ATC-32-1

Improved Seismic Design Criteria for California Bridges: Resource Document

by
APPLIED TECHNOLOGY COUNCIL
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Funded by
CALIFORNIA DEPARTMENT OF TRANSPORTATION
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PROJECT MANAGER
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Earth Mechanics, Inc.
(Foundation Design)
Kercheval Engineers
(Bridge Design)
Kleinfelder/Geospectra
(Seismic Loading)
Modjeski & Masters, Inc.
(Steel & Bearing Design)
Moehle/Priestley Team
(Concrete Design & Analysis)
Quincy Engineering
(Bridge Design)

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Preface

In May 1991 the California Department of Transportation (Caltrans) awarded the Applied Technology Council (ATC) a contract to conduct a critical review of the 1986 Caltrans *Bridge Design Specifications* (together with subsequent seismic-design-related revisions made available to ATC throughout the ATC-32 project's duration) and to recommend improvements where needed. The recommendations developed under the ATC-32 project were published in 1996 in the ATC-32 report, *Improved Seismic Design Criteria for California Bridges: Provisional Recommendations,* which was formatted in 2 columns to provide recommended changes to Caltrans' design provisions (left column) and companion commentary (right column). The report was prepared with the assistance of six technical subcontractors and a publications consultant, with guidance and overview provided by an advisory 13-member Project Engineering Panel (PEP). Topics included seismic loading, seismic effects (analysis), concrete design, foundation design, steel design, and bearing design.

During final preparation of the ATC-32 report, the PEP and Project Manager recognized that a significant amount of potentially valuable work carried out by the subcontractors could not be included in the recommendations for revision to the 1986 Caltrans *Specifications.* Reasons for this decision included the following.

- The material was related to an area of active research, in which there was not a clear consensus among experts in the field.
- There were insufficient resources to allow the PEP to evaluate the material and to decide whether to recommend relevant changes to the 1986 *Specifications.*
- The material was important for the practice of seismic design, but was inappropriate for either design specifications or commentary.

As a result, ATC created this companion resource document (the ATC-32-1 report) to provide a more complete documentation of the ATC-32 project. The ATC-32-1 report contains chapters on specific topics generally developed by the subcontractors responsible for that topic, including the results from trial designs and design parameter studies by project personnel.

ATC gratefully acknowledges the Project Manager, Richard V. Nutt, and the subcontractors who prepared this report, noting that much of their effort was carried out after the completion of the ATC-32 project when project funding was no longer available.

The detailed technical work required for the development of the recommendations was performed primarily by four specialty subcontractors. J.P. Singh and staff at Klienfelder/Geospectra, were responsible for developing new ARS spectra and other recommendations related to seismic loading. Po Lam and staff at Earth Mechanics, working with Geoff Martin of the University of Southern California, were responsible for the development of the foundation design guidelines. Nigel Priestley of the University of California (UC) San Diego and Jack Moehle of UC Berkeley developed the recommendations related to response analysis and reinforced concrete design. They were assisted by Gregg Fenves of UC Berkeley who was particularly helpful in the development of analysis guidelines. John Kulicki and staff at Modjeski and Masters developed new design criteria for steel structures and conventional bridge bearings.

Trial designs using the draft recommendations to the 1986 Caltrans *Specifications* were performed by two bridge design consultants. John Quincy directed the efforts of Quincy Engineering, and Kosal Krishnan directed those of Kercheval Engineers. Nonlinear dynamic analysis studies to evaluate near-fault effects were performed by Dynamic Isolation Systems under the direction of Ronald Mayes. An independent external review of the recommendations for structural steel was conducted by Ahmad Itani of the University of Nevada at Reno.

Technical editing and formatting of this report were performed, respectively, by A. Gerald Brady and Michelle Schwartzbach of ATC.

ATC also gratefully acknowledges the advisory PEP, whose members included Ian G. Buckle (Chair), Robert Cassano, Allen Ely, Nicholas Forell (ATC Board representative), James H. Gates (Caltrans representative), I.M. Idriss, Roy A. Imbson, James O. Jirsa, James R. Libby, Joseph P. Nicoletti, Joseph Penzien, Maurice S. Power, and James E. Roberts (Caltrans representative). (The affiliations of these individuals are provided in the list of project participants).

In addition, ATC is pleased to acknowledge other Caltrans personnel involved in the project. Mohsen Sul-

tan was the Contract Manager and coordinated the technical participation of other Caltrans engineers. Dan Kirkland and Tim Leahy served as Contract Administrators and, along with their staff, provided ATC invaluable assistance in complying with Caltrans requirements. Finally, ATC wishes to thank the many Caltrans engineers who have shown an interest in this project by commenting on the draft recommendations, attending PEP meetings, and participating in other discussions.

Christopher Rojahn
ATC Executive Director

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