

**9 RECOMMENDED DESIGN MODEL 9.1 DESIGN CHECK NO. 1—
Detailing requirements**

Detailing requirements (Refer to Figures 12 to 16 for notation)

End plate width	$b_f \geq b_f + 20$	
Bolt gauge	$s_g \leq b_f$	
	≥ 120	(M20 bolts)
	≥ 140	(M24 bolts)
Bolt pitches	$s_{p1}, s_{p2}, s_{p3} \geq 70$	(M20 bolts)
	≥ 80	(M24 bolts)
Edge distance	$a_e \geq 30$	(M20 bolts)
	≥ 36	(M24 bolts)
	$\leq 2.5d_f$	(d_f = bolt diameter)

Dim. a_f as small as possible but $\geq d_f + L_a \cot \beta$ (angle β and a_f defined in Figure 17)

and $\geq 0.5d_s + L_s \cot \beta$

and $\geq 0.5 \times$ washer dia. + fillet weld leg length

and for impact wrenches ≥ 55 mm (M20 bolts), 65 mm (M24 bolts)

where: $L_a = 2.2d_f +$ grip (actual bolt length)

d_s = socket diameter = 58 mm M20 bolts, 68 mm M24 bolts

L_s = socket length = 63 mm M20 bolts, 70 mm M24 bolts

NOTE: d_s and L_s may be found in Table 23 of Ref. 12.

Bolt gauge s_g , socket diameter d_s , socket length L_s are all for impact wrenches. Smaller dimensions apply for hand wrenches (see Table 22 of Ref. 12).

Washer diameters :42 mm (M20), 50 mm (M24) (see Table 11 of Ref. 12)

Stiffener (Figure 18) 25 mm landings at each end

30 degree slope

Additional limits, which are recommended for Australian applications based on the range of tested parameters given at Table 1, are nominated in Table 3.

**TABLE 3
RECOMMENDED LIMITS ON DETAILING PARAMETERS**

Parameter	4,6,8 bolt unstiffened end plate	4 bolt stiffened end plate	8 bolt stiffened end plate
End plate thickness t_f (mm)	16–40	16–36	16–40
End plate width b_f (mm)	125–330	180–330	230–430
Bolt gauge s_g (mm)	80–180	80–170	150–170
Bolt diameter d_f (mm)	M20, M24	M20, M24	M20, M24
Beam size	200UB*–800WB	200UB–700UB	530UB–900WB
Clearance s_{p0} (mm)	40–75	40–75	40–75

*6 and 8 bolt arrangements may not fit in 200UB or 250UB beam sections.



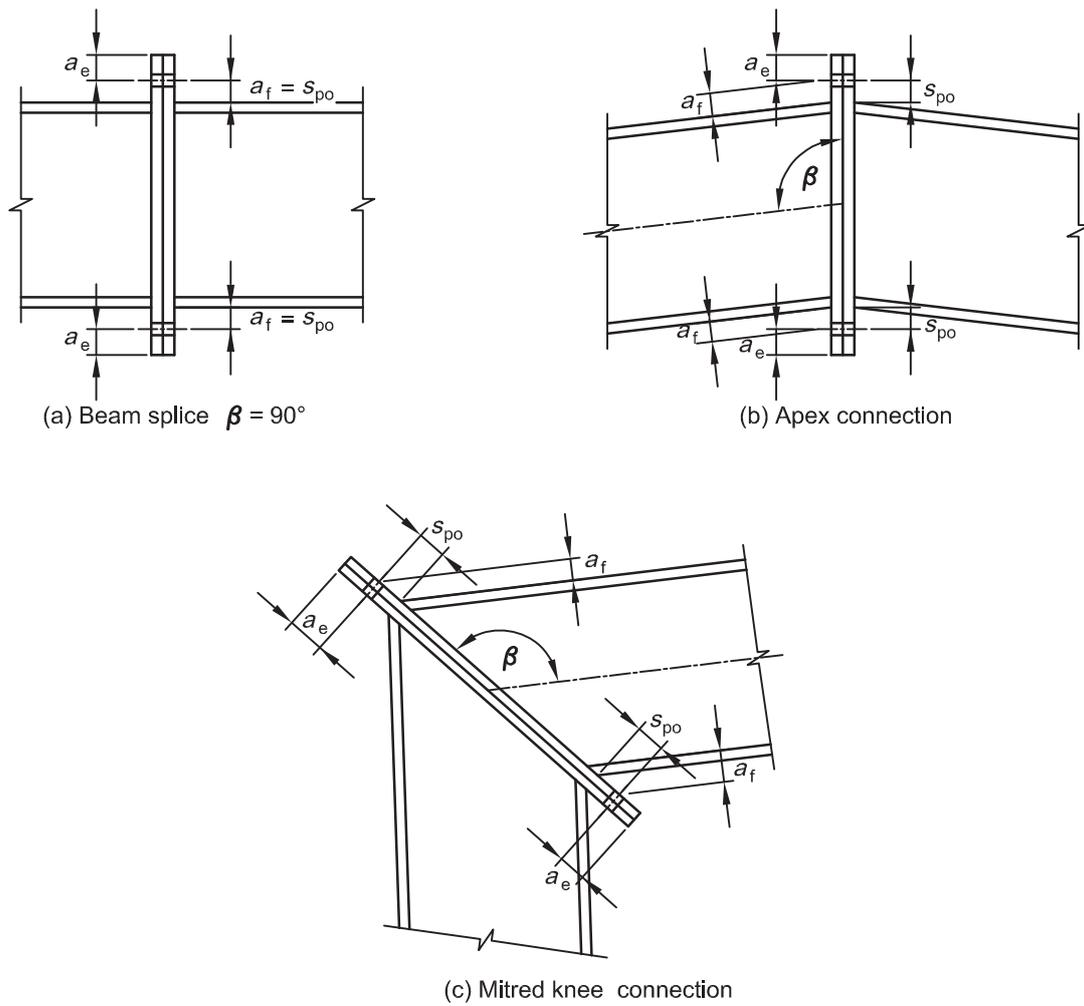


FIGURE 17 CLEARANCE DIMENSIONS a_f , a_e , s_{po}

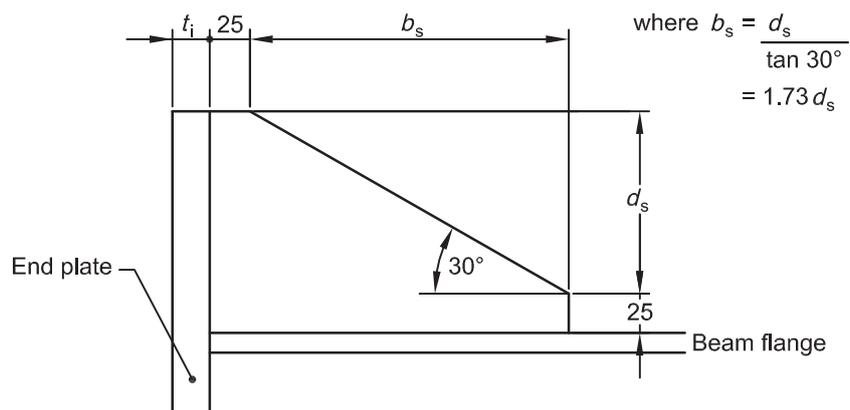


FIGURE 18 END PLATE STIFFENER DETAILING



DESIGN GUIDE 10

Bolted moment end plate beam splice connections

by

T.J. Hogan

contributing author

N. van der Kreek

first edition—2009



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

Design Guide 10
Bolted moment end plate beam splice 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 10: Bolted moment end plate beam splice connections

1st ed.

Bibliography.

ISBN 978 1 921476 10 5 (pbk.).

ISBN 978 1 921476 11 2 (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 11: Welded beam to column moment 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, editors 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	9.5 DESIGN CHECK NO. 5—Design capacity of bolts in shear	26
List of tables	v	9.6 DESIGN CHECK NO. 6—Design capacity of end plate at tension flange	27
Preface	vi	9.7 DESIGN CHECK NO. 7—Design capacity of end plate in shear	31
About the author	vii	9.8 DESIGN CHECK NO. 8—Design requirements for stiffener to end plate	32
About the contributing author	vii	9.9 DESIGN CHECK NO. 9—Design capacity of stiffener welds to end plate	33
Acknowledgements	viii	10 DESIGN EXAMPLES	34
1 CONCEPT OF DESIGN GUIDES.....	1	10.1 Design example No. 1—Four bolt unstiffened end plate beam splice	34
1.1 Background	1	10.2 Design example No. 2—Four bolt stiffened apex connection	37
2 DESCRIPTION OF CONNECTION	2	11 REFERENCES.....	41
3 TYPICAL DETAILING OF CONNECTION..	4	12 DESIGN CAPACITY TABLES	42
4 DETAILING CONSIDERATIONS.....	6	12.1 Four bolt unstiffened end plate	43
5 AS 4100 REQUIREMENTS	8	12.2 Four bolt stiffened end plate	45
6 BASIS OF DESIGN MODEL.....	9	12.3 Six bolt unstiffened end plate	47
7 CALCULATION OF DESIGN ACTIONS ...	11	12.4 Eight bolt stiffened end plate	49
8 RECOMMENDED DESIGN MODEL— SUMMARY OF DESIGN CHECKS.....	17	APPENDICES	
9 RECOMMENDED DESIGN MODEL.....	20	A Thick and thin end plate behaviour	50
9.1 DESIGN CHECK NO. 1—Detailing requirements	20	B Limcon software	52
9.2 DESIGN CHECK NO. 2—Design capacity of welds to beam flanges	22	C ASI Design Guide 10 comment form	59
9.3 DESIGN CHECK NO. 3—Design capacity of welds to beam web	23		
9.4 DESIGN CHECK NO. 4—Design capacity of bolts at tension flange	25		



LIST OF FIGURES

	<i>Page</i>		<i>Page</i>
Figure 1	Bolted moment end plate beam splice connection 2	Figure 15	Notation used for 6 bolt (2/4) unstiffened end plate 19
Figure 2	Forms of extended bolted end plate connection 3	Figure 16	Notation used for 8 bolt (2/6) unstiffened end plate 19
Figure 3	Typical detailing for unstiffened variations of extended bolted moment end plate 4	Figure 17	Clearance dimensions a_f , a_e , s_{po}21
Figure 4	Typical detailing for stiffened variations of extended bolted moment end plate 5	Figure 18	End plate stiffener detailing21
Figure 5	Shims used between end plates 6	Figure 19	Flange weld design actions22
Figure 6	Clearance required for tensioning bolts 7	Figure 20	Web weld design actions.....24
Figure 7	Design actions at connection..... 11	Figure 21	Yield line pattern 4 bolt (2/2) unstiffened end plate27
Figure 8	Calculation of flange force due to bending moment and axial force—Horizontal beam 12	Figure 22	Yield line pattern 4 bolt (2/2) stiffened end plate28
Figure 9	Calculation of force components—Apex connection 13	Figure 23	Yield line pattern 6 bolt (2/4) unstiffened end plate29
Figure 10	Calculation of force components—Mitred knee connection 14	Figure 24	Yield line pattern 8 bolt (2/6) unstiffened end plate29
Figure 11	Alternative stress distributions in beam 15	Figure 25	Yield line pattern 8 bolt (4/4) stiffened end plate30
Figure 12	Notation used for 4 bolt (2/2) unstiffened end plate 18	Figure 26	Beam splice example no. 134
Figure 13	Notation used for 4 bolt (2/2) stiffened end plate 18	Figure 27	Stress distribution in beam of example no. 135
Figure 14	Notation used for 8 bolt (4/4) stiffened end plate 18	Figure 28	Apex end plate example no. 237
		Figure 29	Stress distribution in rafter for example no. 238
		Figure 30	Stiffener detailing example no. 240
		Figure 31	End plate behaviour idealisation.....50



LIST OF TABLES

		<i>Page</i>			<i>Page</i>
Table 1	Range of tested parameters (Ref. 6)	10	Table 9	Design moment capacity of connection ϕM_{conn} —Four bolt stiffened end plate M20 bolts 8.8/TB category threads excluded from shear plane—Universal beam sections > 200 mm deep	46
Table 2	Equations to be applied for different configurations and connection elements.....	16	Table 10	Design moment capacity of connection ϕM_{conn} —Six bolt unstiffened end plate M24 bolts 8.8/TB category threads excluded from shear plane—Welded beam/Universal beam sections > 450 mm deep	47
Table 3	Recommended limits on detailing parameters	20	Table 11	Design moment capacity of connection ϕM_{conn} —Six bolt unstiffened end plate M20 bolts 8.8/TB category threads excluded from shear plane—Universal beam sections > 350 mm deep	48
Table 4	Strength of plate to AS 3678 Grade 250	28	Table 12	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 deep	49
Table 5	Strength of flat bars to AS 3679.1 Grade 300	32			
Table 6	Design moment capacity of connection ϕM_{conn} —Four bolt unstiffened end plate M24 bolts 8.8/TB category threads excluded from shear plane—Welded beam/Universal beam sections > 300 mm deep	43			
Table 7	Design moment capacity of connection ϕM_{conn} —Four bolt unstiffened end plate M20 bolts 8.8/TB category threads excluded from shear plane—Universal beam sections > 200 mm deep.....	44			
Table 8	Design moment capacity of connection ϕM_{conn} —Four bolt stiffened end plate M24 bolts 8.8/TB category threads excluded from shear plane—Welded beam/Universal beam sections > 300 mm deep	45			

