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COLLAPSE ANALYSIS OF BUILDINGS SUBJECTED UNDER SEISMIC EXCITATION, TSUNAMI, AND DEBRIS COLLISION

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The Great East Japan Earthquake and the following tsunami which occurred on the 11th of March, 2011, caused a big disaster along the ocean-side of Tohoku area. The big tsunami carried different kinds of debris such as ships and cars up the stream, which caused additional damages to the buildings in the area [1][2]. In this study, a structural collapse analysis of a steel building is performed using a finite element code based upon the ASI-Gauss technique [3]. A seismic excitation recorded in Kesennuma-shi is first applied to the steel building model, followed by an input of the drag force and buoyant force due to tsunami wave. At the last phase of the analysis, a debris model with a velocity is collided, as shown in Fig. 1, and the collapse behavior of the building is analyzed.

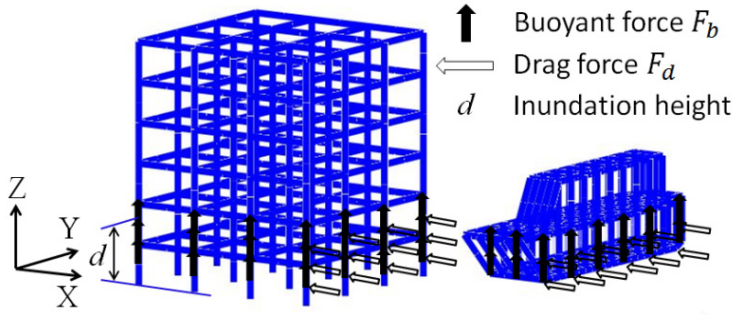

Fig. 1 Drag force and buoyant force applied to the building and tsunami debris

The story drift angle and the drag force applied to the building during the sequence are both investigated, and are compared between models with and without a wall placed under water level. The latter model tends to withstand both the tsunami and the debris collision while the one with a wall is totally washed up by tsunami after a direct hit from the debris (see Fig. 2). However, the impact force of debris and continuous application of the drag force on the collided debris leads to a severe damage of the building with a story drift angle of about 0.036 rad (see Fig. 3), even if the building of the latter case has survived the tsunami itself. This indicates that the anti-collision as well as anti-tsunami considerations are both similarly important in the structural design of a tsunami refuge building.

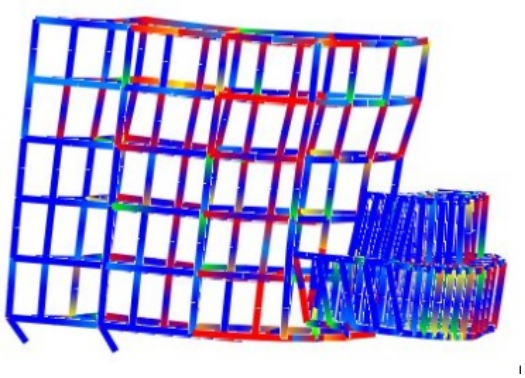

Fig. 2 Behavior of the building after collision with tsunami debris (model with a wall placed under water level)

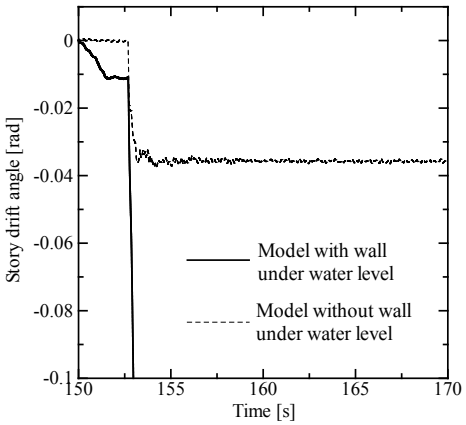

Fig. 3 Story drift angle of the building at the 1st floor

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