13 CONCLUSIONS

The characteristic aspects of the 1999 Kocaeli earthquake disaster are listed below;

(1) The right lateral strike-slip earthquake fault and its secondary normal fault appeared on the ground surface and they directly caused serious damage to bridges, buildings and some industrial facilities.

(2) A huge area subsided due to the normal faulting and was flooded by seawater.

(3) A wide coastal area along the Izmit Bay slided into the sea with a five stories hotel building and some other buildings. The probable causes, which can be guessed from the present data and information is a large seabed sliding triggered by the subsidence due to the secondary normal faulting.

(4) Long period components of earthquake motions caused significant sloshing of the petro-chemical products of storage tanks of an oil refinery, which resulted in a great fire. The direct cause of the fire is guessed as a bouncing of the floating roofs on sidewalls of the tanks.

(5) Liquefaction was observed on alluvial low land areas. In particular, a large number of buildings subsided and severely inclined due to the loss of the bearing capacity of the ground. Liquefaction-induced large ground displacement in the horizontal direction was observed along the coastline of the Sapanca Lake.

(6) Numerous buildings and houses with low earthquake resistance which came from poor design and construction, totally collapsed and killed more than sixteen thousands people.

The following two lessons which are leaned from the Kocaeli earthquake as urgent and important subject for the mitigation of earthquake disaster in the future;

(1) The direct cause of the loss of the human lives is the total collapses of the residential buildings with low earthquake resistance. At the time of the 1995 Kobe earthquake, thousands of old wooden houses collapsed and killed more than six thousands people. In the seismic zone of the world there are numerous houses and buildings

which can not resist against the future large earthquakes. The diagnosis and the retrofitting of these houses and buildings are the only way to reduce the number of the casualties in the future.

(2) In the case of the Kobe earthquake, strong ground motions with a magnitude more than 0.8G nearby the earthquake fault severely damaged buildings, bridges and so on. These near field ground motions were taken into the consideration in the revision of the earthquake resistant codes in Japan. On the contrary, in the case of the Kocaeli earthquake, the fault displacements themselves had a key role for the disastrous damage to the structures. The similar disaster was experienced during the 1999 Taiwan Ji-Ji earthquake which occurred about one month later after the Turkish earthquake. The important lesson learned from these two recent earthquakes in the world is how to treat the fault displacements in the earthquake resistance design of structures.

We, the Japanese people experienced a tragic earthquake disaster in Kobe city and its neighboring areas about five years ago in 1995. At this time the Turkish people also had a severe experience by this Kocaeli earthquake. Turkey and Japan have about fifty years long history of cooperation in the earthquake engineering. All of the members of the JSCE team wish to deepen the partnership and friendship between two countries through close cooperation for the investigation into this earthquake disaster.