I. Introduction

Underwater landslide is one of the most dangerous mechanism of tsunamis in the coastal area. Underwater landslide can generate tsunamis on a small scale in the coastal area and most commonly induced by liquefaction of sediment. Indeed, tsunami is generated by the motion of landslide which can extent the form of sediment vertically. Moreover, landslide can be triggered by the vibration of earthquakes which generally located at continental slope. One of the characteristics of tsunami is it has high amplitude and short length waves, however it can cause the high runup at the coastal area. Therefore, tsunami can be generated by underwater landslide which offers little time warning for local populations [1], [2].

Experimental activities to see directly the impact produced by underwater landslides have been carried out at Centre National du Machinisme Agricole du Génie Rural des Eaux et des Forêts (CEMEGREF) laboratory, on December 1994 [1]. For the reverse configuration of the experiment proposed by CEMEGREF laboratory can be shown in Fig. 1. At Fig. 1, the sediment is given by sand and located at inclined fix bottom. The parameter of this experiment can be observed in Fig. 1 for more detail. Since the experiment is expensive, then the numerical simulation will be elaborated to take a place of experiment.

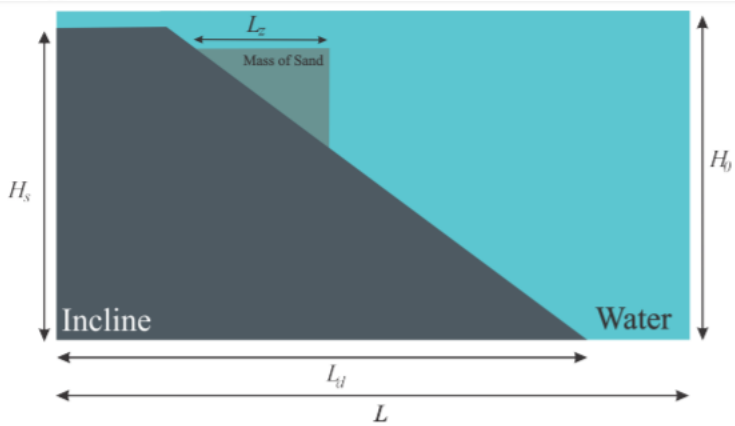

Fig. 1. The reverse lateral view of the water landslide experiment by [1] with the parameters H_0 = 1.5 m, L_d = 1.6 m , L = 2.2 m, H_s = 1.4 m, L_z = 0.65 m.

In the paper of S. Assier Rzadkiewicz et al [1], Nasa-Vof 2D numerical method is used to approximate Bingham model to simulate the water landslide. This numerical method is based on the Eulerian discretization technique. The results using this method is shown satisfying, the numerical solution approximates the observation data very well. In this paper, another numerical model will be used, namely SWE - convection diffusion model. Actually, this model was inspired by (shallow water equation) SWE - Exner model which can describe the water and sediment movement. SWE - Exner model is mathematical model to describe bedload sediment transport due to the movement of water. However in underwater landslide simulation, water will be moved due to the movement of bedload sediment, since Exner equation is influenced by the velocity of water. Therefore, SWE-Exner model is not appropriate to use in this research.

Indeed, the idea of this research is to change Exner equation to convection diffusion model. This convection diffusion model is chosen since the characteristic of sediment is not only can moving but also it can spreading over domain. Here, the speed and diffuseness of sediment is given in a constant along the inclined domain. Therefore, SWE - convection diffusion model is the right equation for simulating underwater landslide case. For approximating SWE - convection diffusion model, a robust semi implicit staggered grid scheme will be used in this paper. Since the movement of water is induced by sediment movement, then the computation of discretization of water and sediment can be decoupled. Therefore the use of semi implicit staggered grid scheme is advantageous, for detail about the method can be explained by Gunawan, et al [3].

As shown in several references [4][5][6][7], the use of high number discrete points in discretization of computational domain will be caused high cost of computational time. Therefore, the parallel computing is proposed to reduce the computational time. On a simple and straight forward parallel codes, OpenMP platform is chosen. This platform use shared memory architecture which allows several cores/threads access a memory during their computation. Even this platform has limited cores compared with GPU platform, however, this platform solving time problem very well since simulation is in 1D spatial problem.

To complete this paper, the organization of this paper is given as follows. In Section II the brief elaboration of semi implicit staggered scheme for SWE and convection diffusion model will be given. In Section III, the parallel computing algorithm for staggered scheme is elaborated. Numerical simulation and parallel performances are elaborated in Section IV. Moreover, to close this paper, the conclusion is given in Section VI.