Y-direction) failed in flexure (Photo 19). At the expansion joint between the existing building and a new steel addition, ceiling panel dropped (Photo 20).



Photo 18: Overall view of Godai Elementary School



Photo 19: Damage of the penthouse



Photo 20: Damage of expansion joint between the existing and a new addition

3.3 Hitachi-Naka City

The Building Guidance Department of Urban Servicing Division, Hitachi-Naka City, reported that 7 buildings (houses) collapsed, 12 buildings (houses) were half-lost, and 1,217 buildings (houses) were partially damaged. 142 buildings (houses) were inundated above the floor, 45 buildings (houses) were inundated below the floor, and 5 buildings (houses) were burnt. Quick damage inspection was carried out on 1,137 buildings (houses); 145 buildings were judged dangerous, 354 buildings cautious. Most private buildings with red stickers were due to falling objects and damage of exterior walls. An elementary school gymnasium of steel construction was judged dangerous due to fracture of joint. Damage of exterior walls and breakage of window glasses were common in private buildings (houses). Fall of a chimney was reported. Near the Naka River mouth, damage was reported by tsunami and soil liquefaction. Tsunami wave height was reported to be as high as human waist.

(1) Naka City Municipal Office Building.((7) in fig. 3)

A chimney was damaged in the Naka City Municipal Office Building; the chimney was removed at the time of visit (Photo 21).

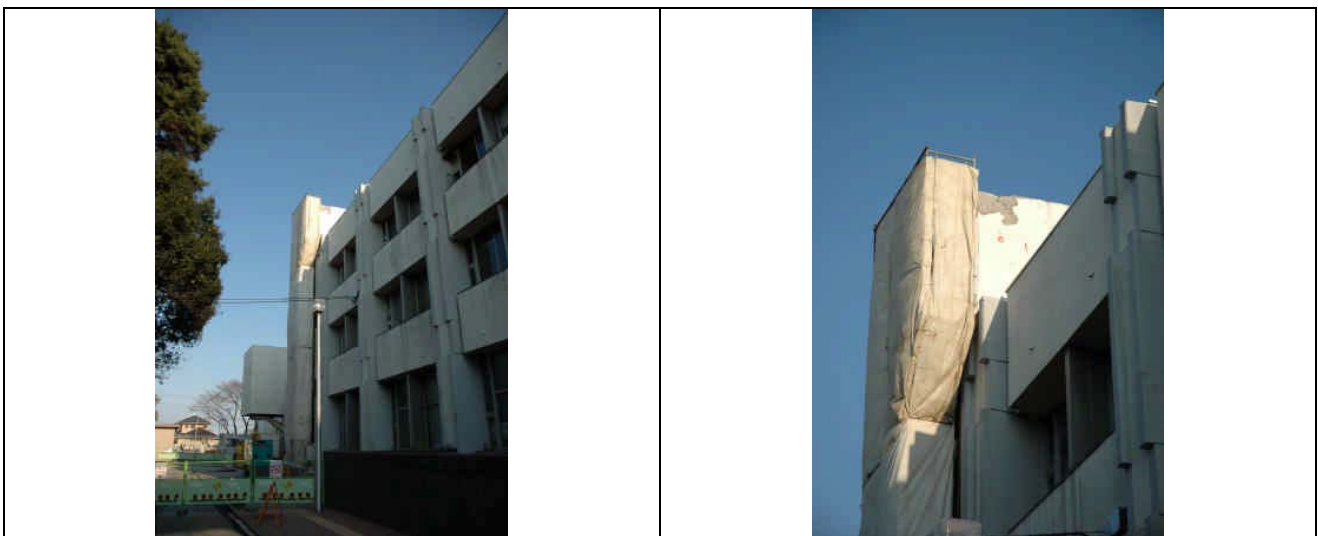


Photo 21: Damage of a chimney (after removal)

(2) Naka-Minato Port ((8) in Fig. 3)

Shops of marine products were inundated above the floor, but they were cleaned at the time of visit. The harbor was also cleared and cleaned.



Photo 22: Naka-Minato Port

(3) Kaimon-machi ((9) in Fig. 3)

Tsunami wave reached the waste height. A house was partially damaged. The edge of a road fell down.



Photo 23: Neighborhood of Naka-Minato Port

(4) Oharai Port ((10) in Fig. 3)

The trace of tsunami wave was seen on roads and private lots, but the debris was all cleared and cleaned. A shopping mall near the sea shore was inundated above the floor and a beach house collapsed.

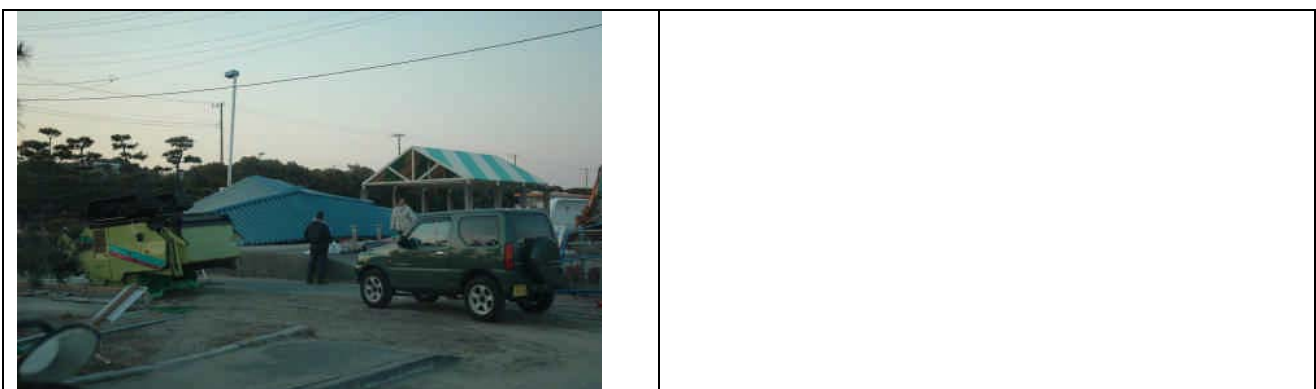


Photo 24: Oharai Beach