

## **Methodology for Estimating Tsunami Disaster Damage Using Geo-Spatial Information**

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### **ABSTRACT**

This paper summarizes a method for estimating the degree and geographic extent of tsunami disaster damage from Indian Ocean Tsunami by using geo-spatial data (such as satellite remote sensing images, aerial photographs, topographic map, ground photos and field survey results) in two case studies of damage to west coast of southern Thailand. The authors learned the following from these case studies: 1) the extent of flooding can be estimated from discoloration of vegetation; 2) damage to buildings can be estimated by deciphering whether the roof was lost or not; and 3) damage to coastal facilities such as seawall can be also estimated by deciphering from geo-spatial information. Moreover, the authors developed a methodology to estimate the risk of a seawall being washed away by using a laboratory experiment and also developed a methodology to show how tsunami damage can be evaluated.

**KEY WORDS :** The Indian Ocean Tsunami; West Coast of Southern Thailand; Field Survey; Satellite Photograph; Estimation Model of Tsunami Damage; Flood Area; Building Damage; Seawall Damage; Aspect of Tsunami Damage

### **INTRODUCTION**

Tsunami is that cause massive damage occur every few decades somewhere in the world. On December 26, 2004, the 9.0 magnitude Sumatra Andaman mega thrust earthquake spawned gigantic seismic waves or tsunami in the Indian Ocean which caused large scale coastal flooding in various countries such as Indonesia, Thailand, Sri Langka, India, Bangladesh, Malaysia, etc. In Thailand, the area affected by the Tsunami was located in the west coast of six of its southern province. The tsunami caused the death of people including Phang-nga, Phuket, Krabi, Ranong, Trang and Satun. The tsunami caused people were killed, coast plain flooding, resulting in damage to many buildings, coastal facilities, beaches, inlets, etc. Preventing the occurrence of tsunamis is impossible with current technology level, but it is possible to minimize tsunami damage if detailed estimates of potential damage are made. In this paper, the authors attempt to develop a methodology for estimating damage by using the western coast of southern part of Thailand at 3 points of each case study in Khao Lak, Phang-nga and Patong Beach, which given available materials regarding

damage from the 2004, Indian Ocean Tsunami, as well as generally available geo-spatial information.

### **RESEARCH PROCEDURE**

#### **(1) Local Survey and Satellite Photograph Analysis**

In mid-January 2005, the authors surveyed in detail the western coastal areas of Thailand that suffered extensive tsunami damage, including the Khao Lak coast of Phangnga Province which has extensive low-land areas with significant vegetation, and Patong Beach in Phuket Island which has a concentration of reinforced concrete structures (Yamamoto et al, 2005, 2006, 2007)

Then, in late September 2006, the authors gathered additional information to supplement the authors' local survey, and obtained high-definition images of the coastal regions before and after the tsunami damage using aerial pictures and IKONOS satellite images respectively from RTSD and GISTDA, Thailand, and including pictures received the assistance from local government in both areas, to ascertain the extent of flooding and building damage at various points.

Figs. 1 & 4 show the overall image of each coast; Figs. 2 & 6 are typical before-after comparison of tsunami damage; and Figs. 3, 5 & 7 provide examples of tsunami damage seen from ground photos. Table 1 shows the evaluation results of building damage.

Figs. 1 & 4 are difficult to read because the image is in black and white and has been contracted. However, with the original images, it was easy to judge the extent of flooding along the Khao Lak coast based on vegetation discoloring, but this was not possible along Patong Beach because flooding was limited to an urban area concentrated with buildings. The white lines in both figures are the flood lines according to the Thailand government, and the image of the Khao Lak coast shows clearly the destruction and discoloration of vegetation up to the white flood line inland from the coast.

In Fig. 2, it is possible to judge from the original satellite photograph whether a building's roof has been swept away or not, and if it has the level of destruction to pillars and walls. For buildings whose roofs have not been swept away, the pillars supporting the roofs obviously remain, but it is not possible to ascertain the level of destruction to the walls. In Patong Beach, it was impossible to judge the level of damage to walls, etc.; from satellite photographs because the roofs of most buildings remained since the buildings were built solidly with reinforced concrete. As such, the authors made evaluations of key buildings (such as in Figs. 3 & 5) based on the authors' local survey.