

1 INTRODUCTION

An earthquake with a magnitude of 7.4(Mw) occurred on 17 August 1999, between Gölcük and Izmit in Kocaeli Province of Turkey. This earthquake is officially called *Kocaeli Earthquake*. The earthquake caused disastrous damage to a huge number of buildings resulting in significant casualties in the provinces of Istanbul, Kocaeli, Sakarya, Bolu, Bursa, Zonguldak, Eskisehir, Yalova. According to a preliminary report, the earthquake caused the loss of more than 16,000 lives and injured more than 23,000 people, and collapsed 2000 buildings totally. This earthquake caused severe structural damages in Gölcük, Izmit, Düzce, Yalova, Adapazari and the suburbs of Istanbul. Estimated economic lost due to only structural damages is about 6 billion US dollars.

The joint investigation mission of Japan Society of Civil Engineers (JSCE), Architectural Institute of Japan (AIJ), and the Japan Geotechnical Society (JGS) conducted a field investigation in the damaged area for eight days from September 5 to 12. This report outlines the findings of the investigation undertaken by the JSCE team on various aspects of the earthquake damage in Marmara region. At the beginning of the report, the geology, tectonics and seismotectonics of the Marmara Region are outlined from a general point of view, and the findings from the site observations, measurements, computations, and some laboratory tests are introduced.

In the field investigation, team members visited strong motion observation stations that were located in the earthquake affected region and measured the shear wave velocities of foundation ground using a portable elastic wave exploration. Ground motions were simulated by using fault rupture models.

The earthquake fault was traced on the land for about 100 km, and the damage directly caused by the fault movement was investigated. The magnitude of the right lateral movement of the fault on the ground surface was measured as 2 to 4 m.

An overbridge crossing the expressway TEM was completely collapsed by an expansion of the spans induced by the right lateral movement of the fault, and rails and embankments of a railway were ruptured by the fault crossing. A large number of buildings and houses was perfectly broken by the fault movement.

Normal faults, which were secondarily caused by the main right lateral strike-slip fault, were traced for about 3km distance on the land at Gölcük. A huge area was sunk by the normal faults with a magnitude of 2 - 3 m and the seaside area was flooded.

It was reported that a wide coastal area along the south bank of the Izmit Bay disappeared into the sea with a five-story hotel building. The cause of this catastrophic event is not clear at present, but a seabed sliding is considered as one of most probable reasons, which was triggered by the strong ground motion and the subsidence by secondary normal faulting.

High waves (Tsunami) were observed along the coastline of the Izmit Bay. A vessel landed on the land and many residents of the bay area witnessed that the wave height was 4 to 12 m. It can be supposed that the high waves were induced by seabed sliding and / or seabed subsidence by the normal faulting and / or their combinations.

A significant liquefaction was observed in the city of Adapazari and around the Sapanca Lake. A large number of buildings and houses were severely inclined and sunk in Adapazari, while buried pipes for water distribution in the town of Sapanca were broken. Furthermore, liquefaction-induced large ground displacements were observed along the coastline of the Sapanca Lake.

Several storage tanks for petroleum products in a national oil refinery plant were burnt down by a fire triggered by a bouncing of the floating roofs against the sidewalls. It can be guessed that a long period component of earthquake ground motion, which was observed at a station near the refinery, caused high sloshing waves of the stored liquid.

In Turkey there exist many historical structures, particularly in Istanbul area, but fortunately no significant damage was reported besides partial collapse of the city wall of Istanbul, because the earthquake ground motion in Istanbul area is generally low, less than 100 cm/s^2 .

This is a preliminary report of the investigations carried out by the JSCE survey team. At present, the information and the data about the damaged structures, and geological and ground conditions

are not enoughly collected. More detailed investigations are essential to fully learn the lessons from this earthquake disaster and to apply those for the earthquake hazard mitigation in the future. The researchers in earthquake engineering in Japan have a long history of cooperation with the Turkish counterparts. The members of the Japanese team wish that further detailed studies on this earthquake will be conducted under close partnerships with the researchers and practitioners in Turkey.