Temporary Works Seminar
Scaffolding

Ray Johnson BSc

Joint Managing Director

Case Study1 - Cardiff

Case Study 1

- Over 300 Masonry Anchors specified by the design
- Only 98 installed & only 30 had been installed satisfactorily
- Inadequate testing regime and report
- Very high winds in excess of 100 mph
- Sheeting on the inside which HSE claimed was a contributory factor
- HSE prosecuted the Scaffolding Contractor under the Health & Safety at Work etc. Act 1974
    - Section 2 Supervision failing to ensure that the design was followed and training in the use of anchors
    - Section 3 Endangering the health and safety of others (general public)
- Fined £240K plus costs of £26.2K
- The Principle Contractor was also fined £80K plus costs of 13.1K

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Case Study 2 – Milton Keynes

Case Study 2

- Following its investigation into the fatal scaffold collapse at Milton Keynes in April 2006, HSE has brought criminal proceedings against: ********, Northern Ireland, ******* of Hampshire, *** Scaffolding Limited of Leicester and Mr *******, Director of NNM Scaffolding Ltd. NNM Scaffolding Ltd has since been wound up.

- On Friday, 13 February 2009 ********* Ltd pleaded guilty in Milton Keynes Magistrates Court to breaching section 2 and 3 of the Health & Safety at Work etc Act 1974 (£90,000 and ordered to pay costs of £42,000) ; a warrant was issued for the arrest of Mr *****. On Tuesday, 29 September 2009 in Peterborough Crown Court. ***** Carpentry Ltd pleaded guilty to four breaches of health and safety regulation. (£36,000 and ordered to pay costs of £28,000).

- Background to incident

- On Tuesday 11 April 2006, just after noon, an independent tied perimeter scaffold collapsed at ****** construction site in Milton Keynes. The collapse started on the West Elevation (with a partial collapse of the North Elevation. The scaffold collapse was contained within the Jury's Inn site boundary.
- Three workers who were on the scaffold sustained multiple injuries. Sadly, one worker, ********, died 3 days later in hospital.

Findings

- **The court heard that a combination of failures led to the scaffolding collapse. The scaffolding was not strong or stable enough for the work being carried out. Inspection of the scaffold was also inadequate, despite specific instructions from HSE and ****** health and safety manager**

Key Causes of Accidents Involving Scaffolding

Why do accidents involving scaffolding occur?

- **Poor design**
- **Poor construction**
- **Poor quality materials**
- **Inadequate ties or sub-structure**
- **Undermining or subsidence**
- **Adverse weather – High Winds**
- **Overloading Interference**
- **Vehicle or plant impact**
- **Lack of training**

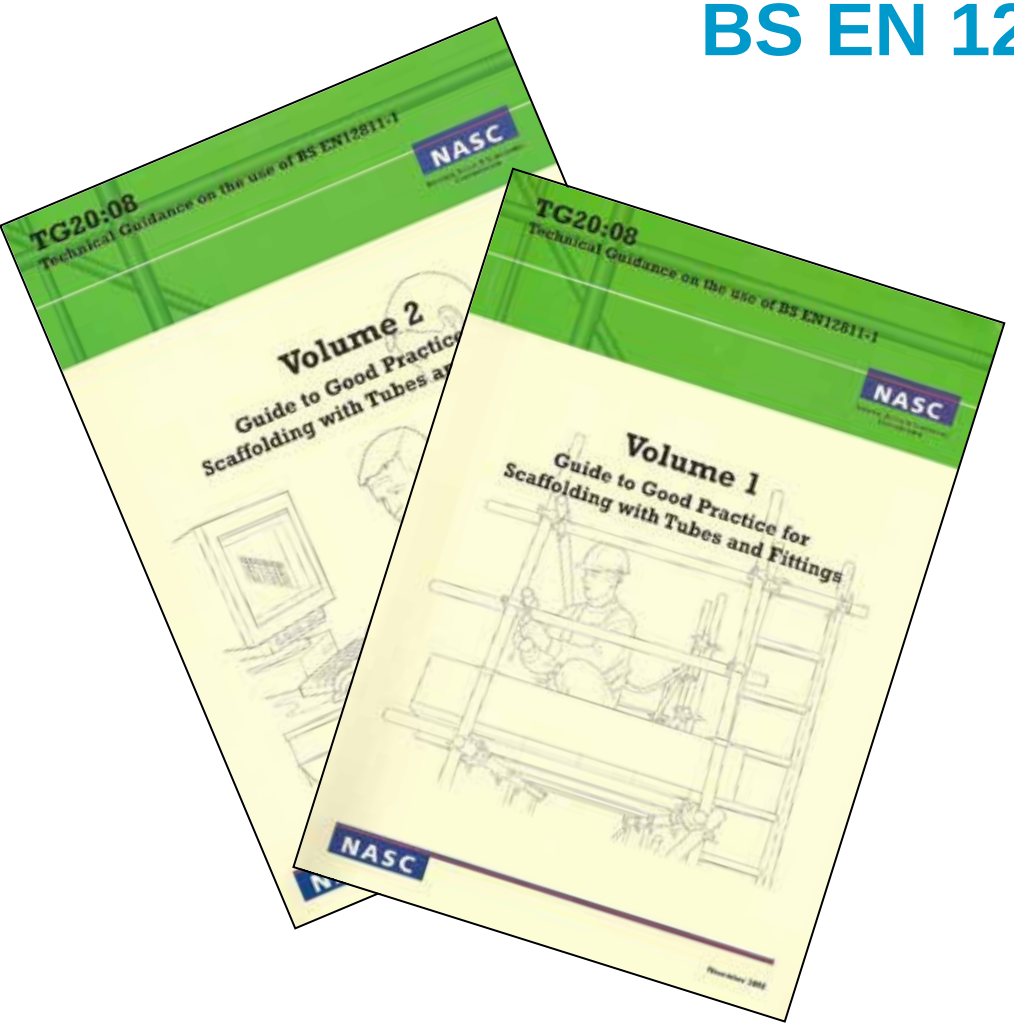
Or a combination…

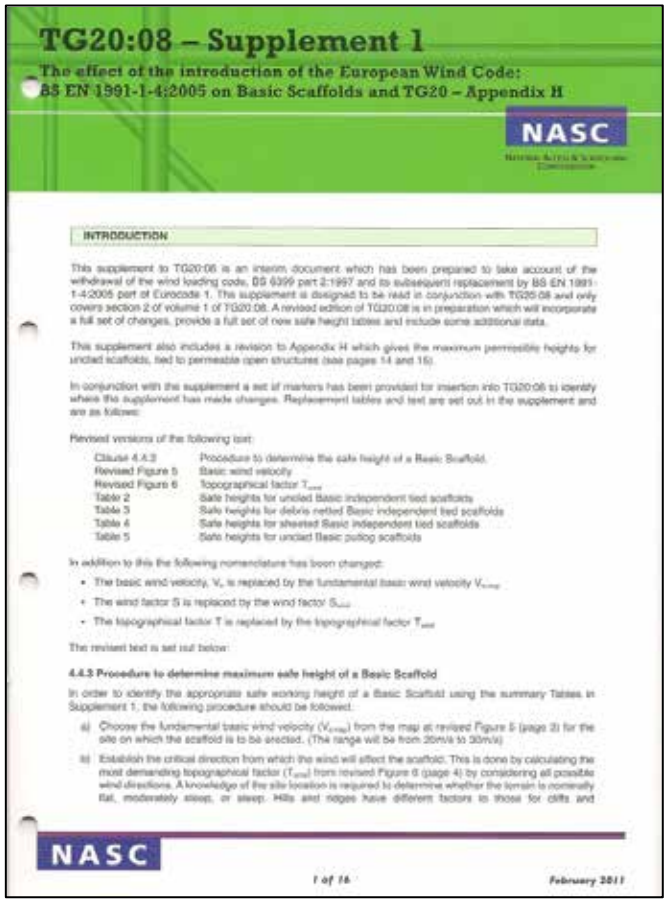
Scaffold Design

- **Unless a scaffold is a basic configuration described in recognised guidance e.g. NASC Technical Guidance TG20 for tube and fitting scaffolds or manufacturers' guidance for system scaffolds, the scaffold should be designed by calculation, by a competent person, to ensure it will have adequate strength and stability.**

- **For scaffolds that fall outside the scope of 'Basic Scaffolds' as described in bullet point 1, the design information should describe the sequence and methods to be adopted when erecting, dismantling and altering the scaffold.**
- **Any proposed modifications or alterations outside a generally recognised standard configuration should be designed by a competent person.**

TG20 :08 Technical Guidance on the use of BS EN 12811-1





TG20:08 – Supplement 1

The effect of the introduction of the European Wind Code: BS EN 1991-1-4:2005 on Basic Scaffolds and TG20 – Appendix H

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INTRODUCTION

This supplement to TG20:08 is an interim document which has been prepared to take account of the withdrawal of the wind loading code, BS 6399 part 2:1997 and its subsequent replacement by BS EN 1991-1-4:2005 part of Eurocode 1. This supplement is designed to be read in conjunction with TG20:08 and only covers section 2 of volume 1 of TG20:08. A revised edition of TG20:08 is in preparation which will incorporate a full set of changes, provide a full set of new safe height tables and include some additional data.

This supplement also includes a revision to Appendix H which gives the maximum permissible heights for unclad scaffolds, tied to permeable open structures (see pages 14 and 15).

In conjunction with the supplement a set of markers has been provided for insertion into TG20:08 to identify where this supplement has made changes. Replacement tables and text are set out in the supplement and are as follows:

Revised versions of the following text:

Clause 4.4.3	Procedure to determine the safe height of a Basic Scaffold.
Revised Figure 5	Basic wind velocity
Revised Figure 6	Topographical factor T_{orog}
Table 2	Safe heights for unclad Basic independent tied scaffolds
Table 3	Safe heights for debris netted Basic independent tied scaffolds
Table 4	Safe heights for sheeted Basic independent tied scaffolds
Table 5	Safe heights for unclad Basic putlog scaffolds

In addition to this the following nomenclature has been changed:

- The basic wind velocity, V_b is replaced by the fundamental basic wind velocity $V_{b,orog}$
- The wind factor S is replaced by the wind factor S_{orog}
- The topographical factor T is replaced by the topographical factor T_{orog}

The revised text is set out below:

4.4.3 Procedure to determine maximum safe height of a Basic Scaffold

In order to identify the appropriate safe working height of a Basic Scaffold using the summary Tables in Supplement 1, the following procedure should be followed:

a) Choose the fundamental basic wind velocity ($V_{b,orog}$) from the map at revised Figure 5 (page 3) for the site on which the scaffold is to be erected. (The range will be from 20m/s to 30m/s)

b) Establish the critical direction from which the wind will affect the scaffold. This is done by calculating the most demanding topographical factor (T_{orog}) from revised Figure 6 (page 4) by considering all possible wind directions. A knowledge of the site location is required to determine whether the terrain is nominally flat, moderately steep, or steep. Hills and ridges have different factors to those for cliffs and

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1 of 16

February 2011

TG20:08 Basic Scaffolds

- Standard scaffold
- Load class, bay length & width to Table 1
- Max lift height 2m, except 1st max 2.7m
- 2 working lifts, 1 @ 100% load, 1 @50%
- If base lift > 2m, must tie 1st lift
- Scaffold loaded by forklift, loading bays to be designed
- Wind factor S no greater than 40
- Alternate pairs of standards ledger braced
- Min 50% ties to ledger braced standards
- No more than 4m vertically between ties
- Any line of ties, distance between ties max 4 lifts or 4 bays…

TG20:08 Basic Scaffolds – con't

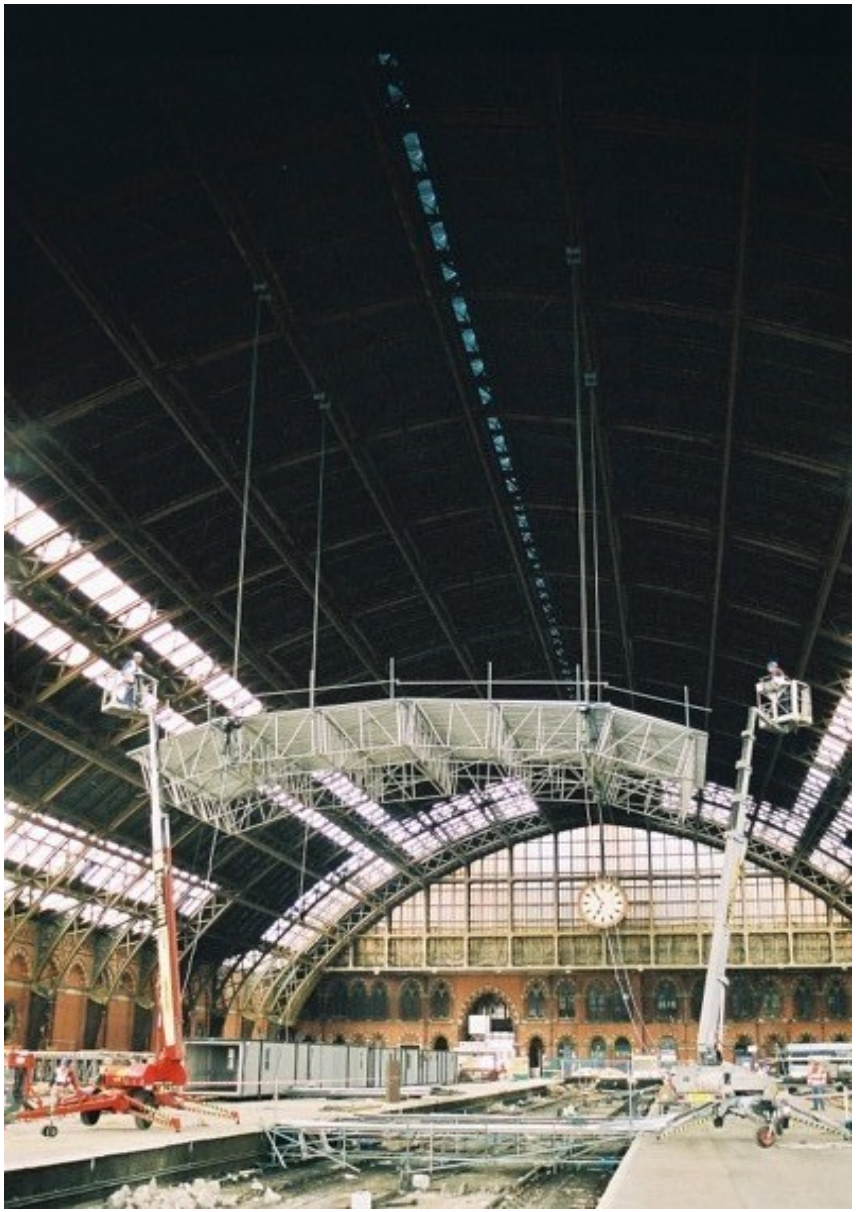
- **Sheeting or debris nets fixed to ledgers & main guard rails on outside follow suppliers instructions**
- **When sheeting or debris nets fixed then top platform MUST be tied at alternate standards as a minimum**
- **Façade bracing fitted**
- **ALL OTHER FORMS OF SCAFFOLD SHALL BE SUBJECT TO DESIGN…**

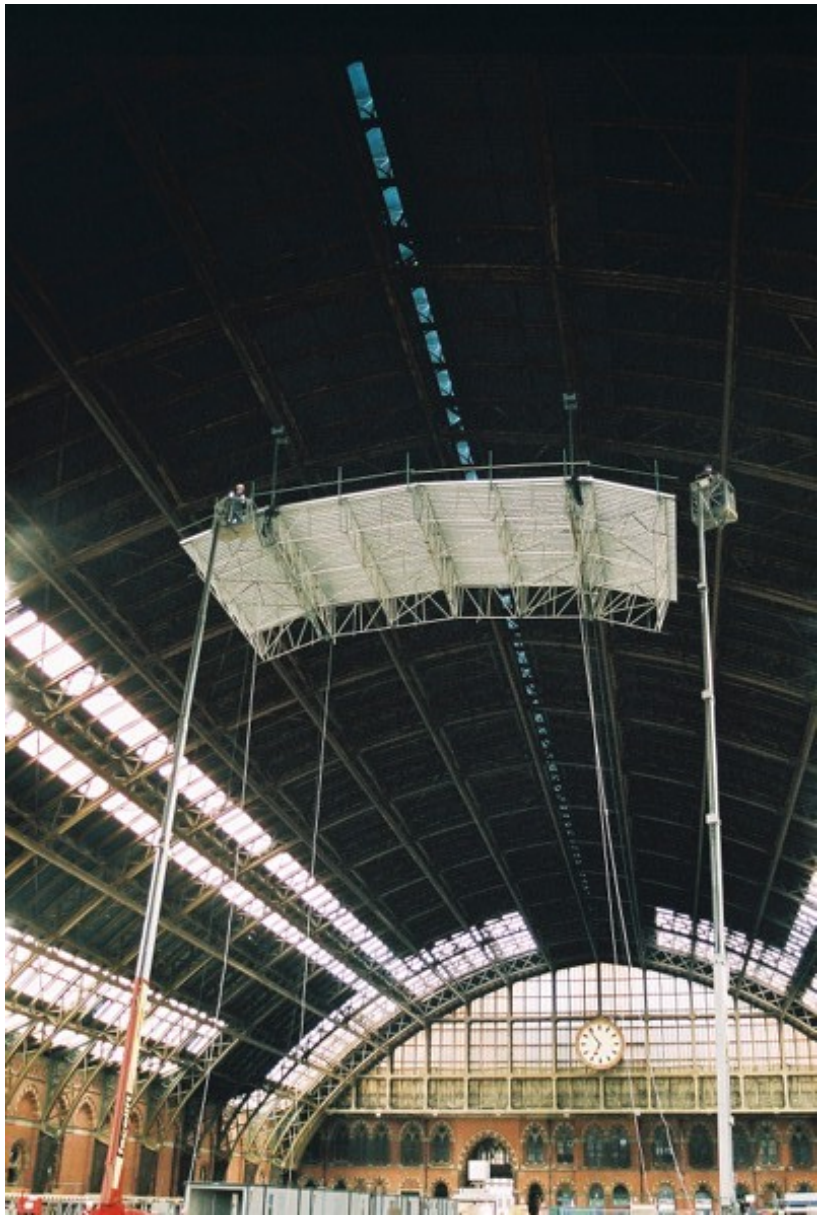
Scaffolds that are subject to design

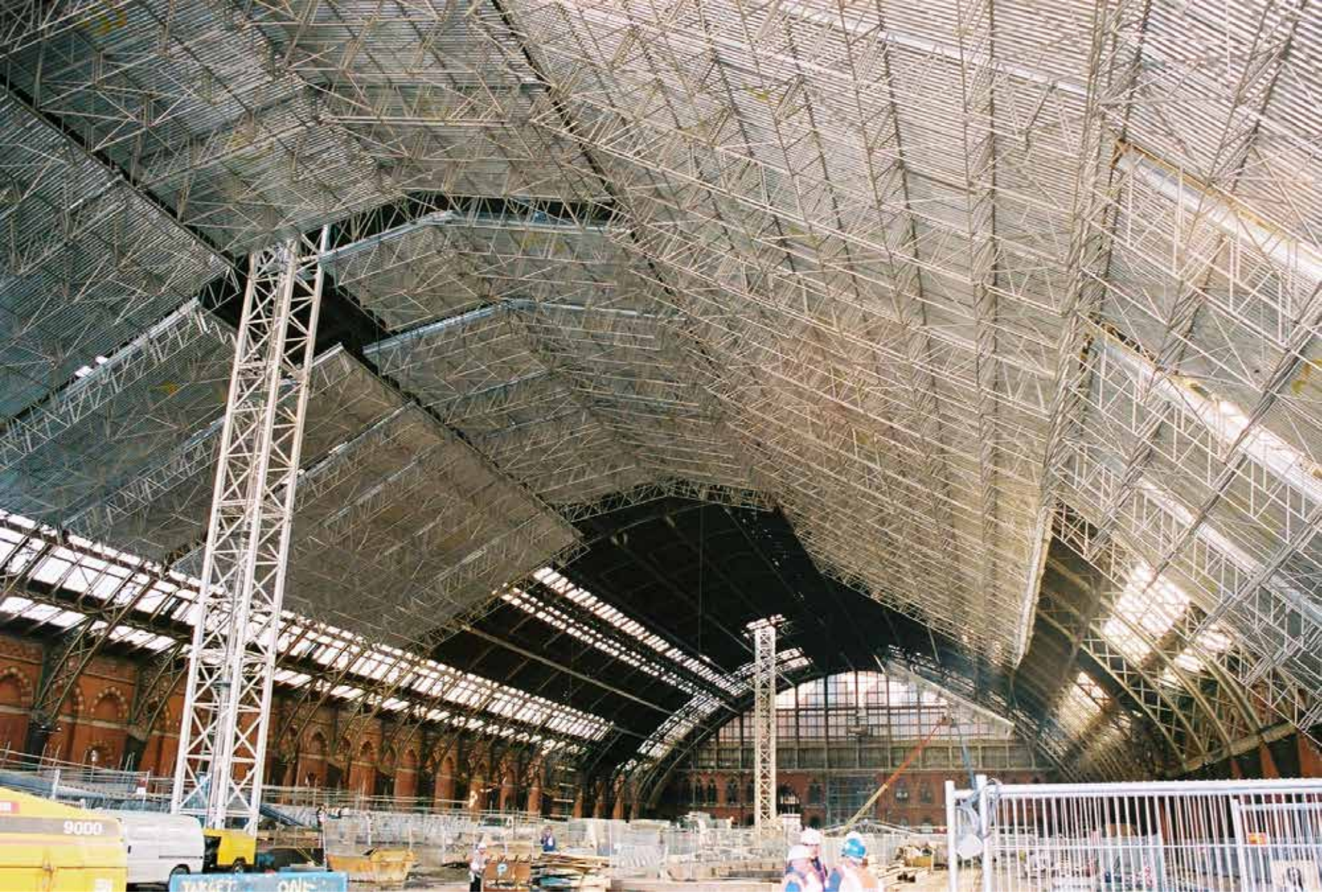
- Scaffolds that are not ‘Basic Scaffolds’ detailed in NASC guidance note TG20
- Dead Shores
- Flying shores
- Raking shores
- Cantilevered scaffolds
- Truss-out Scaffolds
- Access Birdcages
- Façade retention
- Access scaffolds with more than the 2 working lifts allowed with TG20 ‘Basic Scaffolds’
- Buttressed free-standing scaffolds
- Temporary roofs and temporary buildings
- Support scaffolds
- Loading Bays founded on the ground
- Mobile and static towers outside base/height limitations
- Free standing scaffolds outside base/height Limitations
- Temporary ramps and elevated roadways
- Staircases and fire escapes
- Spectator Terraces and Seating Stands
- Bridge scaffolds
- Towers requiring guys or ground anchors
- Offshore scaffolds outside Offshore Contractors Association (OCA) handbook…

Scaffolds that are subject to design

- Pedestrian footbridges or walkways
- Slung and Suspended scaffolds
- Protection fans, Nets and Pavement Frames
- Marine scaffolds
- Boiler scaffolds
- Power line crossings
- Lifting gantries and towers
- Steeple scaffolds
- System scaffolds outside users guide parameters
- Sign board supports
- Sealing end structures
- Temporary Storage on Site
- Masts, Lighting Towers and Transmission Towers
- Advertising hoardings/banners
- Any scaffold structure subject to:
  - Vibration
  - High Loading
  - Long term duration
  - High risk areas
  - Loading from passenger/goods hoists
- Note: The above list is not exhaustive and any system scaffold and/or system component that does not comply with manufacturer's guidelines as published in handbooks will require a specific design produced by a competent person…







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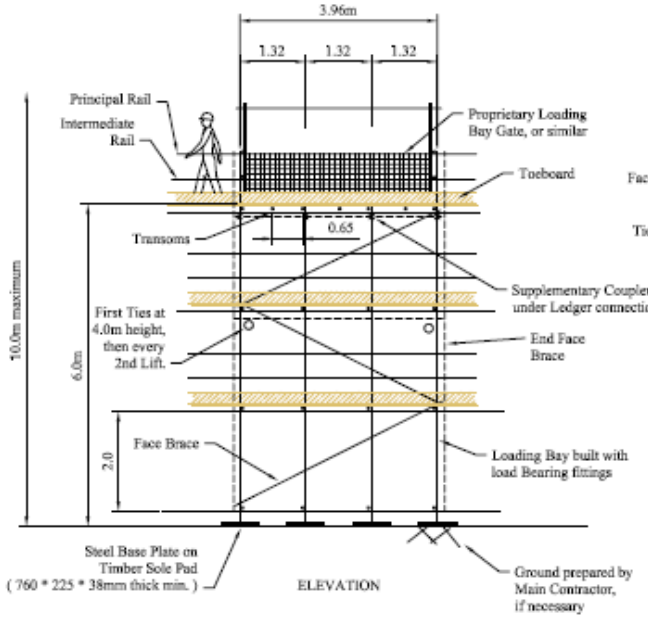
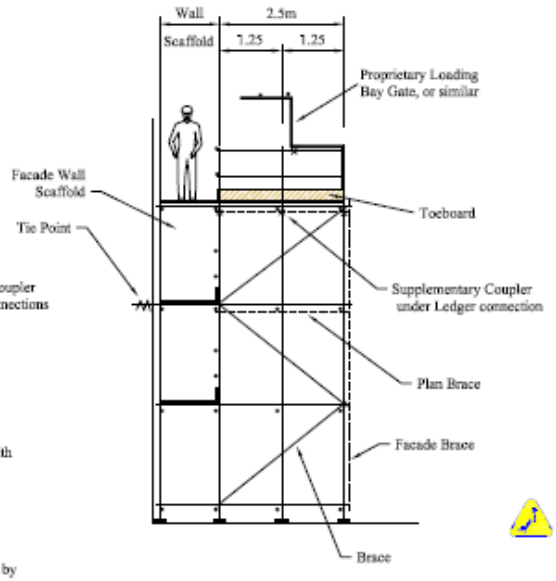
Tube & Fitting Staircase

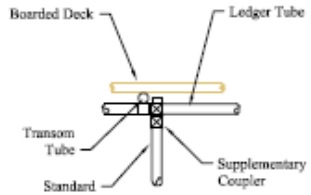
Note that staircase is NOT Sheeted as it is fire escape

Loading Bay

ThyssenKrupp Palmers Limited	*Standard Design :* 3.5 Tonne (35.0 kN) Loading Bay		Scaffold to comply with NASC TG20:08
	Drawn By :– A.Anderson	*Date :–* 3rd March 2004	*Drawing Number :–* SD001A

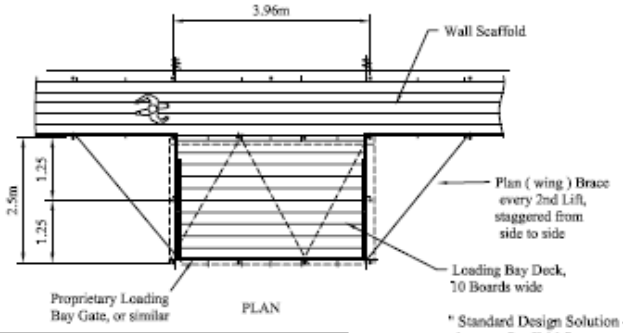






DECK DETAIL

Work at height must be undertaken in accordance with Work at Height Regulation 2005 (WAHR)



Maximum Loading Bay Load = 3.5kN/m2
Maximum Total Load = 35.0kN

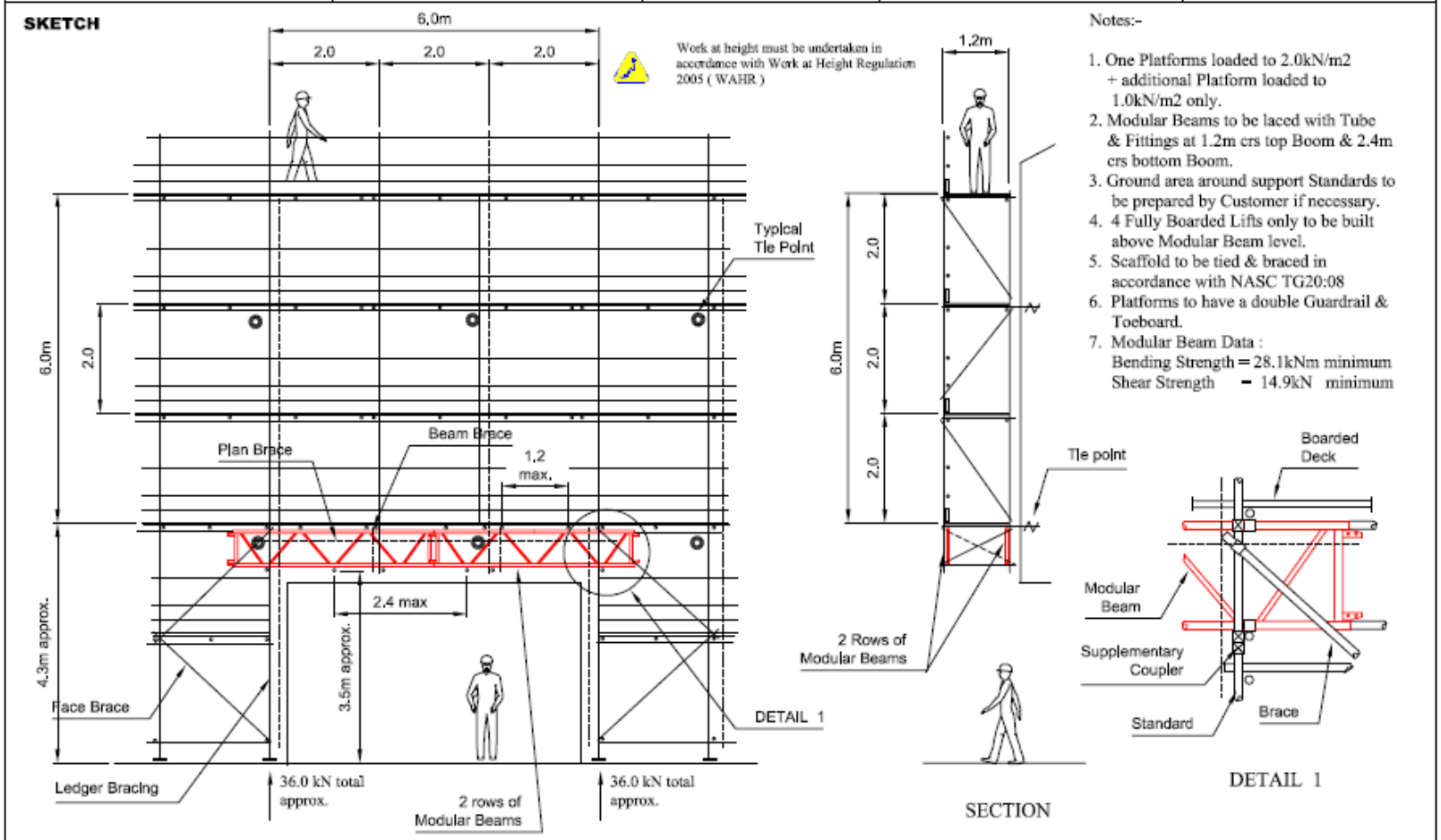
Notes : -
1. Maximum Height = 10.0m.
2. Loading Bay to be linked to existing Access Scaffold which in turn is tied to Building Structure.
3. Maximum Load = 3.5kN/m2 (35.0 kN total, evenly distributed over Deck)
4. Scaffold to comply with NASC TG20:08
5. Supplementary coupler to be adopted under centre bay Ledgers.
6. Loading Bay to be 10 Boards wide.
7. Wall Scaffold assumed fully boarded with 1 working lifts at 2.5 kN/m2 + additional Lift at 1.25kN/m2.
8. Estimated mutual Leg Load = 15.0 kN max.

" Standard Design Solution - It is the responsibility of the Manager / Supervisor to ensure that any Scaffold Structure is fit for purpose. A Company Engineer should be contacted for advice, if required."

REV.	A	Loading Bay updated	A.A.	13:5:09

Beam Bridging

ThyssenKrupp Palmers Limited	*Standard Design :* Modular Beam Bridging		Scaffold to comply with NASC TG20:08
	Drawn By :– A. Anderson	*Date :–* 13th April 2004	*Drawing Number :–* SD006A



Notes:-

1. One Platforms loaded to 2.0kN/m2 + additional Platform loaded to 1.0kN/m2 only.
2. Modular Beams to be laced with Tube & Fittings at 1.2m crs top Boom & 2.4m crs bottom Boom.
3. Ground area around support Standards to be prepared by Customer if necessary.
4. 4 Fully Boarded Lifts only to be built above Modular Beam level.
5. Scaffold to be tied & braced in accordance with NASC TG20:08
6. Platforms to have a double Guardrail & Toeboard.
7. Modular Beam Data :
   Bending Strength = 28.1kNm minimum
   Shear Strength = 14.9kN minimum

" Standard Design Solution - It is the responsibility of the Manager / Supervisor to ensure that any Scaffold Structure is fit for purpose. A Company Engineer should be contacted for advice, if required."

REV. A	Drawing updated	A.A.	13:5:09

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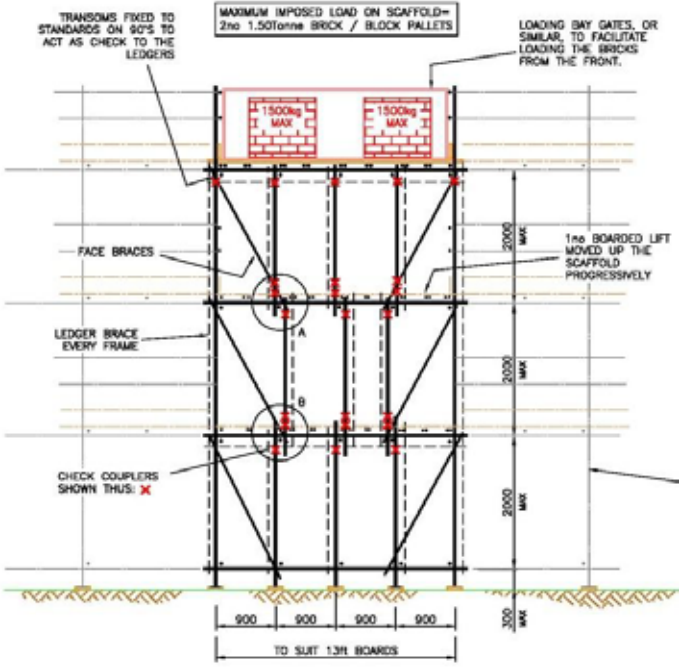
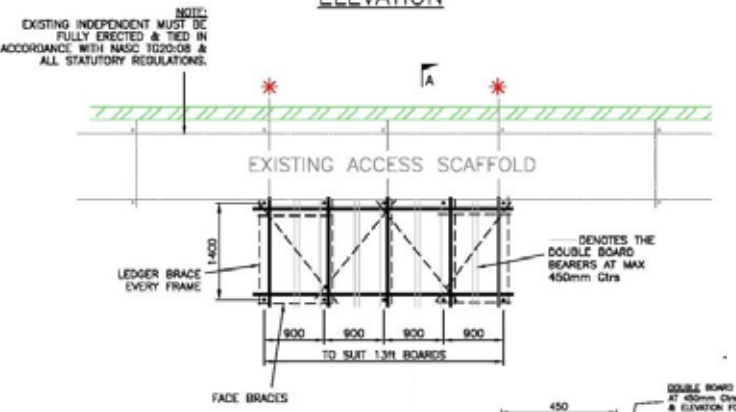
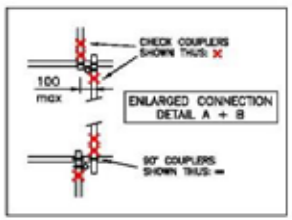
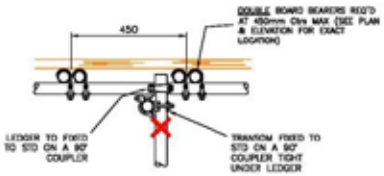


ELEVATION







CONNECTION DETAIL

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TG20:13

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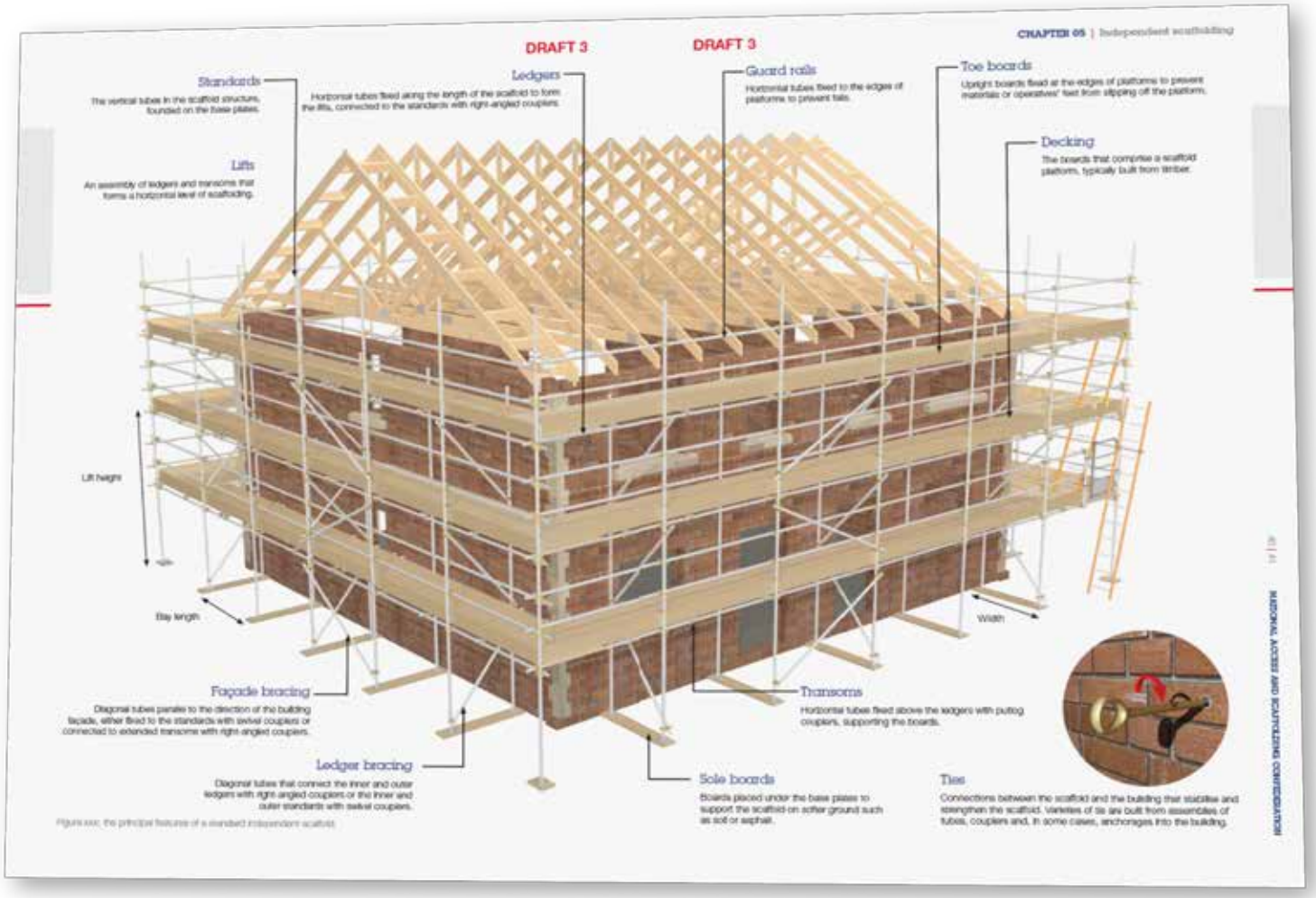
About TG20:13

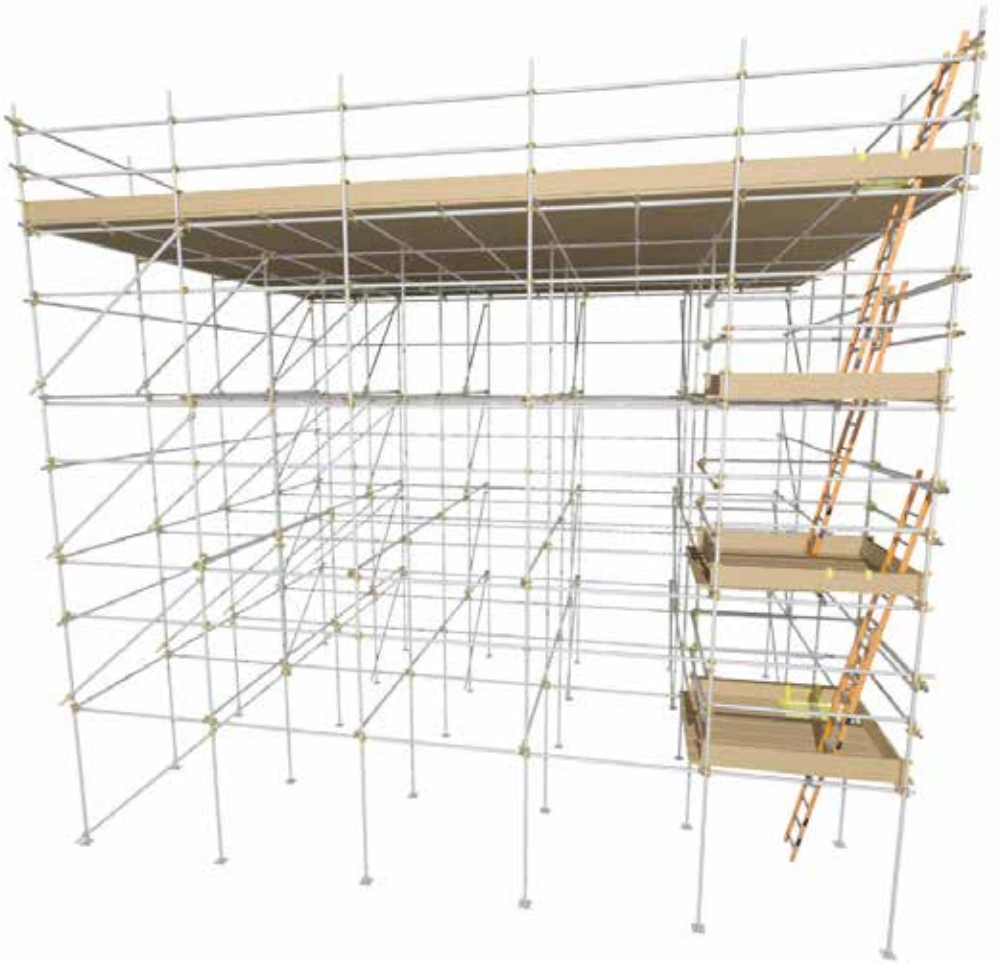
- A new TG20 Management Guide is being written for all those involved in the procurement, supply and use of scaffolding
- A new TG20 eGuide will be included as a simple pocket reference
- The Technical Guidance is also being updated for scaffolding designers

- **The Management Guide is a new full-colour illustrated book that provides clear guidance for the construction and use of ‘TG20 compliant’ scaffolding**



TG20:13 - Scaffold types

- **TG20:13 will include more types of 'TG20 compliant' scaffolding that are exempt from design**
- **These will include loading bays, towers and interior birdcages**
- **Variations of independent scaffolding including storey-height lifts will be included**
- **Prefabricated (Readylock style) structural transoms are being tested, aiming to provide TG20 compliant designs**

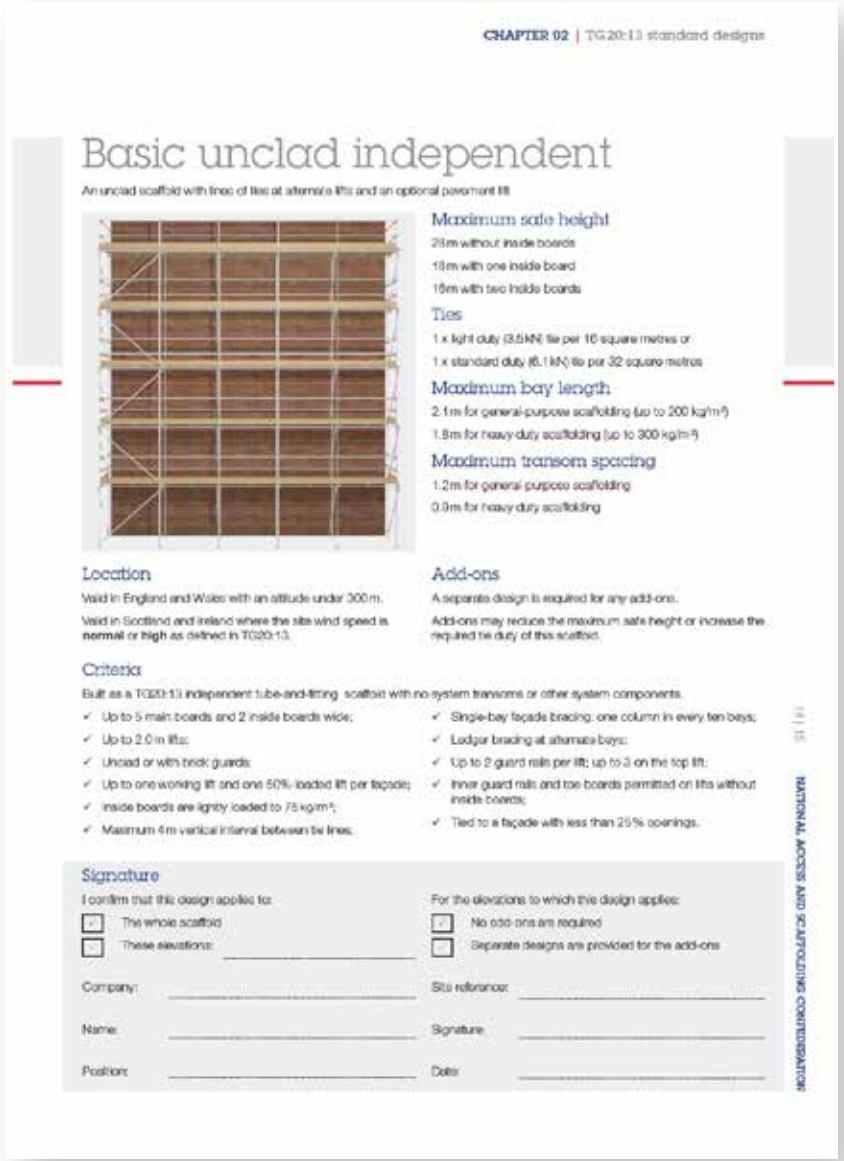


TG20:13 - Scaffolding features

- **TG20 compliant independent scaffolding will permit specific configurations of:**
  - **Inside board bracket platforms**
  - **Cantilevered access platforms**
  - **Bridges**
  - **Protection fans**
  - **Pavement lifts**

TG20:13 - Compliance Sheets

- TG20 compliance sheets provide a clear summary of the requirements for TG20 scaffolding
- TG20 scaffolding has been designed by structural calculation and is exempt from the need for further design
- TG20 compliance sheets are provided in the Management Guide and in the TG20 eGuide



CHAPTER 02 | TG20:13 standard designs

Basic unclad independent

An unclad scaffold with lines of ties at alternate lifts and an optional pavement lift

Maximum safe height

28m without inside boards

18m with one inside board

18m with two inside boards

Ties

1 x light duty (3.5kN) tie per 16 square metres or

1 x standard duty (6.1kN) tie per 32 square metres

Maximum bay length

2.1m for general-purpose scaffolding (up to 200 kg/m²)

1.8m for heavy duty scaffolding (up to 300 kg/m²)

Maximum transom spacing

1.2m for general-purpose scaffolding

0.9m for heavy duty scaffolding

Location

Valid in England and Wales with an altitude under 300m.

Valid in Scotland and Ireland where the site wind speed is **normal** or **high** as defined in TG20:13.

Add-ons

A separate design is required for any add-ons.

Add-ons may reduce the maximum safe height or increase the required tie duty of this scaffold.

Criteria

Built as a TG20:13 independent tube-and-fitting scaffold with no system transoms or other system components.

- ✓ Up to 5 main boards and 2 inside boards wide;
- ✓ Up to 2.0m lifts;
- ✓ Unclad or with brick guards;
- ✓ Up to one working lift and one 50% loaded lift per façade;
- ✓ Inside boards are lightly loaded to 75 kg/m²;
- ✓ Maximum 4m vertical interval between tie lines;
- ✓ Single-bay façade bracing; one column in every ten bays;
- ✓ Ledger bracing at alternate bays;
- ✓ Up to 2 guard rails per lift; up to 3 on the top lift;
- ✓ Inner guard rails and toe boards permitted on lifts without inside boards;
- ✓ Tied to a façade with less than 25% openings.

Signature

I confirm that this design applies to:

- ☑ The whole scaffold
- ☐ These elevations: _____

For the elevations to which this design applies:

- ☑ No add-ons are required
- ☐ Separate designs are provided for the add-ons

Company: _____ Site reference: _____

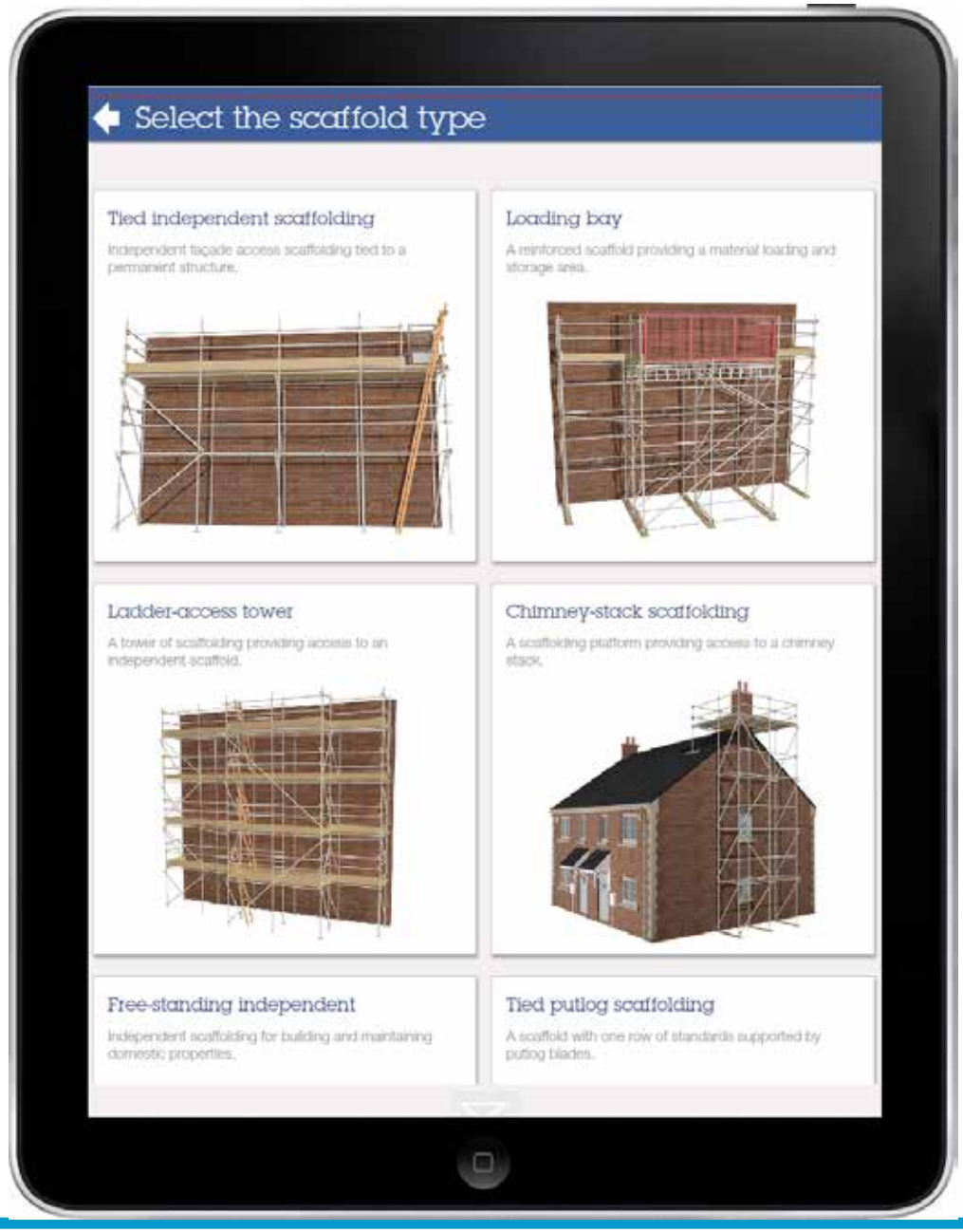
Name: _____ Signature: _____

Position: _____ Date: _____

NATIONAL ACCESS AND SCAFFOLDING CONFEDERATION

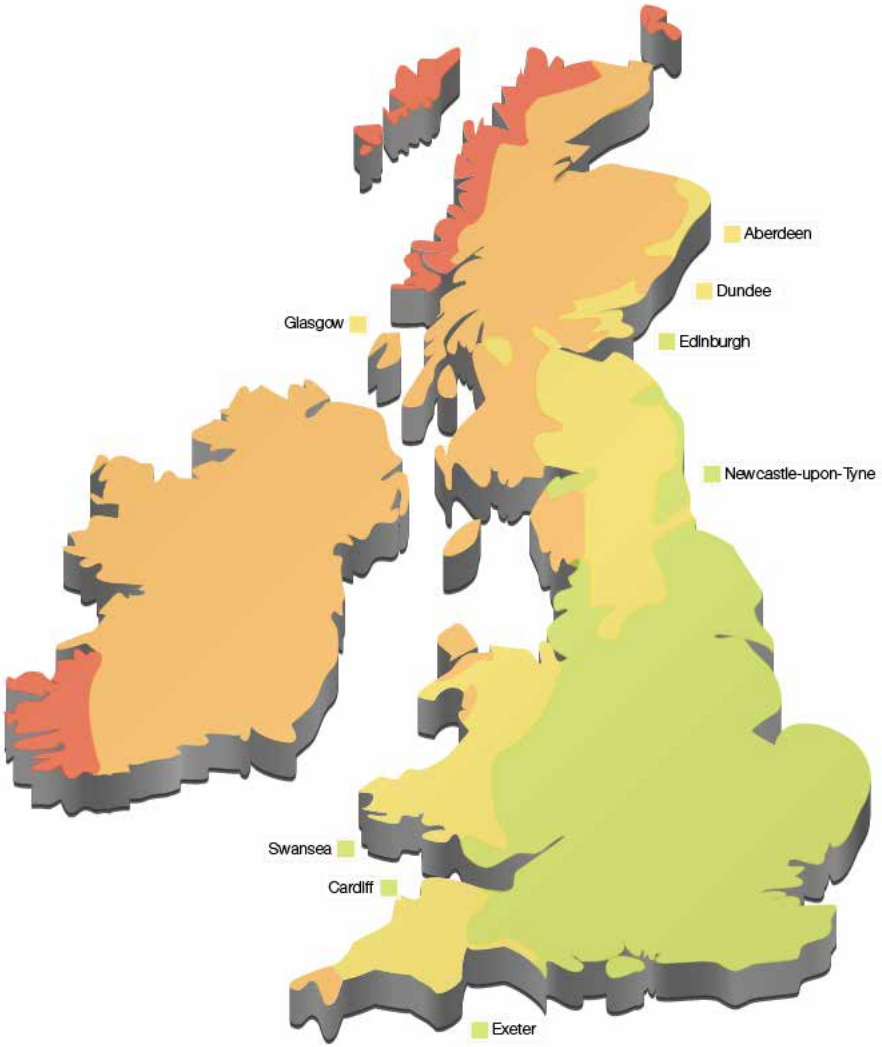
TG20:13 - eGuide

- The TG20 eGuide allows TG20 compliance sheets to be easily found and printed
- This enables more combinations of compliant scaffolding to be provided than in the book alone



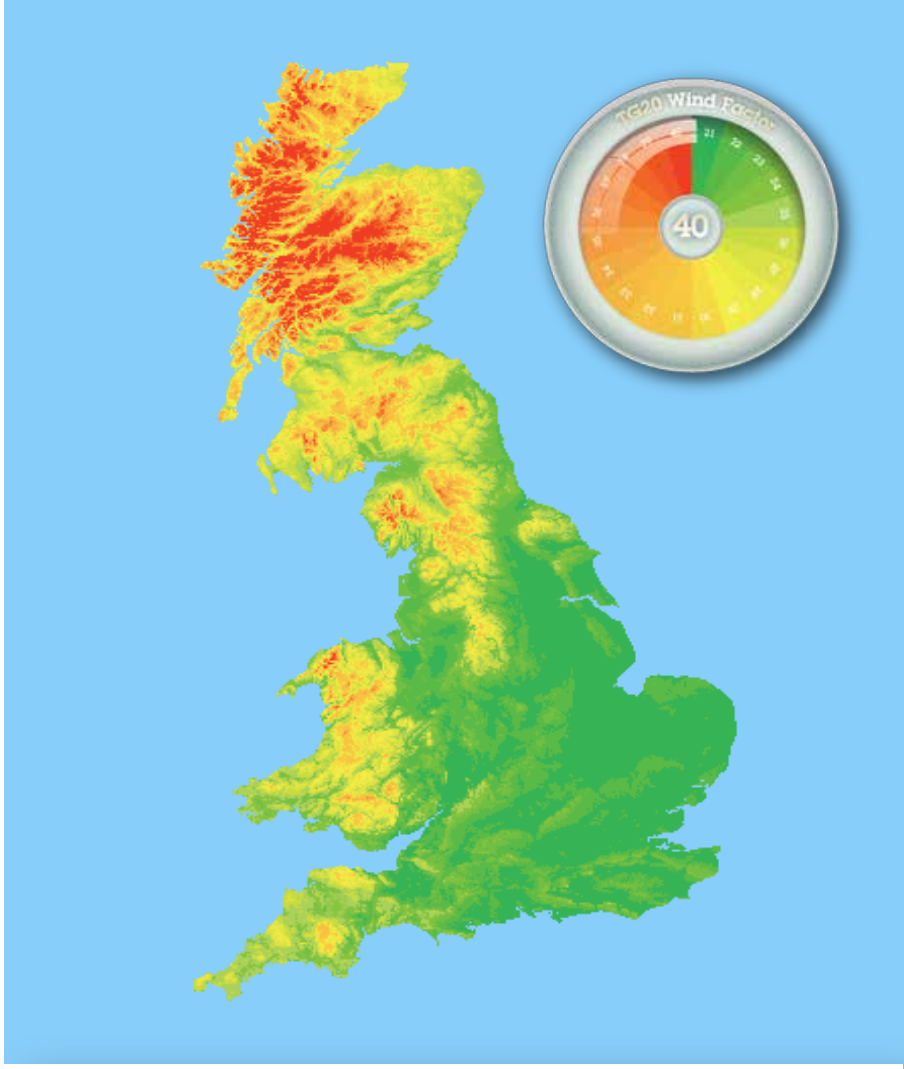
TG20:13 - Simplified wind system

- A new simplified wind system has been researched and developed for use with the TG20 compliance sheets in the book
- The accurate wind calculation for engineers will be available in the Design Guide (Volume 2)
- An automatic, accurate wind calculator is provided in the TG20 eGuide



TG20:13 - Wind map research

- Extensive research has been completed to study the wind exposure in the UK
- The automated wind map in the TG20 eGuide calculates an accurate wind exposure based on an automatic topography assessment
- This typically significantly reduces the site wind exposure compared to the basic TG20 wind factor

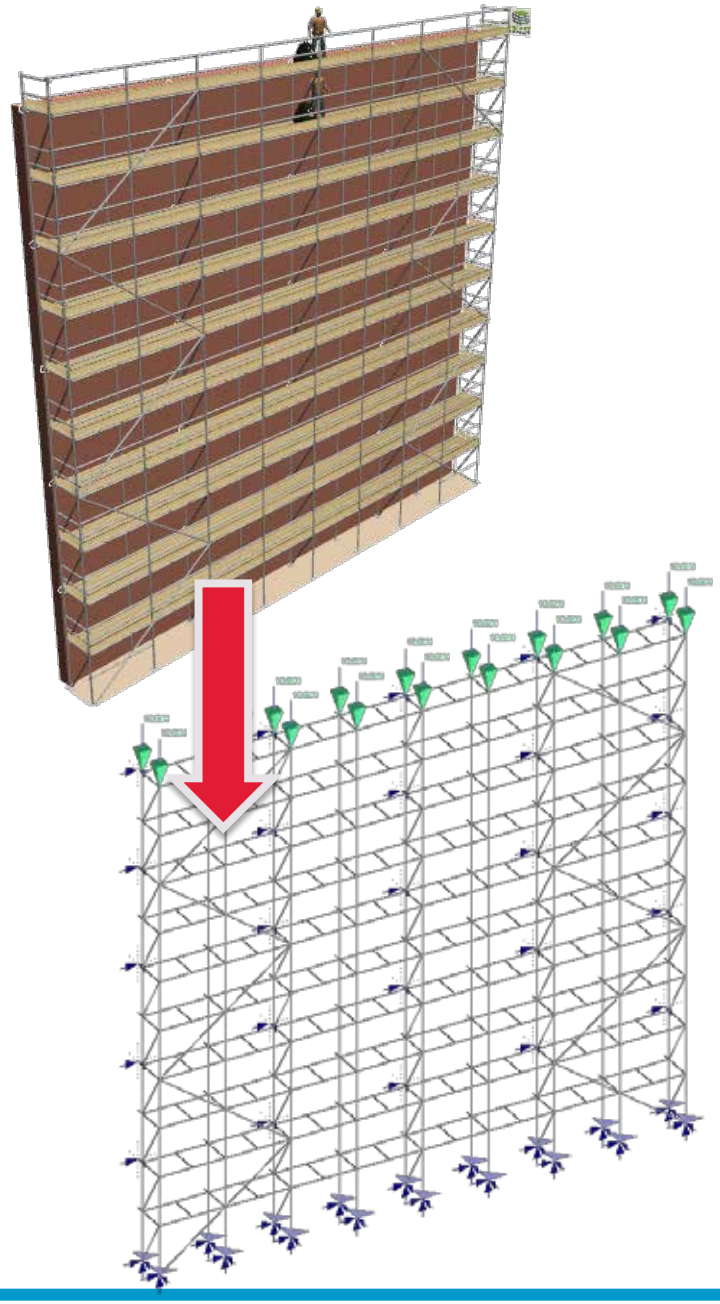


$$S_{wind} = \max\{dir \mid 0..30..270 \bullet S_{wind,dir}\}$$

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

TG20:13 - Structural research

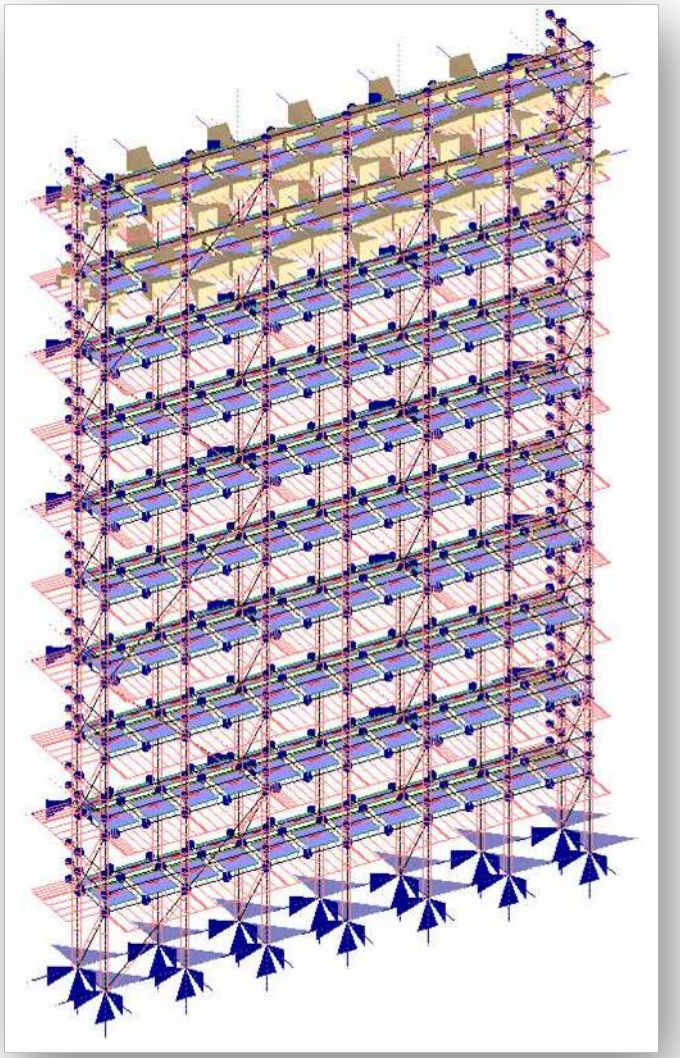
- The safe heights, tie duties and other design criteria reported by the TG20 compliance sheets are justified by structural analysis and design
- Structural research software has been developed to run detailed 3D analyses to the Eurocodes
- The aim is to maximise the safe heights reported by the TG20 compliance sheets



TG20:13 - Structural research

- **NASC are aiming, where possible, to resolve areas of TG20:08 that do not match practice**

- **Examples:**
  - ü **Guidance for erecting typical scaffolding with single-bay façade bracing, without plan bracing**
  - ü **Reducing the requirement for structural transoms for unclad and debris-netted scaffolding**
  - ü **Guidance for tying to the inner face of the scaffold**



TG20:13 Next steps

- **The TG20 Management Guide is presently under review**
- **The TG20 eGuide is being completed and tested**
- **All current guidance remains valid**

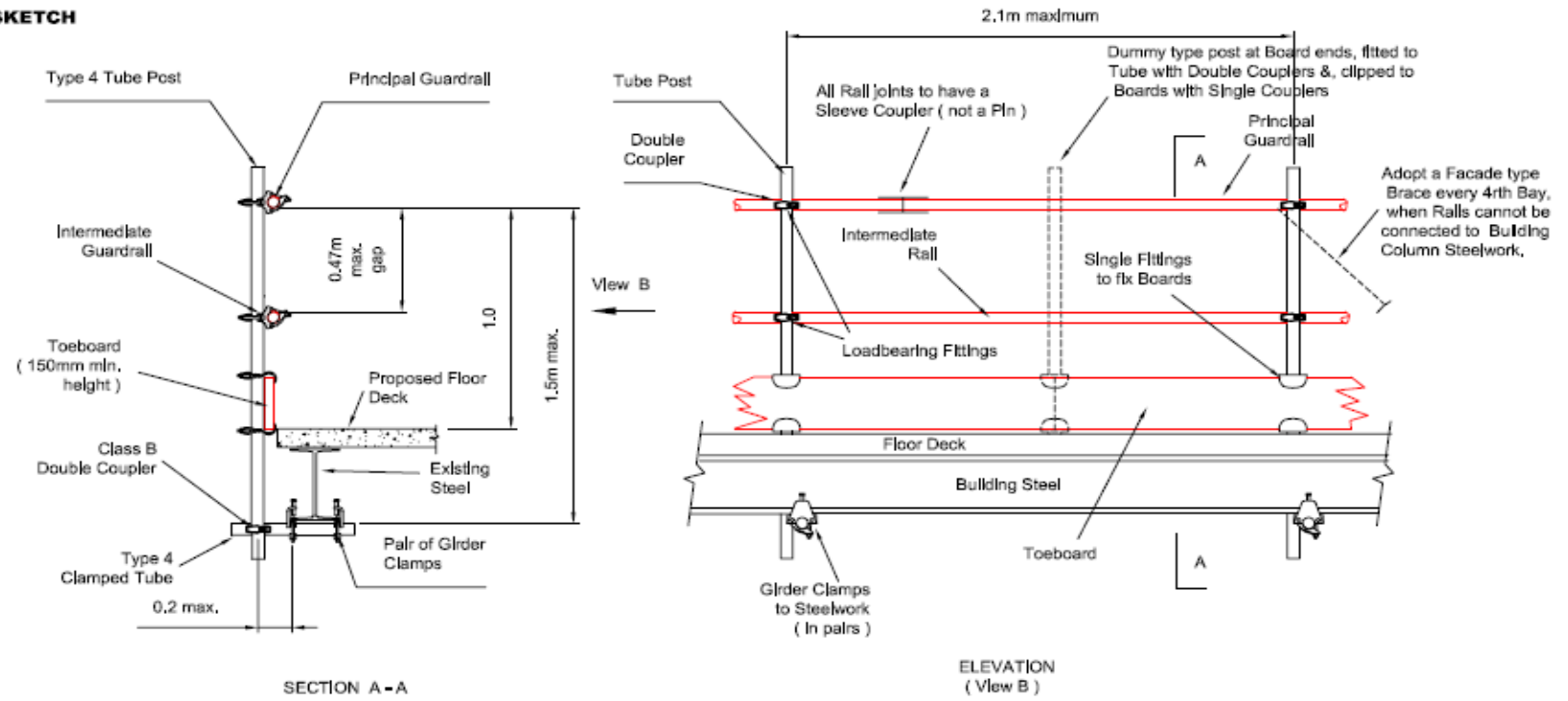
BS EN 13374 Temporary Edge Protection

- European Directive
- Adopted in the UK October 04
- Applies to Construction & Maintenance, but not:
  - Vehicle or plant impact
  - Bulk materials (including Snow)
  - Protection of the Public
  - Guard-rails on Scaffolding (BS EN 12811)
- Introduces 3 Classifications
  - Class A = Static Load
  - Class B = Static Load + Low Dynamic Load
  - Class C = High Dynamic Load
- Can be tested or calculated using limit state principle
- EDGE PROTECTION GUARDRAILS MUST BE SUBJECT TO DESIGN…

Edge Protection

ThyssenKrupp Palmers Limited	*Standard Design* :- Temporary Class A Edge Protection Detail		Scaffold to comply with NASC TG20:08
	Drawn by :- A.Anderson	*Date* :- 23:9:05	*Drawing Number* :- SD14A

SKETCH



Alternative Design should be considered when;

- Building Height greater than 40.0m above Ground level
- Time period for the Protection is greater than 6 Month
- Protection built in areas of possible high Wind exposure (qi > 0.6kN/m2)
- Height of Principal Rail above Girder Clamps > 1.5m
- A single Tube Post cannot rely on the Load sharing ability of adjacent Posts.
- Load Parameters outside Class A, BS EN 13374:2004 are to be adopted.
- A Class 'B' Loadbearing Fitting cannot be used to connect Post to Clamped Tube

Work at height must comply with Work at Height Regulation 2005 (WAHR)

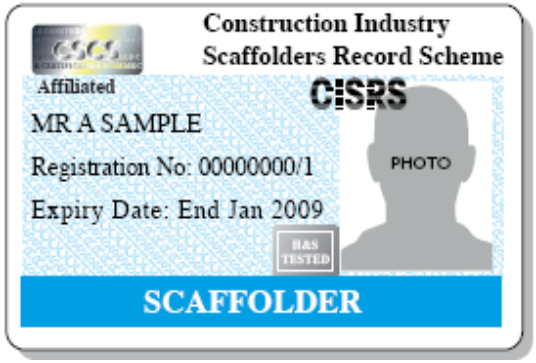
Class 'A' type Edge Protection

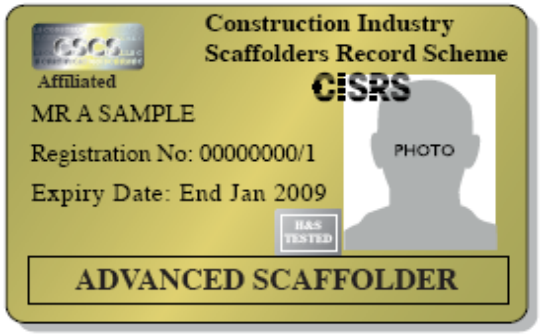
REV. A	Edge Protection detail updated	A.A.	1:10:09

Temporary Edge Protection to comply with BS EN 13374:2004, BS EN 12811-1:2003& NASC TG20:08.

Competence of Scaffolders?

q Scaffolders trained to CISRS/PASMA Standards

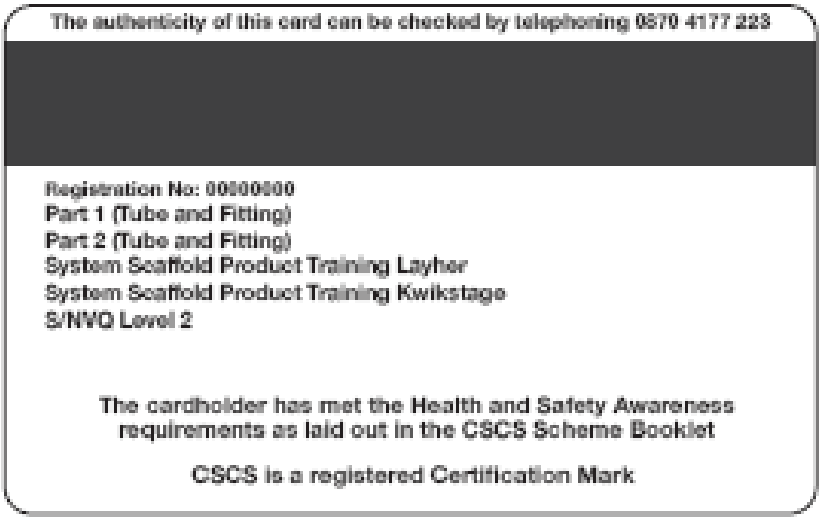


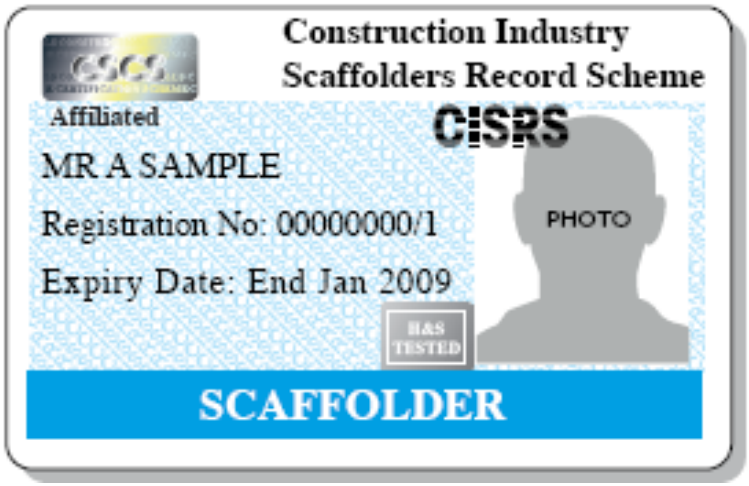


System Scaffold Product Training Scheme (SSPTS)

- System product training for existing CISRS Card Holders (min. Part 1)
- 2-Day Product Training Course
- Not available to new entrants
- Card endorsed with specific product

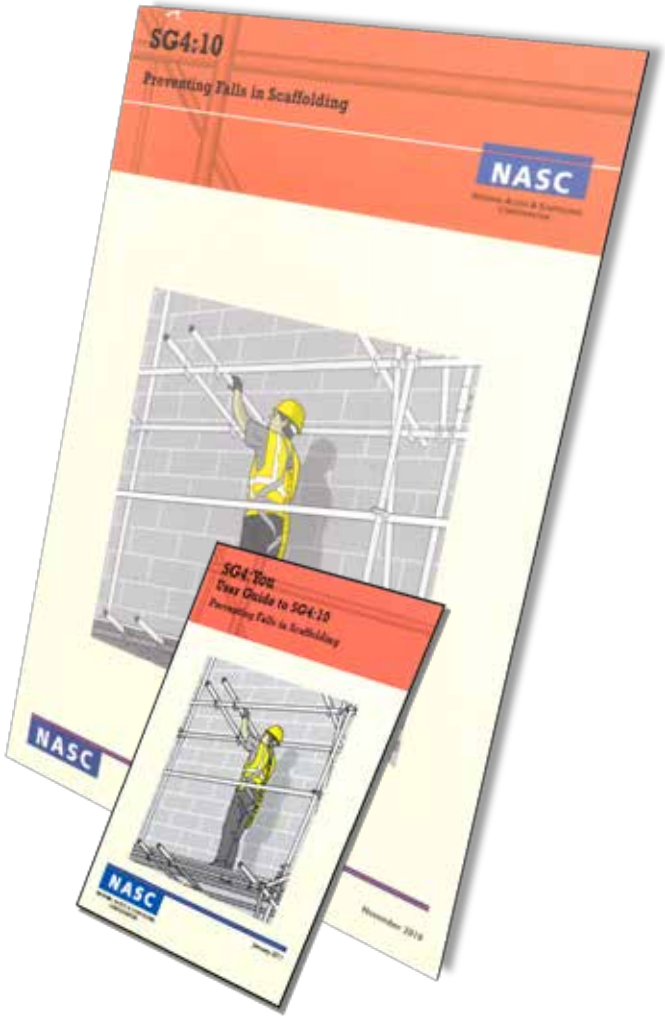
  - Genuine Kwikstage
  - K-Lok
  - Cuplok
  - Layher Allround
  - Haki Universal
  - Peri Up Rossett Flex
  - DSL Climastage
  - GenLock
  - Plettac Contur
  - Plus 8
  - TRADLok
  - Scafom-rux Ringscaff





NASC Safety Guidance Note SG4:10

“Preventing Falls In Scaffolding”



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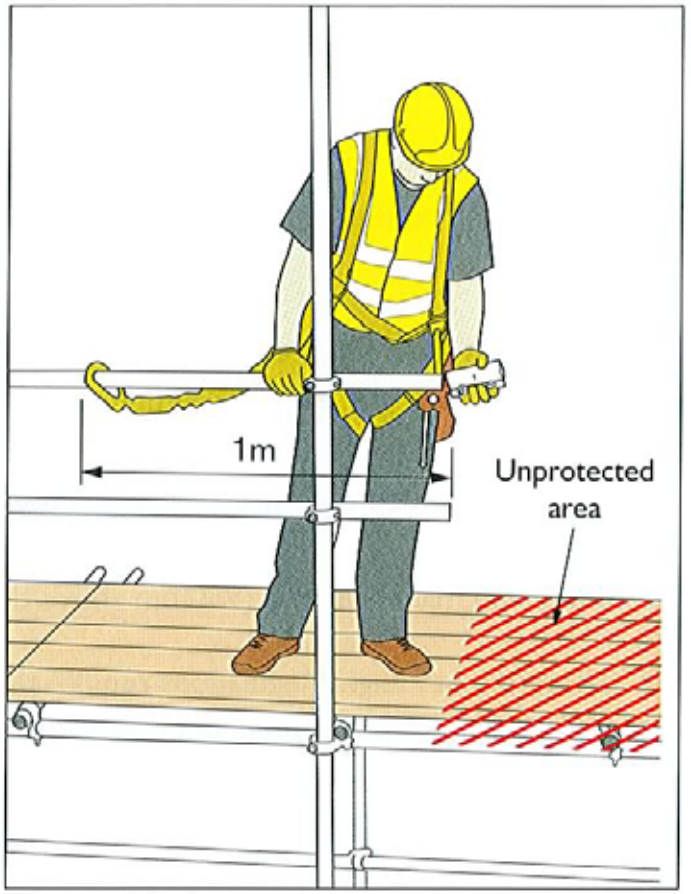
What is the Scaffolders safe zone?

- A fully boarded and correctly supported platform without gaps where someone could fall; and,

- A single main guardrail (950mm above platform) where there is a risk of fall (inside edge, window openings & stop ends) to remain in place on all lifts ready for dismantle

- When within 1m of unprotected edge Scaffolders are considered “at risk” and personal fall arrest equipment must be used…



What is available to create a Scaffolders Safe Zone?

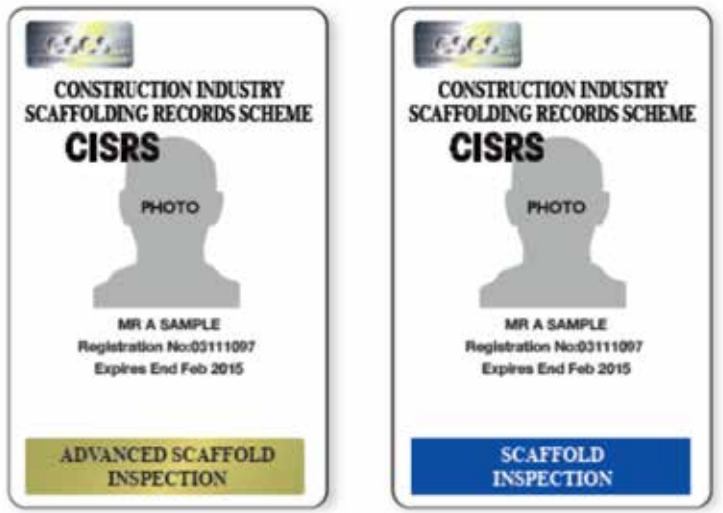
Scaffolders Safe Zone" – Proprietary Systems

SG4 Compliant?

- SG4:10 Prevention of Falls in Scaffolding
- Safe System of Work at height for Scaffolders.
- Single guardrails on non working lifts
- Intermediate transoms for support of board
- Fall arrest Equip worn at all times
- Collective protection 1st Priority

Proper statutory scaffold inspection?

- q **Before first used**
- q **Within every seven days**
- q **Following adverse weather**
- q **Following substantial adaption**
- q **Competent Inspector**
- q **Enough time available to inspect properly**



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Temporary Works - Scaffolding

- Have personal knowledge, experience and training of type of scaffolding on-site
- Understand what type of scaffold needs design input
- Appreciate that scaffold design takes time
- Consider that a scaffold needs to be tied to the structure, standard ties 4m by 4m, any more and design can get complex (eg:7.5m column centres)
- Ensure that ties are tested TG4:11, min 3 or 5% per elevation
- Make roof load and structure loads available to scaffold designers as soon as possible
- Allow time for scaffold design process and complex erection sequence and check scaffold erected in line with design
- Consider how scaffolding materials are delivered & stored
- Ensure Scaffolders are competent ie: CISRS cards
- Specify quality scaffold inspections (independent?), if done by Scaffold Contractor consider auditing process to check, before 1st use, every 7 days etc

Scaffold Industry Guidance

- 32 x Safety Guidance
- 17 x Technical Guidance
- 19 x Contractual Guidance
- 3 x Security Guidance

Available to: members | sites | contractors | everybody

www.nasc.org.uk

Questions?

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