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INTERPRETATION OF PUBLISHED DATA OF THE 1976 TANGSHAN, CHINA EARTHQUAKE FOR THE DETERMINATION OF A FATALITY RATE FUNCTION

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Analyzing the seismological and damage data of the Tangshan earthquake, we derived a function correlating the percent loss of masonry buildings to that of human lives. We determined the relationship so that the spatial distribution of the death estimated on the basis of the relationship was the most consistent with that of the data. We employed the method of system identification in this determination. The relationship obtained was a downward-convex, monotonously increasing function having a fatality rate of 30% at a collapse rate of 100%.

Key Words: *earthquake, mass casualty, fatality, Tangshan earthquake, China*

1. INTRODUCTION

With a death toll of 242,000, the Tangshan, China earthquake of July 28, 1976, was one of the most devastating earthquakes in the world. In addition to the massive damage, the earthquake was remarkable for the extensive technical survey that took place after the event. Consequently, a great number of publications on this disaster have appeared.

Despite the vast accumulation of data, however, information on the human losses in the disaster was surprisingly limited compared that of the whole. We found plenty of sound data regarding ground shaking and material losses, including isoseismal maps and collapse rate functions. Concerning human losses, in contrast, we could find very little quantitative data that were applicable to an in-depth interpretation of the disaster. We only found a very little amount of statistics that was fragmentary to say the least, often ambiguous, and, consequently, uncertain regarding their accuracy and reliability.

This situation always resulted in a serious bottleneck preventing us from discussing the human loss aspect of the disaster. We need to learn more concerning what happened to the people in Tangshan toward the development of knowledge applicable to the reduction in human casualties in future earthquakes.

To settle this problem, we decided to develop a tool for deriving reliable estimates that make up for the lack of casualty data. In this development, we particularly focused our attention on the construction of a fatality rate function, namely, the relationship between the percent loss of building stock and that of human lives. We developed the relationship so that we could apply it, together with an isoseismal map and a collapse rate function, to our estimation model[1)~3)] for the spatial distribution of earthquake fatalities.

Since the most part of affected buildings in the Tangshan earthquake was of masonry construction, our product from this study is applicable only to the assessment of disasters in built environment composed of masonry structures. In spite of this limitation, however, the result of this study can be expected useful, if we realize that masonry construction is broadly employed, even in earthquake-prone areas, and, accordingly, there is a large population worldwide living with serious threat of earthquake-related collapse of such kinds of structures.

In addition to the determination of a fatality rate function, which was the primary objective of this paper, we tried to depict in detail the entire structure of our estimation model. The model will be of use being applicable not only to the interpretation of data from a past disaster, which we did in this study, but also to the assessment of human losses in a future event. The model includes building quality in terms of the structural vulner-