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Evaluation of Static and Response Spectrum Analysis Procedures of SEAOC/UBC for Seismic Isolated Structures

by

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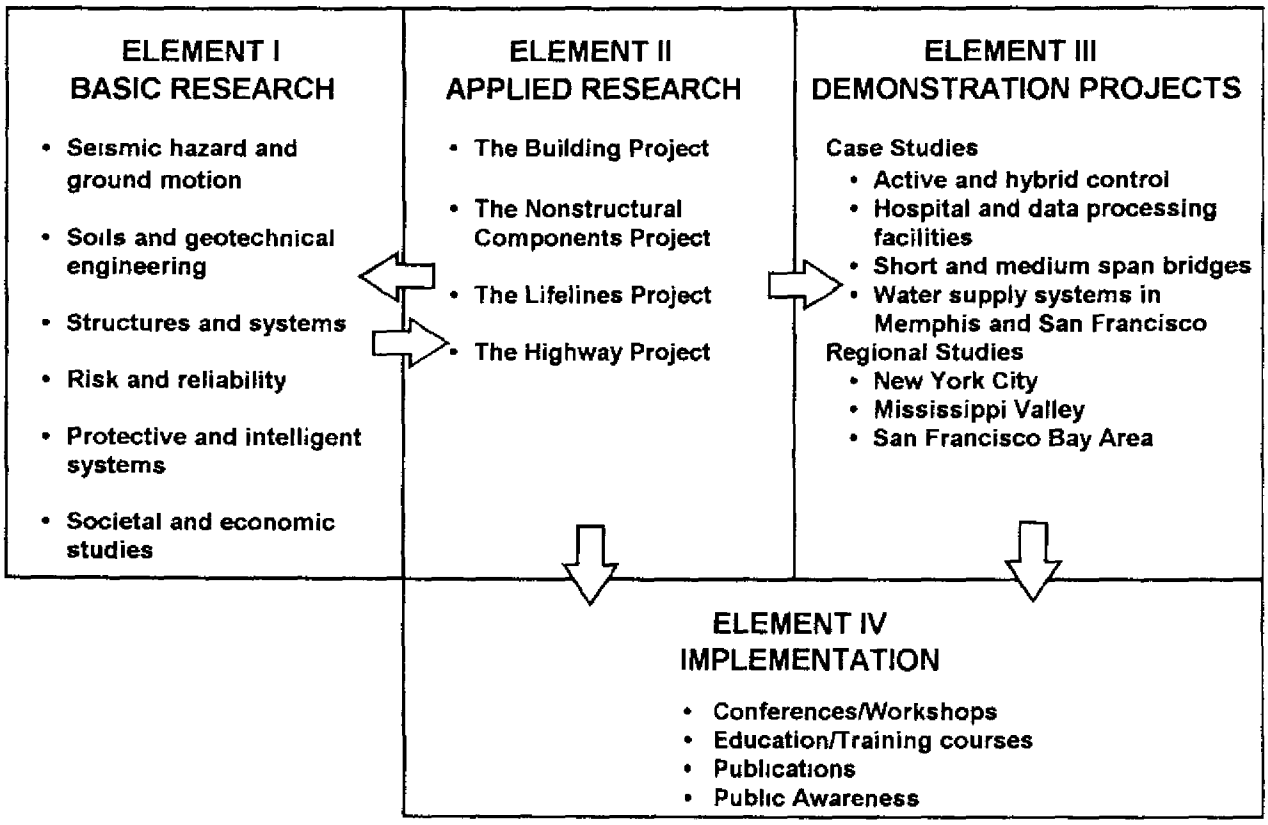
PREFACE

The National Center for Earthquake Engineering Research (NCEER) was established to expand and disseminate knowledge about earthquakes, improve earthquake-resistant design, and implement seismic hazard mitigation procedures to minimize loss of lives and property The emphasis is on structures in the eastern and central United States and lifelines throughout the country that are found in zones of low, moderate, and high seismicity.

NCEER's research and implementation plan in years six through ten (1991-1996) comprises four interlocked elements, as shown in the figure below Element I, Basic Research, is carried out to support projects in the Applied Research area Element II, Applied Research, is the major focus of work for years six through ten Element III, Demonstration Projects, have been planned to support Applied Research projects, and will be either case studies or regional studies. Element IV, Implementation, will result from activity in the four Applied Research projects, and from Demonstration Projects.



Research in the **Building Project** focuses on the evaluation and retrofit of buildings in regions of moderate seismicity. Emphasis is on lightly reinforced concrete buildings, steel semi-rigid frames, and masonry walls or infills. The research involves small- and medium-scale shake table tests and full-scale component tests at several institutions. In a parallel effort, analytical models and computer programs are being developed to aid in the prediction of the response of these buildings to various types of ground motion.

Two of the short-term products of the **Building Project** will be a monograph on the evaluation of lightly reinforced concrete buildings and a state-of-the-art report on unreinforced masonry

The **protective and intelligent systems program** constitutes one of the important areas of research in the **Building Project**. Current tasks include the following:

1. Evaluate the performance of full-scale active bracing and active mass dampers already in place in terms of performance, power requirements, maintenance, reliability and cost
2 Compare passive and active control strategies in terms of structural type, degree of effectiveness, cost and long-term reliability.
3. Perform fundamental studies of hybrid control.
4. Develop and test hybrid control systems.

This report addresses the guidelines and regulations for the design of seismic-isolated structures recently adopted by the Structural Engineers Association of California and the International Conference of Building Officials. The static and response spectrum analysis methods provided in the guidelines are assessed by comparing their results with those obtained from nonlinear dynamic analysis for a class of seismic isolated structures. This comparison is discussed in terms of center bearing displacements, corner bearing displacements, and shear force distribution over the building height over a wide range of structural properties and elastomeric isolation system characteristics.

ABSTRACT

The Structural Engineers Association of California (SEAOC) and the International Conference of Building Officials have adopted guidelines and regulations for the design of seismic-isolated structures. These guidelines and regulations specify procedures for the analysis and design of isolated structures. These procedures include a static analysis method for establishing minimum limits of design, and a dynamic analysis method which includes response spectrum and time history analysis methods.

This report presents a comparison of results of the static and response spectrum analysis methods to results of nonlinear dynamic analysis for a class of seismic-isolated structures. The structures include 1-story (stiff) and 8-story (flexible) superstructures on stiff and medium soil sites and isolation systems described by twenty-two different generic nonlinear hysteretic models, which are representative of a wide range of elastomeric isolation systems.

It is shown that when the response spectrum analysis procedure is properly applied, the static and response spectrum analysis procedures predict results which match the mean of time history results for the bearing displacements and shear forces at the base of the building. However, the static and response spectrum analysis procedures can significantly underpredict the shear force in the upper stories even for the case of low effective damping in the isolation system.

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