



***Background
Document***

SAC Phase 2 Test Plan

Report No. SAC/BD-00/16

SAC Joint Venture

A partnership of

Structural Engineers Association of California (SEAOC)

Applied Technology Council (ATC)

California Universities for Research in Earthquake Engineering (CUREe)

By

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Submitted for distribution to

SAC Joint Venture

650-595-1542

<http://www.sacsteel.org>

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DISCLAIMER

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THE SAC JOINT VENTURE

SAC is a joint venture of the Structural Engineers Association of California (SEAOC), the Applied Technology Council (ATC), and California Universities for Research in Earthquake Engineering (CUREe), formed specifically to address both immediate and long-term needs related to solving performance problems with welded, steel moment-frame connections discovered following the 1994 Northridge earthquake. SEAOC is a professional organization composed of more than 3,000 practicing structural engineers in California. The volunteer efforts of SEAOC's members on various technical committees have been instrumental in the development of the earthquake design provisions contained in the *Uniform Building Code* and the 1997 *National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions for Seismic Regulations for New Buildings and other Structures*. ATC is a nonprofit corporation founded to develop structural engineering resources and applications to mitigate the effects of natural and other hazards on the built environment. Since its inception in the early 1970s, ATC has developed the technical basis for the current model national seismic design codes for buildings; the *de facto* national standard for postearthquake safety evaluation of buildings; nationally applicable guidelines and procedures for the identification, evaluation, and rehabilitation of seismically hazardous buildings; and other widely used procedures and data to improve structural engineering practice. CUREe is a nonprofit organization formed to promote and conduct research and educational activities related to earthquake hazard mitigation. CUREe's eight institutional members are the California Institute of Technology, Stanford University, the University of California at Berkeley, the University of California at Davis, the University of California at Irvine, the University of California at Los Angeles, the University of California at San Diego, and the University of Southern California. These laboratory, library, computer and faculty resources are among the most extensive in the United States. The SAC Joint Venture allows these three organizations to combine their extensive and unique resources, augmented by subcontractor universities and organizations from across the nation, into an integrated team of practitioners and researchers, uniquely qualified to solve problems related to the seismic performance of steel moment-frame buildings.

ACKNOWLEDGEMENTS

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PREFACE

The primary objectives of the FEMA/SAC Phase II Steel Project are to develop guidelines for the seismic evaluation, inspection, repair, design and construction of moment resisting steel frame buildings. A diverse collection of technical investigations is supporting this effort, including the identification of basic material properties in rolled steel sections; development of appropriate welding materials, details, and inspection procedures; specification of anticipated seismic demands imposed on connections as a result of structural response to strong ground motions; and large-scale connection testing to calibrate and verify the design procedures that are ultimately proposed. Tying these activities together is a series of detailed finite element analyses of various connection configurations to quantify the influence of material properties, geometry, and detailing on predicted behavior. In addition, a series of studies have been performed to incorporate the results of the various investigations into a performance based seismic engineering format that can become the basis of the SAC guidelines. Cost and risk studies and investigations into the past performance of this class of structures were also performed to gather valuable information used in the development of the guidelines and other documents.

The primary responsibility of the Connection Performance team in the Phase II Steel Project is to develop straightforward and reliable design and analysis tools for seismic moment resisting connections in steel frame structures. This report describes the preparation of the Test Plan that was followed in the course of the project. This test plan established the logic behind each experimental program and the requirements and objectives for each project. This information was vital in preparing the scopes of work for each investigation conducted by the Connection Performance team, and in the monitoring the progress of the work. All members of the Connections Performance Team participated in the discussions that resulted in the Test Plan. The plan was a living document that was changed updated and modified many times during the course of the work to reflect new information and developments that occurred. The test plan summarizes the goals and objectives of the various studies, and explains how the different projects were intended to fit together. It should be recognized there were significant opportunities for corroboration and expansion of the data generated from individual projects in developing a better understanding of the performance of moment connections as a whole. In other words, the whole of the investigations is greater than the sum of the parts. The results of all the studies in concert led to the development of design procedures for the various connections. This task was identified as Task 7.01 of the SAC Phase II program.

Numerous individuals helped to develop the information provided in this report. These individuals included members of the Technical Advisory Panel (TAP) for Connection Performance; selected members of the Joining and Inspection TAP; and several members of the Project Management Committee and the Project Oversight Committee. The contributions of these individuals are greatly appreciated.

Summary

A Test Plan was prepared for the SAC Phase 2 Research Program. This test plan established the logic behind each experimental program, and the requirements and objectives for each research project. These requirements and objectives provided the basis for Requests for Proposals that were prepared for each project, and the requirements of the contract for each individual research study. The Test Plan was written by the author, but the document and the requirements for each task were discussed with and approved by the Connection Performance Technical Advisory Panel (TAP) and the Project Management Committee (PMC).

The Test Plan was a living document and many changes were made during the 3 year period between early 1997 and 2000. These changes were made as information was learned from individual test programs, as revisions were made to research tasks, and as new studies were initiated. This report is the final version of the Test Plan that includes descriptions of all tests, and benefits from knowledge gained in early research programs.

The Test Plan was developed under a contract for SAC Task 7.01, and it serves as the basis for research completed in Task 7.02 through 7.12 as well as portions of Task 5.3. Therefore, the Test Plan summarizes the goals and objectives of these individual studies, and it provides a format for how the projects were planned to fit together. The overall goal of the Test Plan was to be able to predict the strength, stiffness and ductility of a wide range of connection types. To do this, it was necessary to understand all yield mechanisms and failure modes for each connection type, and to develop simplified design models that could be used to predict them and the resulting connection behavior.

This Test Plan describes the goals and objectives of the individual research studies. The document is fairly brief, and the reader is referred to the individual research reports [12 to 25] and the Connection Performance State of Art Report [11] for further information on these Tasks.

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