Preface to the English Edition

This report is the English edition of the Preliminary Reconnaissance Report of the 1995 Hyogoken-Nanbu Earthquake, which was published originally in Japanese by the Architectural Institute of Japan. This edition was prepared by the Working Group for the English Edition, whose membership is provided in the member list appearing at the beginning of this report. It was prepared in answer to the international interest generated by this devastating earthquake which has severely hit a highly developed modern urban area endowed with numerous buildings originally designed with seismic-resistance in mind.

Although the utmost care was taken during the translation process to reflect truthfully the intentions of the original authors, translations errors may have inadvertently been introduced. Hence, should discrepancies be found between the English and Japanese versions of this report, the original Japanese version should obviously prevail. Furthermore, it must be recognized that the opinions and views expressed herein are solely those of the authors who prepared each section of the original Japanese document. The authorship of that report is as listed in the member list appearing at the beginning of this report. Likewise, the overlaps that exist in the Japanese version (for reasons described in Chapter 5) have not been edited either, to convey as truthfully as possible the message of the original authors.

Special thanks are extended to Prof. J. P. Moehle, Director of the Earthquake Engineering Research Center, University of California at Berkeley, for helping organize the working group for the English Edition.

For those readers not familiar with Japan, the following information is provided to expedite their reading of this report.

Prior to the earthquake, Kobe was home to the busiest sea-port of Japan. Kobe is located at the west end of the Hyogo prefecture (Hyogo-ken, ken meaning prefecture), approximately 20 km west of Osaka. The figures of Chapters 1 and 2 should be sufficient to locate Kobe within Japan. The Hyogo prefecture encompasses the continuous urban development which starts west of Kobe and extent to Osaka, with a population of more than 4 millions. It is one of the prefectures of the very large geographic region known as the Kansai area (which includes Kyoto, Osaka, and Kobe, among many large cities, for a combined population of nearly 25 millions). The Hyogo prefecture is not only home to manufacturing industries too numerous to list here, but also the most important corridor linking Osaka to west Japan. The Hyogo prefecture thus encompasses many cities, which in turn are sometimes subdivided in wards (i.e. designated by the suffix "-ku"), usually further subdivided into neighborhoods and neighborhood-blocks (i.e. designated by the suffix "-cho" or "-machi" and "-chome" respectively). Other relevant information about the Hyogo prefecture area is provided within the report.

The Architectural Institute of Japan (AIJ) is a learned society of professionals from all disciplines related to buildings (architectural planning, structural engineering, building physics and environment, etc). Therefore, this preliminary report on the Hyogoken-Nanbu earthquake understandably focuses on buildings only, and more particularly on structural damage at this time. Damage from fires following this earthquake has not been considered. The performance of other civil engineering structures during this earthquake is being studied by other learned societies, such as the Japanese Society of Civil Engineers.

The Japanese Shindo scale of intensity is frequently mentioned in this report. The international

reader may find it convenient to convert the seven level Shindo intensity scale into the corresponding levels of the Modified Mercali Intensity Scale (MMI) according to the following rough equivalences: The Shindo intensities 1 to 7 respectively corresponds to the MMI I to II, II to IV, IV to V, V to VII, VII to VIII, VIII to IX, and IX to XII.

Japanese seismological activities have traditionally used gals units to quantify acceleration values. It is useful to know that 1 gal equals 1 cm/s/s. Also, vertical accelerations are often reported as Up-Down (UD) motion, as a natural extension of the commonly used North-South (NS) and East-West (EW) describers.

Although it might have been desirable, a comprehensive description of the profile of the construction industry in Japan is unfortunately beyond the scope of this report. However, the reader may appreciate to know that timber, steel, concrete and steel-encased reinforced concrete buildings respectively account for approximately 30%, 40%, 20% and 10% of all square-meters of construction in Japan (as per data collected for the year 1989). Timber is obviously almost exclusively used for residential houses, either built according with the traditional style (with ceramic roof tiles and beam and column type of construction) or using 2" by 4" timber members to construct stud-walls (a practice imported from North America some decades ago). Steel-encased reinforced concrete construction, also refereed to as SRC throughout this report, and used for decades in Japan to enhance the seismic resistance of buildings, consists of the encasement of a steel frame into a reinforced-concrete frame. This uniquely Japanese construction method has considerably evolved over the years, with built-up steel members used in the early days of this construction technique, and rolled wide-flange members nowadays. Reinforced concrete and steel structures also have particularities germane to Japan, but these will hopefully become obvious upon reading of this report. However, it is important to know that, as far as seismic resistance is concerned, an important revision to the Japanese Building Code occurred in 1971, when requirements necessary to enhance the shear behavior of reinforced concrete members were first considered. A major overhaul of the Japanese Building Code then occurred in 1981, when a two-level design procedure was implemented, along with requirements to explicitly consider ductile behavior. These two periods provide important milestones in the Japanese history of earthquake-resistant design, as will be noticed upon reading of this report.

The reader will also notice that base-isolated structures, active-control systems, or passive energy dissipation systems, and the likes, are not mentioned in this report. However, although Japan has made extensive contributions in these field in the last decades, buildings having these systems are very few in the Hanshin area and their performance during this earthquake was apparently unknown at the time of writing of the original Japanese report.

Hopefully, this report will provide engineers, architects, responsible agencies, and many others worldwide, an opportunity to appreciate the impact this earthquake had on buildings.

Masayoshi Nakashima and Michel Bruneau
Editors of English Edition
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