

4 DETAILING CONSIDERATIONS

DETAILING CONSIDERATIONS—CONNECTION

- 1 The economics and practicality of field welding should be reviewed with the fabricator before it is specified. Any field welding should be arranged for welding in the flat or horizontal position. Good working access and welding screens are required.
- 2 Flange weld preparations will require a backing strip which requires local coping of the beam web. The backing strip is usually left in place, although the structural engineer may require it to be removed for design situations involving fatigue or seismic considerations.
- 3 Preference should be given to the use of fillet welds rather than butt welds, at least for fillet welds up to 8 mm leg length.
- 4 A full penetration butt weld may shrink up to 2–3 mm when it cools and contracts. Such shrinkage can cause erection problems when plumbing the columns. This is best controlled by fabricating the beam longer than required by the amount of the weld shrinkage or by increasing the weld root opening by that amount.
- 5 Lamellar tearing of the column flange may be of concern when there is a flange weld on one side and a stiffener weld on the other and both are shrinking and contracting. The correct welding procedure and sequencing should be employed (see Reference 16 for a discussion of lamellar tearing).
- 6 This connection requires extra care in both shop fabrication and field erection. Fabrication of this type of connection requires close control in cutting the beam to length and adequate consideration must be given to squaring the beam flanges such that the flanges at each end are parallel and the effect of any beam camber does not result in out-of-square beam flanges which make erection and field fit-up difficult.
- 7 Any shop welded connection has the benefit of all the welding being carried out in controlled fabrication shop conditions where the workpiece can be placed in jigs or manipulators for ease of welding. It does involve more connections due to the need for beam or column splices adjacent to the beam-column connection (Figures 2(a) and 3).
- 8 For the field welded connection, the web erection cleat may be used as a backing plate for a full penetration butt weld to the web.



DESIGN GUIDE 11

Welded beam to column moment connections

by

T.J. Hogan

contributing author

N. van der Kreek

first edition—2009



Design Guide 11
Welded beam to column moment connections

Copyright © 2009 by AUSTRALIAN STEEL INSTITUTE

Published by: AUSTRALIAN STEEL INSTITUTE

All rights reserved. This book or any part thereof must not be reproduced in any form without the written permission of Australian Steel Institute.

Note to commercial software developers: Copyright of the information contained within this publication is held by Australian Steel Institute (ASI). Written permission must be obtained from ASI for the use of any information contained herein which is subsequently used in any commercially available software package.

FIRST EDITION 2009 (LIMIT STATES)

National Library of Australia Cataloguing-in-Publication entry:
Hogan, T.J.
Design Guide 11: Welded beam to column moment connections

1st ed.

Bibliography.

ISBN 978 1 921476 12 9 (pbk.).

ISBN 978 1 921476 13 6 (pdf.).

1. Steel, Structural—Standards – Australia.
2. Steel, Structural—Specifications – Australia.
3. Joints, (Engineering)—Design and construction.
 - I. van der Kreek, N.
 - II. Australian Steel Institute.
 - III. Title

(Series: Structural steel connection series).

This publication originated as part of
Design of structural connections
First edition 1978
Second edition 1981
Third edition 1988
Fourth edition 1994

Also in this series:

Handbook 1: Design of structural steel connections
Design Guide 1: Bolting in structural steel connections
Design Guide 2: Welding in structural steel connections
Design Guide 3: Web side plate connections
Design Guide 4: Flexible end plate connections
Design Guide 5: Angle cleat connections
Design Guide 6: Seated connections
Design Guide 10: Bolted moment end plate beam splice connections
Design Guide 12: Bolted end plate beam to column moment connections
Design Guide 13: Splice connections

Disclaimer: The information presented by the Australian Steel Institute in this publication has been prepared for general information only and does not in any way constitute recommendations or professional advice. While every effort has been made and all reasonable care taken to ensure the accuracy of the information contained in this publication, this information should not be used or relied upon for any specific application without investigation and verification as to its accuracy, suitability and applicability by a competent professional person in this regard. The Australian Steel Institute, its officers and employees and the authors of this publication do not give any warranties or make any representations in relation to the information provided herein and to the extent permitted by law (a) will not be held liable or responsible in any way; and (b) expressly disclaim any liability or responsibility for any loss or damage costs or expenses incurred in connection with this publication by any person, whether that person is the purchaser of this publication or not. Without limitation, this includes loss, damage, costs and expenses incurred as a result of the negligence of the authors or publishers.

The information in this publication should not be relied upon as a substitute for independent due diligence, professional or legal advice and in this regards the services of a competent professional person or persons should be sought.



CONTENTS

	Page		Page
List of figures	iv	11.2 DESIGN CHECK NO. 10—Local yielding at beam tension flange of column web with doubler plate(s)	31
List of tables	v	11.3 DESIGN CHECK NO. 11—Local yielding at beam compression flange of column web with doubler plate(s)	32
Preface	vi	11.4 DESIGN CHECK NO. 12—Crippling of column web with doubler plate(s) at beam compression flange	34
About the author	vii	11.5 DESIGN CHECK NO. 13—Compression buckling of column web with doubler plate(s)	36
About the contributing author	vii	11.6 DESIGN CHECK NO. 14—Shear on column web panel with doubler plate(s)	38
Acknowledgements	viii	12 RECOMMENDED DESIGN MODEL—COLUMNS WITH TRANSVERSE STIFFENERS	40
1 CONCEPT OF DESIGN GUIDES.....	1	12.1 DESIGN CHECK NO. 15—Column with transverse stiffeners at tension flange	40
1.1 Background	1	12.2 DESIGN CHECK NO. 16—Column with transverse stiffeners at compression flange	42
2 DESCRIPTION OF CONNECTION	2	12.3 DESIGN CHECK NO. 17—Column with transverse diagonal shear stiffeners	44
3 TYPICAL DETAILING OF CONNECTION..	5	13 ADDITIONAL CONSIDERATIONS	46
4 DETAILING CONSIDERATIONS.....	8	14 ECONOMICAL CONSIDERATIONS	47
5 AS 4100 REQUIREMENTS	10	15 DESIGN EXAMPLES	48
6 BASIS OF DESIGN MODEL.....	11	15.1 Design example 1—Beam on one side of column	48
7 CALCULATION OF DESIGN ACTIONS ...	12	15.2 Design example 2—Beams on both sides of column	54
8 RECOMMENDED DESIGN MODEL—SUMMARY OF DESIGN CHECKS.....	16	16 REFERENCES.....	58
9 RECOMMENDED DESIGN MODEL—BEAM WELDS	19	17 DESIGN CAPACITY TABLES	59
9.1 DESIGN CHECK NO. 1—Design capacity of flange welds to beam	19	17.1 Configuration A—Full penetration butt welds to flanges and webs	60
9.2 DESIGN CHECK NO. 2—Design capacity of web welds to beam	20	17.2 Configuration B—Fillet welds required to develop section moment capacity	62
10 RECOMMENDED DESIGN MODEL—UNSTIFFENED COLUMN	22	17.3 Configuration C—Fillet welds to flanges and web	64
10.1 DESIGN CHECK NO. 3—Local bending of column flange at beam tension flange	22	APPENDICES	
10.2 DESIGN CHECK NO. 4—Local yielding of column web at beam tension flange	23	A Limcon software	66
10.3 DESIGN CHECK NO. 5—Local yielding of column web at beam compression flange	25	B ASI Design Guide 9 comment form	73
10.4 DESIGN CHECK NO. 6—Column web crippling at beam compression flange	26		
10.5 DESIGN CHECK NO. 7—Column web compression buckling	28		
10.6 DESIGN CHECK NO. 8—Column web panel in shear	29		
11 RECOMMENDED DESIGN MODEL—COLUMNS WITH DOUBLER PLATES.....	30		
11.1 DESIGN CHECK NO. 9—Local bending of column flange with flange doubler plates at beam tension flange	30		



LIST OF FIGURES

	<i>Page</i>		<i>Page</i>
Figure 1 Typical welded beam to column moment connection	2	Figure 22 Dispersion arrangement used in DESIGN CHECK NO. 7	24
Figure 2 Alternative arrangements for welded beam to column connections	3	Figure 23 Application of c_t term—Column web yielding at beam compression flange	25
Figure 3 Arrangement with shop welded beams and column splices	3	Figure 24 Case I arrangement.....	26
Figure 4 Possible configurations of the welded moment beam to column connection	4	Figure 25 Case II and Case III arrangement...	27
Figure 5 Stub girder connection, fully shop welded beam stub, beam spliced on site.....	5	Figure 26 Examples of web panel shear conditions	29
Figure 6 Field welded moment connection—including erection cleat	5	Figure 27 Column flange doubler plate details at beam tension flange.....	30
Figure 7 Column doubler plate types and column flange replacement alternative.....	6	Figure 28 Column web doubler plate details at beam tension flange.....	31
Figure 8 Column stiffener types.....	7	Figure 29 Column web doubler plate detail at beam compression flange .	32
Figure 9 Stiffener detailing.....	9	Figure 30 Web doubler plate—Welds to column flange.....	33
Figure 10 Design actions on beam at column	12	Figure 31 Case I arrangement.....	34
Figure 11 Calculation of flange forces due to bending moment and axial force—Beam at right angles to column	13	Figure 32 Case II and Case III arrangement...	34
Figure 12 Calculation of forces on column elements where beam is inclined upwards at column	13	Figure 33 Column web doubler plate details at beam compression flange	35
Figure 13 Alternative stress distributions in beam due to design bending moment	14	Figure 34 Column web doubler plate details for compression buckling.....	37
Figure 14 Column and beam dimensions used in design model.....	17	Figure 35 Column web doubler plate details for shear.....	38
Figure 15 Stiff bearing dimension b_{sc} used in design model	17	Figure 36 Tension stiffener arrangement.....	40
Figure 16 Summary of DESIGN CHECK locations on column.....	18	Figure 37 Compression stiffener details	42
Figure 17 Flange weld design actions	19	Figure 38 Diagonal shear stiffener arrangements	45
Figure 18 Web weld design actions.....	21	Figure 39 Transverse stiffener options when beam flanges are offset due to unequal beam depths	46
Figure 19 Application of c_t term—Local bending at tension flange	22	Figure 40 Design example no. 1—Beam on one side of column	48
Figure 20 Application of c_t term—Column web yielding at beam tension flange	23	Figure 41 Shear stiffener geometry	52
Figure 21 Angle of dispersion used in DESIGN CHECK NO. 4 and NO. 5	24	Figure 42 Design example no. 1—Beam on one side of column—Alternative detailing to Figure 40.....	53
		Figure 43 Design example no. 2—Beams on both sides of column	54
		Figure 44 Stress distribution in beam #2 due to 180 kNm	55



LIST OF TABLES

		<i>Page</i>			<i>Page</i>
Table 1	Equations to be applied for different configurations and connection elements.....	15	Table 6	Welded beams Grade 300— Weld configurations to achieve design section moment capacity ϕM_s	63
Table 2	Stiffener material design strengths	41	Table 7	Universal beams Grade 300— Design moment capacity of welded connection with 10 mm flange fillet welds and 8 mm web welds	64
Table 3	Universal beams Grade 300— Design section moment and web capacities	60	Table 8	Universal beams Grade 300— Design moment capacity of welded connection with 8 mm flange fillet welds and 6 mm web welds	65
Table 4	Welded beams Grade 300— Design section moment and web capacities	61			
Table 5	Universal beams Grade 300— Weld configurations to achieve design section moment capacity ϕM_s	62			

