FOREWORD

The behavior of structures during earthquakes have come to be fairly well clarified as a result of the rapid progress made in the field of earthquake engineering in the course of the past decade and a half or so. Particularly, computations of earthquake responses of structures in linear range have been formularized.

On the other hand, however, it is extremely distressing that so many lives were lost in the earthquakes which occurred recently in countries such as Peru, Nicaragua, Turkey and Guatemala. A change in living enviroment due to the progress in regional development and concentration of populations in urban areas is accelerating to make an earthquake disaster greater than that in the past. Earthquakes have rapidly come to be of more concern in human life.

The safety of a structure during earthquakes has often been discussed in relation only with the problem of economical structural design. However, a measure for minimizing earthquake damage should not be limited to the structural aspects. It would be difficult to give absolute safety to structures in earthquakes with respect to structural design, and it has become necessary for such measures to be considered through methods encompassing the regional planning based on seismic zoning, the alarming system of earthquake and the emergency steps and facilities, etc. Synthesis consideration of these factors in structural design might be said to constitute the earthquake engineering in a broad sense. It may be considered that earthquake engineering has now come to acquire or is in the process of acquiring the potential and flexibility to cope with problems of earthquake resistance in a variety of situations.

Under such circumstances, it would seem that the task to be shouldered by earthquake structural engineering is to make it possible to make synthesis planning and designing of structures having rational earthquake resistances. The "synthesis" in this case would not simply mean "only the strength" of a structure, but also, besides structural matters such as controlling and repairing damage, various other factors such as facilities for communication, liaison, fire extinguishing, ventilation, refuge, rescue, etc. during emergencies, and structures for these facilities to function reliably at times of earthquake.

There are still numerous problems to be solved in order to carry out this task, but from the standpoint of earthquake resistance of structures, it is wished to take up the matter of failure of structures due to earthquake. There have been a number of studies which have recently been initiated regarding dynamic

failures of structural members comprised of reinforced concrete or steel. In case of failure due to earthquake, even if input earthquake motions are suitably selected and applied, it is not an easy matter to accurately grasp the behaviors of members in the nonlinear range because of nonstational random characteristics. Much less it is not easy to clarify failure of a structure since the complex earthquake responses as a structural body will be further added. However, in order to be able to produce a synthesis structural design which gives a rational earthquake resistance to the structures, the study of the above is by all means required. If the failure process can be explained, it would become possible, for instance, to make a structure having a sort of safety value with respect to earthquake failure, where, by producing or tolerating partial collapse of a structure, total collapse or decisive failure can be avoided. In effect, it would become possible to evaluate earthquake resistance and safety during earthquake of a structure in a broader sense. Considering that probability of catastrophic earthquakes is usually very rare, studies of the failure processes of structures in the above light have an more important meaning.

It is thought the stage has been reached where the problems of earthquake resistance of structures should be investigated and studied, synthetically and comprehensively, from various angles.

Choshiro Tamura
Professor, Institute of
Industrial Science,
University of Tokyo