



Design Guide 21

Welded Connections— A Primer for Engineers

Second Edition



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Duane K. Miller, PE, ScD

American Institute of Steel Construction

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Many people participated in the production of this document. The contributions of the individuals on the review panel (listed separately) are gratefully acknowledged; given the length of this Guide, their undertaking was no minor task, and the detailed comments submitted by various individuals improved the quality of this publication.

Carlo Lini collected various Solution Center inquiries and drafted some initial replies, while Leigh Arbor assisted with the drafting of portions for the Seismic chapter. Margaret Matthew patiently oversaw the project, permitting the schedule to drift to accommodate the author's schedule. The contributions of Thomas Schlafly are incorporated into nearly every section of this Guide. Tom's commitment to technical accuracy, clear communication and grammatical accuracy required untold hours of review, often performed on the train during his daily commutes.

Subject matter experts reviewed specialized portions of the Guide, and the contributions of the following individuals as related to these topics are acknowledged: Dr. Caroline Bennett, galvanizing and LMAC; Carlos de Oliveira, castings; Doug Rees-Evans, steel issues; Mark Davis, phased array ultrasonic testing.

Dr. John M. Barsom thoroughly critiqued the entire Guide, with additional focus directed at the chapters on fatigue and fracture. Dr. Barsom has served as a mentor and role model in my life for more than 20 years, and words cannot express my appreciation for his contributions, to not only this Guide, but to my professional life.

This document would not have been possible without the assistance of my Lincoln Electric colleague, Michael Florczykowski, who functioned as a master editor for the project. In addition to providing technical reviews of the content, he made certain the document adhered to editorial guidelines, managed the production of artwork and tables, and helped keep the project on schedule. Ron Skoczen prepared most of the figures, and Carla Rautenberg provided editorial reviews; their contributions are acknowledged and appreciated.

While not part of this project, the role of Dr. Omer W. Blodgett as a mentor to the author is humbly acknowledged. While this acknowledgment was in preparation, Dr. Blodgett passed away; he was 99 years old. For more than 30 years, Dr. Blodgett shared his knowledge and passion for welding with me in a life-changing way. For his example, I will ever be grateful. This publication is dedicated to his memory.

Finally, the ongoing support of The Lincoln Electric Company is acknowledged. The company has been unwavering in its support of my professional activities involving technical committees of organizations such as AISC and AWS. The flexibility afforded me to pursue assignments such as writing this Design Guide is appreciated.

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Steve Herlache	Keith Landwehr*	Bill Scott	*deceased

Preface

No Preface was supplied for the first edition of this Design Guide, and that was an unfortunate oversight. The First Edition came about because of the vision of Dr. Charles Carter, who reasoned that since there was a Design Guide on bolting (Design Guide 17: *High Strength Bolts—A Primer for Structural Engineers*, by Dr. Geoffrey Kulak), there should be a similar document on welding. An outline of the expected coverage of the Design Guide on welding was prepared and circulated to a review panel and AISC staff. Suggestions were made for a few deletions and many additions.

The comments of one of the outline reviewers, the late William “Bill” Liddy, significantly changed the scope of the anticipated document. At the time, Bill was working in the AISC Steel Solutions Center, and he expressed his hope that the anticipated publication would provide answers to the welding-related questions that he frequently received in the Solution Center. He dug into his file of questions and added those topics to the outline, creating significant initial frustration on my part as I anticipated the additional work. But Bill’s idea was sound and ultimately added great value to the Guide. The content of Chapter 12, Special Welding Applications, of the First Edition addressed the topics Bill identified. Mr. Liddy’s vision made the first edition of Design Guide 21 more popular, and it continues to be a go-to resource for the Solution Center.

This edition expanded upon Bill’s vision. The former Chapter 12 became Chapter 14, and retains the same title, but has been expanded to address additional topics, all subjects of Solution Center inquiries; the coverage of this chapter assumes that an unusual application is involved and provides information necessary for dealing with the situation. A new Chapter 15, Problems and Fixes, has been added that does what the title suggests—provides practical solutions to unanticipated problems. The scope of Chapter 16, The Engineer’s Role in Welded Construction, has changed from the First Edition, with the current focus on providing guidance for situations when AWS D1.1 requires the engineer’s approval. All of these chapters are the result of Bill’s ongoing influence.

New to the Second Edition are the chapters on seismic (Chapter 11) and fracture (Chapter 13), with a primary focus on welding-related issues. These chapters were requested by AISC staff and are totally new.

USER NOTE:

To aid in the usability of this Design Guide, the following have been provided:

- a. The Table of Contents lists the subject matter of chapters, sections and subsections.
- b. An index of key words is provided at the end of the document.
- c. References to related materials are provided throughout.
- d. References to AWS D1.1 and AISC documents dealing with the subject matter are listed.
- e. A listing of acronyms and their meaning is summarized at the end of the document.

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