NASC

NATIONAL ACCESS & SCAFFOLDING CONFEDERATION

NASC TG20:13

SETTING THE INDUSTRY STANDARDS IN SCAFFOLDING

Introducing TG20:13

Terry Roberts, CADS

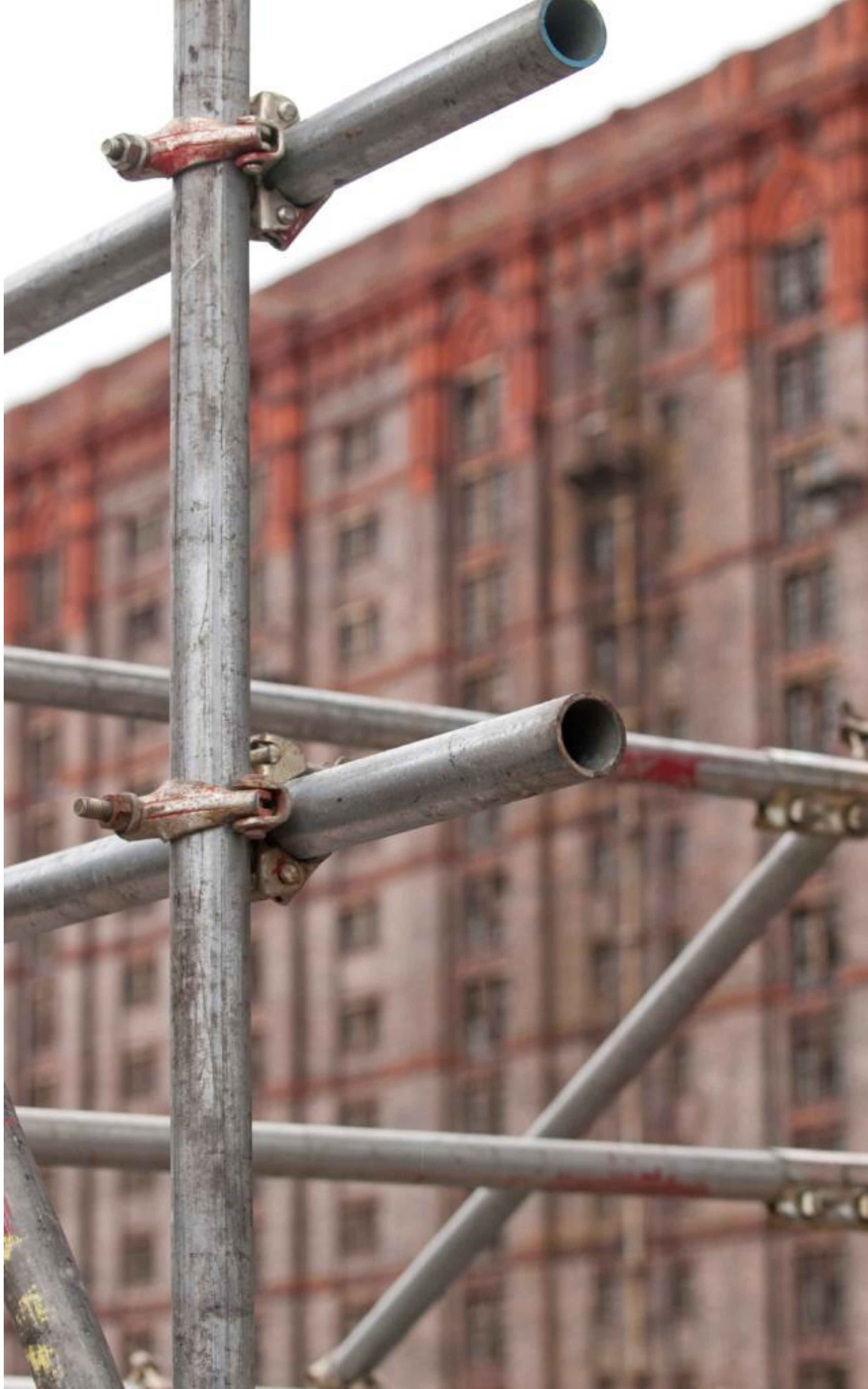
DESIGNED BY CALCULATION
TG20 COMPLIANT
TO BS EN 12811

Introduction

- Thank you for joining us for this presentation of TG20:13, the good practice guidance for tube and fitting scaffolding from the NASC

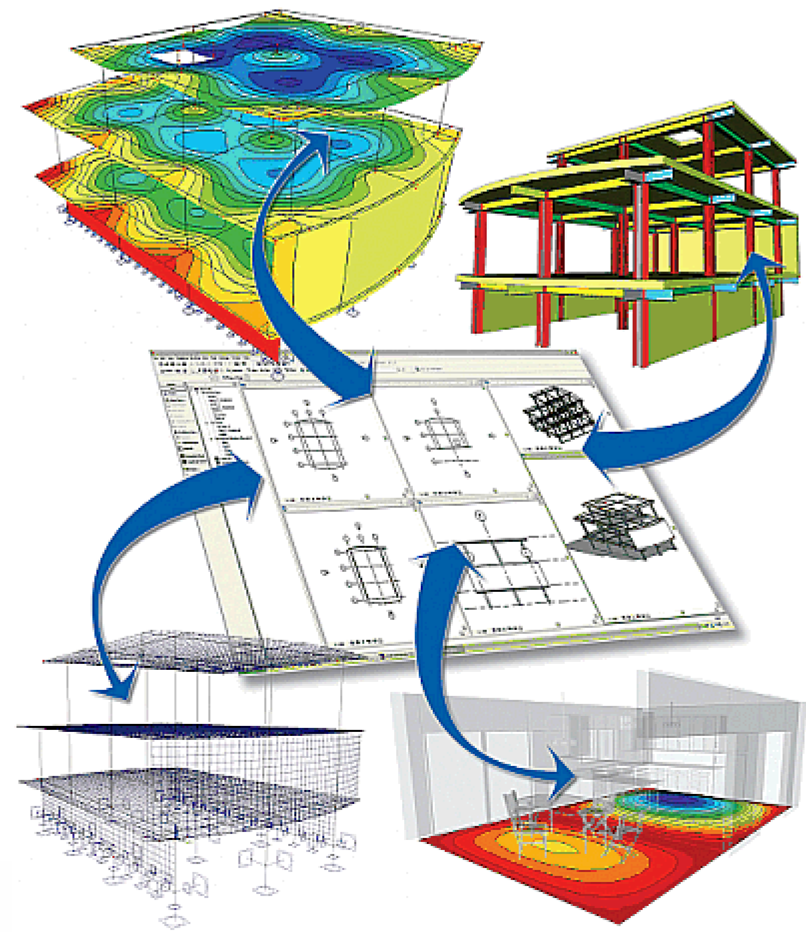
- This presentation summarises the purpose of TG20:13 and how it aims to raise awareness of good practice in scaffolding across the construction industry

- The imminent update to TG20:13 will be demonstrated, plus news about the future plans for the guidance



About CADS

- A global construction services company for 40 years
- 500+ employees including structural engineers, detailers and software developers.
- Develop and support software for BIM, structural analysis and design, detailing and scaffolding
- SMART Scaffolder, CADS RC, SCIA Engineer, Revit, AutoCAD
- Customer base of 5000+ consulting engineers, contractors and scaffolders across 70 countries



Terry Roberts

BSc (Hons) MSc (Oxon) CITP MBCS

CADS

Microsoft GOLD CERTIFIED Partner

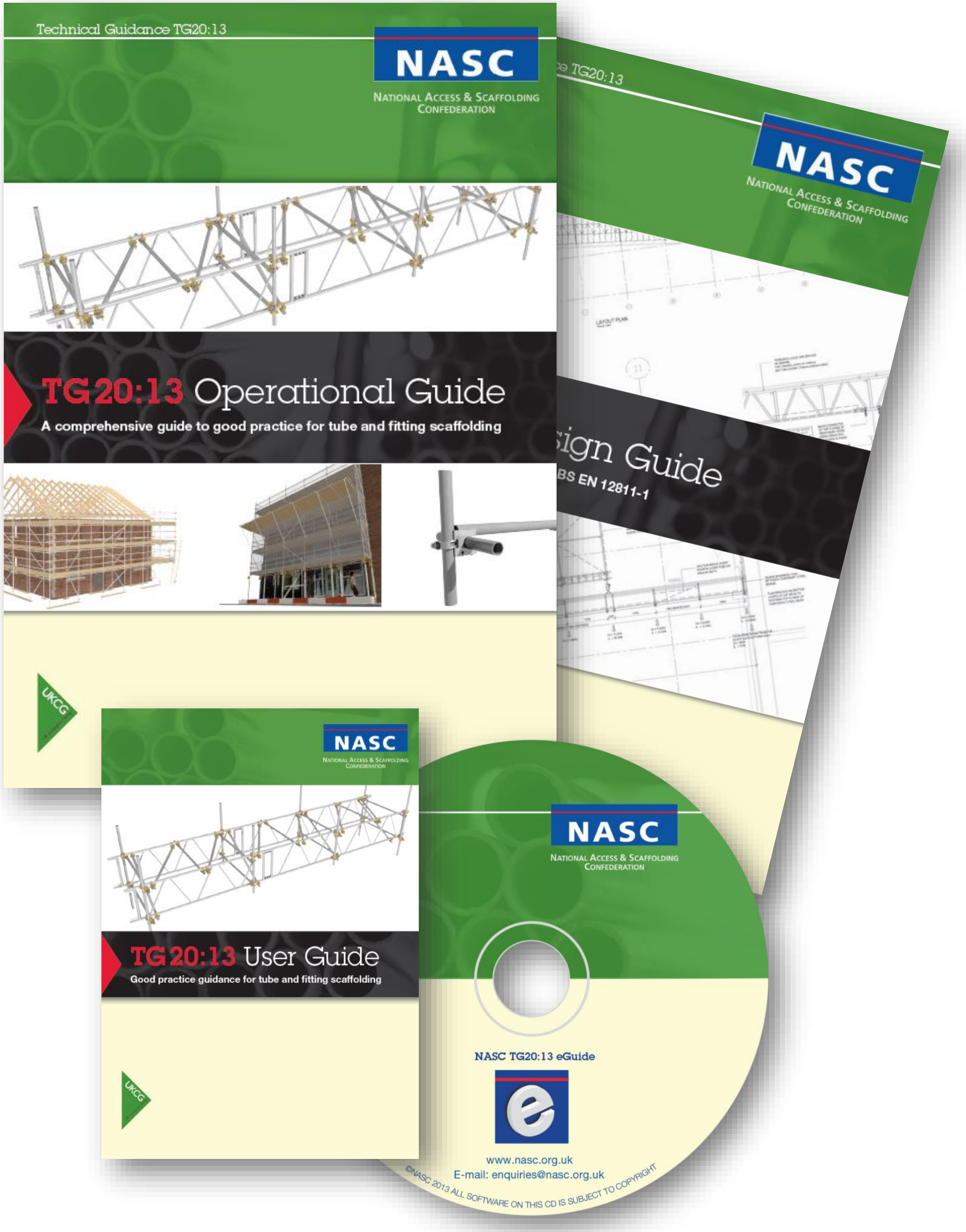
Autodesk Authorised Developer

What is TG20:13?

- TG20:13 is a guide to good practice for tube and fitting scaffolding

- It is supplied in 3 books for **contractors**, **designers** and **operatives** plus an electronic guide

- TG20:13 is underpinned by structural research and is designed to conform to the European standard for scaffolding: BS EN 12811



A brief history

- The European standard for scaffolding BS 12811-1:2003 replaced the withdrawn British Standard BS 5973:1993
- Unlike BS 5973, BS EN 12811 is a performance document for the design of scaffolding by calculation and not a practical guide
- NASC developed TG20:05 and then TG20:08 in the style of BS 5973 to ease the transition to the European standard
- NASC and CADS redeveloped TG20:13 as new guidance for the wider industry to eliminate the need for bespoke scaffolding design for typical projects

Requirements for scaffolding design

> “Strength and stability calculations for scaffolding shall be carried out unless [...] it is assembled in conformity with a generally recognised standard configuration.”
>
> Work at Height Regulations 2005, Schedule 3 Part 2 (Additional Requirements for Scaffolding), Regulation 7

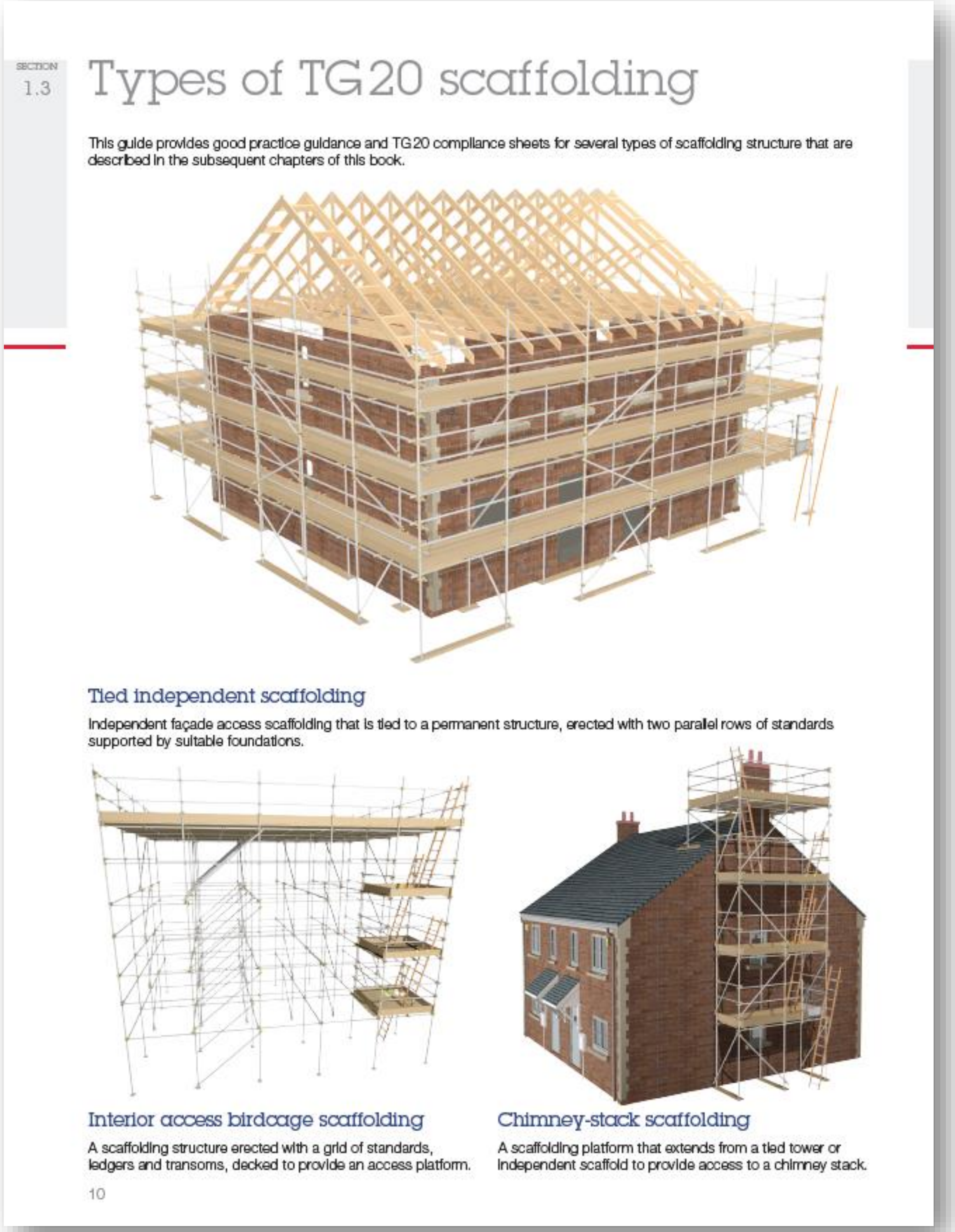
- TG20:13 introduces standard configurations of scaffolding recognised by the HSE and designed by strength and stability calculations to BS EN 12811
- These are **TG20 compliant scaffolds**

TG20:13 Operational Guide

- Guidance for TG20 compliant scaffolds is provided in the **Operational Guide**: a full colour 226 page book

- Its guidance is supported by structural research and calculations

- Guidance is provided for a wide range of common scaffolding structures, including many that have traditionally required bespoke design


SECTION 1.3

Types of TG20 scaffolding

This guide provides good practice guidance and TG20 compliance sheets for several types of scaffolding structure that are described in the subsequent chapters of this book.

Tied independent scaffolding

Independent façade access scaffolding that is tied to a permanent structure, erected with two parallel rows of standards supported by suitable foundations.

Interior access birdcage scaffolding

A scaffolding structure erected with a grid of standards, ledgers and transoms, decked to provide an access platform.

Chimney-stack scaffolding

A scaffolding platform that extends from a tied tower or independent scaffold to provide access to a chimney stack.

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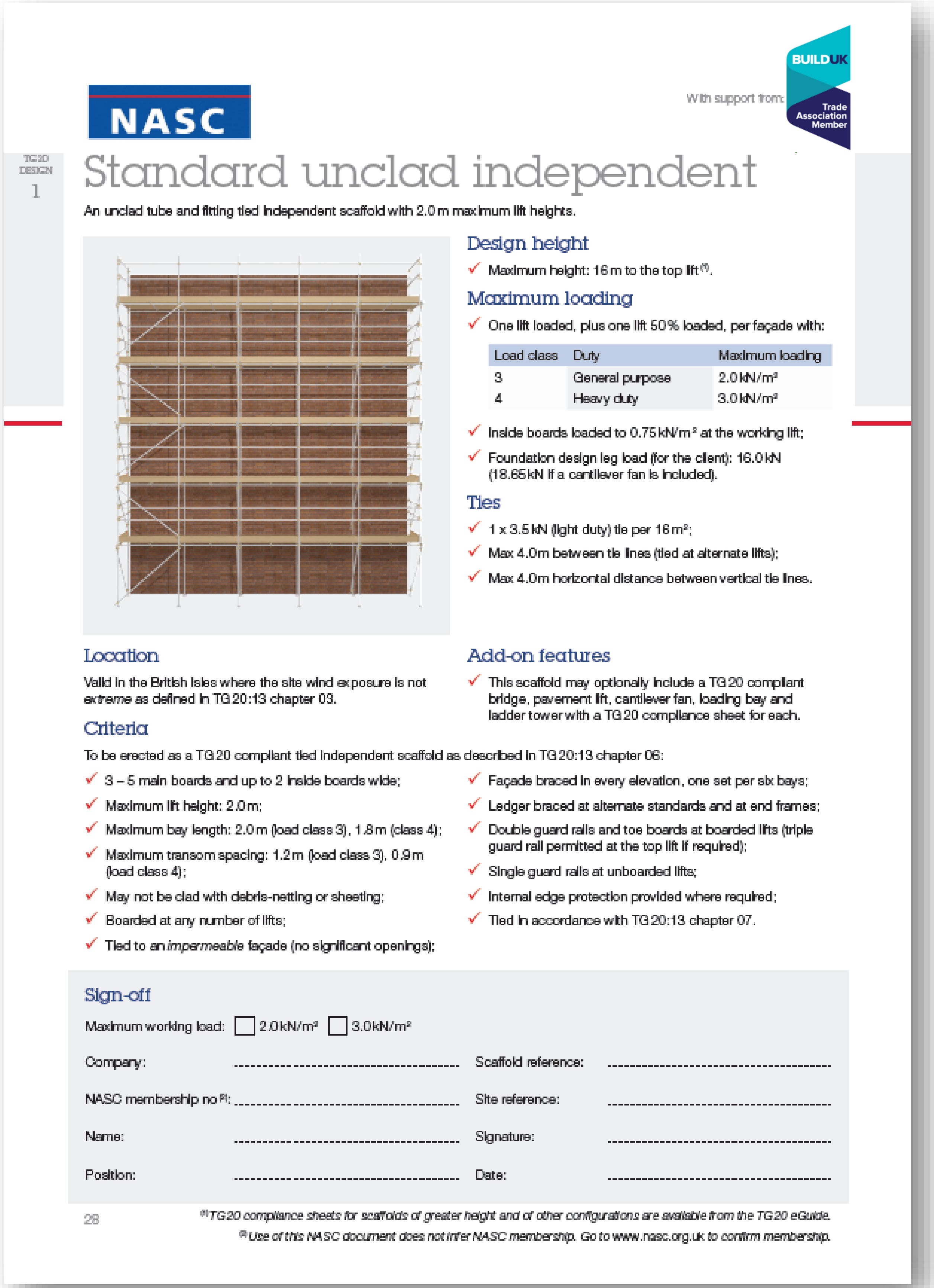
TG20:13 Operational Guide

- Guidance is provided for independent scaffolding, birdcages, loading bays, ladder-access and free-standing towers, and chimney scaffolds
- Typical features such as bridges, protection fans, inside board brackets, cantilevered platforms and pavement lifts are included
- Variations including floor-level lifts and double standards provide flexibility
- Guidance is provided for the first time for structural transom units

TG20 Compliance Sheets

- TG20 **compliance sheets** provide a clear summary of the requirements for TG20:13 scaffolding
- TG20:13 scaffolding has been designed by structural calculation and does not need further design
- ‘Basic’ TG20 compliance sheets are provided in the Operational Guide
- The full set is provided in the TG20 eGuide



NASC

With support from: BUILDUK Trade Association Member

TG20 DESIGN 1

Standard unclad independent

An unclad tube and fitting tied independent scaffold with 2.0 m maximum lift heights.

Design height

- ✓ Maximum height: 16 m to the top lift [1].

Maximum loading

- ✓ One lift loaded, plus one lift 50% loaded, per façade with:

Load class	Duty	Maximum loading
3	General purpose	2.0 kN/m²
4	Heavy duty	3.0 kN/m²

- ✓ Inside boards loaded to 0.75 kN/m² at the working lift;
- ✓ Foundation design leg load (for the client): 16.0 kN (18.65 kN if a cantilever fan is included).

Ties

- ✓ 1 x 3.5 kN (light duty) tie per 16 m²;
- ✓ Max 4.0m between tie lines (tied at alternate lifts);
- ✓ Max 4.0m horizontal distance between vertical tie lines.

Location

Valid in the British Isles where the site wind exposure is not *extreme* as defined in TG20:13 chapter 03.

Add-on features

- ✓ This scaffold may optionally include a TG20 compliant bridge, pavement lift, cantilever fan, loading bay and ladder tower with a TG20 compliance sheet for each.

Criteria

To be erected as a TG20 compliant tied independent scaffold as described in TG20:13 chapter 06:

- ✓ 3 – 5 main boards and up to 2 inside boards wide;
- ✓ Maximum lift height: 2.0 m;
- ✓ Maximum bay length: 2.0 m (load class 3), 1.8 m (class 4);
- ✓ Maximum transom spacing: 1.2 m (load class 3), 0.9 m (load class 4);
- ✓ May not be clad with debris-netting or sheeting;
- ✓ Boarded at any number of lifts;
- ✓ Tied to an *impermeable* façade (no significant openings);
- ✓ Façade braced in every elevation, one set per six bays;
- ✓ Ledger braced at alternate standards and at end frames;
- ✓ Double guard rails and toe boards at boarded lifts (triple guard rail permitted at the top lift if required);
- ✓ Single guard rails at unboarded lifts;
- ✓ Internal edge protection provided where required;
- ✓ Tied in accordance with TG20:13 chapter 07.

Sign-off

Maximum working load: ☐ 2.0 kN/m² ☐ 3.0 kN/m²

Company: ------------------------ Scaffold reference: ------------------------

NASC membership no [2]: ------------------------ Site reference: ------------------------

Name: ------------------------ Signature: ------------------------

Position: ------------------------ Date: ------------------------

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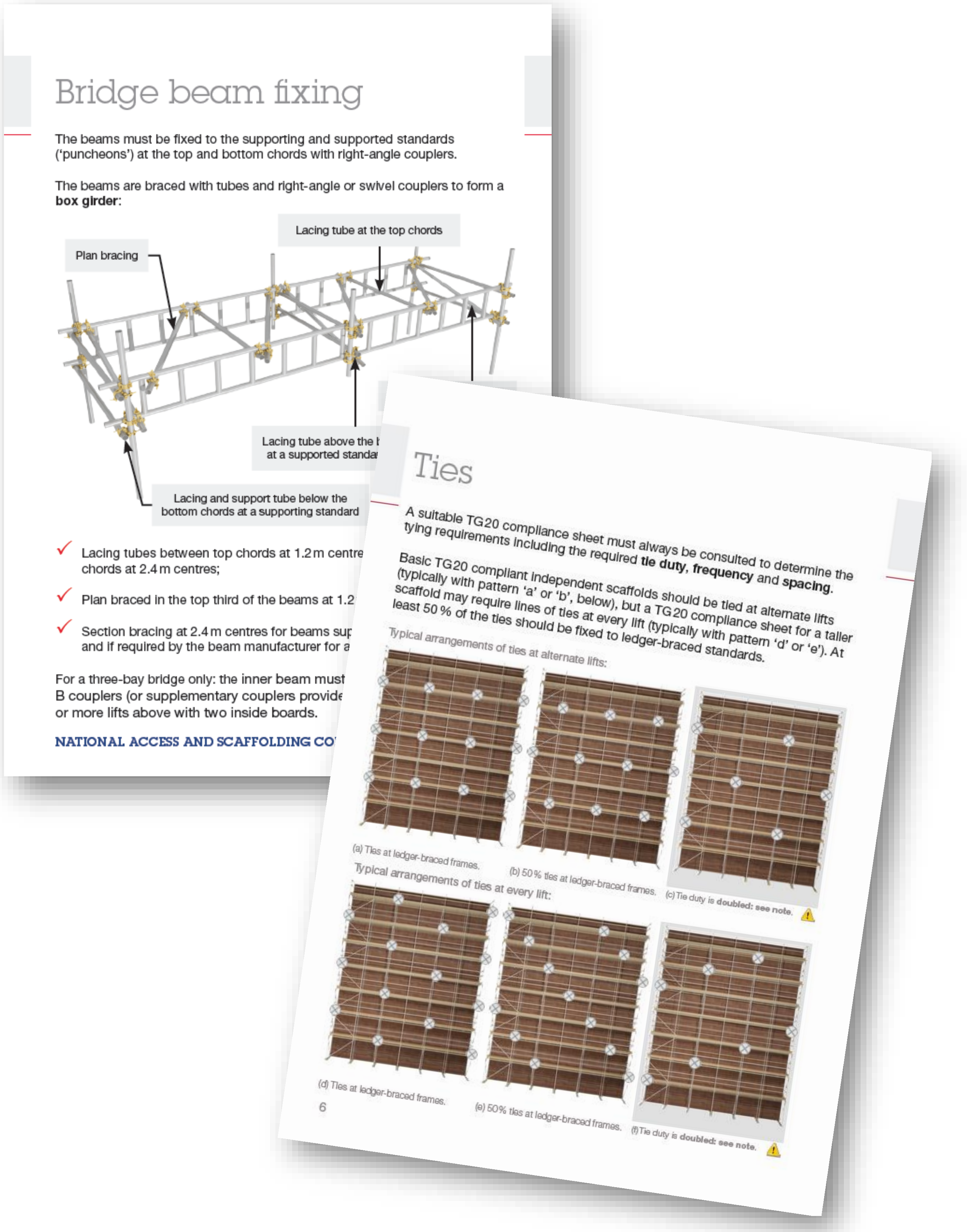
[1] TG20 compliance sheets for scaffolds of greater height and of other configurations are available from the TG20 eGuide.

[2] Use of this NASC document does not infer NASC membership. Go to www.nasc.org.uk to confirm membership.

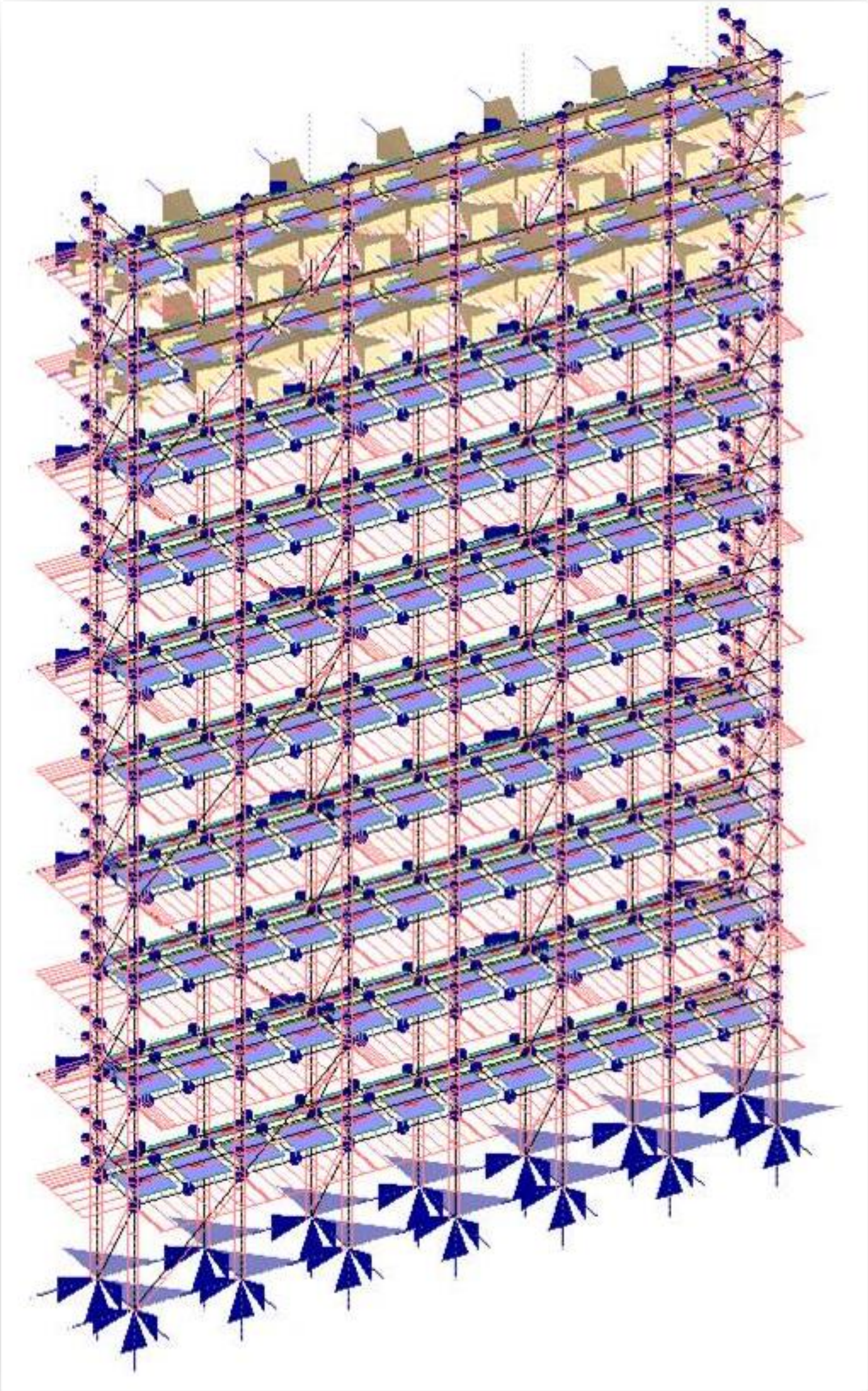
TG20:13 User Guide

- A new pocket **User Guide** has been written for site operatives
- It clearly summarises the principal rules for TG20 compliant scaffolding in 26 pages
- Each page is illustrated in full colour and explained with brief text



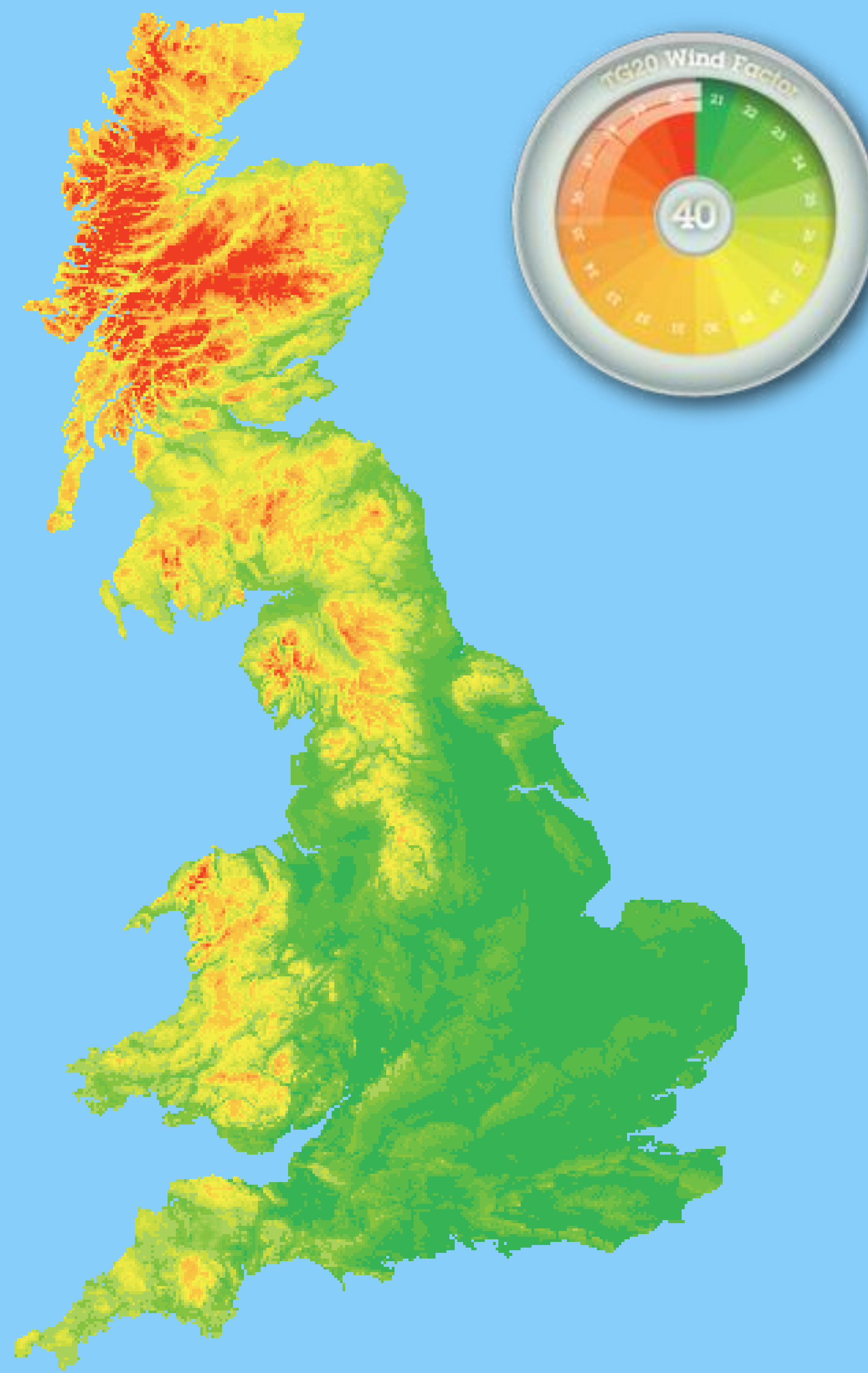
Structural research

- The TG20 compliance sheets are supported by new structural research
- Bespoke research software was developed to prove that ‘BS 5973 style’ scaffolding is Eurocode compliant, which required an extremely accurate computer model
  - ✓ Single-bay façade bracing can be used without plan bracing
  - ✓ Structural transoms are not required for unclad and ‘basic’ debris-netted scaffolding
  - ✓ Guidance is provided for tying to the inner face of the scaffold
  - ✓ Triangulating ties with inside boards only in exceptional circumstances



Wind map research

- The site wind exposure has a significant effect on the scaffold design
- Extensive research has been completed to study the wind exposure in the UK
- This enables a simple treatment of wind exposure to be provided in the guidance that is supported by calculation
- It also allows an automated wind map to be provided in the TG20 eGuide for a refined wind assessment



$$S_{wind} = \max\left\{dir \mid 0..30..270 \bullet S_{wind,dir}\right\}$$

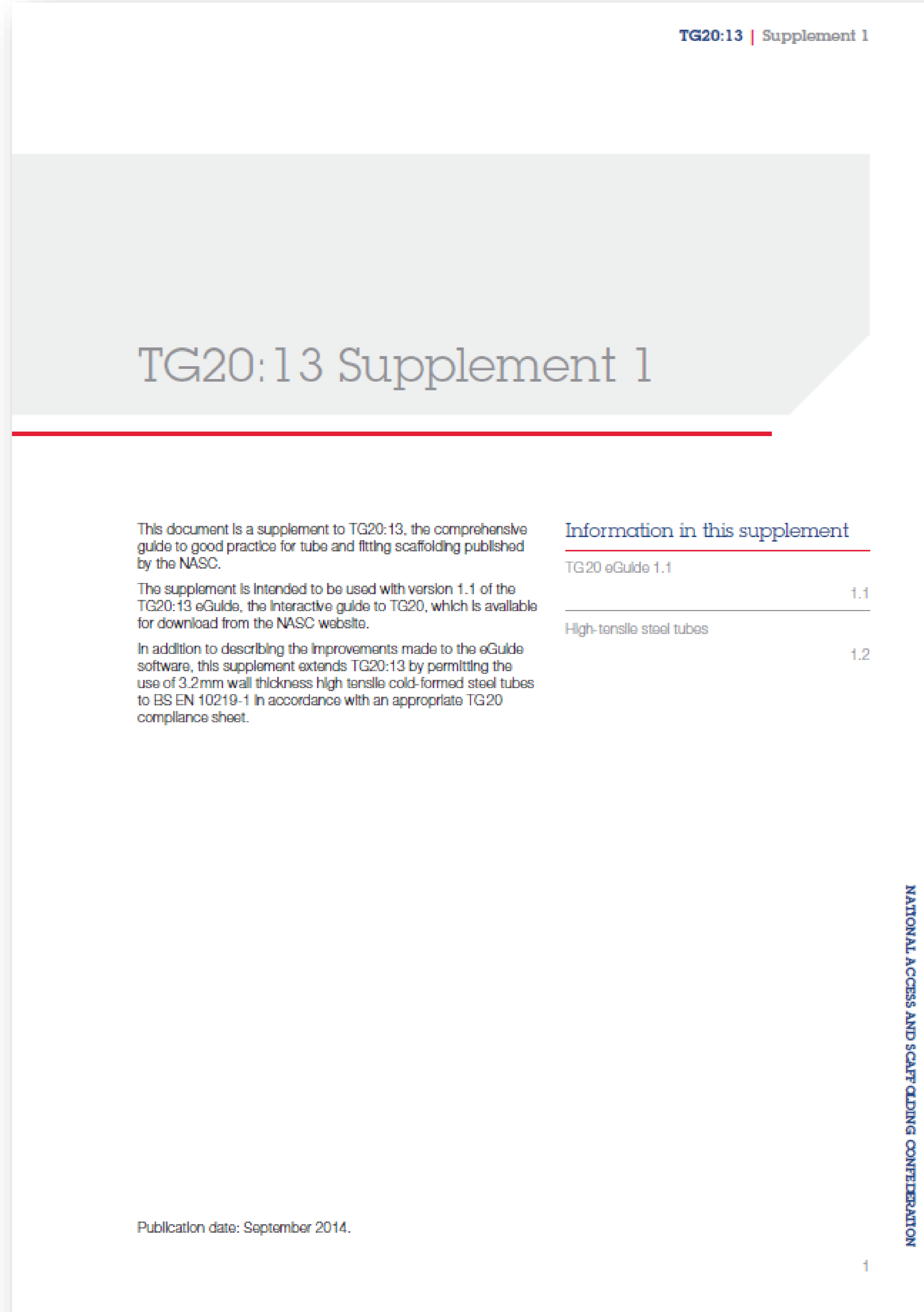
$$S_{wind,dir} = V_{b,map} \times T_{wind,dir} \times \left(1 + 0.001 \cdot A\left(\frac{10}{\max(z,10)}\right)^{0.2}\right) \times C_{season} \times C_{dir} \times \sqrt{\frac{C_e(z).\,C_{e,T}}{C_e(z).\,C_{e,T}max}}$$

Transom unit research

- The NASC has invested in the testing and structural modelling of prefabricated structural transom units
- In many cases scaffolding with these transoms can be erected without ledger bracing
- The NASC has developed a minimum structural performance standard and test specification because an applicable British or European standard is not available
- Manufacturers and suppliers are certifying their transoms as **TG20 compliant**
- TG20 compliance sheets are available for scaffolds with TG20 compliant transom units

High tensile tubes

- TG20:13 Supplement 1 provides a definition for TG20 compliant 3.2mm wall thickness high-tensile steel tubes to BS EN 10210-1
- Tubes manufactured by a **hot-rolling** process or a **cold-formed** process are supported
- Specific TG20 compliance sheets are available that allow for the lower axial load capacity of cold-formed high-tensile 3.2mm tubes
- Mixed stocks of type 4 and high-tensile steel tubes are permitted using these compliance sheets


TG20:13 | Supplement 1

TG20:13 Supplement 1

This document is a supplement to TG20:13, the comprehensive guide to good practice for tube and fitting scaffolding published by the NASC.

The supplement is intended to be used with version 1.1 of the TG20:13 eGuide, the interactive guide to TG20, which is available for download from the NASC website.

In addition to describing the improvements made to the eGuide software, this supplement extends TG20:13 by permitting the use of 3.2mm wall thickness high tensile cold-formed steel tubes to BS EN 10219-1 in accordance with an appropriate TG20 compliance sheet.

Information in this supplement

TG20 eGuide 1.1 1.1
High-tensile steel tubes 1.2

Publication date: September 2014.

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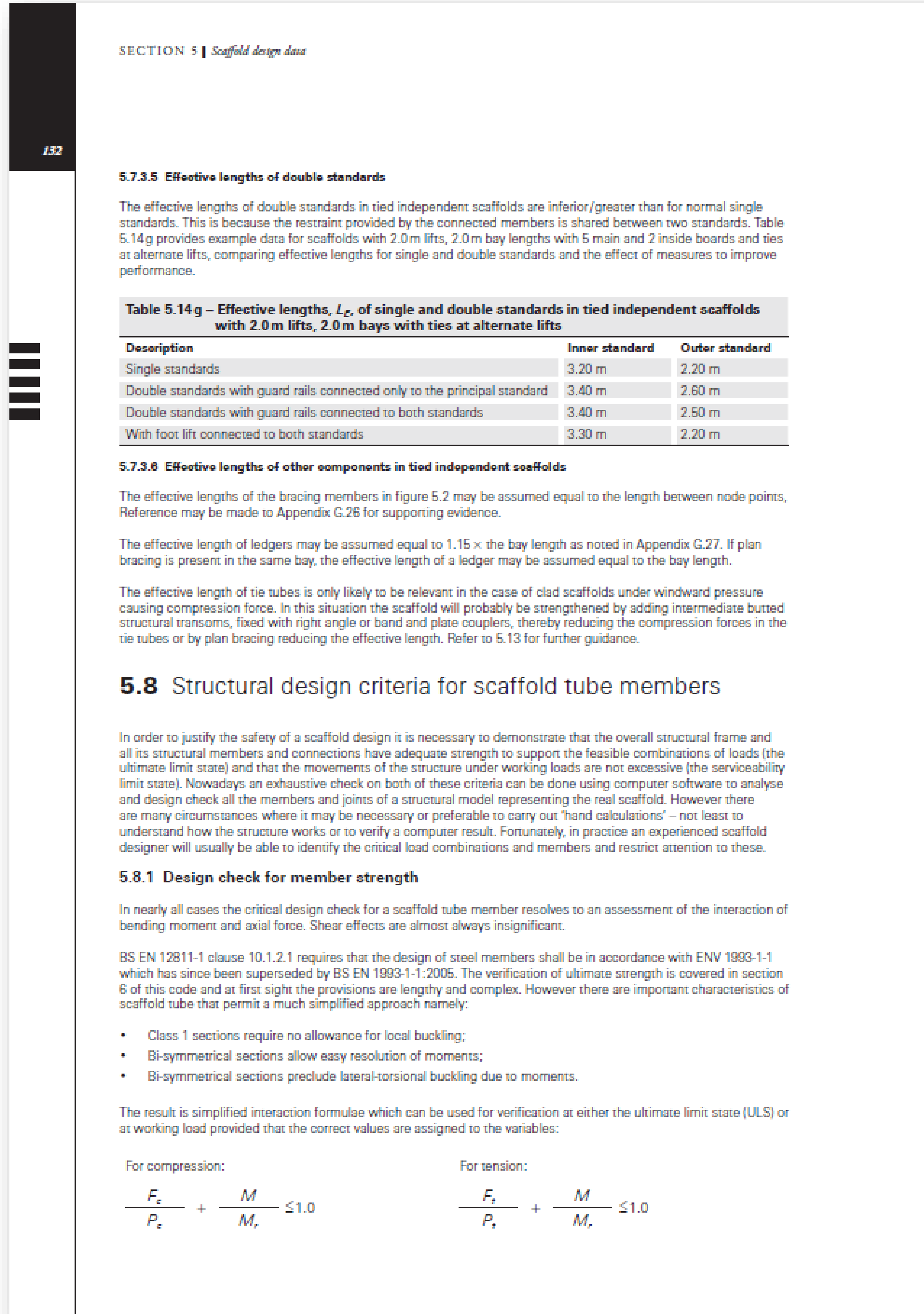
TG20:13 Design Guide

- The technical guidance from TG20:08 Volumes 1 and 2 has been combined into the TG20:13 **Design Guide**
- It provides straightforward design advice in the style of BS 5973
- New tables and calculations have been provided for TG20:13 compliant scaffolds
- The TG20:13 basis for design is explained



5.7.3.5 Effective lengths of double standards

The effective lengths of double standards in tied independent scaffolds are inferior/greater than for normal single standards. This is because the restraint provided by the connected members is shared between two standards. Table 5.14g provides example data for scaffolds with 2.0 m lifts, 2.0 m bay lengths with 5 main and 2 inside boards and ties at alternate lifts, comparing effective lengths for single and double standards and the effect of measures to improve performance.

Table 5.14g – Effective lengths, L_E, of single and double standards in tied independent scaffolds with 2.0 m lifts, 2.0 m bays with ties at alternate lifts

Description	Inner standard	Outer standard
Single standards	3.20 m	2.20 m
Double standards with guard rails connected only to the principal standard	3.40 m	2.60 m
Double standards with guard rails connected to both standards	3.40 m	2.50 m
With foot lift connected to both standards	3.30 m	2.20 m

5.7.3.6 Effective lengths of other components in tied independent scaffolds

The effective lengths of the bracing members in figure 5.2 may be assumed equal to the length between node points. Reference may be made to Appendix G.26 for supporting evidence.

The effective length of ledgers may be assumed equal to 1.15 × the bay length as noted in Appendix G.27. If plan bracing is present in the same bay, the effective length of a ledger may be assumed equal to the bay length.

The effective length of tie tubes is only likely to be relevant in the case of clad scaffolds under windward pressure causing compression force. In this situation the scaffold will probably be strengthened by adding intermediate butted structural transoms, fixed with right angle or band and plate couplers, thereby reducing the compression forces in the tie tubes or by plan bracing reducing the effective length. Refer to 5.13 for further guidance.

5.8 Structural design criteria for scaffold tube members

In order to justify the safety of a scaffold design it is necessary to demonstrate that the overall structural frame and all its structural members and connections have adequate strength to support the feasible combinations of loads (the ultimate limit state) and that the movements of the structure under working loads are not excessive (the serviceability limit state). Nowadays an exhaustive check on both of these criteria can be done using computer software to analyse and design check all the members and joints of a structural model representing the real scaffold. However there are many circumstances where it may be necessary or preferable to carry out 'hand calculations' – not least to understand how the structure works or to verify a computer result. Fortunately, in practice an experienced scaffold designer will usually be able to identify the critical load combinations and members and restrict attention to these.

5.8.1 Design check for member strength

In nearly all cases the critical design check for a scaffold tube member resolves to an assessment of the interaction of bending moment and axial force. Shear effects are almost always insignificant.

BS EN 12811-1 clause 10.1.2.1 requires that the design of steel members shall be in accordance with ENV 1993-1-1 which has since been superseded by BS EN 1993-1-1:2005. The verification of ultimate strength is covered in section 6 of this code and at first sight the provisions are lengthy and complex. However there are important characteristics of scaffold tube that permit a much simplified approach namely:

- Class 1 sections require no allowance for local buckling;
- Bi-symmetrical sections allow easy resolution of moments;
- Bi-symmetrical sections preclude lateral-torsional buckling due to moments.

The result is simplified interaction formulae which can be used for verification at either the ultimate limit state (ULS) or at working load provided that the correct values are assigned to the variables:

For compression:

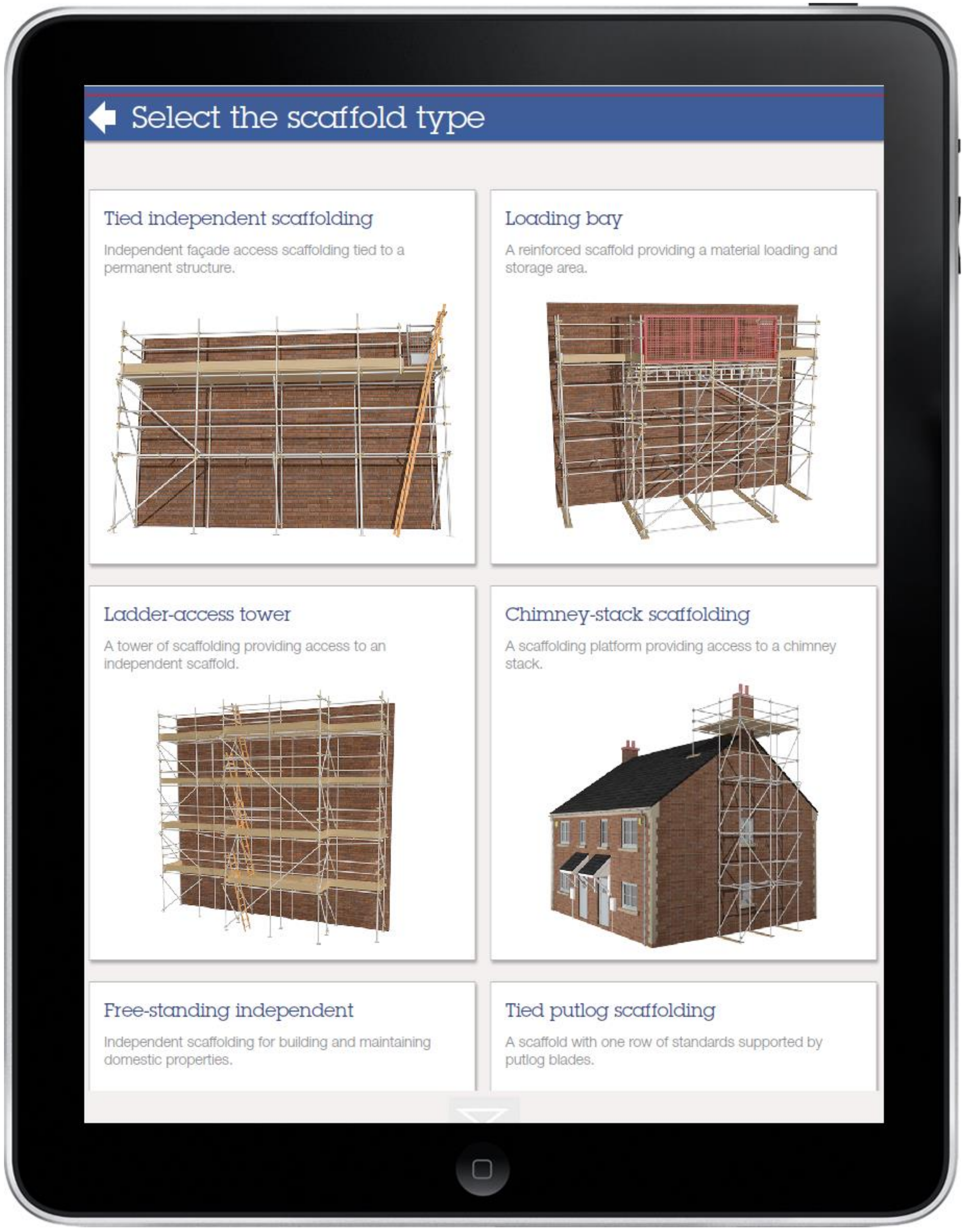
$$\frac{F_c}{P_c} + \frac{M}{M_r} \leq 1.0$$

For tension:

$$\frac{F_t}{P_t} + \frac{M}{M_r} \leq 1.0$$

TG20 eGuide

- The **TG20:13 eGuide** calculates and prints compliance sheets for TG20 compliant scaffolding
- It allows TG20 to incorporate a wide range of scaffolding configurations without becoming complicated
- The eGuide accurately calculates safe heights, tie duties and leg loads for TG20 scaffolding



Next steps

- A consultation exercise was held in May – June 2016 to gather feedback from purchasers and users of TG20:13
- Responses were received from 65 companies, with responses from Contractors, Engineers and Safety Professionals
- A total of 144 separate requests were received and reviewed

TG20 2017 update

- The most requested feedback: adding to the TG20 compliance sheets:
    - Automatic site location
    - Permitted standing seasons
    - Checker name and signature
    - Company logo
- A software update to the TG20:13 eGuide will be released this month
- Free to all purchasers of the eGuide.

NASC CADS

With support from:

Independent scaffolding

A tied independent scaffold with 2.0 m maximum lift heights, unclad, assembled from tubes and fittings.

Design height

✓ Maximum height: 16.0 m to the top lift.

Maximum loading

✓ One lift loaded, plus one lift 50% loaded, per façade to a maximum of: 2.0 kN/m²;

✓ Inside boards loaded to a maximum of 0.75 kN/m² at the working lift;

✓ Foundation design leg load (for the client): 15.4 kN.

Ties

✓ 1 x 1.39 kN (very light duty) tie per 16.0 m²;

✓ Max. 4.0 m between tie lines (tied at alternate lifts);

✓ Max. 4.0 m horizontal distance between vertical tie lines.

Location

Suitable for sites with a wind factor of 20.0 (low wind exposure), during any season.

Add-on features

✓ A gin wheel may be used to lift a maximum of 50 kg.

Design advice may be required if any add-on features not stated on this compliance sheet are attached to the scaffold.

Criteria

To be erected as a TG20 compliant tied independent scaffold as described in TG20:13 chapter 06:

✓ 3 – 5 main boards and up to 2 inside boards wide;

✓ Maximum lift height: 2.0 m;

✓ Maximum bay length: 2.0 m;

✓ Maximum transom spacing: 1.2 m;

✓ The scaffold will not be clad with debris-netting or sheeting;

✓ Boarded at any number of lifts;

✓ Tied to an impermeable façade (no significant openings);

✓ Façade braced in every elevation, one set per six bays;

✓ Ledger braced at alternate standards and at end frames;

✓ Double guard rails and toe boards at boarded lifts (triple permitted at top);

✓ Single guard rails at unboarded lifts;

✓ Internal edge protection provided where required;

✓ Tied in accordance with TG20:13 chapter 07. Tie tubes may be connected only to the inner face of the scaffold.

Sign-off

Contract no:	12345	Client:	Client ABC
Company:	CADS	Scaffold reference:	
NASC membership no (¹):	NASC123	Site reference:	Bridewell Pl, London EC4V 6AP, UK
Name:	Terry Roberts	Position:	Contracts Manager
Signature:		Date:	09/05/2017
Checker name (²):	Gary Frank	Checker signature:	

Notes:

(¹) *Use of this NASC document does not infer NASC membership. Go to www.nasc.org.uk to confirm membership. Illustrations are indicative.*

(²) *The checker is responsible for reviewing the input information.*

Looking to the future

- The TG20 Working Group is reviewing the feedback to plan the future of TG20

- Still in discussion! But:

  - Major software update likely

  - Additional TG20 compliant scaffolds

  - Updates to the books to include current guidance and good practices

Industry support at the TG20 launch

Falls from height remain the dominant cause of fatal and serious injuries in the construction industry. Properly designed and constructed scaffolding has a key role to play in reducing that toll of injuries.

The Work at Height Regulations 2005 (WAHR) require that strength and stability calculations are carried out for all scaffold structures unless they conform to a recognised standard. The responsibility for ensuring that this duty is met falls to both the scaffolding contractor and his client.

HSE is pleased to acknowledge that the NASC has written TG20:13 to provide a standard for traditional tube and fitting scaffolds to help industry manage safety risks effectively in the scaffolding and wider construction sector.

HSE recognises that this guidance contains some advice that may go further than the minimum needed to comply with health and safety law.

Heather Bryant, HM Chief Inspector of Construction,
Health and Safety Executive

Industry support at the TG20 launch

We applaud and support the work of the NASC which will no doubt result in safer scaffolding structures being installed and thus reduce the frequency of scaffolding failures, which at present occur far too frequently across the industry.

The UKCG recommend the adoption and standardised use of TG20:13 to the wider industries that utilise scaffolding structures both within and outside the construction sector.

Stephen Ratcliffe,
Director, UK Contractors Group

TG20 compliance sheets are now endorsed by Build UK and every compliance sheet includes their logo

Thank you

Questions?