FEDERAL EMERGENCY MANAGEMENT AGENCY

SEISMIC SAFETY OF BUILDINGS

Sources of information for design professionals and other decision makers in earthquake hazard mitigation

EXISTING BUILDINGS

Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook (FEMA-I 54, 1988, 185 pages) and ***Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation*** **(FEMA-I 55,1988,137 pages).** Prepared by the Applied Technology Council, Redwood City, CA (ATC-21 and ATC-21 -1).

The Handbook presents a method for quickly identifying buildings posing risk of death, injury, or severe curtailment in use following an earthquake. The methodology, "Rapid Screening Procedure (RSP)," can be used by trained personnel to identify potentially hazardous buildings on the basis of a 15 to 30 minute exterior inspection, using a data collection form included in the Handbook. Twelve basic structural categories are inspected, leading to a numerical "structural score" based on visual inspection. Building inspectors are the most likely group to implement an RSP, although this report is also intended for building officials, engineers, architects, building owners, emergency managers and interested citizens. The Supporting Documentation reviews the literature and existing procedures for rapid visual screening.

NEHRP Handbook for the Seismic Evaluation of Existing Buildings (FEMA-178, 1992, 227 pages). Prepared by the Building **Seismic Safety Council, Washington, D.C.**

The Handbook presents a nationally applicable method for engineers to identify buildings or building components that present unacceptable risks in case of an earthquake. Four structural subsystems in which deficits may exist are identified: vertical elements resisting horizontal loads; horizontal elements resisting lateral loads; foundations; and connections between structural elements or subsystems. Fifteen structural categories are defined for the evaluation of buildings by engineers. The Handbook is formulated to be compatible with NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings (FEMA-172/1992).

NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings (FEMA-172, 1992,197 pages). Prepared by the Building Seismic Safety Council, Washington, DC.

This handbook presents techniques for solving a variety of seismic rehabilitation problems. intended for engineers concerned with seismic rehabilitation of existing buildings, the handbook identifies and describes seismic rehabilitation techniques for a broad spectrum of building types and building components (both structural and nonstructural). Most techniques are illustrated with sketches, and the relative merits of the techniques are discussed. Designed to be compatible with the NEHRP Handbook for the Seismic Evaluation of Existing Buildings (FEMA-178/1992), this publication is based on a prelimary version prepared by URS/John A. Blume and Associates, Technique for Seismically Rehabilitating Existing Buildings (FEMA-172/1989).

Typical Costs for Seismic Rehabilitation of Existing Buildings: Volume 1: Summary, Second Edition (FEMA-156, 1994, approx. 70 pages); ***Volume 2: Supporting Documentation, Second Edition*** (FEMA-1 57, 1995,approx. 102 pages). Prepared by the Hart Consultant Group, Inc. Santa Monica, CA. [FEMA-156, 1994 **AND FEMA-157, 1995 SUPERSEDE FEMA-156, 1988 AND FEMA-157. 1988].**

Typical Costa for Seismic Rehabilitation of Existing Buildings: Volume I: Summary second Edition provides a methodology that enables users to estimate the costs of seismic rehabilitation projects at various locations in the United States. This greatly improved edition is based on a sample of almost 2100 projects. The data were collected by use of a standard protocol, given a stringent quality control verification and a reliability rating, and then entered into a database that is available to practitioners. A sophisticated statistical methodology applied to this database yields costs estimates of increasing quality and reliability as more and more detailed information on the building inventory is used in the estimation process. Guidance is also provided to calculate a range of uncertainty associated with this process. The Supporting Documentation contains an in-depth discussion of the approaches and methodology that were used in developing the second edition.

Benefit-Cost Model for the Seismic Rehabilitation of Hazardous Buildings. **Volume *1: A User's* Manual (FEMA-227,** 1992, approx. 68 pages); ***Volume 2: Supporting Documentation (FEMA-228,*** 1992, approx. 62 pages); and ***Computer Software for Benefit-Cost Model for the Seismic Rehabilifation of Hazardous Buildings.*** Prepared by VSP Associates, Inc., Sacramento, CA.

The two benefit-cost models presented in this report are designed to help evaluate the economic benefits and costs of seismic rehabilitation of existing hazardous buildings. The single class model analyzes groups of buildings with a single structural type, a single use, and a single set of economic assumptions. The multi-class model analyzes groups of buildings that may have several structural types and uses. The User's manual presents background information on the development of the benefit-cost model and an introduction to the use of benefit/cost analysis in decision making. It reviews the economic assumptions of benefit-cost models, with and without including the value of life. The User's Manual guides the user through the model by presenting synopses of data entries required, example model results, and supporting information. Seven applications of the models are presented: five of the single-class model; two of the multi-class model.

Supporting Documentation complements the User's Manual by providing four appendices that help the user understand how the benefit-cost models were constructed. The appendices include: 1) a review of relevant literature; 2) a section on estimating costs for seismic rehabilitation; 3) a compilation of tables for the Seattle building inventory; and 4) some insights into the building rehabilitation of the nine cities visited during this project.

Computer Software to run the benefit/cost models is also available. The programs are on 3½" diskettes and can be used on IBM compatible personal computers.

Seismic Rehabilitation of Federal Buildings: A Benefit/ Cost Model. Volume 1: A User's Manual (FEMA 255,1994, approx. 158 pages); ***Volume 2: Supporting Documentation (FEMA-256, 1994,*** approx. 71 pages) and ***Computer Software for the Seismic Rehabilitation of Federal Buildings.*** Prepared by VSP Associates, **Inc., Sacramento, CA.**

This User's **Manuel** and accompanying software present a second generation cost-benefit model for the seismic rehabilitation of federal and other government buildings. Intended for facility managers, design professionals, and others involved in decision making, the cost/benefit methodology provides estimates of the benefits (avoided damages, avoided losses, and avoided casualties) of seismic rehabilitation, as well as estimates of the costs necessary to implement the rehabilitation. The methodology also generates detailed scenario estimates of damages, losses, and casualties. The **Manual** describes the computer hardware and software required to run the program. It also explains how to install the program, how to use Quattro Pro for Windows, and how to enter necessary data. A tutorial provides a fully worked example. Benefit/Cost analyses of eight federal buildings are included. The Supporting Documentation contains background information for the **User's Manual** including information on valuing public sector services, discount rates and multipliers, the dollar value of human life, and technical issues that affect benefit/cost analysis, such as seismic risk assessment and sensitivity analysis.

Computer Software to run the benefit/cost model is available on 3 1/2" diskettes and can be used on IBM compatible personal computers with at least 386 CPU. The computer must also have Windows and Quattro Pro.

Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: handbook(FEMA-174,1989,122 **pages) and *Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Supporting Report*** (FEMA-173, 1989, 190 pages). Prepared by Building *Sys*tems Development, Inc. with integrated Design Services and Claire B. Rubin.

These two **volumes** provide the information needed to develop a seismic rehabilitation? program, with particular reference establishing priorities. The Handbook is intended to assist local jurisdictions in making informed decisions on rehabilitating seismically hazardous existing buildings by providing nationally applicable guidelines. It discusses the pertinent issues that merit consideration, both technical and societal, and suggests a procedure whereby these issues can be resolved. The Supporting Report includes additional information and commentary directly related **to sections in** the Handbook supporting documentation, annotated bibliographies, and reproductions of selected laws and ordinances that are presented in summary form **in the Handbook.**

Financial Incentives for Seismic Rehabilitation of Hazardous Buildings - An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations **(FEMA-198, 1990,104 pages); *Volume 2: State and Local Case Studies and Recommendations*** **(FEMA-199, 1990, 130 pages); and *Volume 3: Applications Workshops Report*** (FEMA-216, 1990, about 200 pages). **Prepared by Building Technology, Inc., Silver Spring, MD.**

The **intent** of these documents is to identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. **Volume 1** includes a discussion of the methodology used for these documents, background information on financial incentives, as well as findings, conclusions and recommendations for use by decision makers at local, state and national levels. **Volume 2 includes detailed descriptions of the twenty case studies that were examined as part of this project. Volume** 3 reports on workshops for the development of local agendas for action in seismic rehabilitation. It includes directions for convening additional workshops and teaching materials which can be used in such workshops. This information is directed primarily to groups that are interested in planning for local seismic mitigation in existing buildings who wish to convene a workshop to initiate the process.

***Development of Guidelines for Seismic Rehabilitation of Buildings - Phase 1: issues identification and Resolution (FEMA-237,* November 1992, 150 pages). Prepared by the Applied Technology Council, Redwood City CA (ATC-28).**

This report is intended to assist in the preparation of Guide**lines for the Seismic Rehabilitation of Existing Buildings. The** report identifies and analyzes issues that may impact the preparation of the **Guidelines** and offers alternative as well as recommended solutions to facilitate their development and implementation. Also discussed are issues concerned with the scope, implementation, and format of the **Guidelines,** as well as coordination efforts, and legal, political, social, and economic aspects. Issues concerning historic buildings, research and new technology, seismicity and mapping, as well as engineering philosophy and goals are discussed. The report concludes with a presentation of issues concerned with the development of specific provisions for major structural and nonstructural elements.

Publications concerning ***existing buildings*** can be obtained at no charge from the FEMA Distribution Center, P.O. Box 2012, Jessup, MD 20794. Telephone: 1-800-480-2520; Fax: (301) 497-6378.

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