

The Great Tangshan Earthquake of 1976

Volume 4

Earthquake Engineering Research Laboratory
California Institute of Technology
Pasadena, California 91125
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To insure that the technical meaning in the Tangshan earthquake report was translated correctly it was necessary that the first draft of the translation should be reviewed by persons knowledgeable in the particular technical subject: geology, seismology, geotechnical engineering, structural engineering, performance of structures during earthquakes, and also knowledgeable in both the English and the Chinese language. The following persons volunteered to do this technical review:

| | |
|--------------------------|--|
| Dr. Frank K. Chang | U.S. Army Engineer-Waterways Experimental Station, retired |
| Professor Nien-Yin Chang | Department of Civil Engineering, University of Colorado |
| Professor Zhikun Hou | Department of Mechanical Engineering, Worcester Polytechnic Institute |
| Dr. Moh-Jiann Huang | Office of Strong Motion Studies, California Division of Mines and Geology |

Sharon Beckenbach, Denise Okamoto, Carolina Sustaita and Leslie Ann Crockett carried out the final editing and the preparation for publication at the California Institute of Technology.

The valuable work by all of the foregoing persons contributed greatly to a successful translation and publication of the report "The Great Tangshan Earthquake".

George W. Housner
Li-Li Xie

FOREWORD

On July 28, 1976, a magnitude 7.8 earthquake devastated the city of Tangshan, China and surrounding regions. Of the 1.5 million people living in the affected area, it was reported that about 242,000 died and 164,000 were severely injured and most of the surviving inhabitants lost their homes because of collapse. This earthquake caused one of the greatest natural disasters in human history.

The great structural, economic, and social impacts of this earthquake made it obligatory to record the seismic effects and also the geological and seismological setting of the earthquake. An effort of six years was made to prepare a report on the Tangshan Earthquake under the leadership of Professor Huixian Liu, the former director of the Institute of Engineering Mechanics (IEM), China Seismological Bureau. The report titled "Damage in the Great Tangshan Earthquake" in Chinese language was published in four volumes including fifteen chapters. Volume I presents the basic information on seismological and geological features relevant to the earthquake; Volume II records real and vivid damage to civil structures and facilities; Volume III describes damage to the lifeline systems, disaster relief and rebuilding of the Tangshan city and Volume IV contains about seven hundred photographs of various typical damages. A unique feature of this report is that all damages collected in the book are described in detail with little subjective explanation so as to insure that the information provided is as objective as possible. This report reflects the whole picture of damages to the various buildings, structures, lifeline systems, etc. distributed in a vast region, ranging from completely destroyed in the near-field to more distant regions where structures suffered only slightly damage. The report provides also basic information on seismic damage for further earthquake engineering research.

The years 1990-2000 have been designated by the United Nations as the International Decade for Natural Disaster reduction (IDNDR). The Decade would be a potent first step in reducing the impacts of natural hazards through coordinated research, data gathering and information sharing. In 1986, four years earlier than the beginning of the Decade, Professor George W. Housner proposed a program to translate the book "Damage in the Great Tangshan Earthquake" into English language after he received and examined a copy of this book. In his letter to Professor Liu Huixian he highlighted "This appears to be an excellent report that contains much information that would be valuable to all earthquake-prone countries in the world. Earthquake engineers and seismologists everywhere could learn from this report how to improve the safety of their cities". This initiation received an active response from Liu Huixian who mentioned in his reply letter that he decided to arrange an English language edition of the Tangshan Earthquake Report. Since then under the sponsorship of the Ministry of Construction and the State Seismological Bureau of China and U.S. National Science Foundation a joint project was finally established and executed in 1991 between the Institute of Engineering Mechanics in Harbin, China and the California Institute of Technology in USA with Professors Liu and Housner as Principal Investigators for the project.

The translation from Chinese to English was done at the Institute of Engineering Mechanics. Many authors who had written the original Chinese report translated many of the chapters. The editing and the publication were done in the United States under the direction of Professor Housner.

Unfortunately, Professor Liu Huixian became ill in 1991 and died on June 24, 1992. Thus, he did not live to see the completion of the report. As his successor, Professor Xie Li-li, who was the director of IEM, has undertaken the responsibility of carrying on the unfulfilled work left by Professor Liu. Through the joint effort since then, the English language version of the report is now completed and published. Undoubtedly, it will be a significant contribution to world earthquake disaster reduction.

On the occasion of the Twenty-fifth Anniversary of the Tangshan Earthquake, we would like to publish and distribute this report in memory of the Tangshan Earthquake and as an expression of sympathy we dedicate it to the victims of this great disaster.

Xie Lili
June 30, 2001

PREFACE

The large coal mines in Tangshan City provided the base for the development of heavy industry, such as locomotive manufacture, cement manufacture, chemical manufacture, etc. All of these industries were damaged by the earthquake and this inflicted a great economic impact on the country. It was of great importance to repair the damaged industries and to restore manufacturing. Because of the need for a speedy recovery, engineers did not have time to thoroughly study the damage and, therefore, an effort was made to document the damage by photographing the most important features.

Many of the inhabitants of Tangshan City and the surrounding area lived in one-story or two-story buildings that had been constructed without benefit of architecture or engineering. These small buildings had low earthquake resistance and most of them collapsed during the earthquake. These collapsed dwellings accounted for the majority of deaths as the earthquake occurred about four o'clock in the morning. The collapse of these structures is not documented in this report but in some of the aerial photographs it is possible to see the destroyed area where these buildings had been located.

The photographs in this volume provide a number of lessons to those concerned about destructive earthquakes. First, it is clear that buildings not designed to resist earthquakes will be badly damaged or will collapse during strong ground shaking; second, the few buildings that had been designed for earthquake resistance performed very much better than the other buildings; third, the relatively few structures that had been retrofitted for earthquake resistance performed better than those which had not; fourth, earthquake engineers looking at these photographs will find it very interesting to try to explain why the damage occurred the way it did; fifth, an engineer while looking at the photographs would find it interesting to try to determine what retrofit could have been undertaken to minimize the damage.

Any reader of this report should ask himself: what would happen to my city if it experienced strong ground shaking? It should be kept in mind that the building code had put Tangshan City in a seismic zone not requiring earthquake design, so that a city which does not require seismic design is not necessarily safe from an earthquake disaster. Even cities that do have modern seismic design requirements in their building code also have a large group of structures that were not designed to resist earthquakes according to modern principles and the experience of Tangshan shows what could happen in the event of strong ground shaking.

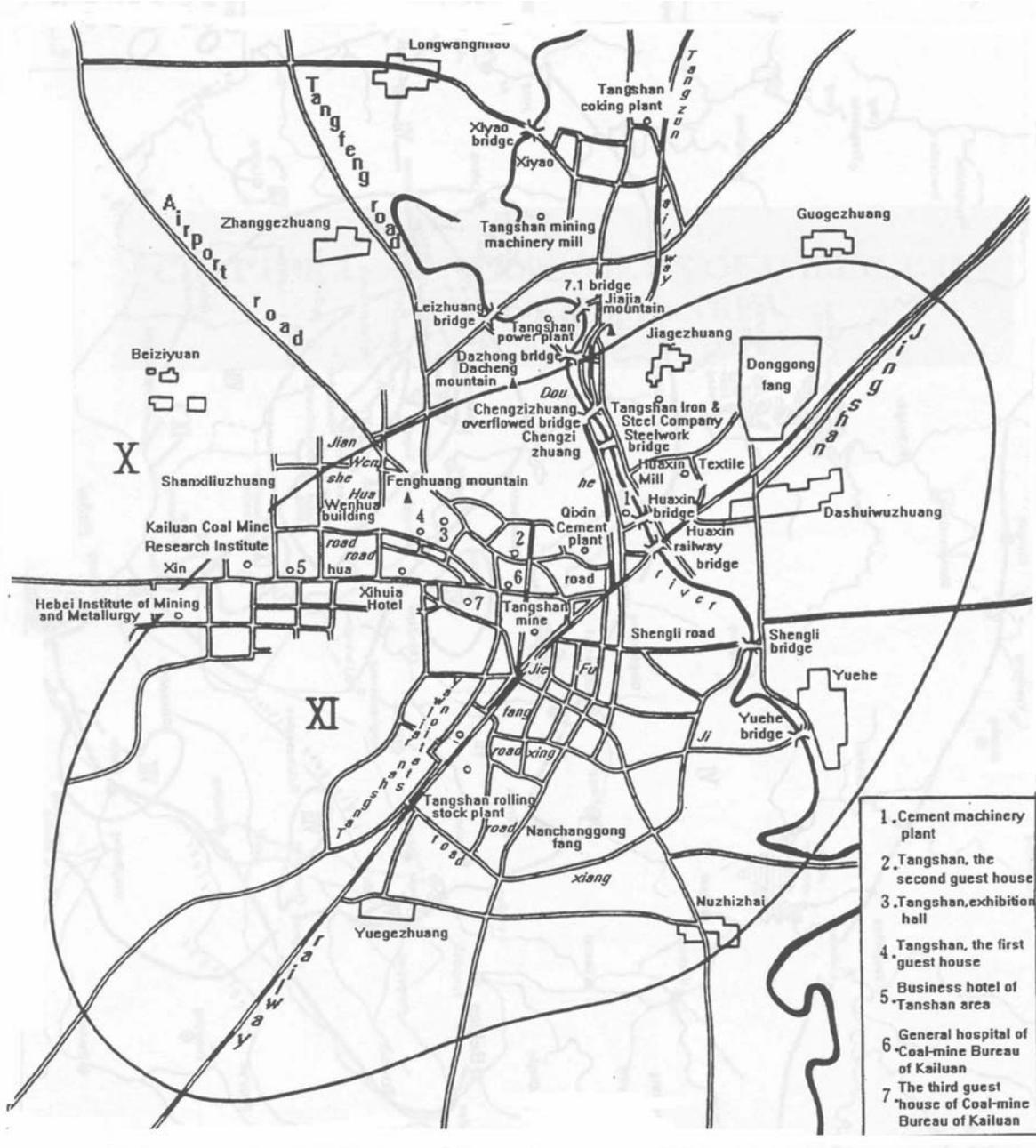
George W. Housner
California Institute of Technology

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Distribution map of meizoseismal area during the M7.8 Tangshan earthquake.

