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### Abstract (Doctor)

Title of Thesis	Numerical Study on Tsunami Disaster Mitigation around Aceh Province, Indonesia
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Approx. 800 words

Dreadful damages was caused by tsunami waves in several coastal areas in this world. Especially tsunami in 2004, the tsunami gave damage to infrastructures in coastal area and caused about 230,000 numbers of human casualties at several countries such as Indonesia, Sri Langka, Thailand, and India. One decade after the 2004 tsunami, about seven big earthquake such as the Nias and Simeulu tsunami on 2005, Mentawai island tsunami on 2010, and on 2012 have been occurred in Sumatra subduction zone. That tsunamis caused different impact in Indonesia especially along the coastal areas of Aceh Province. The reflected tsunami wave in Pulo Raya Island during the 2004 tsunami able to caused massive impact toward the lee side of the island. The tsunami wave amplification have been happened toward several cities in western coast of Aceh such as Meulaboh, Tapaktuan, and Singkil due to influence of small island that located in front of the cities.

The tsunami waves also have caused significantly morphological changes in coastal area such as could separate a mainland and leave the small amount of the mainland at the sea which change it become a new small island. This indicated the tsunami waves have the strong force which it could be erode the sediment at the bottom of the sea and the land. The form of dark-murky water which witnesses by the local community who survive from the Indian Ocean Tsunami evidences that tsunami waves which come to the shore brought the large number of sediment to mainland while run-up.

Following this series of tragic events, which caused huge losses of life and enormous damage to infrastructure, several researchers developed a numerical model to gain a greater understanding of tsunami wave process from its generation until inundation to the coastal areas. The numerical simulation becomes one method which widely was used by several researchers to investigate tsunami wave impact toward the coastal area. Therefore, several mitigation process were derived from the simulation results such as estimated of inundation area (EIA) and estimated time of arrival (ETA). The EIA and ETA data were used by several

country to create tsunami hazard map and incorporate with the tsunami early warning system. However, other tsunami mechanism such as sediment transport is rather not consider in the tsunami simulation model. The sediment transport is one of important things in process of tsunami mitigation such as to study about the coastal morphological changes, recovery process after tsunami, and tsunami deposit.

Chapter One illustrates the impact from tsunami wave toward coastal area of Aceh Province. The previous studies on tsunami wave impact, the reflected wave effect, the small island influence, and morphological changes are summarized.

In Chapter Two, a general information about numerical model and equations such as shallow water, sediment transport, and bottom level changes formula that applied are summarized. Several cities in Aceh Province such as the western coast of Aceh Province and Pulo Raya island as a large domain and Banda Aceh as a small domain were used as study case. The large domain was investigated by observing the wave propagation process toward the coastal area by using the COMCOT model. The coastal morphological changes was investigated by coupling a hydrodynamic model with a sediment transport module on Banda Aceh city as the small domain. The Cornell Multigrid Coupled Tsunami Model (COMCOT) was coupled with the XBeach Model to simultaneously simulate sediment transport and the hydrodynamic process during the tsunami. The coupled model is known as COMCOT-SED.

In Chapter Three, the numerical simulation of the 2004 Indian Ocean Tsunami were validated, analyzed, and discussed. The satellite measurement, field observation, and geospatial information data were applied to validate the simulation results for large and small domain. The results show that the simulation results have a good agreement with the observation data. The propagation process results also show different characteristic toward the western cities and Pulo Raya island as the large domain. The COMCOT-SED model indicated that coastal area of Banda Aceh city as the small domain received massive morphological changes impact due to the 2004 tsunami.

In Chapter Four, the influence of the small island against tsunami wave is investigated through a numerical simulations. Past and hypothetical earthquake have been applied to investigate the influence of the small island. Small changes of the location of epicenter in future tsunami will result in different tsunami impact along Sumatra Island due to the influence of small island. The hydrodynamic processes of reflected tsunami waves and their impact on Pulo Raya Island are also investigated with the numerical model. The simulation confirms eyewitness accounts that it was not the initial run-up, but the reflected waves that devastated the worst-hit areas of the island.

In Chapter Five, major findings, conclusions, and recommendation obtained in this study are summarized.