

Liquefaction Damage in Uchinada Town and Kahoku City

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The 2024 Noto Peninsula earthquake caused liquefaction. In order to better understand the relationship between building damage and geology (microtopography classification) and topography in liquefied areas, we conducted a field survey on January 31, 2024 in Uchinada Town and Kahoku City, where liquefaction damage was severe. We report on the characteristics of the damage revealed by the survey.

The survey focused on ground surface conditions (sand eruptions, ground deformation, cracks, etc.) and the appearance of buildings and structures (damage to tile roofs and exterior walls, collapsed walls and lanterns, etc.), walking around the area and noting on a map the points where these were visually observed and the category of damage. The surveyed areas were along Prefectural Road No. 8 and surrounding roads in Uchinada Town (Tsurugaoka, Mukaiwazaki, Onekabu, Miyasaka, Nishiaraya, Muro) and Kahoku City (Osaki, Uchinikaku, Unoki). Information on topographical divisions is based on the "Land Condition Map" of the Geographical Survey Institute, and information on liquefaction hazard is based on the "Liquefaction Susceptibility Map" of the Hokuriku Regional Development Bureau.

Upon inspection of the surveyed area, many notable damages were observed, including sand eruptions due to liquefaction, tilting and sinking of structures such as utility poles and signs, unequal sinking of buildings, depression, open cracks, and wave deformation of residential land and pavements, and dislodging of manholes and gutters. Furthermore, land surface cracks and damage to buildings were also observed, which were thought to be caused by land cracks. Some areas on the reclaimed land side (southeast side) at lower elevations had collapsed by about 1 m. The cracks were scattered along a strip along the boundary between the dunes and the reclaimed land from Uchinada Town to Kahoku City, and building damage was particularly concentrated directly on and near the cracks. In areas where roads are close to and parallel to the cracks in this strip, there was an opposite distribution of damage, with greater damage to buildings on one side of the road and relatively little damage on the other side. The river bank on the crack was damaged, with sand spewing into the river and spilling out, while no major damage was observed on other banks. On the other hand, a 1-meter-high embankment for residential land development adjacent to the road had moved sideways and overhung the road. As a result, the ground of the housing site was distorted and the entire foundation of the building tilted, causing extensive damage. This type of damage was seen mostly in the area between Miyasaka, Uchinada Town and Osaki, Kahoku City.

The fill development was constructed on the slope from the higher elevation northwest side dune to the lower elevation southeast side reclaimed land. The lateral movement of the ground of the entire region toward the lower elevation reclaimed land (southeast side) is considered to have caused extensive damage to buildings on the embankment construction areas. The lateral movement is thought to have originated from cracks scattered near the boundary of topographic divisions, i.e., the boundary between dunes and reclaimed land with different geological characteristics, causing the ground to slide from the higher elevations (northwest) to the lower elevations (southeast). The dunes rising in the northwest (sea side) of Uchinada Town become lower in elevation as one moves from Miyasaka, Uchinada Town to Unoki, Kahoku City. In the area from Miyasaka, Uchinada Town to Osaki, Kahoku City, where the elevation of the dunes is higher, liquefaction as well as land cracking and lateral movement are thought to have

contributed to the damage. This suggests that as the elevation of the dunes decreases, damage at the foot of the dunes tends to be relatively small.

In the future, when assessing the risk to buildings in liquefaction-prone areas in more detail, it will be necessary to examine the damage function near the boundaries of topographic zones that are likely to be the starting points of lateral movement. Even in cases where damage to buildings is relatively minor, further research is also needed to assess the risk of indirect damage, as disruptions to infrastructure and major roads can significantly disrupt the continuation of lifestyles and businesses.

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