A Research on Ships Evacuation Simulation due to a Tsunami Attack in the Seto Inland Sea

Masako Murayama
Electronics and Information Engineering, Toyama National College of Technology
Imizu, Toyama, Japan

Eiichi Kobayashi
Graduate School of Maritime Sciences, Kobe University
Kobe, Hyogo, Japan

Hideaki Kondo
Setonaikai Maritime Safety Association
Hiroshima, Hiroshima, Japan

Shunich Koshimura
Department of Civil and Environmental Engineering, Tohoku University
Sendai, Miyagi, Japan

ABSTRACT

The probability of the Tonankai and Nankai earthquakes that will occur along the Nankai Trough is estimated to be 50% or more in these 30 years. Moreover, because some tsunamis occurred along with these earthquakes, come into the Seto Inland Sea, it is recommended that ships should be maneuvered to shelter areas outside the port areas when a tsunami warning is issued. This could result in traffic congestion as numerous ships transit to the safe areas simultaneously. In this study, the ability of ships to evacuate to the shelter areas was confirmed by a dynamic ship traffic computer simulation.

KEY WORDS: ship evacuation; tsunami; dynamic simulation

INTRODUCTION

In recent years, large-scale sea earthquakes of magnitude 8.0 on the scale have occurred around the world. Tsunamis are sometimes generated along with these earthquakes, and such tsunamis may cause serious damage to coastal regions, such as flooding, ship collisions with various obstacles, and ship groundings. A tsunami occurring at the Nankai Trough would not only raise the sea surface, it would also generate strong horizontal currents along the coastal region of Osaka Bay, after passing through the Kii Channel, which is the entrance to the bay and the Seto Inland Sea.

Comparatively few studies on maritime traffic under tsunami-induced flow conditions have been conducted, even though numerous countermeasures have been investigated for land areas threatened by tsunamis. However, there are numerous industrial facilities along the coastal areas of Osaka Bay and the Seto Inland Sea. Furthermore, a large number of ships are constantly transiting to and from these facilities while carrying dangerous materials such as crude oil and/or LNG.

It is recommended that those ships should be maneuvered to shelter areas outside the ports after a tsunami warning is issued. Under such circumstances, traffic congestion would probably occur as numerous ships attempt transit to the safe areas simultaneously.

The focus of this study is Mizushima Port, which is the primary port in the Seto Inland Sea, a location where multiple ships are constantly navigating, and where numerous cargos are handled. In the first part of the study, the traffic density in Mizushima Port was analyzed using Automatic Information System (AIS) data to determine the level of traffic density around those areas. In the second, several ship evacuation routes (from port to shelter areas) were determined based on initial ship locations, received AIS data, and depth required for each ship to navigate safely, as shown in the harbor charts. In the third part, the time necessary to evacuate multiple ships to safe areas outside the port in the event of an imminent tsunami attack was calculated using dynamic ship traffic computer simulation.

The primary purpose of this study was to evaluate probable times needed for ships located in Mizushima Port to evacuate to the shelter areas.

TRAFFIC CONDITIONS

Mizushima Port

Mizushima Port is located on the northern shores of the Southern Seto Inland Sea in Japan’s Okayama Prefecture. The Port is one of those specially designated by a government ordinance as a base of Japan’s international marine transportation network. Mizushima Port itself is located at the rear of the marine industrial area, and at the intersection