

Design of Portal Frame Buildings

including
Crane Runway Beams and Monorails

Fourth Edition

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Preface

In October 1985, Scott Woolcock and Sritawat Kitipornchai presented a non-technical paper entitled *Some Aspects of the Design of Industrial Buildings* to a conference of the Australian Institute of Construction Supervisors at the Gold Coast. The paper outlined some of the grey areas in the design of portal framed buildings. ASI (or AISC as it then was) was very interested in the paper and invited these two authors to write the earlier working stress version of this book. It was entitled *Design of Portal Frame Buildings* and was published in 1987.

The working stress version was then completely rewritten for the change to limit states design. The first limit state edition was published in 1991 and was entitled *Limit State Design of Portal Frame Buildings*. It was prepared with contributions from the third author Mark Bradford. Further changes were made for the second limit state edition in 1993 to incorporate amendments to AS 4100 and AS 1170.2, to reflect changes in the AISC structural connections manual and to generally refine the limit state design process.

The third limit state edition was published in 1999. It was largely rewritten to cater for the change in basic steel grade from 250 MPa to 300 MPa and the change in roof wind loads in Amendment No. 2 of AS 1170.2. The release of the limit states cold formed structures code AS 4600 in 1996 and the publication of the Lysaght and Stramit limit states purlin and girt brochures in 1999 were also accounted for. A new chapter dealing mainly with the design of portal frame buildings for overhead travelling cranes was added. Design capacity tables for crane runway beams and monorails were included and these should have been useful to designers because there had been little if anything published since the sixth edition of AISC's *Safe Load Tables for Structural Steel* in 1987. Because limit states design was by then well established, the title reverted to the simpler, original title - *Design of Portal Frame Buildings*.

This fourth edition has been almost completely rewritten to account for changes in the loading codes particularly the new wind code, the availability of new purlin and girt sections and ASI's publication of new connection manuals. The previous chapter on plastic design has been deleted and the previous chapter on crane runway beams and monorails has been split into two chapters. The information and design guidance on monorail cranes has been significantly expanded and design examples added. There has also been the opportunity to correct previous errors and to generally refine and update the previous edition.

The changes in the loading codes include the introduction of AS/NZS 1170.0 with its revised load factors of 1.2 and 0.9 for dead loads in place of 1.25 and 0.8 and a new 2011 version wind loading code AS/NZS 1170.2. Changes to the 2011 wind code include the introduction of a local pressure factor of 3 at the corners of roofs and a simplification of the combination factor K_c including the lifting of the embargo on the application of K_c to cladding, purlins and girts. The 2002 revision to the previous 1989 wind code first introduced the combination factor K_c but its application was somewhat complex. The K_c factor was not included in the previous 1999 edition of this book because the new wind code was issued in 2002.

The publication of the 2002 code also marked the first appearance of rectangular or elongated local pressure patches in the code diagrams thereby indicating that the local pressure patches were meant to be areas which were not necessarily square. The 2010 code continues that approach to local pressure patches but it does set a limit of 4 on the aspect ratio of the rectangle.

The design capacity tables for CHS and SHS roof and wall bracing struts, which are unique to this book, have been slightly amended to cater for the reduced dead load factor of 1.2 rather than 1.25. These tables account for the effect of self-weight bending in combination with axial compression.

As in previous editions, the design of bored piers is generally in accordance with the limit states design approach of AS 2159-1995 but with different geotechnical capacity reduction factors proposed depending on whether the piers are classified as short or long. The quadratic expression derived from Broms' work by the authors for use in determining the lateral load capacity of short bored piers continues to be presented in the text of Chapter 7 but the derivation has now been added. This expression facilitates the preparation of spreadsheet programs for determining the lateral capacity of bored piers.

The original authors' association started at the University of Sydney where all three obtained doctorates conducting research into steel structures under the supervision of Professor N.S. Trahair. This association continued over the years. George Haddad has reviewed the fourth edition and made useful contributions based on his experience and the use of the third edition as a designer.

Overall, this edition should prove to be of great assistance to practising engineers and students. The authors gratefully acknowledge the positive feedback from many users. Firstly, they would like to thank consulting engineers Bonacci Group for its support in preparing this edition and the Departments of Civil Engineering at the University of Queensland and the University of New South Wales for their original support in preparing this book. Secondly, they would like to thank Chris Eden of Bonacci Group for patiently preparing new diagrams and redrawing some of the old ones. Thirdly, the input and review of portal frame and tubular connections by Richard Collins of Engineering Systems has been very valuable. Fourthly, they acknowledge the assistance of Kone Cranes in providing hoist wheel loads for monorails and some general advice on hoists from Demag. The continued support of the Australian Steel Institute including Margrit Colenbrander and Margaret Clift is also much appreciated.

Finally, the authors would like to express their appreciation for the continued support of their wives and families during the preparation of this edition.

Scott Woolcock
Sritawat Kitipornchai
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