Force Analysis of Coastal buildings Damaged by Tsunami Wave Impact Load using Fluid-Structure Coupling Method

***Hongjie Zheng[1], Ryuji Shioya[2] and Naoto Mitsume[3]**

[1]Center for Computational Mechanics Research, Toyo University, Japan.

[2]Faculty of Information Sciences and Arts, Toyo University, Japan

[3]Department of Systems Innovation, School of Engineering, The University of Tokyo, Japan

*Presenting and corresponding author: tei@toyo.jp

Abstract

Tsunami is one of the most serious natural disasters in coastal areas. Tsunami energy is spread to all directions from the source of earthquake. The buildings in the coastal area are damaged by the tsunami impact and these cause serious casualties and economic loss. For disaster prevention and mitigation, numerical simulation of fluid-structure interaction is an important method for analysis of coastal buildings damaged by the tsunami wave.

In this paper, we introduce a three-dimensional (3D) numerical model coupling the MPS (Moving Particle Simulation) method [1] and the FEM (Finite Element Method) to simulate the effects on buildings by tsunami loadings. We use the ADVENTURE_Solid ver.2.0 [2] for the structure computation and the LexADV_EMPS ver.0.1.2b [3] for the fluid computation. We discussed the calculation accuracy of the MPS-FEM coupling method and the interpolation methods for conversion of the fluid pressure load to node forces. As a practice problem, the Fukushima Daiichi Turbine Building damage caused by the tsunami was analyzed. This 3D large-scale coupling simulation was done by using the K computer.

Keywords: Tsunami, Fluid-Structure Interaction, Moving Particle Simulation (MPS), Finite Element Method (FEM), K Computer, ADVENTURE System.

References

[1] Murotani K, Koshizuka S, Tamai T, Shibata K, Mitsume N, Yoshimura S, Tanaka S, Hasegawa K, Nagai E and Fujisawa T (2014): Development of Hierarchical Domain Decomposition Explicit MPS Method and Application to Large-scale Tsunami Analysis with Floating Objects, Journal of Advanced Simulation in Science and Engineering (JASSE), Vol. 1, No. 1, October 31, 16-35.

[2] ADVENTURE project home page, http://adventure.sys.t.u-tokyo.ac.jp/

[3] LexADV Library, http://adventure.sys.t.u-tokyo.ac.jp/lexadv/

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