



FIGURE 38 BOLTED COVER PLATE SPLICE

The bolted cover plate splice to an I-section comprises (see Figures 38 to 41):

- one or three cover plates bolted to each flange either side of the splice location;
- two cover plates bolted either side of the web (either full depth or partial depth).

Bolts are fully tensioned Grade 8.8 to AS 1252 (Ref. 11) used in bearing-type mode (bolting category 8.8/TB) in either M20 or M24 diameter. Cover plates are either cut from plate (Grade 250) to AS/NZS 3678 (Ref. 10) or are cut from standard square edge flat bar components (Grade 300) to AS 3679.1 (Ref. 9).

Design capacity tables for structural steel
Volume 4: Rigid connections—Open sections

by

T.J. Hogan

contributing author

N. van der Kreek

first edition—2009



AUSTRALIAN STEEL INSTITUTE
(ABN)/ACN (94) 000 973 839

Design capacity tables for structural steel
Volume 4: Rigid connections—Open sections

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 capacity tables for structural steel. Volume 4: Rigid connections—Open sections

1st ed.

Bibliography.

ISBN 978 1 921476 18 1 (pbk.).

ISBN 978 1 921476 19 8 (pdf.).

This publication originated as part of
Design of structural connections

First edition 1978

Second edition 1981

Third edition 1988

Fourth edition 1994

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).

Also in this series:

Design Capacity Tables for Structural Steel Volume 3: Simple connections—Open sections

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 end plate beam splice connections

Design Guide 11: Welded beam to column moment connections

Design Guide 12: Bolted end plate 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

	<i>Page</i>		<i>Page</i>
List of figures	iv	5.5	Design capacity tables 50
List of tables	v	5.6	Four bolt unstiffened end plate— Design capacity tables 51
Preface	vii	5.7	Four bolt stiffened end plate— Design capacity tables 53
About the author	viii	5.8	Six bolt unstiffened end plate— Design capacity tables 55
About the contributing author	viii	5.9	Eight bolt stiffened end plate— Design capacity tables 57
Acknowledgements	ix		
1 CONCEPT OF DESIGN GUIDES.....	1	6 BOLTED END PLATE TO COLUMN MOMENT CONNECTION	58
1.1 Background	1	6.1 Description of connection	58
1.2 Preliminary considerations	2	6.2 Typical detailing of connection	61
1.3 Included connections	3	6.3 Calculation of design actions	66
2 GEOMETRICAL DETAILS.....	9	6.4 Recommended design model— Summary of design checks 67	
2.1 Standard parameters	9	6.5 Design capacity tables	68
2.2 Connection components— Bolted moment end plate	10	6.6 Four bolt unstiffened end plate	69
2.3 Connection components— Column stiffeners	12	6.7 Four bolt stiffened end plate	73
2.4 Bolt gauges to columns for bolted moment end plate connection	15	6.8 Six bolt unstiffened end plate	75
2.5 Flange cover plates for splices	16	6.9 Eight bolt stiffened end plate	77
2.6 Bolting layout to webs for bolted web splices	20	7 BOLTED COVER PLATE SPLICE	78
2.7 Web cover plate components for bolted splices	22	7.1 Description of connection	78
3 DESIGN BASIS	23	7.2 Typical detailing of connection	79
3.1 Design models	23	7.3 Calculation of design actions	82
3.2 Minimum design actions on connections	24	7.4 Recommended design model— Summary of design checks 83	
4 WELDED BEAM TO COLUMN MOMENT CONNECTION	28	7.5 Design capacity tables	84
4.1 Description of connection	28	8 BOLTED/WELDED COVER PLATE SPLICE	90
4.2 Typical detailing of connection	31	8.1 Description of connection	90
4.3 Calculation of design actions	33	8.2 Typical detailing of connection	91
4.4 Recommended Design Model— Summary of design checks	34	8.3 Calculation of design actions	94
4.5 Design capacity tables	35	8.4 Recommended design model— Summary of design checks 95	
4.6 Configuration A—Full penetration butt welds to flanges and webs	36	8.5 Design capacity tables	96
4.7 Configuration B—Fillet welds required to develop section moment capacity	38	9 FULLY WELDED SPLICE	102
4.8 Configuration C—Fillet welds to flanges and web	40	9.1 Description of connection	102
5 BOLTED MOMENT END PLATE BEAM SPLICE CONNECTION.....	42	9.2 Typical detailing of connection	103
5.1 Description of connection	42	9.3 Calculation of design actions	105
5.2 Typical detailing of connection	44	9.4 Recommended design model— Summary of design checks 106	
5.3 Calculation of design actions	48	9.5 Design capacity tables	107
5.4 Recommended design model— Summary of design checks	49	10 REFERENCES.....	110
		APPENDIX	
		A Rigid connections DCTs, V4 comment form	111



LIST OF FIGURES

	<i>Page</i>		<i>Page</i>
Figure 1	Typical detailing for unstiffened variations of extended bolted moment end plate 4	Figure 25	Shims used between end plates 46
Figure 2	Typical welded beam to column moment connection 4	Figure 26	Clearance required for tensioning bolts 47
Figure 3	Typical detailing for 4 bolt unstiffened bolted end plate to column connection 5	Figure 27	Design actions at connection 48
Figure 4	Typical detailing of bolted cover plate splice 6	Figure 28	Bolted end plate to column moment connections 58
Figure 5	Typical detailing of bolted/welded cover plate splice 7	Figure 29	Forms of extended end plate connection 59
Figure 6	Typical detailing of welded splice ... 8	Figure 30	Possible configurations of the bolted moment end plate beam to column connection 60
Figure 7	Bolting layouts for M24 bolts in bolted moment endplate 11	Figure 31	Typical detailing for 4 bolt unstiffened bolted end plate to column connection 61
Figure 8	Bolting layouts for M20 bolts in bolted moment endplate 11	Figure 32	Typical detailing for haunched rafter to column bolted end plate connection 62
Figure 9	Transverse stiffener arrangement 12	Figure 33	Removal of column flange with thicker plate inserted 62
Figure 10	Geometry of flange splice plates .. 16	Figure 34	Column doubler plate types 63
Figure 11	Web splice bolting layout M20 bolts 20	Figure 35	Shims used between end plate and column flange 64
Figure 12	Web splice bolting layout M24 bolts 21	Figure 36	Clearance required for tensioning bolts 65
Figure 13	Web cover plate components 22	Figure 37	Design actions on beam at column 66
Figure 14	Typical welded beam to column moment connection 28	Figure 38	Bolted cover plate splice 78
Figure 15	Alternative arrangements for welded beam to column connections 29	Figure 39	Typical detailing in flexural member 79
Figure 16	Arrangement with shop welded beams and column splices 29	Figure 40	Typical detailing in column/beam-column 80
Figure 17	Possible configurations of the welded moment beam to column connection 30	Figure 41	Typical detailing in tension member 80
Figure 18	Stub girder connection, fully shop welded beam stub, beam spliced on site 31	Figure 42	Design actions at splice 82
Figure 19	Field welded moment connection—including erection cleat 31	Figure 43	Bolted/welded cover plate splice 90
Figure 20	Design actions on beam at column 33	Figure 44	Typical detailing in flexural member 91
Figure 21	Bolted moment end plate beam splice connection 42	Figure 45	Typical detailing in column/beam column 92
Figure 22	Forms of extended bolted end plate connection 43	Figure 46	Typical detailing in tension member 92
Figure 23	Typical detailing for unstiffened variations of extended bolted moment end plate 44	Figure 47	Design actions at splice 94
Figure 24	Typical detailing for stiffened variations of extended bolted moment end plate 45	Figure 48	Fully welded splice 102
		Figure 49	Typical detailing of welded splice 103
		Figure 50	Use of backing strips 104
		Figure 51	Preferred splice location in column 104
		Figure 52	Design actions at splice 105



LIST OF TABLES

	<i>Page</i>		<i>Page</i>
Table 1	Connection components bolted moment end plate 10	Table 20	Universal beams grade 300 design moment capacity of welded connection with flange welds and web welds.....41
Table 2	Stiffener material design strengths..... 12	Table 21	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M24 bolts welded beam/universal beam sections > 300 mm deep51
Table 3	Flat bar components as stiffeners..... 13	Table 22	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M20 bolts universal beam sections > 200 mm deep52
Table 4	Flat bar width/column combinations suited to stiffening... 14	Table 23	Design moment capacity of connection ϕM_{conn} four bolt stiffened end plate M24 bolts welded beam/universal beam sections > 300 mm deep53
Table 5	Plate width/column combinations suited to stiffening 14	Table 24	Design moment capacity of connection ϕM_{conn} four bolt stiffened end plate M20 bolts universal beam sections > 200 mm deep54
Table 6	Suitable bolt gauges for column section flanges 15	Table 25	Design moment capacity of connection ϕM_{conn} six bolt unstiffened end plate M24 bolts welded beam/universal beam sections > 450 mm deep55
Table 7	Flange cover plate width/ thickness combinations for one plate bolted cover plate splice 17	Table 26	Design moment capacity of connection ϕM_{conn} six bolt unstiffened end plate M20 bolts universal beam sections > 350 mm deep56
Table 8	Flange cover plate width/ thickness combinations for one plate bolted/welded cover plate splice..... 17	Table 27	Design moment capacity of connection ϕM_{conn} eight bolt stiffened end plate M24 bolts 8.8/TB category threads excluded from shear plane welded beam and universal beam sections > 520 mm deep57
Table 9	Flange cover plate width/ thickness combinations for three plate bolted cover plate splice 18	Table 28	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M24 bolts unhaunched welded beam/universal beam sections > 300 mm deep69
Table 10	Flange cover plate width/ thickness combinations for three plate bolted/welded cover plate splice..... 19	Table 29	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M20 bolts unhaunched universal beam sections > 200 mm deep70
Table 11	Values of n_{max} in web splice 20		
Table 12	Values of n_{max} in web splice..... 21		
Table 13	Universal beams, Grade 300 design section moment and web capacities 26		
Table 14	Welded beams, Grade 300 design section moment and web capacities 27		
Table 15	Universal beams Grade 300 design section moment and web capacities 36		
Table 16	Welded beams Grade 300 design section moment and web capacities 37		
Table 17	Universal beams Grade 300 weld configurations to achieve design section moment capacity ϕM_s 38		
Table 18	Welded beams Grade 300 weld configurations to achieve design section moment capacity ϕM_s 39		
Table 19	Universal beams Grade 300 design moment capacity of welded connection with flange welds and web welds..... 40		



	Page		Page
Table 30	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M24 bolts haunched universal beam sections > 300 mm deep 71	Table 40	Design moment capacity of bolted three cover plate splice 700WB/800WB welded beam sections M24 bolts.....88
Table 31	Design moment capacity of connection ϕM_{conn} four bolt unstiffened end plate M20 bolts haunched universal beam sections > 200 mm deep 72	Table 41	Design moment capacity of bolted three cover plate splice 900WB/1000WB welded beam sections M24 bolts.....89
Table 32	Design moment capacity of connection ϕM_{conn} four bolt stiffened end plate M24 bolts unhaunched welded beam/universal beam sections > 300 mm deep..... 73	Table 42	Design moment capacity of bolted/welded single cover plate splice universal beam sections < 400 deep M20 bolts, 6 fillets to flange plates, 5 fillets to web plates.....97
Table 33	Design moment capacity of connection ϕM_{conn} four bolt stiffened end plate M20 bolts unhaunched universal beam sections > 200 mm deep 74	Table 43	Design moment capacity of bolted/welded single cover plate splice universal beam sections > 400 deep M24 bolts, 8 or 6 fillets to flange plates, 5 fillets to web plates98
Table 34	Design moment capacity of connection ϕM_{conn} six bolt unstiffened end plate M24 bolts unhaunched welded beam/universal beam sections > 450 mm deep 75	Table 44	Design moment capacity of bolted/welded three cover plate splice universal column sections M24 bolts, 6/8 fillets to flange plates and web plates and 6 fillets to web plates99
Table 35	Design moment capacity of connection ϕM_{conn} six bolt unstiffened end plate M20 bolts unhaunched universal beam sections > 350 mm deep 76	Table 45	Design moment capacity of bolted three cover plate splice 700WB/800WB welded beam sections M24 bolts, 6/8 fillets to flange plates and 5 fillets to web plates 100
Table 36	Design moment capacity of connection ϕM_{conn} eight bolt stiffened end plate M24 bolts unhaunched welded beam and universal beam sections > 520 mm deep 77	Table 46	Design moment capacity of bolted/welded three cover plate splice 900WB/1000WB welded beam sections M24 bolts, 8 or 6 fillets to flange plates and 6 fillets to web plates.. 101
Table 37	Design moment capacity of bolted single cover plate splice universal beam sections < 400 deep M20 bolts 85	Table 47	Universal beams Grade 300 design section moment and shear capacities 107
Table 38	Design moment capacity of bolted single cover plate splice universal beam sections > 400 deep M24 bolts 86	Table 48	Welded beams Grade 300 design section moment and shear capacities 108
Table 39	Design moment capacity of bolted three cover plate splice universal column sections > 240 deep M24 bolts 87	Table 49	Universal columns/welded columns grade 300 design section moment and shear capacities 109

