

Consideration of tsunami design load for building by comparison between Japan and the U.S.

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1. Introduction

Pile-supported reinforced concrete (RC) buildings were uplifted and overturned by the 2011 Great East Japan Earthquake and Tsunami. Multistory RC buildings, especially pile-supported buildings in the tsunami inundation zone, had been expected to serve as evacuation buildings for people. In Japan, the design guideline for a tsunami evacuation building, which had been published in 2005, has been revised in 2012. On the other hand, in the U.S., the American Society of Civil Engineers (ASCE) proposed a guideline on tsunami design loads in 2016, which can be a standard for tsunami-prone states.

2. Objection

In this study, we focused on 13 buildings in Onagawa town, Japan. Six of them were uplifted, toppled, and washed away by the 2011 tsunami, and the other seven buildings were not overturned (Fig.1). Based on the tsunami horizontal force calculated using the tsunami flooding analysis and the tsunami evacuation building design standards of Japan and the US for buildings in Onagawa town, Miyagi prefecture, which suffered particularly great damage due to the 2011 Tohoku earthquake tsunami Tsunami design loads are compared.

3. Method

The calculated values are compared by the following three methods.

(1) Calculation of tsunami horizontal force

After verifying the validity of the flood depth calculated by the two-dimensional tsunami flooding analysis, the tsunami horizontal force is calculated.

(2) Calculation of US tsunami design load

We calculate the tsunami design load using the US tsunami design load formula by obtaining ASCE's Energy Grade Line

Analysis method, the depth of flood of the tsunami and the flow velocity.

(3) Calculation of tsunami design load in Japan

Tsunami design load is calculated by Japanese tsunami design load formula using flood depth by two-dimensional tsunami flooding analysis.

4. Conclusion

In this study, we compare the tsunami horizontal force calculated using the tsunami flooding analysis with the tsunami design load calculated based on the tsunami design standards of Japan and the US on the buildings in Onagawa town, Miyagi prefecture. As a result, it was found that the surviving and overturned building can't be explained only by the tsunami horizontal force and the tsunami design load value of Japan and the US exceeds the tsunami horizontal force by the tsunami flooding analysis. It became clear that the tsunami design load value of Japan and the US has a margin with respect to the load which can occur compared with other external forces such as earthquake.

Reference

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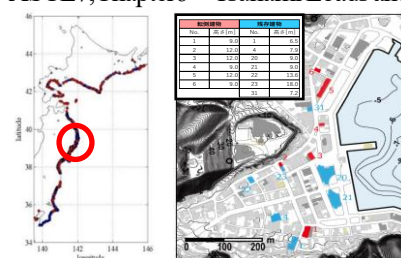


Fig.1 Onagawa town