



ELSEVIER

# Preliminary seismic performance assessment procedure for existing RC buildings

Ahmet Yakut\*

*Department of Civil Engineering, Middle East Technical University, ODTU 06531 Ankara, Turkey*

Received 10 October 2003; received in revised form 23 February 2004; accepted 17 May 2004

## Abstract

A preliminary procedure to assess rapidly the likely seismic performance of existing reinforced concrete buildings is presented. In this procedure, a Capacity Index is computed considering the orientation, size and material properties of the components comprising the lateral load resisting structural system. This index is then modified by several coefficients that reflect the quality of workmanship and materials, and architectural features. The procedure has been tested and calibrated based on the data compiled from damage surveys conducted after the earthquakes that occurred within the last decade in Turkey. The method classifies the buildings either as safe, meaning the building might suffer no severe damage or as unsafe, indicating that life safety performance level would not be met.

© 2004 Elsevier Ltd. All rights reserved.

*Keywords:* Seismic vulnerability; Reinforced concrete; Evaluation; Performance

## 1. Introduction

The need to predict the seismic vulnerability of existing buildings has led to increased interest on research dealing with the development of seismic vulnerability assessment techniques. A number of procedures have been proposed in the literature, which can generally be classified into three categories. The simplest and quickest way, called walk-down survey or street survey, requires only superficial data collected from a brief inspection of the building. The number of stories, vertical and plan irregularities, location of the building, age of the building, its structural system and apparent material and workmanship quality are typical parameters that are used. FEMA 154 [1], FEMA 310 Tier 1 [2] evaluation and Japanese system of assessment [3] fall into this category. The purpose of rapid evaluation techniques is to identify or rank highly vulnerable buildings that deserve further investigation.

When a more detailed and reliable assessment is needed, then preliminary assessment techniques are

employed. In addition to what is collected from the street survey, data on the size and orientation of the structural components, material properties and layout are needed. This requires entry to the building and review of drawings. This procedure does not rely on sophisticated and time-consuming analysis of the building but some quick calculations are performed. The structural capacity is usually expressed in terms of an index, which is checked against an anticipated demand. By this comparison, the expected performance of the building is predicted. The success of these techniques depends on the availability and quality of data. FEMA 310 Tier 2 [2] evaluation is a widely used preliminary assessment technique.

The in-depth evaluation of the buildings through sophisticated structural analyses falls into the third category of vulnerability assessment. The comprehensive information on the geometrical properties of the components, mechanical properties of the materials, and detailing of the components are obtained from the structural drawings and as-built features of the building. Linear or non-linear analysis techniques are used to determine the response quantities for an anticipated seismic action. These response quantities are then

\* Tel.: +90-312-210-5406; fax: +90-312-210-1193.

E-mail address: [ayakut@metu.edu.tr](mailto:ayakut@metu.edu.tr) (A. Yakut).