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UPDATE FOR 'DESIGN OF STRUCTURAL STEEL HOLLOW SECTION CONNECTIONS—VOLUME 1 DESIGN MODELS', First edition 1996

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INTRODUCTION

The 1996 publication is under consideration for updating by the Australian Steel Institute. Since this is likely to be a lengthy process, this Technical Note has been prepared in order to advise of known Errata and of more up-to-date information that could be used by structural engineers in the interim for some sections of the publication.

The existing Syam and Chapman publication is commonly referred to as the 'Blue Connections Book' and will be so referred to in this Technical Note.

ERRATA TO THE PUBLICATION

[1] Page 4-5

In the expression for δ, '$n_b = 4$' should read '$n_b \geq 4$'.

[2] Page 5-2 Note 1

Ref. [5.4] of the 'Blue Connections Book' also notes that yield line distortion is never a critical limit state. An additional provision is also to ensure that:

$$\frac{b}{t}\left(\text{or } \frac{d}{t}\right) < \frac{670}{\sqrt{f_y}}$$

for local distortions on RHS/SHS walls to be negligible.

[3] Page 5-3

The inequality in Fig. 5.1-2 of '$0.5d_b \leq d \leq d_1$' should read '$0.5d_b \leq d_p \leq d_1$'

[4] Page 6-6 and 6-11

The expression for ϕN_h for RHS/SHS column sections is missing the term $f(n')$ which adjusts the design capacity for the presence of axial compression. The same term $f(n')$ is included in the case of CHS column members and the expression for $f(n')$ used for CHS members should also be used for RHS/SHS members. The equation for RHS and SHS columns should read:

$$\phi N_H = \frac{f_y t^2}{(1-\beta)}\left(2\eta + 4\sqrt{1-\beta}\right) f(n')$$

It should be noted that the bracing cleat in compression (load component bearing onto the column face) is subject to an overall revision when designing the cleat (as noted below).

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[5] Page 7-2

Insert new Note 10:

10. The connection design model can also be used for the configuration of the flattened end welded directly to the support (i.e. no intermediate bracing cleat and bolts). In this instance, a check of the weld capacity must be undertaken.

[6] Page 7-11

The equation which calculates N_e and expressed as:

$\therefore N_e = 280$ kN

should read as:

$\therefore N_e = 2 \times 280$ kN $= 560$ kN

to allow the calculation of block shear capacity to reflect the fact that there are two plies being considered because the tube is flattened.

[7] Page 8-7

In the evaluation of y:

$$y = \frac{t_c}{2} + t_{w2}$$

the equation should read:

$$y = \frac{t_c}{2}$$ (see Note 2 below)

[8] Page 9-2

Delete Note 7 and renumber subsequent Note numbers. Further guidance is provided in the connection design model on non-uniformly loaded welds.

[9] Sections 11, 12, 13, 14

In all these sections, functions $f(n)$ for RHS/SHS and $f(n')$ for CHS are used to relate the efficiency of the chord member of Y/T, X, and K/N gap connections. All such functions should have an upper limit of 1.0 on the values calculated as clearly the efficiency cannot exceed 1.0 but the design model does not specify this upper limit. The references quoted as sources for the design expressions all have an upper limit of 1.0.

[10] Page 13-1

In Fig.13.1, for the right hand brace member (i.e. Brace Member 2), the lower 'h_1' should read 'h_2'.

[11] Pages 13–9 and 13–14

The text 'If g/b_o is greater than the larger of 1.5 (1-β) and (t_1 + t_2), the connection should be treated as two T or Y connections ....'

should read as follows:

'If g/b_o is greater than 1.5(1-β), check the joint also as two separate T or Y joints.'

[12] Page 13-23

In (ii), the following equation:

$$125 \times \sqrt{\frac{200 \times 10^3}{350}}$$

should read :

$$1.25 \times \sqrt{\frac{200 \times 10^3}{350}}$$

REVIEW OF SECTIONS OF EXISTING PUBLICATION AND SUGGESTIONS AS TO UPDATED INFORMATION

Section 1 Introduction

This section is now covered by 'Handbook 1 : Design of Structural Steel Connections' (Ref. [1]).

Section 2 Design Parameters

This section is now covered by 'Handbook 1 : Design of Structural Steel Connections' (Ref. [1]).

Section 3 Base Plate

A new separate Design Guide has been published for this connection to hollow section columns as part of Design Guide 7 'Pinned Base Plate Connections for Columns' (Reference [2]).

The compression case can be designed using the design model provided in Ranzi and Kneen's paper on pinned base plates (Reference [3]). Packer in his commentary (see Reference [4]) on the Ranzi and Kneen publication (Reference. [3]) has some suggestions for the tension case which revolve around using the yield line approach adopted for the bolted end plate connection to hollow sections in the publications referenced by him in Reference [4].

Section 4 Cap Plate

The existing design model is based on two references in the 'Blue Connections Book' namely Reference [4.1] (Packer and Henderson 1992 edition) and Reference [4.2], a 1989 paper on bolted hollow section end plates. More up-to-date material is available from Reference [5] and the 1997 edition of Packer and Henderson (Reference [6]). The references quoted by Packer (Reference [4]) are also likely to be useful and the AISC/STINA/AISI Manual also has design guidance on the cap plate (Reference [7]).

Essentially, the major issue is the yield line method to be used for assessing the strength of the plate. The design of the bolts and welds is straightforward.

Section 5 Side Plate

Design Guide 3 (Reference [8]) provides an updated design model which should be used in lieu of the design model in the 'Blue Connections Book'. The unique feature of the existing design model in Section 5 of the 'Blue Connections Book' is the connection to a hollow section column which is included in (Reference [8]).

Section 6 Bracing Cleat

The existing design model in the 'Blue Connections Book' covers an isolated cleat fixed to a hollow section member, subject to tension and compression loadings from a bracing member. For the compression case, only open section bracing members are treated while for hollow section bracing members users are referred to Sections 7/8/9 of the 'Blue Connections Book' for the design of the cleat for compression buckling (which is the contentious area—see Technical Note TN003—Reference [9]). The 'Blue Connections Book' may be used for tension bracing loadings (see also Sections 7, 8 and 9 below).

A new publication by Hogan and Collins (Reference [10]) should be used for the bracing cleat design in lieu of the existing design model for tubular compression bracing members in the 'Blue Connections Book'. Additionally, further work in this area has been done by other sources such as the American Institute of Steel Construction, CIDECT, HERA (NZ), which can also be consulted.

Section 7 Flattened End CHS

Section 8 Welded Tee End

Section 9 Slotted End Plate

As indicated in Technical Note TN003, when these connections are subject to compression, the existing design model in the 'Blue Connections Book' may be unconservative. A new publication by Hogan and Collins (Reference [10]) should be used in lieu of the existing design model in the 'Blue Connections Book' for sections 7.3.1.3, 8.3.2.3 and 9.3.1.3.

The existing design models for the Flattened End CHS and the Slotted End Plate are otherwise relatively straightforward and any updating of the existing design models should be based on Reference [1].

CIDECT publications (References [11], [12]) contain design models for the slotted end plate and welded tee end for CHS members (Reference [11]) and RHS/SHS members (Reference [12]).

The AISC/STINA/AISI Manual (Reference [7]) contains design recommendations for the Welded Tee and the Slotted End Plate Connection, but not the Flattened End connection. Reference [5] also contains suggested design models for these same two connections but not for the Flattened End connection. Reference [5] is more recent than Reference [7].

Section 10 Mitred Knee

This section of the 'Blue Connections Book' deals only with the welded mitred knee connection, either unstiffened or stiffened with a division plate. References [10.1], [10.2] and [10.3] in the 'Blue Connections Book' seem to be the basis of the design model.

There is a limited amount of design guidance on these connections in the Packer/Henderson book (Reference [6]) or in the AISC/STINA/AISI Manual (Reference [7]) so a literature search will be needed to see if the later information than the design model in the 'Blue Connections Book' is available, especially for the bolted end plate. Packer's commentary in Reference [4] offers some possible sources of design guidance though Packer has noted in correspondence there is no further significant work in this area since Refs [10.1], [10.2] and [10.3] in the 'Blue Connections Book' were published.

Section 11 Y and T Connections

Section 12 X Connection

Section 13 K and N Gap Connections

Section 14 K and N Overlap Connections

Each of these sections in the 'Blue Connections Book' deals with the one or two types of connection in the title for each section and which covers both circular and rectangular hollow section members. The existing design models are based on the 1991/1992 CIDECT publications plus some other material referenced in each section.

The latest CIDECT publications are shape based like the previous editions—one publication with all connection types for Circular Hollow Sections, one publication with all connection types for Rectangular Hollow Sections. Reference [11] should be used for all the above connection types for CHS sections and Reference [12] should be used for all the above connection types for RHS/SHS sections in lieu of Sections 11 to 14 inclusive of the 'Blue Connections Book'. Reference [14] contains a summary of the information contained in References [11] and [12] and also can be used in lieu. Alternatively, Reference [5] contains the current American approach.

REFERENCES

[1] Australian Steel Institute, 'Handbook 1, Design of structural connections', Author T.J. Hogan, contributing author and editor S.A. Munter, 1st Edition 2007.

[2] Australian Steel Institute, 'Design Guide 7: Pinned base plate connections for columns', Author T.J. Hogan, 1st Edition, April 2011.

[3] Australian Steel Institute, 'Design of pinned column base plates', Authors G. Ranzi and P. Kneen, Steel Construction, Vol. 36 No. 2, Sept 2002.

[4] Discussion on Reference [3] by J.A. Packer, Australian Steel Institute, Steel Construction, Vol. 37 No. 1, March 2003.

[5] American Institute of Steel Construction, 'Hollow structural section connections', Steel Design Guide 24, 2010.

[6] J.A. Packer and J.E. Henderson, 'Hollow structural section connections and trusses—A design guide', Canadian Institute of Steel Construction, Second edition, June 1997.

[7] AISC/STINA/AISI, 'Hollow structural sections connections manual', 1997 Edition.

[8] Australian Steel Institute, 'Design Guide 3: Web side plate connections', Author T.J. Hogan, contributing author and editor S.A. Munter, 1st Edition, 2007.

[9] Australian Steel Institute, 'Technical Note TN003, Design of eccentrically loaded bracing cleats', Author T.J. Hogan, Version 1, June 2010.

[10] Australian Steel Institute, 'Design model for light bracing cleat connections', Authors T.J. Hogan and R.T. Collins, Steel Construction, Vol. 43 No. 2, March 2010.

[11] CIDECT, 'Design Guide 1 for circular hollow section joints under predominantly static loading', 2nd Edition, 2008.

[12] CIDECT, 'Design Guide 3 for rectangular hollow section joints under predominantly static loading', 2nd Edition, 2009.

[13] CIDECT, 'Design Guide 9 for structural hollow section column connections', 1st Edition, 2005.

[14] Wardenier, J., Packer, J.A., Zhao, X.-L., van der Vegte, G.J., 'Hollow sections in structural applications', CIDECT, 2010. Printed by Bouwen met Staal.