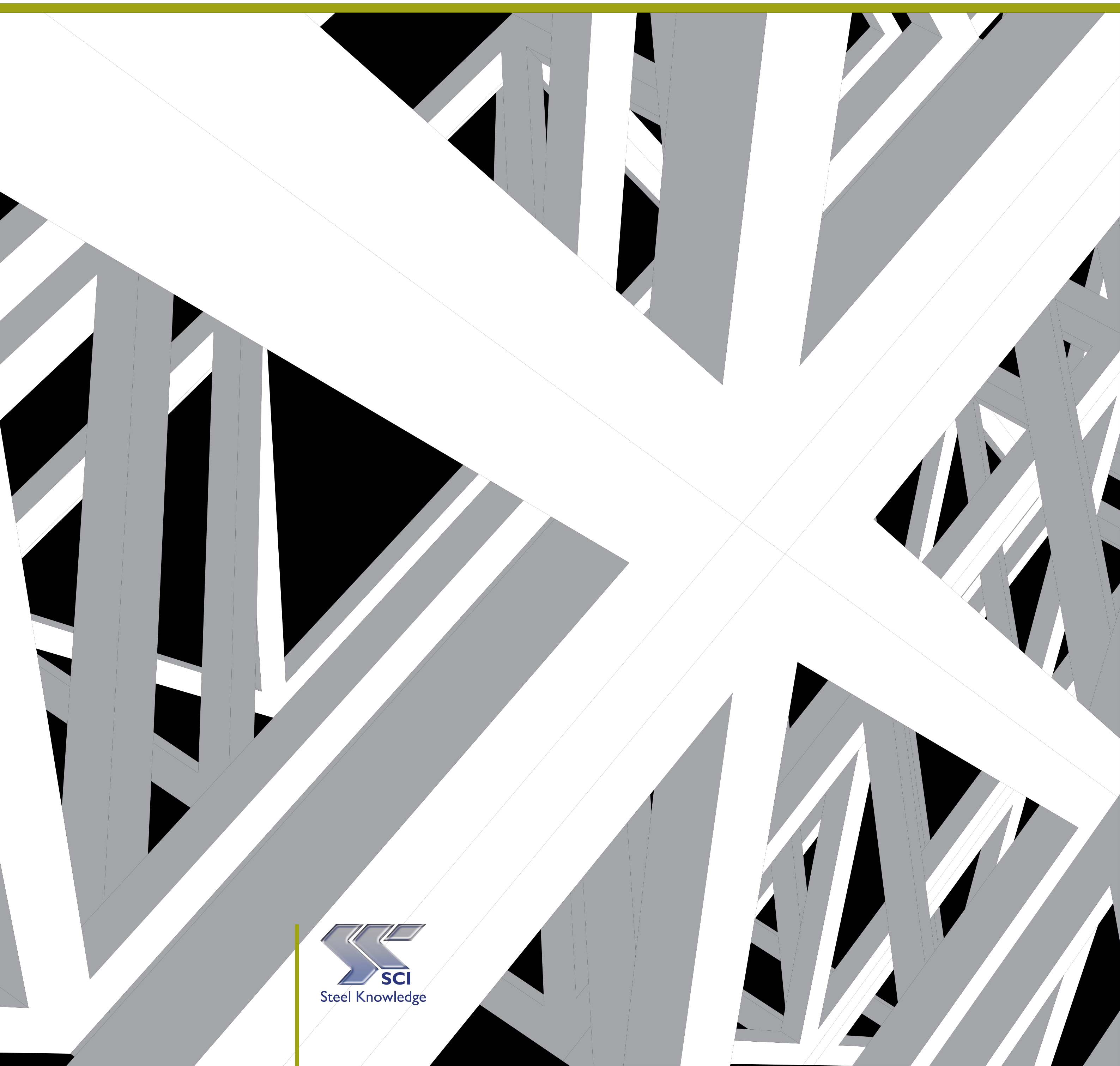
CELEBRATING 40 YEARS OF SCI



SCI
Steel Knowledge

EDITORIAL

What can happen over 40 years?

When SCI was formed 40 years ago, the UK steel construction sector was dominated by one steel producer, namely British Steel. That's why we were formed – they wanted to grow the market they could sell their products into, and funded us to help achieve that ambition. Sadly, the UK steel production industry is currently on its knees, although with government investment in new technologies, provided it can hang on for a few more years, the future may be brighter. The same is not true for the UK steel fabrication industry, which is world-class and has made massive progress over the past 40 years. Those not 'in the know' claim that the steel construction sector has changed little over that period, wrongly citing the example of automotive steels and the changes made to help combat the threat of aluminium with higher-grade thinner products. The most significant changes in steel fabrication have been automation and efficiency. One of the other big changes to the sector during that period has been the appearance of light gauge steel, facilitating greater off-site content for steel-framed structures. It is an area with significant unfulfilled potential, well placed to meet future construction needs.

Dr Graham Couchman

CEO, Steel Construction Institute

LOOKING BACK

As we proudly reach 40 years in the industry, we look back fondly on some of the milestones we have reached along the way. These landmarks show a clear trend, as SCI has moved from using a limited number of large income sources to provide generic support for the sector, to specialist consultancy for multiple clients.

SCI's first office, Silwood Park (Ascot), being constructed in 1988

1980

- Professor Patrick Dowling explained his idea of SCI to British Steel chairman, Sir Ian McGregor
- SCI received £500,000 funding from British Steel for three years
- SCI was established
- SCI began publishing guidance
- Launch of the European Steel Design Education Programme (ESDEP)

1990

- New Steel Construction (NSC) Magazine was born and SCI began writing its AD notes
- CIMSteel project produced ground breaking guidance including 'Green Books'
- FABIG (Fire and Blast Information Group) formed following the Piper Alpha disaster
- UK Government developed its Partners in Innovation scheme to support research projects
- Steel Bridge Group (SBG) became established
- Steel Piling Group (SPG) was established

2000

- SCI launched its Assessed Scheme to provide third party validity to manufacturers' products and processes
- RFCS (Research Fund for Coal and Steel) established when ECSC (European Coal and Steel Community) expired
- The global recession hit UK steel production hard

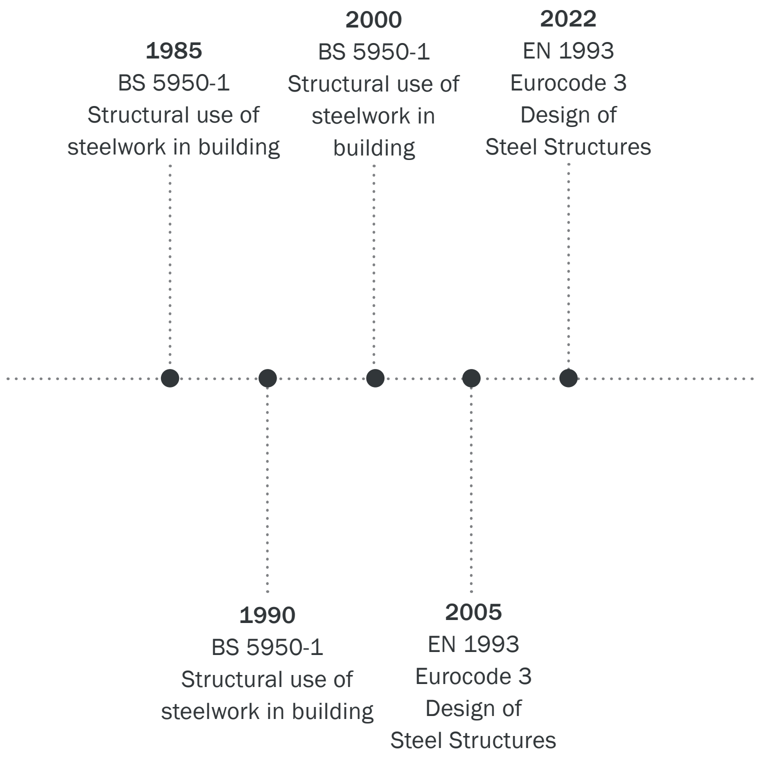
2010

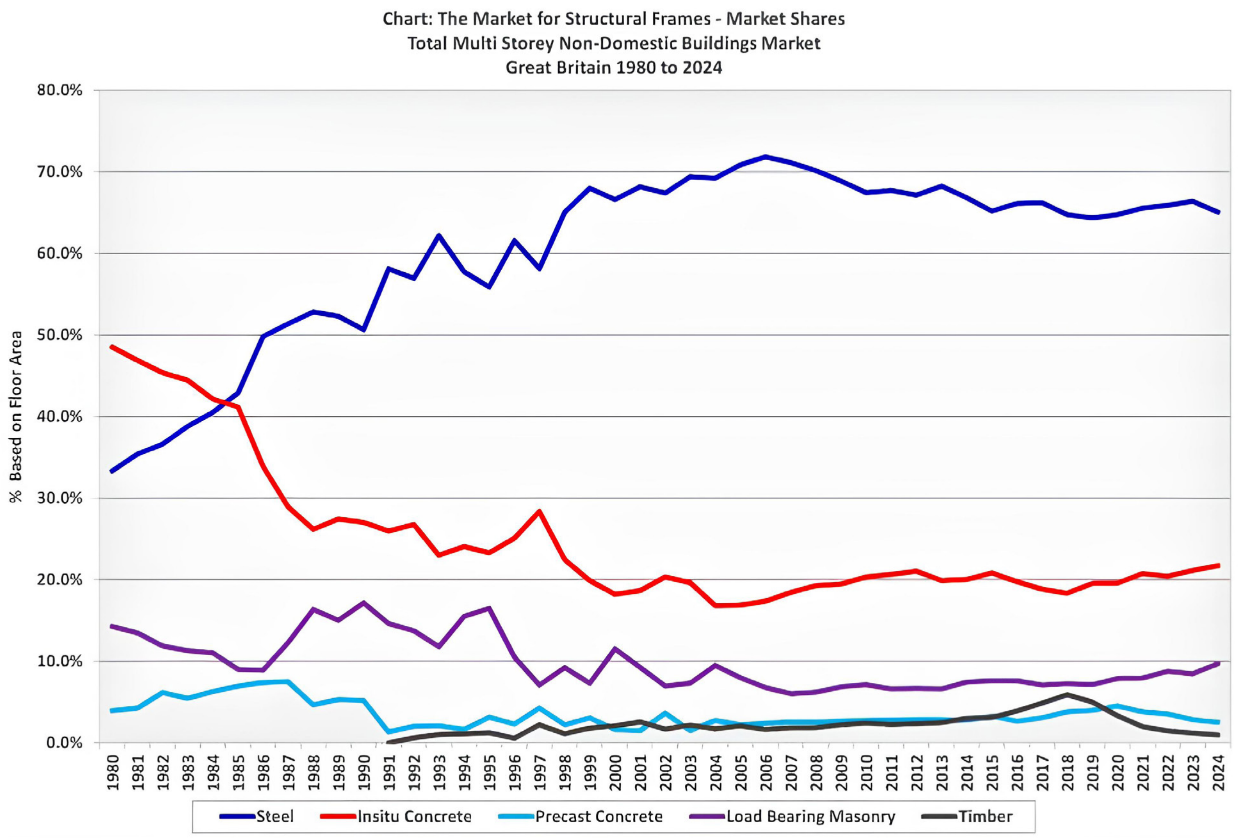
- The Light Steel Framing Group transformed into the Light Steel Forum, with membership restricted to manufacturers
- EMBIG (Energetic Materials Blast Information Group) was formed
- European research funding was lost as the impact of BREXIT was felt
- SCI webinars and online courses were launched

2020

- The National Lockdown saw SCI webinars go from strength-to-strength, with the most popular to date attracting a staggering 601 attendees
- SCI received UKAS accreditation to offer third party product certification
- Fallout from the Grenfell tragedy began to have an impact on many aspects of construction
- SCI said goodbye to Silwood Park as the office moved from Ascot to Bracknell
- SCI turned 40!

The BS5950 to EN Gen 2 Timeline





KEY PEOPLE

In this section, we recognise some key individuals who have helped shape SCI. At the time of writing, the average length of service of an SCI employee is a whopping 16 years! This speaks volumes for the type of work we do (rarely boring), and the commitment of our staff. Once you have worked at SCI, there really is no better place to go!

Chairs

Professor Patrick Dowling was SCI's first Chairman. This was fitting as he played a key role in SCI's creation. At the time Professor of Steel Structures at Imperial College London, he subsequently maintained contact with SCI as he became Vice-Chancellor of the University of Surrey. Imperial is an establishment with which we have always maintained a close relationship.

The last of our external chairmen was Martin Manning, who took over the role in 2006 and therefore served the Institute during the turbulent period following the 2008-09 recession. This was the time when funding sources changed fundamentally, as the national steel producer struggled. Martin was succeeded as Chairman of the Board by Dr Graham Couchman, who became the first SCI-employed Chairman.

Professor Patrick Dowling

Martin Manning

Chief Executives

Over its 40-year lifespan, SCI has only had three executive leaders. The first two were called Director, whilst the third is the current CEO. The change in title reflects the change from a Council to a Board of Directors.

Dr Colin Billington was the first Director and served until 1990. He was succeeded by Dr Graham Owens, who had previously served as Deputy. Dr Graham Couchman took over the role in 2007.

Dr Colin Billington

Dr Graham Owens

Dr Graham Couchman

Senior Management Team

The current Senior Management Team comprises a number of internationally known experts. Perhaps more important is the team's collective number of years working in different aspects of steel construction - on site, in design offices, at steelwork contractors, in academia, and of course in 'applied research/specialist consultancy' at SCI. At the time of writing, the Senior Management Team, which also includes Dr Graham Couchman, has been part of SCI for more than a century!

Dr Bassam Burgan
Director

David Brown
Technical Specialist

Nancy Baddoo
Associate Director

Andrew Way
Associate Director

Guillaume Vannier
Associate Director

Advisory Desk Managers

Bernard Boys was our first dedicated Advisory Desk Manager. Having taken early retirement from British Steel, he brought a wealth of knowledge to SCI. When he retired 'for a second time', Tom Cosgrove took over, bringing extensive steelwork contractor experience to the position. When Tom moved to BCSA, Abdul Malik succeeded him. Abdul was one of our first handful of employees, having transferred from British Steel's CONSTRADO when SCI was formed. Following in these illustrious shoes, the current incumbent is Liam Dougherty.

Tom Cosgrove

Abdul Malik

Liam Dougherty
Advisory Desk Lead

Key Contacts

Our Senior Management Team is ably supported by the next generation of engineers, who add new capability in areas such as numerical modelling.

In addition, the two key contacts below are particularly relevant for our members and clients.

Amelia Hoareau
Membership Lead

Judith Drake
Education Lead

SCI team photograph, taken in the early 1990s

SCI MEMBERSHIP

SCI Membership is available to companies of all sizes and we offer several membership packages. Each has specific benefits including: unlimited access to the SCI Advisory Desk and our technical portal: Steelbiz, monthly live webinars, exclusive discounts, events and more.

Traditionally, our members have had two key points of contact – our Membership Manager, and our Advisory Desk Manager. For many years Sandi Gentle was our Membership Manager. She retired in 2024 and will still be known to many of you. Her predecessor, Pat Ripley, was also Secretary to Colin Taylor. Colin led our advisory and code development activities and was one of the cornerstones of SCI. This link between membership and technical advice reflects the fact that access to technical expertise has always been a, if not the, key member benefit.

If you would like to discuss the value of SCI membership for your company, contact: **membership@steel-sci.com**.

From left to right: Eve Reynolds, Pat Ripley, Sandi Gentle and Amanda Hicks

The very first SCI member was Tony Gee and Partners, who joined on 6 April 1986 and remains SCI Corporate Members at the time of writing.

Back in the day, forty years ago, the steel community decided that a technical group would help to compete with the Cement and Concrete Association and that it should be separate from the trade organisation, BCSA - British Constructional Steelwork Association. The Steel Construction Institute (SCI) was formed and Tony Gee was happy to step forward to become its first member. Very quickly though, other notable organisations saw the benefits of an association like this and followed suit.

We place a high value on the expertise and guidance provided by the SCI; their research, technical publications and design tools continue to be a fantastic supporting resource for our structural design work, ensuring safety, efficiency and compliance with industry standards.

Our staff continue to engage with the SCI and contribute to the industry learning and knowledge sharing. This year, one of our Associates, Mathew Howells will become Chair of the Steel Piling Group, one of the many specialist groups that the SCI supports.

We are delighted to continue to provide our support and wish the Institute a happy anniversary.

- Tony Gee and Partners

By 1990, SCI was up to 263 members and our reputation for producing practical, quality information of value to the constructional steelwork sector was quickly established. Membership remains a key part of SCI today and we are proud to have 400 corporate members at the time of writing.

For more information on SCI membership scan below:

SCI Member List

2411 Group Ltd
7 Solutions

A

A C Bacon Engineering Ltd
A Steadman & Son
A Winterbotham Ltd
Absolute Cad Designs Ltd
Abstruct Consulting
Adept Consulting (UK) Ltd
Adey Steel Ltd
Adstone Construction Ltd
Advanced Bolting Solutions Ltd
Aecom
AJ Engineering & Construction Services Ltd
AKM Design
AKSWard
AKT II Ltd
Alan Clarke & Associates
Alan Wood & Partners
Albion Sections Ltd
Alexander Associates (Salisbury) Ltd
AMF Steel Design Ltd
AMP Consultants
Andrew Brown
Angle Ring Company Ltd
Apex Construction Engineering
Apex Consulting Engineers Ltd
Arcadis Human Resources Ltd
Armatherm Thermal Bridging Solutions
Arminhall Engineering Ltd
Arromax Structures Ltd
ASD Westok Ltd
Ash & Lacy Holdings Ltd
Asme Engineering Ltd
Aspire Consulting Engineers LLP
AtkinsRealis
Atlasco Constructional Engineers Ltd
AVIE Consulting Ltd
AWE Plc
Ayrshire Metals Ltd

B

B D Structures Ltd
B&K Hybrid Solutions Ltd
Babcock Marine
BAE Systems Marine Ltd
BakerHicks
BAM Construction Ltd
BAM UK & Ireland Enabling Services Ltd
Barnshaw Section Benders Ltd
Baxter Glaysher Consulting
BDP Ltd
Beaver Bridges Ltd
Bentley Systems Ltd
BG&E Consulting Engineers Ltd
BHC Ltd
Billington Structures Ltd
Birkbeck Structures Ltd
Blind Bolt Company
Blyth & Blyth Consulting Engineers Ltd
Bourne Group Ltd
British Constructional Steelwork Association
British Offsite Ltd
Briton Fabricators Ltd
Buro Happold Ltd
BW Industries Ltd
BWB Consulting Ltd

C

C S Pringle t/a MNK Engineering Ltd
Computer & Design Services Ltd
Cairnhill Structures Ltd
Caledan Ltd
Campbell of Doune Ltd
Campbell Reith Management Services Ltd
Canadian Institute of Steel Construction
Cass Hayward LLP
Cast Connex Corporation
Caunton Engineering Ltd
Cavendish Nuclear
Cementation Fabrications
CIMTAS
City, University of London
Civil & Structural Computer Services Ltd
Cleveland Steel & Tubes Ltd

CMF Ltd
Coleman & Company Ltd
Compass Engineering Ltd
Construction Metal Forming Ltd
Coventry Construction Ltd
Coventry University
COWI UK Ltd
Crouch Waterfall
CTICM
Cundall
Curtins Consulting Ltd
Cypron International Consulting Engineers Ltd

D
D H Structures Ltd
D Hughes Welding & Fabrication Ltd
Dar Al-Handasah
Davicon Mezzanine Floors
Davis Consultants
Design 4 Structures
Design and Maintain Ltd
Design Engine Ltd
DeSimone Consulting Engineering
Devon County Council
DLT Engineering Ltd
Doherty Finegan Kelly
Doshi & Company Hardware Ltd
Dougall Baillie Associates
Downes Associates
DragonHeart Homes Ltd
Drywall Steel Sections Ltd
Duggan Profiles & Steel Service Centre Ltd
Duggan Steel

E
Eadon Consulting Ltd
ECS Engineering Services Ltd
EirEng Consulting Engineers
Elland Steel Structures Ltd
Elliott Wood Partnership Ltd
Embrace Steel Group Ltd.
Engenuiti Ltd
Epic Metals Corporation
Etex UK Remagin Ltd
Euro Quality Cladding Ltd
Euroclad Group Ltd
EvadX Ltd
Evolusion Innovation Ltd
Evolve

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Fabsec Ltd
Fairhurst Group LLP
Farrat Isolevel Ltd
Finite Engineering Ltd
Fluor Ltd
Four-Tees Engineers Ltd
Frameclad Ltd
Francis & Lewis International Ltd
FRANK H. DALE LTD
Fullpen Fabrications Ltd

G
G.R.Carr Ltd
GGP Consult
Glass Light and Special Structures
Goler Ltd
Gorge Fabrications Ltd

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H Young Structures Ltd
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Hadley Industries Holdings Ltd
Hallmason Design Ltd
Hambleton Steel Ltd
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Haskoning UK Ltd
HBE Service Ltd
Hescott Engineering Company Ltd
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Hockley & Dawson Consulting Engineers Ltd
HOP Consulting Ltd
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Hurst Peirce & Malcolm LLP

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Imperial College
Institution of Structural Engineers
International Paint Ltd
Intersteels Ltd

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J&D Pierce (Contracts) Ltd
Jamestown Manufacturing Ltd
JCP Engineers
Jewers Doors Ltd
Jig Consulting Engineers Northern Ltd
John Cranna
John Tooke & Partners
JPSE Construction Ltd

K
KD Leach Ltd
KGAL Consulting Engineers Ltd
Kier Professional Services Ltd
Kiernan Structural Steel Ltd
Kilgallen & Partners Consulting Engineers Ltd
Kingspan Ltd
Kingspan Steel Building Solutions
Kitall
Krabbenhøft & Ingolfsson

L
Laing O'Rourke
Leach Structural Steelwork Ltd
Legge Steel (Fabrications) Ltd
Leman Engineering Ltd
Leviat
Lindapter International
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Loaninghill Fabrication Co Ltd
LSW Consulting Engineers Pte Ltd

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M & S Engineering Ltd
M Hasson & Sons Ltd
M.J. Patch Engineering Ltd
Mackay Steelwork & Cladding Ltd
Mark Lovell Design Engineers
Mark Tyler
Martin Casey
Mason Navarro Pledge Ltd
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Mereside Consulting Ltd
Metalex Trading & Contracting Co W.L.L
Metek PLC
MetStructures
Michael Barclay Projects Ltd
Midland Structures Ltd
Millar Callaghan Engineering Services Ltd
Minconsult SDN BHD
MiTek Industries Ltd
MJH Structural Engineers
MJM Consulting Engineers Ltd
Modular Plantrooms Ltd
Mott MacDonald Ltd
MPN UK Ltd
Mr Nedim Alimli
Murphy International Ltd

N
Nationwide Structures Ltd
Network Rail
Newbridge Engineering Ltd
NMD Consulting Engineers
Nodetec Oy
Norder Design Associates Ld
North Lincs Structures Ltd
Northern Steel Decking Ltd
Nusteel Structures Ltd

O
O'Connor Sutton Cronin
O'Loughlin Project Engineers Ltd
OPS Structures
Ove Arup & Partners Ltd

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Patterson Heggie Consulting Engineers
Paul Hunter
Pell Frischmann
Perega Ltd
Peter Dann Ltd
Peter Marshall Steel Stairs Ltd
Pick Everard
Plandescil Ltd
PM Engineering & Design
PM Group
PMS Fabrications Ltd
Portakabin Ltd
Portal Frame Steel Ltd
Price & Myers Consulting Engineers LLP

R

R G Parkins & Partners Ltd
Ramage Young Design Ltd
Ramboll UK Ltd
Ramon Freixes
REID Steel
Rendel Limited
RG Carter Technical Services
Richard Alan Engineering Ltd
Rigby Consulting Engineers Ltd
Robert Bird & Partners Ltd
Roger Locke Consulting
Rogers Clarke Landers Ltd
Roughan & O'Donovan Consulting Engineers
Royal School of Military Engineering
RPS Consulting Engineers (Ireland)
RPS Consulting Services Ltd (UK)

S

SAH Luton Ltd
Sampar Ltd
SC4 UK Ltd
Sean Power Construction Consultants Ltd
SECO
Sellafield Ltd
Severfield PLC
Shane Curtin
Shanette Sheds
Shaun Hodgson Engineering Ltd
Shell UK Ltd
Sherwin Williams
Shipley Structures Ltd
Shuffletbottom Ltd
Simpson Associates Consulting
Sir Robert McAlpine Design Group
Skanska Technology Ltd
Skidmore, Owings & Merrill Inc
Snashall Steel Fabrications Co Ltd
South Lincs Consulting Ltd
Southern Fabrications Ltd
Spannverbund
Stage One Creative Services Ltd
Stantec UK Ltd
Steel & Roofing Systems Ltd
Steel Beam Calculator Ltd
Steel Connections (NW) Ltd
Steel Design Solutions Ltd
Steel Formed Sections Ltd
Steve Gilman Design Ltd
Stirling Maynard
Strictly Structural Engineering
Structural and Civil Design
Structural Metal Decks Ltd
Studwelders Composite Floor Decks Ltd
Sunshine Skyway Structures
SW & H Ltd
Sweco UK Limited
Swedish Institute of Steel Construction

T

Teague & Sally Ltd
Tension Control Bolts Ltd
Tetra Tech Limited
The Structural Drawing Office Ltd
Tier Consult Group
Tony Gee and Partners LLP
True Consulting Engineers Ltd
TSI Structures Ltd
Tully De'Ath Ltd
Typhoon Performance Products Ltd

U

Universita Degli Studi Di Trento
Universiti Teknologi Malaysia
University College London
Useful Simple Group Ltd

V

Vision Built
Voestalpine Metsec PLC
Walsh Associates

W

Walsh Goodfellow
Walter Watson Ltd
Waterman Group
Wentworth House Partnership
Westbury Park Engineering Ltd
Whitby Wood Ltd
WIG Engineering Ltd
William Attwell & Associates
William Haley Engineering Ltd
William Hare Ltd
William J Marshall & Partners
WSP UK Ltd

ADVISORY DESK SERVICE

Whilst we have always spoken about an ‘Advisory Desk’ – hence the AD notes that provide the latest technical guidance – in reality, our responses to members’ technical questions come from a team of engineers with expertise covering different areas. If they can’t answer it themselves then the Advisory Desk Manager sitting at ‘the desk’, acts as a conduit. AD Notes are often inspired by questions we get asked, generally more than once, which means they cover issues of real and wide relevance. They often fill in specific details that complement SCI publications and other less specific guidance. SCI members can opt-in to receive each new AD note as it is published.

AD notes were originally published from 1988, in SCI’s own journal ‘Steel Construction Today’. During this initial period note production was prolific, with approximately 20 new ADs issued per year. BS 5950 was relatively new at the time, so perhaps there was plenty of advice needed as designers got used to working with a limit state code. By 1992 the journal had evolved into ‘New Steel Construction (NSC) Magazine’ – a joint SCI-BCSA publication. Since 1992 Advisory Desk notes have become less frequent (around twelve per year), but as codes, and indeed structures themselves, become more complex the notes remain as necessary and relevant as ever.

Our very first AD Note (AD 001), which was issued in April 1988, is entitled “Guidance on compactness” and concerns the classification limits which must have seemed quite new at the time. Unsurprisingly, this advice is no longer current best-practice.

One of our most recent is AD 528, which considers ‘Lateral Restraint Forces for Beams’. It compares the requirements of Eurocode 3 and BS 5950. At a time when a new Eurocode 3 is about to come into force, UK designers still use BS 5950 more often than you might think!

Different writing styles can be seen over the years – some more formal and some rather more conversational. Members are encouraged to keep the enquiries flowing to help inspire new ADs.

SCI ADVISORY DESK

AD 001: Guidance on compactness

Many of the queries we receive about BS 5950: Part 1 relates to Table 7, especially the compactness limits for webs. A typical question is:

> “In a UB subject to combined axial load and moment, how do I check the compactness of the web if the section is not fully stressed?”

Before getting down to detail, let us clarify some basics:

- The *purpose* of giving compactness limits, or “section classification” as some call it, is merely to avoid the need to do the local buckling check. So, if your compactness check is getting complicated – or gives borderline decisions – it may be simpler or better actually to do the local buckling check instead.
- The entry “Web subject to compression throughout” actually refers to a web *in a section which is* subject to compression throughout – and the values 28ε and 39ε are actually valid for Class 1 and Class 2 plastic and compact sections as well as for Class 3. When you realize this, the sentence in Note 1, which says that “if $\alpha > 2$ the section should be taken as having compression throughout”, becomes clear.
- The entry “Web, generally” is related to this limit of $\alpha \leq 2$, which occurs when the plastic neutral axis (PNA) is at the edge of the web connected to the tension flange. This is shown in Fig. 1(a), whilst Fig. 1(b) shows the case of “compression throughout”. The limiting value of *d/t* is 49ε (from $98\varepsilon/\alpha$ when $\alpha = 2$) in Fig. 1(a), compared with 39ε or 28ε in Fig. 1(b) for rolled and welded sections respectively.

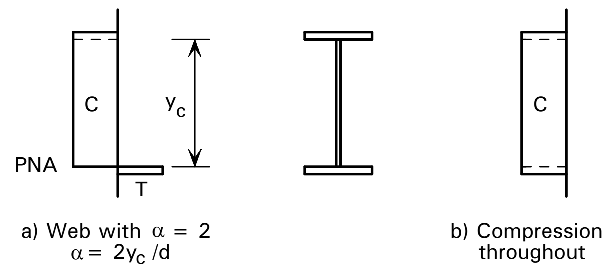


Figure 1 *Compact section web in compression.*

- The general limit for webs is expressed in a way that covers beams with unequal flanges as well as members subject to combined axial load and bending moment. As far as local buckling of the web is concerned, it is the position of the PNA that matters, provided that the compression flange is compact. Figure 2 illustrates a stress-block diagram that could equally be produced by either case.

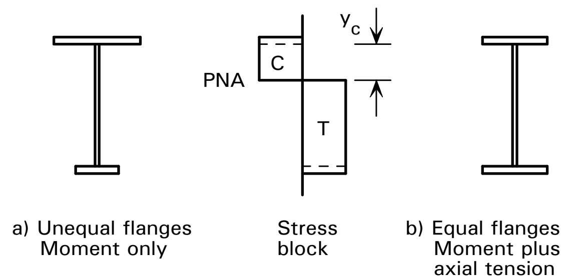


Figure 2. *Stress blocks for unequal flanges, or for moment plus axial load.*

SCI ADVISORY DESK

We can now answer the original question, which relates to combined axial load and moment on a rolled I-section, which commonly is not stressed to full capacity because the design is governed by the overall buckling resistance.

Taking it in stages:

(a) If $d/t \leq 39\varepsilon$ the web is always compact;

(b) If $d/t \leq 49\varepsilon$ the web is always compact if $F_c \leq tdp_y$;

(c) If $d/t > 49\varepsilon$ the web is always compact if $F_c \leq (98\varepsilon - d/t)\ t^2 p_y$;

(d) If $d/t > 49\varepsilon$ and $F_c > (98\varepsilon - d/t)\ t^2 p_y$, use Appendix H.

If F_c *only* slightly exceeds this limiting value, it may be found that in fact the section is still satisfactory according to Appendix H. Note that the constant in the formula for $p_{c.cr}$ should actually be 815, rather than 850 (see draft Amendment No. 1).

(e) If $F_c > tdp_y$ and $d/t > 39\varepsilon$, use Appendix H, as modified by draft Amendment No. 1.

Example: $406 \times 140 \times 39$ UB grade 43: $\varepsilon = 1$.

$F_c = 450$ kN; $M = 150$ kNm.

Plastic resistance

$dtp_y = 359.7 \times 6.3 \times 275/1000 = \underline{623}$ kN

$F_c = 450$ kN < 623 so PNA is in web

$$M_{pr} = M_p - \frac{F_c^2}{4tp_y} = \frac{721 \times 275}{1000} - \frac{450^2}{4 \times 6.3 \times 275} = 198.3 - 29.2 = \underline{169.1} \text{ kNm}$$

$M = 150$ kNm < 169.1 so plastic resistance is OK.

Compactness

$d/t = 57.1 > 49$

Web always compact if $F_c \leq (98\varepsilon - d/t)\ t^2 p_y = (98 - 57.1)\ 6.3^2 \times 275/1000 = \underline{446.4 \text{ kN}}$

$F_c = 450$ kN > 446.4 so use Appendix H.

Local buckling resistance

$$M_p \text{ of web} = \frac{6.3 \times 359.7^2 \times 275}{4 \times 1000^2} = \underline{56.0} \text{ kNm}$$

M_p of flanges etc. $= 198.3 - 56.0 = \underline{142.3}$ kNm

$M_w = 150 - 142.3 = \underline{7.7}$ kNm

$p_{b.cr} = (1630/57.1)^2 = \underline{814.9}$ N/mm^2

SCI ADVISORY DESK

$$M_{cr} = \frac{6.3 \times 359.7^2 \times 814.9}{4 \times 1000^2} = \underline{166.1} \text{ kNm}$$

$p_{c.cr} = (815/57.1)^2 = \underline{203.7}$ N/mm^2

$P_{c.cr} = dtp_{c.cr} = 359.7 \times 6.3 \times 203.7/1000 = \underline{461.6}$ kN

$$\frac{F_c}{P_{c.cr}} + \left[\frac{M_w}{M_{cr}}\right]^2 = \frac{450}{461.6} + \left[\frac{7.7}{166.1}\right]^2 = 0.975 + 0.002 = \underline{0.977} < 1 \text{ OK.}$$

Notes

1. When $F_c = 461.6$ kN:

$F_c/P_{c.cr} = 1$; $M_w = 0$; $M \leq \underline{142.3}$ kNm.

2. When $F_c = 446.6$ kN:

$$M_{pr} = 198.3 - \frac{446.4^2}{4 \times 6.3 \times 275} = 198.3 - 28.8 = \underline{169.5} \text{ kNm}$$

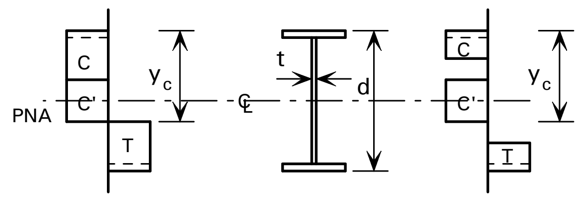
$M_w = 169.5 - 142.3 = \underline{27.2}$ kNm

$$\frac{446.4}{461.6} + \left[\frac{27.2}{166.1}\right]^2 = 0.967 + 0.027 = \underline{0.994} \approx 1.$$

Explanation

When the flanges carry all the bending moment, the maximum axial compression F_c for a compact web is $P_{c.cr}$. However, when the web also carries part of the bending moment, the maximum value for F_c is reduced.

The formula $F_c \leq (98\varepsilon - d/t)\ t^2 p_y$ actually gives the maximum axial force for a compact web when the section is fully stressed, see Fig. 3(a). As the value of F_c is relatively insensitive to variations in M, this provides a safe approximation when the section is not fully stressed [see Fig. 3(b)].



a) Stress blocks for full capacity C = T:C' balances F_c: C and T balance M

b) Lower bound stress blocks for F_c and 0.9 M C and T balance 0.9M

Figure 3. *Approximation for moment below capacity.*

The formula is derived thus:

$y_c = [d + F_c/(tp_y)]/2$

$\alpha = 2y_c/d = 1 + F_c/(dtp_y)$

SCI ADVISORY DESK

$$\frac{d}{t} \le \frac{98\varepsilon}{\alpha} = \frac{98\varepsilon}{1 + F_c/(dtp_y)}$$

$$\frac{d}{t} + \frac{d}{t}\left[\frac{F_c}{dtp_y}\right] \le 98\varepsilon$$

$$F_c/(t^2 p_y) \le 98\varepsilon - d/t$$

$$F_c \le (98\varepsilon - d/t)\, t^2 p_y.$$

Note: See also AD123

SCI ADVISORY DESK

AD 528: Lateral restraint forces for beams

SCI's Advisory Desk has received queries from designers as to what restraint forces should be used to restrain the compression flange of a beam. This AD Note compares the lateral restraint force requirements for BS EN 1993-1-1[1] and BS 5950-1[2].

To use a steel beam economically, the compression flange needs to be restrained laterally against buckling and two requirements may be identified for all restraint systems[3,4]:

1. The restraint should have sufficient stiffness to increase the buckling load of the restrained member to the desired level by limiting the buckling deformations.

2. The restraint should have sufficient strength to resist the loads transmitted as a result of restricting the buckling deformations.

The relationship between stiffness and strength is such that the greater the stiffness of the restraint, the smaller its required strength. Despite the importance of both strength and stiffness, many structural design codes provide only strength requirements (e.g. BS 5950-1) and it is assumed that a member of such strength will also possess sufficient stiffness. Long span structures will develop large restraint forces and additional checks may be required.

In BS 5950-1, the restraint force required is straightforward, in BS EN 1993-1-1, the approach is more detailed.

BS EN 1993-1-1

In BS EN 1993-1-1, restraint is dealt with by assuming an initial geometric imperfection. The initial geometric imperfection may be replaced by an equivalent stabilizing force q_d, defined by Equation 5.13 of BS EN 1993-1-1, which is applied as a uniformly distributed load on the member to be resisted by a bracing system.

The equivalent stabilizing force q_d is defined in clause 5.3.3(2) of BS EN 1993-1-1 as:

$$q_d = \sum N_{Ed} 8 \frac{e_0 + \delta_q}{L^2}$$

Where:

N_{Ed} is the axial force in the compression flange of the beam, taken as:

$$N_{Ed} = \frac{M_{Ed}}{h}$$

M_{Ed} is the maximum moment in the beam

h is the overall beam height

Where a beam is subjected to external compression N_{Ed}, it should include the part of the compression force carried by the flange.

e_0 is the member imperfection defined by Equation 5.12 of BS EN 1993-1-1 as:

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$e_0 = \alpha_m L/500$

α_m is a reduction factor when multiple beams are being restrained by a bracing system, given in clause 5.3.3(1) of BS EN 1993-1-1 as:

$$\alpha_m = \sqrt{0.5\left(1 + \frac{1}{m}\right)}$$

m is the number of members to be restrained

L is the length of the beam

δ_q is the inplane deflection of the bracing system under q_d plus any external loads. The in-plane deflection of the bracing system could have a significant impact on the stabilising force. SCI's P360 suggests that the deflections of typical bracing systems in buildings are unlikely to exceed $L/2000$ and a useful approach is to assume initially (and subsequently confirm) that the deflection of the bracing system δ_q will be less than this conservative value. The total resulting equivalent stabilising force ($q_d L$) is then 2% of N_{Ed}.

Where two or more intermediate lateral restraints are provided, P360 suggests that each restraint should be capable of resisting a force of not less than $5q_d L/8$. Provided that the actual deflection of the bracing system δ_q is less than the $L/2000$, the restraint force equals 1.25% of N_{Ed}.

The restraints should also be capable of resisting any additional forces due to external actions and it must be ensured that sum of the restraint forces for the individual beams are transferred to some 'stiff' point in the structure, for example, to in-plane bracing or concrete core walls.

BS 5950-1

BS 5950-1, clause 4.2.2 says that full lateral restraint may be assumed to exist if the frictional or positive connection of a floor (or other) construction to the compression flange of the member is capable of resisting a lateral force of not less than 2.5% of the maximum force in the compression flange of the member.

Similarly, clause 4.3.2.2 says that where intermediate lateral restraint is required at intervals within the length of a beam, the intermediate lateral restraints should be capable of resisting a total force of not less than 2.5% of the maximum value of the factored force in the compression flange within the relevant span, divided between the intermediate lateral restraints in proportion to their spacing.

Where three or more intermediate lateral restraints are provided, each intermediate lateral restraint should be capable of resisting a force of not less than 1% of the maximum value of the factored force in the compression flange within the relevant span.

The intermediate lateral restraints should either be connected to an appropriate system of bracing capable of transferring the restraint forces to the effective points of support of the member, or else connected to an independent robust part of the structure capable of fulfilling a similar function.

The bracing system should be capable of resisting each of the following alternatives:

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a) the 1% restraint force considered as acting at only one point at a time and

b) the 2.5% restraint force divided between the intermediate lateral restraints in proportion to their spacing

Clause 4.3.2.2.3 requires that bracing systems that supply intermediate lateral restraint to more than one member should be designed to resist the sum of the lateral restraint forces from each member that they restrain, reduced by the factor k_r obtained from:

$k_r = (0.2 + 1/N_r)^{0.5}$

N_r is the number of parallel members restrained

Conclusion

Both BS EN 1993-1-1 and BS 5950-1 result in similar lateral restraint forces, for full lateral restraint a force equal to 2% and 2.5% of the axial force in the compression flange respectively and for intermediate lateral restraints a force equal to 1.25% and 1% of the axial force in the compression flange respectively. However, in BS EN 1993-1-1 the determination of restraint forces is an iterative process, due to the dependence of the forces on the level of deflection of the bracing system.

Both approaches include a reduction factor on the restraint forces to bracing systems when multiple beams are being restrained.

Long span structures will develop large restraint forces and additional checks may be required.

1 BS EN 1993-1-1:2005 Eurocode 3 - Design of steel structures - General rules and rules for buildings, BSI
2 BS 5950-1:2000 Structural use of steelwork in building. Code of practice for design. Rolled and welded sections
3 Nethercot, D.A. and Lawson, R.M. Lateral stability of steel beams and columns (P093), SCI, 1992
4 Gardner, L. Stability of steel beams and columns (P360), SCI, 2011

Contact: Liam Dougherty

EDUCATION

From the very beginning, the provision of education and training has been one of our most visible activities. Educating designers is an essential part of our original vision to encourage the correct use of steel in construction.

Previously, many hours were spent on the road by SCI staff travelling to deliver courses. These included the British Steel sponsored 'Evening CPDs' that used to take place over a number of evenings each winter, with two one-hour presentations each week.
By 2020, however, the National Lockdown and social distancing had revolutionised the way we presented our courses and we haven't looked back! Teaching our courses online means that both our presenters and the delegates can benefit from lower costs, less travel and the ability to fit the sessions in around other work commitments.
Broken into bitesize chunks, our in-depth, technical online training courses, along with our convenient lunchtime webinars that cover a wider range of subjects and include guest speakers, keep engineers updated and informed. Our training equips them to design competently, efficiently and safely. As the Generation 2 Eurocodes come into force early in 2028, we anticipate an increase in demand!

Most of our lunchtime webinars are for SCI Members only who also enjoy a 20% discount on public courses. Many of our courses can also be run 'in-house', either in-person at the client's offices or online, and can be tailored to specific needs. If this is something you would like to discuss, please contact: **education@steel-sci.com** to talk through your requirements.

All upcoming SCI courses and webinars can be viewed using the QR code below.

SPECIAL INTEREST GROUPS

Although they dominate in terms of tonnage of steel sold, the UK steel construction sector comprises more than just 'sheds' and multi-storey buildings with composite floors. One of our most successful groups has always been the Steel Bridge Group, which brings together enthusiastic volunteers from consultants, steelwork contractors and clients. Their input to numerous documents, including the highly respected Bridge Guidance Notes, has been invaluable.

The Light Steel Framing Group was formed at the time British Steel was trying to develop the market, selling 'coil' and its own framing product, Surebuild. They wanted to hear what designers and suppliers in that market needed, then support SCI to produce the necessary, high-quality guidance. With time, this evolved into the Light Steel Forum, which has a membership restricted to framing suppliers who are happy to fund the group and direct what generic work is needed.

The Steel Piling Group was formed in 1995 and, after a period during which BRE provided the secretariat, realigned itself with SCI in 2017. It has developed into a forum that provides a platform for discussion and an outlet for dissemination of steel piling knowledge to the UK industry.

Two other Special Interest Groups were created for a different purpose.

FABIG, the Fire And Blast Information Group, was established in 1992 as a result of the Piper Alpha disaster in 1988. The government and industry decided to instigate the group in order to collate, appraise and disseminate knowledge on hydrocarbon fires and explosions. FABIG acts as a leading forum for discussion of fire and blast issues in relation to the design and operation of offshore and onshore facilities. Over the years, FABIG has broadened its scope beyond hydrocarbon fire and explosions and now covers all industrial fire and explosion hazards.

In 2018, following discussions with industry and government agencies, the need for a group to develop the knowledge required to ensure the safe processing, transportation and storage of explosives was identified. SCI was asked to establish and host the new group EMBIG, the Energetic Materials Blast Information Group. The Group today has 15 members that include government agencies, consultants, academic partners and the Health and Safety Executive (HSE). EMBIG aims to improve the knowledge available to those involved in assessing the safety of sites for the storage, manufacturing and handling of explosive materials by providing a forum for the development and exchange of best practice. The group has now expanded its scope to also consider the protection of structures and our built environment from terrorist attacks and accidental detonations of energetic materials in nearby chemical and explosive storage and manufacturing facilities.

EMBIG

STEEL BRIDGE GROUP

STEEL PILING GROUP

FABIG
FIRE AND BLAST INFORMATION GROUP

Light Steel Forum

KEY PARTNERSHIPS

SCI was created to be an integral part of a partnership with British Steel and the British Constructional Steelwork Association (BCSA). British Steel supplied most of the money, but having the steelwork contractors on board via BCSA as part of a joint initiative made perfect sense. Bringing together those who design the steel and those who fabricate, it enabled landmark projects such as the “Green Books” on connection design to be so successful – by using standard connection details the designer is specifying something that the fabricator is happy to create. This joint approach, which continues even though the steel producer funding disappeared a long time ago, was crucial to delivering British Steel’s vision to grow the market for steel in construction.

British Steel

BCSA

SCI’s team on its 20th anniversary

From left to right: Dr Colin Billington and Sir Bob Scholey

Dr Owens (left) receives his Life Member certificate from Professor Dowling

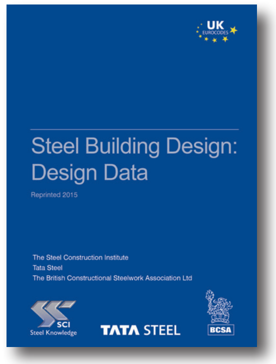
PUBLICATIONS: FROM P001 TO P454 IN 40 YEARS

Publications have always been a key output from SCI, widely distributed and widely appreciated. Less known perhaps, given their high profile, is that we make very little money from our publications! The model was always that somebody – invariably British Steel 'back in the day' – paid SCI to produce guidance that was then distributed freely to as many readers as possible. The end game was to sell the sponsor's product, not to sell SCI's publications.

Not surprisingly, the most widely distributed publication to date is the so-called 'Blue Book' – in its various versions. P363 is the latest, reprinted in 2015, and soon to be updated to cover Generation 2 Eurocode 3. Since first launched it has been a key resource for designers, providing section and member properties and resistances in accordance with the codes and standards in use at the time.

All SCI resources are distributed via the Accuris (formerly I H S) Construction Information Service. Approximately 500 SCI resources are downloaded from that source every week, showing the extent of our reach and the credibility our guidance has.

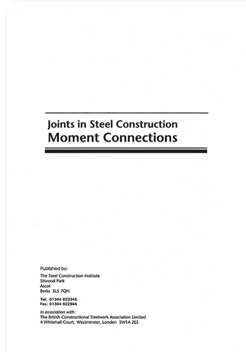
The first SCI publications (P001 to P004) were published by others but, for reasons lost in time, acquired an SCI number. P005 Design of Castellated Beams (1985) was the first publication that was really ours. Although it no longer provides current advice, it is still available for historic reference via Steelbiz.



Steel Building Design: Design Data "Eurocode Blue Book" (P363)

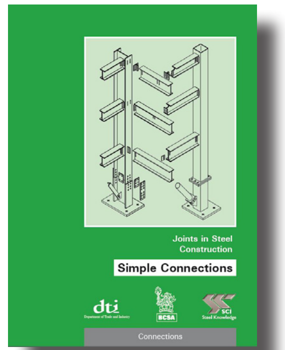
The "Blue Book" is consistently an SCI bestseller and the essential aid for the design of steelwork. Comprehensive tables of member resistances are given for S275 and S355 steel, to enable rapid selection of steel members in compression, bending and tension. Tables are also provided for combined bending and compression, web resistance and shear resistance.

The latest edition provides resistances in accordance with the UK version of Eurocode 3 (parts 1-1, 1-5, and 1-8 together with their relevant UK National Annexes).



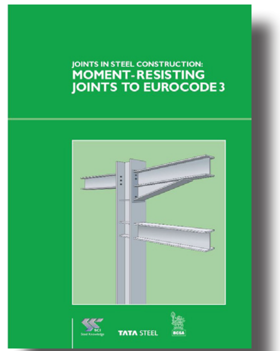
Joints in Steel Construction - Moment Connections (P207)

This publication provided guidance on moment connections. It included guidance on both bolted and welded connections suitable for use in continuous frame design, together with bolted wind-moment connections, which may be used in semi-continuous design.



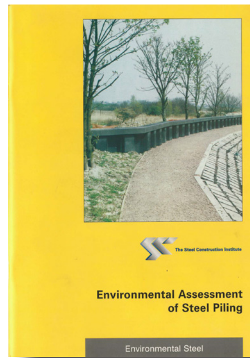
Joints in Steel Construction - Simple Connections (P212)

This publication provides design guidance for structural steelwork connections for use in buildings designed by the "Simple Method", i.e. braced frames where connections carry mainly shear and axial loads only. It is in accordance with BS 5950-1:2000.



Joints in Steel Construction: Moment-Resisting Joints to Eurocode 3 (P398)

This publication covers the design of moment-resisting joints in accordance with Eurocode 3. Moment-resisting joints are typically found in portal frames and in continuous construction. This publication is the successor to Joints in steel construction – Moment connections (P207/95), which covers connections designed in accordance with BS 5950.

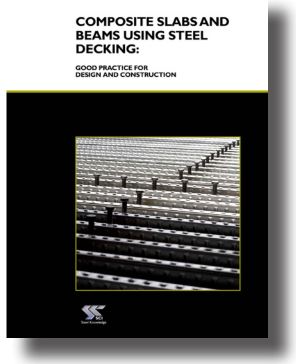


Environmental Assessment of Steel Piling (P199)

The purpose of this publication is to discuss the environmental impact of piling and substructures by presenting the issues that are most significant when considering substructures and the environment.

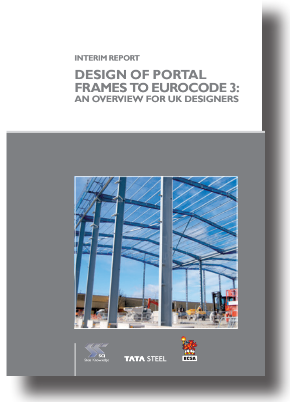
Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction - Revised Edition (P300)

This revised edition reflects the latest guidance for good practice and gives information on design to the Eurocodes, as well as design to BS 5950, including comments on changes that will be incorporated in the second generation of Eurocodes. Information on the specification and use of low carbon concrete has been added, as well as a new chapter on demountable composite construction systems. A Tedds Module is available to support the implementation of the procedure described in this publication.



Interim Report - Design of Portal Frames to Eurocode 3: An Overview for UK Designers (P400)

This publication provided an overview of portal frame design at a time before the use of portal frame analysis and design software to Eurocode 3 became commonplace. It provides succinct advice for designers using older software (to BS 5950), yet needing to provide a design that is in accordance with the Eurocode. The advice covers frame analysis (elastic and plastic), member verification and connection design for this very popular form of structure.



Explore our Bookshop via the QR code below.

SCI CERTIFICATION AND ASSESSMENT

SCI's independence and credibility make us uniquely placed to assess proprietary, generally steel, products. The SCI Assessed 'stamp' is highly valued by specifiers.

Our relationship with NHBC is very focused. We compare a steel frame supplier's proprietary details with the standard details required by NHBC, and if there is alignment, we issue a so-called Stage 1 Certificate.

Our SCI Assessed scheme is, on the other hand, very flexible. We assess engineering methodologies, software, and anything else required, as well as physical steel products. A full list of assessed products can be found using the QR code below.

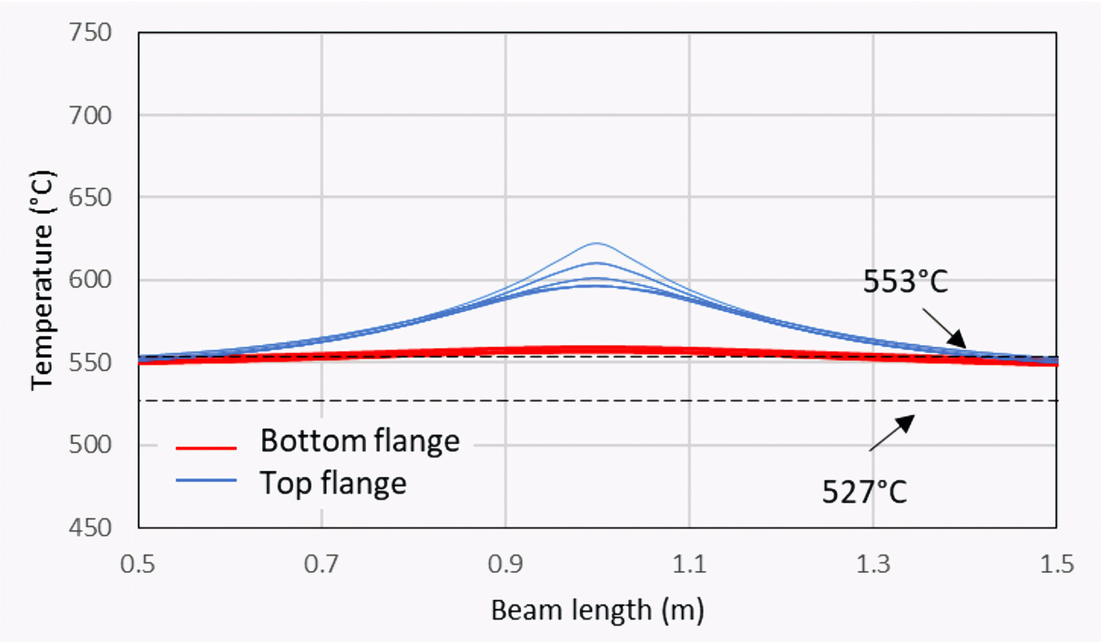
Our most recent offering builds on our experience with NHBC. We are UKAS accredited to offer third-party product certification of both modular and panelised light steel framing systems. Our schemes cover both 'what comes out of the factory' and how those products are combined on-site to form a building (the latter is not yet covered by the UKAS scope). As well as being extremely rigorous and documented, a key difference from our other assessment offerings is that this certification includes factory production control – to confirm that what is produced reflects the design.

Details of all assessment and certification schemes can be found at **scicerts.com**.

CONSULTANCY FOR AN ESTABLISHED SECTOR

Whilst an immature sector needs generic development, an established sector needs support. Approximately half of SCI's income now comes from specific clients who pay us for activities that will bring them commercial benefit or avoid them suffering commercial damage.

There are two areas of consultancy that have become increasingly important to us in the past few years - reflecting where questions are being asked by clients, specifiers and checking authorities - these two areas are numerical modelling of construction details in fire, and site inspections of light steel framing and infill walling. Whilst the latter is often associated with replacement of cladding and confirming the ability of an existing structure to support greater self-weight, we have also visited several sites to advise contractors who have no previous experience of light steel framing.




TOOLS FOR DESIGNERS

SCIPHYR

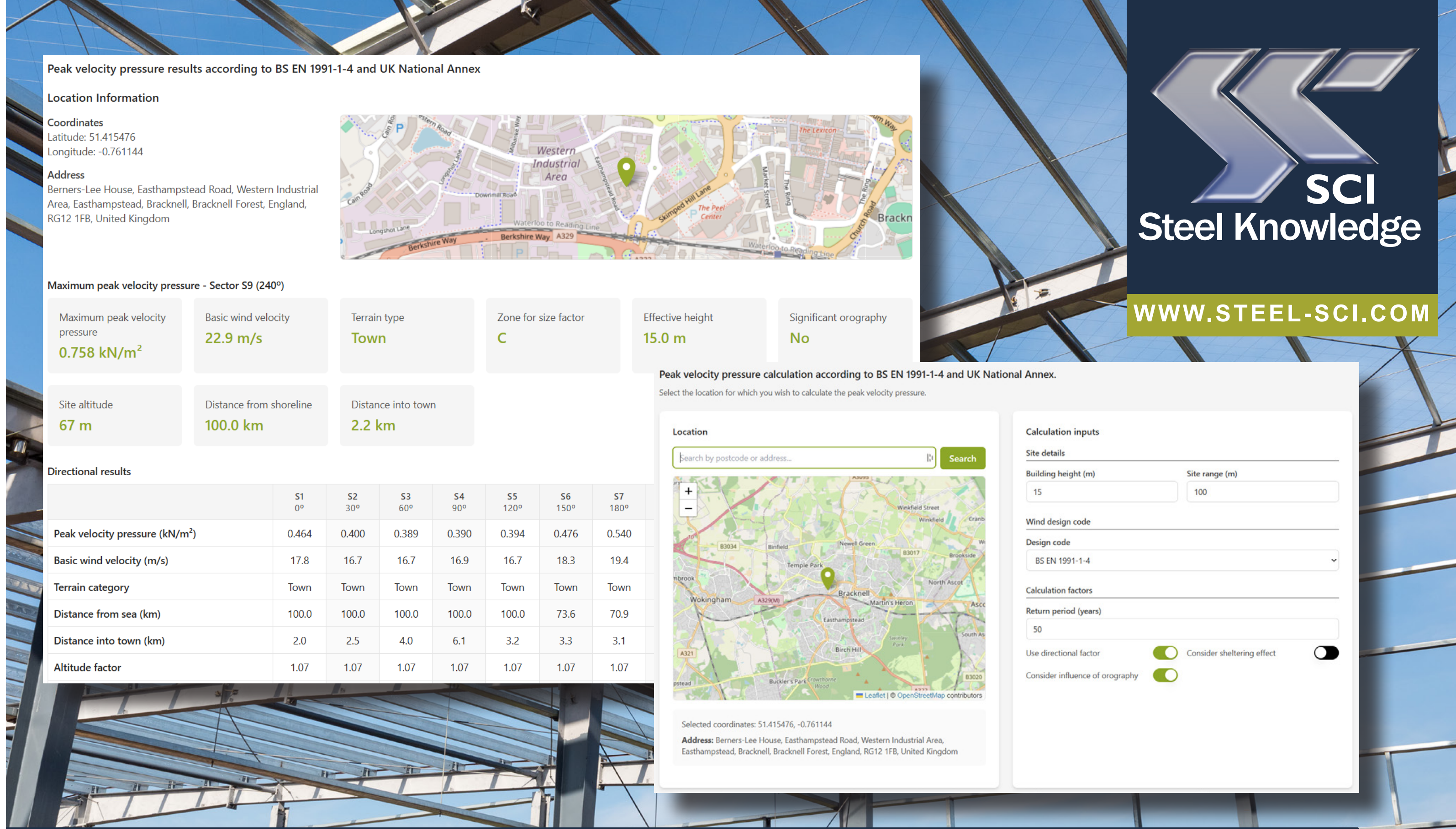
SCIPHYR is a specialist wind analysis tool developed by the Steel Construction Institute. It calculates site-specific wind actions in accordance with BS EN 1991-1-4 and the UK National Annex, or BS 6399-2. The tool considers terrain, altitude, and orographic effects to determine peak velocity pressures in 12 directions, as well as directional wind loads on walls and roofs.

Available both as an end-user web application and as a RESTful API for integration with third-party tools, SCIPHYR sets a new benchmark in the industry, widely used by manufacturers and software providers because it delivers accurate wind analysis for a variety of engineering workflows.

SCI Tedds Modules

Recognising that Trimble's Tedds is a widely used and widely appreciated tool, SCI has developed a number of specialist steel modules:

- Method for Extending Fire Test Results - this module implements the procedures described in the 2021 SCI publication "P424 - Fire Resistance of Light Steel Framing".
- Composite Slab Opening Designer – this module addresses the topic of service openings in composite slabs, providing a method to design the reinforcement required around individual or multiple service openings. The calculation method is based on the guidance provided in "SCI P300 Composite Slabs and Beams using Steel Decking: Best Practice for Design and Construction".
- Resistance of Composite Slabs to Concentrated Loads – this module implements a new calculation procedure produced by SCI (and published in SCI Advisory Desk notes AD 450 & AD 477), which determines the transverse reinforcement required in a composite slab subject to one or more concentrated loads. The process may also be used to justify existing transverse reinforcement provision when an 'unexpected' load, such as that from a MEWP or similar vehicle, is applied.
- Light Gauge Steel Member Designer is based on the provisions of EN 1993-1-3 for the design of cold-formed members and sheeting along with EN 1993-1-1 and their associated UK National Annexes. Built-in sections available in the module are plain C-shapes (tracks), lipped C-sections (studs), lipped Z-sections (purlins). The scope of this module is to perform all the required member strength checks (ULS) to Eurocode 3.



SCIPHYRWEB

The smart and simple way to perform wind analysis

With an intuitive interface and without the need for installation or downloads, users can obtain accurate calculations of peak velocity pressures for any site in the UK and Ireland. Whether designing façades, roofs or entire buildings, **SCIPHYR**WEB delivers accurate wind pressure calculations specific to your site.

SCALABLE	Making the most of cloud-based technologies to ensure high-performance
COMPREHENSIVE	Cover of the UK and Ireland for BS-6399 and BS-EN-1991-1-4 UK NA
INTEGRATED	Seamless integration with design tools from spreadsheets to bespoke applications via APIs
PRECISE	Up-to-date and high-resolution terrain database, pressures in twelve directions
HOLISTIC	From location specific data and topography to complete pressures on building faces
YEARLY	Updates and licensing period
RELIABLE	Developed, tested, and maintained by SCI

SCIPHYRWEB is available to license from SCI. Visit our website or contact us for a **FREE** trial.

SCI is committed to helping the steel construction industry meet design, manufacture, installation and commercial objectives.

+44 (0)1344 636525
software@steel-sci.com

THE NEXT 40 YEARS AND BEYOND

So what of the next 40 years? We recently asked this question of our social media followers and the responses included:

Wherever the steel comes from, I'm sure that steel framed buildings will remain a major part of the built environment. We need buildings that best satisfy a range of demands (not just specific demands that may be over-emphasised at a given time), and steel is a very strong contender in a number of ways.

The people & skills to deliver structural steel projects. As technology, sustainability and AI develop we must ensure we quickly develop an infrastructure to best accommodate this in line with what the structural steel industry needs. Firstly, we need to close the competency gap. Then as we continue to lose the invaluable experience, we must adapt with a sharper focus on the development of youth within the industry alongside modern methods, technology and the behaviours to suit.

The UK steel-construction market is moving fast toward decarbonisation, electrification and modular fabrication, driven by national net-zero policy, public procurement rules and a few major industrial projects (e.g., Port Talbot EAF, Teesside decarbonisation). That creates opportunities (greener steel premium, retrofit demand, off-site manufacture) but also big near-term challenges: capital intensity, regional jobs disruption, skills gaps, energy supply & cost, and supply-chain resilience. To meet the challenges:

- *Steelmakers must accelerate EAF planning where viable, secure grid/H_2 offtake agreements and lead on transparent EPDs.*
- *Fabricators & contractors must invest in BIM, off-site capability and whole-life carbon reporting and build partnerships with greener steel suppliers to win public contracts.*
- *Policymakers must combine capital support with retraining programmes, regional transition plans for affected towns and incentives to stabilise green energy prices.*
- *Investors/financiers must look for integrated projects that link energy, steel and Carbon Capture, Usage, and Storage (CCUS); these joint projects de-risk single investments.*

At SCI, we believe that steel will continue to make an important contribution to the built environment, wherever that steel may come from. It has certain strengths and capabilities that other structural materials simply cannot match. What other material can achieve such clear open internal spaces, such high rise buildings, and be recyclable and readily reusable? Those are attributes that will always be needed.

At the moment it feels as though the battleground is being fought almost exclusively on the basis of ‘carbon’ and ‘fire safety’, and steel does not always come out on top. This focus is for understandable reasons, but in the longer term we need solutions that provide the best overall performance. Let’s hope that more sensible contractual arrangements will replace the current preference for sourcing each stage of the design and build process separately, and paying the lowest price for each stage.

We need better collaboration, and early involvement of relevant parties to create better, more efficient structures. Elevated temperature structural engineering is a great example – it makes much more sense than the current almost universal norm of ambient temperature design then ‘fire protect’ (which is a result of contract scope for designers).

It is clear that current demands for housing will only increase, and there is no short-term solution to the ‘on-site’ labour shortage. Off-site housing solutions, be they steel or timber, are an obvious answer if planning issues (politics) can be resolved.

CELEBRATING 40 YEARS OF SCI

This booklet reflects on the last four decades of the Steel Construction Institute (SCI)'s journey. From one man's vision to promote structural steel, to a thriving organisation firmly positioned at the heart of the global steel construction community. SCI remains a trusted, independent source of technical expertise and best practice, supporting engineers, architects, manufacturers and educators with practical solutions, rigorous advice and a commitment to sustainability.

This booklet celebrates SCI's enduring legacy being one of excellence, partnership and lasting impact on the steel construction industry worldwide.

Scan to sign up to receive our FREE quarterly eNewsletter

SCI
Unit 2, The E Centre, Bracknell, Berkshire RG12 1NF, UK
T: +44 (0)1344 636525
E: hello@steel-sci.com
W: **www.steel-sci.com**