Experiment on tsunami run-up in a river using the largest hydraulic model

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1. Basic information for the countermeasures against tsunami in a river

The tsunami occurred on the 2011 off the Pacific coast of Tohoku Earthquake overflew and washed out levees and inflicted immense damages. Accordingly, the assumed tsunami for the countermeasures against the tsunami in a river, two types of tsunami were set: as type 1, 'the maximum class of tsunami' of which generating frequency is extremely low but once generated it will bring an immense damages like the one experienced this time, and as type 2, 'tsunami for the cause of facilities planning' which are generated more frequently but tsunami height is relatively low[1]. When drawing up the countermeasures for the tsunami in a river, it will be necessary to have, as basic information, to how upper stream does tsunami propagate and the maximum water levels at each distance from the river mouth.

2. The knowledge and issue regarding tsunami run-up in a river

It is generally possible to get information to draw up the countermeasures by making tsunami run-up calculation. The analytical method would be as follows:

"Guidance to analyze tsunami propagation in a river (draft)" shows the case example of the tsunami run-up in a river in the past[2]. Maximum water level within the river channel of the tsunami this time was replicated in accordance with the guidance and that was compared with the actual observed value of high-watermark. However, there were some discrepancies in reproducibility depending on the rivers where further improvement of accuracy was desired. Because, it was the first time in Japan to experience the tsunami height exceeding the bank height, even a basic knowledge such as tsunami run-up phenomenon itself or its reflection on the analysis were not sufficient that we cannot get further into the fundamental improvement in a period. For instance, it is common that water height of tsunami in a river drops to a lower level as it propagates from the river-mouth towards upper stream, but those river channels, not like sea area, are shallow and together with the surrounding landform and land cover, they would presumably change the water height in a complicated manner, but those characteristics are yet to be comprehended sufficiently. It is also beyond one's understanding still of the knowledge concerning the difference of characteristics which may change depending on the tsunami wave height and, like the tsunami this time, water height of the tsunami that flows over the bank, run-up distance or extent of the damage inflicting the bank.

3. Breakthrough on tsunami propagation in a river phenomenon by using hydraulic model experiment

To bring out such knowledge, deliberation was made by using various data observed at the site of the tsunami this time, but there was a limit, so it was decided to conduct experiments with large-size hydraulic model (Photo). The model fabricated this time was a replication of Shin-Kitakami River area covering from bay entrance to about 10 kilo–meters upper stream on the reduction scale of 1/330th. In this experiment, using the variables such as size of the tsunami, form of the river channel and state of the land cover, verifications and analyses are made on how water height and flow velocity are affected in the river channels and highlands area when tsunami propagates, and comprehend tsunami run-up phenomenon on the rivers. Furthermore, by making comparison between replication of tsunami run-up calculation and the actual experiment results for every experiment condition, the issues regarding the replicate calculation will be cleared up and improved, and consequently more accurate setting method regarding water height and flow velocity at the time of propagation will be worked out.

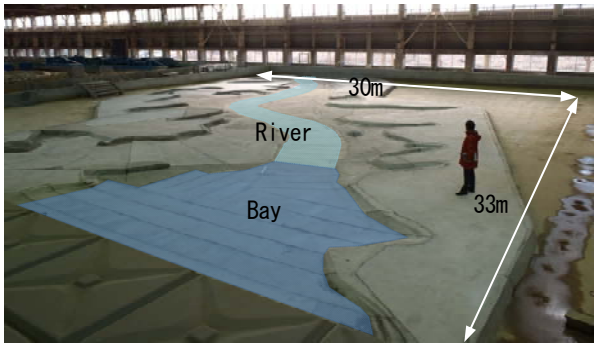

Photo: Experiment model

【References】

(1) Countermeasures for the tsunami in a river investigative commission: An urgent proposal regarding the countermeasure against the tsunami run-up in a river, Aug, 2011

(2) Japan Institute of Construction Engineering: Guidance to the analysis of tsunami run-up in a river (draft), May, 2007