AN ESTIMATION METHOD FOR HUMAN CASUALTIES DUE TO TSUNAMI INUNDATION FLOW

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Recent improvements in tsunami inundation modeling techniques have increased the accuracy and resolution of the tsunami hazard mapping that estimates tsunami height, current velocity, and extent of inundation. Although this mapping reflects the local hydrodynamic characteristics of tsunami inundation flow, this information has not been used for direct estimates of human casualty. The present study aims to suggest a method to estimate an index of human casualty that may occur while people are evacuating from tsunami inundation. The method is based on a simple model of hydrodynamic force as it affects the human body. The assumed condition of whether human casualty occurs due to tsunami inundation flow is expressed by the following relationship:

$$f(mg - w) \le \alpha \int 0.5 \rho C_D u^2 dS + \int \rho C_M \frac{\partial u}{\partial t} dV$$

Equation (1)

Standing in the tsunami inundation flow, people are supposed to resist the hydrodynamic force by friction on the bottom. The left side of Equation (1) is the friction force on the bottom, where f is the friction coefficient, mg is a person's weight, w is buoyancy that affects on the human body within the tsunami inundation flow. The right side of Equation (1) is Morison's formula. □ is a correction factor that was obtained by the experiment of Suga et al. (1995). Here, a value of □=2.0 is used.

The model case for the present study is focused on tsunami inundation within Seattle Waterfront, which is under the threat of tsunami generation due to a Seattle Fault earthquake of Mw 7.6 (Koshimura et al., 2002). According to Koshimura et al. (2002), a >3 m tsunami would strike the Waterfront within 3 minutes after the earthquake. Figure 1 indicates the distribution of maximum tsunami inundation depth within the Seattle Waterfront, based on the inundation modeling. Figure 2 represents the result of human casualty estimation based on Equation (1), with regard to non-dimensional inundation depth (computed inundation depth / actual height of human body) and Froude number. Dotted area in Figure 2 shows the inundation flow conditions that satisfy Equation (1), indicating the occurrence of human damage due to the inundation flow.

Figure 1. Estimated tsunami inundation depth distribution within the Seattle Waterfront.

Due to a problem (figure 2.) is missing

Figure 2. A diagram of occurrence of human casualty within the tsunami inundation flow, shown by the dotted area.

References

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