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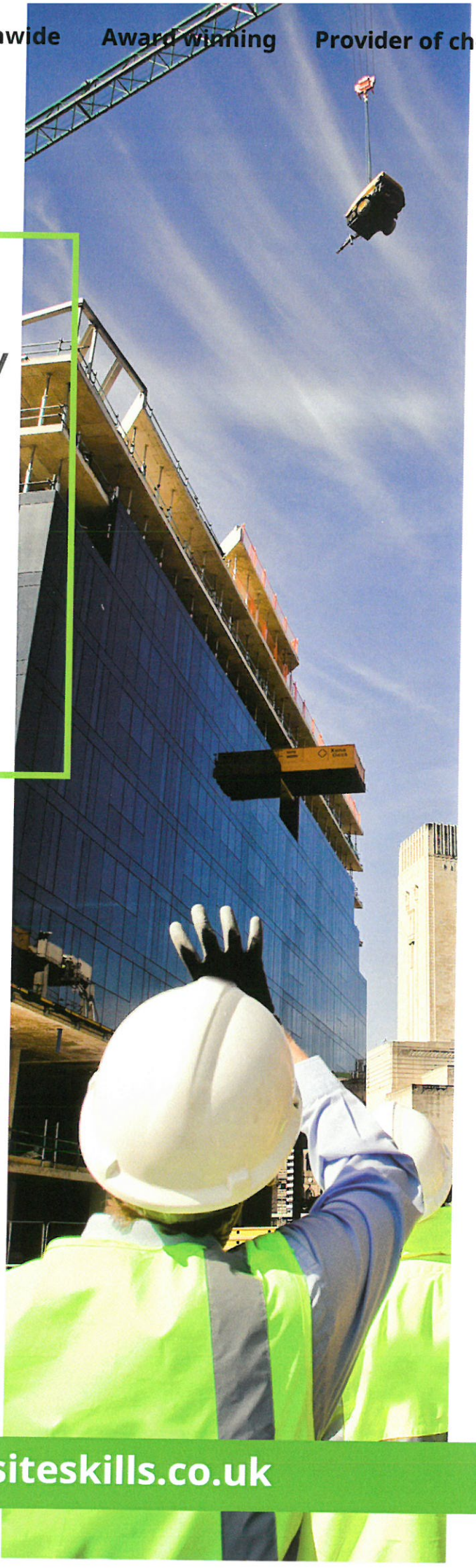
CITB Temporary Works Coordinator Training Course (TWCTC)



Name:

Organisation:

Location:

Course Date:

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CONTENTS

Appendices

APPENDIX A - Formwork and Falsework

A1 Design Issues

A1.1 Roles and responsibilities for design
A1.2 Design checks on falsework
A1.3 HSE guidance on design check categories for falsework

A2 Site Issues

A2.1 When to carry out site checking of falsework
A2.2 What to check when carrying out site checking of falsework
A2.3 Site tolerances for aluminium towers and props

APPENDIX B - Scaffolding and Access

B1 Design Issues

B1.1 Scaffolding Services Classes and loadings
B1.2 HSE guidance on design check categories for scaffolding
B1.3 TG20:21 Compliant Scaffolds

B2 Site Issues

B2.1 Site tolerances for tube and coupler scaffolds
B2.2 SC4:15 Scaffolders Safe Zone
B2.3 Mast Climbing Work Platforms (MCWP)

B3 Sources of further information

B3.1 British & European Standards (BSi)
B3.2 National Access & Scaffolding Confederation (NASC)
B3.3 Miscellaneous

APPENDIX C - Excavations and Earthworks

C1 Design Issues

C1.1 Slope stability
C1.2 Information likely to be required for excavation design
C1.3 HSE guidance on design check categories for excavations

C2 Site Issues

C2.1 Excavation safety

APPENDIX D - Demolition, Propping and Shoring

D1 Design Issues

D1.1 HSE guidance on design check categories for demolition, propping and shoring
D1.2 Planning for explosive demolition

D2 Site Issues

D2.1 Checking of purposely fabricated steelwork on site
D2.2 Installation and checking of BS 4074 adjustable steel props D2.3High reach demolition
D2.4 Robotic demolition machines

D3 Sources of further information

D3.1 British and European Standards (Bsi)
D3.2 National Federation of Demolition Contractors (NFDC)
D3.3 Miscellaneous

APPENDIX E - Site Establishment and Equipment

E1 Design Issues

E1.1 TWf "Hoardings – A Guide to Good Practice"
E1.2 HSE guidance on design check categories for site establishment and equipment
E1.3 Design of ground supported working platforms
E1.4 Weathervaning of tower cranes and luffing jibs.

E2 Site Issues

E2.1 Weather awareness

PROGRAMME DAY ONE

Times	Subject	Content
0900---0920	Course Administration and introductions	
0920---1000	Module 1 - What are temporary works	Aspects of Temporary works
1000---1030	Module 1- What are temporary works	
1030---1100	Break	
1100---1130	Module 1- What are temporary works	
1130---1200	Module 2 – The History of temporary works	Bragg Report
1200---1230	Module 2 – The History of temporary works	
1230---1300	Module 2 – The History of temporary works	3P's
1300---1400	Lunch Break	
1400---1430	Module 2 – The History of temporary works	4C's
1430---1500	Module 3 – Legal and Management Procedures	
1500---1530	Module 3 – Legal and Management Procedures	
1530---1600	Break	
1600---1630	Module 3 – Legal and Management Procedures	
1630---1730	Module 3 – Legal and Management Procedures	
1730	Course closes	

Times	Details	Comments
0900---0930	Day two introductions	
0930---1000	Module 4 – Who is involved in Temporary works	DI, PC TWC, TWC, TWS
1000---1030	Module 4 – Who is involved in Temporary works	
1030---1100	Break	
1100---1130	Module 4 – Who is involved in Temporary works	
1130---1200	Module 5 – Planning Temporary works	Register
1200---1230	Module 5 – Planning Temporary works	Design brief/checks
1230---1300	Lunch Break	

1330---1430	Module 5 – Planning Temporary works	
1430---1530	Module 6 – Managing Construction, erection and dismantling of Temporary works	Permit
1530---1600	Break	
1600---1645	Test Paper	
1645---1715	Test Paper review	
1715---1730	Course critique and feedback	Feedback questionnaires to be completed
1730	Course closes	

Definition of Temporary Works

An "**Engineered solution**" used to protect, support and provide access **during the construction** of the permanent works which might or might not be left on completion of the works.

Or

To support an item of plant or equipment, or the vertical sides or side slopes of an excavation during construction operations on site or to provide access - BS 5975:2008

Notes for Delegates

Learning Difficulties and other Special Requirements

If you have any special requirements regarding this course, for example physical difficulties such as sight, hearing or writing, or learning difficulties such as dyslexia, or simply that you suffer from "exam nerves", please talk to me in confidence at the earliest opportunity so that I can adapt the running of the course, and the examination, to cater for your needs as well as everyone else's.

CITB CSkills Scheme Rules place an obligation on tutors to adapt the running of courses where necessary according to delegates needs to enable everyone to engage equally, especially during the examination. The examination is a test of your knowledge of the BS5975 Temporary Works processes and not your ability to "do examinations". Within the scheme rules, I am permitted to:

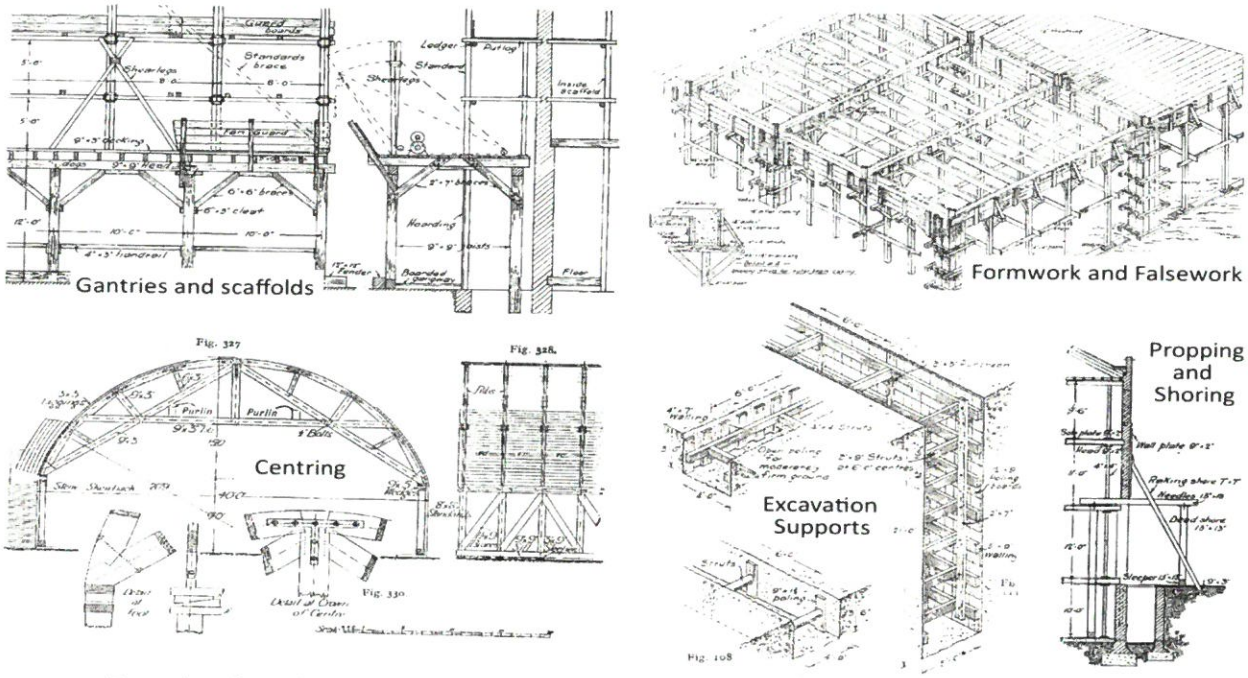
- Hold your examination separately if you wish and read the questions to you (but not discuss or comment upon your answers).
- Where appropriate, extend the examination period by up to 25%

Your objectives on this course: As part of the course introduction, I will ask you to introduce yourself and say what you would like to take away from this course (apart from a Pass!). If you have specific issues or experiences you would like discussed, or specific topics you have had trouble with on site in the past, please make a note of them below:

Disclaimer

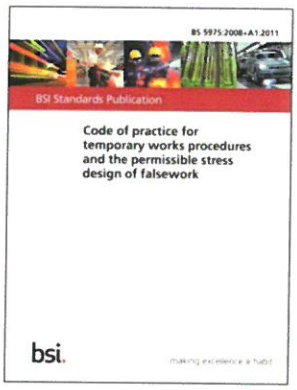
The sole purpose of these notes is to support and inform delegates attending accredited CITB Temporary Works courses delivered by the author, and to assist them in the end-of-course open-book examination. It is not a technical manual or reference book on the design or installation of Temporary Works, or other construction or legal issues.

Whilst every effort has been made to ensure the content of the training course and these notes is factually accurate, the author accepts no responsibility or liability for any reliance placed upon information gained



Examples of standard carpentry temporary works from Mitchell's Building Construction (1944)

1.1.1 Modern BS 5975 definition of Temporary Works



Temporary works are *"parts of the works that allow or enable construction of, protect, support or provide access to, the permanent works and which might or might not remain in place at the completion of the works."*

Temporary works is an "engineered solution" used to support or protect either an existing structure or the permanent works during construction, or to support an item of plant or equipment, or the vertical sides or side slopes of an excavation during construction operations on site or to provide access. The temporary works may be removed or left in place after the completion of the permanent works but in the latter case would not necessarily contribute to the strength of the permanent works.

1.1.2 Examples of Temporary Works

Excavations and earthworks	Earth support, batter and slope stability, cofferdams, temporary river / stream / culvert diversions, trenches, underpinning, shafts, tunnels, sheet piling, secant piling, contiguous piling, diaphragm walling, trench boxes, drag boxes, soldier piles and lagging, king-post walls, soil nailing, tie-backs and ground anchors, settling / stilling basin, lagoon, temporary underground sludge / sewage tanks, well-point dewatering
Falsework and formwork	Support structures, falsework, formwork, centering, table forms, flying forms, climbing forms, wall/column reinforcement cage stability (i.e. prior to restraining between formwork), wall/column formwork stability
Scaffolding and access equipment	Working platforms, mobile towers, stair & ladder towers, ladders, podiums, mast-climbing platforms, lifts and hoists, mobile elevating work platforms (MEWPs – cherry pickers, booms, scissor lifts), edge protection, crash decks, fans, load-out areas and loading gates, chimney scaffolds, temporary roofs, debris netting, debris chutes

Demolition, propping and shoring	Facade retention, temporary shoring and support, propping and back-propping, underpinning, structural openings, loadbearing wall removal, structural weakening, explosive demolition, high-reach plant stability, debris netting, dust netting, litter netting, stockpiles, storage systems,
Site and plant (miscellaneous)	Hoardings, welfare facilities, temporary haul roads, traffic management arrangements, piling & other plant platforms, crane and plant mats, crane foundations, outrigger pads, temporary foundations, temporary bridges, bridge launch "noses", lifting equipment, floats and pontoons, lanyard systems, temporary masts and flagpoles, cement silos, storage bays, racking systems

1.1.3 Why managing Temporary Works is important

Temporary works are **SAFETY CRITICAL** – Failure of inadequately considered or poorly executed temporary works can result in injury or death. Legislation requires that employers reduce the risk of this happening "so far as reasonably practicable" (SFARF).

Temporary works are **BUSINESS CRITICAL** – Failure of inadequately considered or poorly executed temporary works can result in financial loss, delays, breach of contract and prosecution, as well as attracting bad publicity for the company, and potentially losing the opportunity to tender for future work. Conversely, considering temporary works carefully and selecting optimum solutions can result in substantial savings that can be the difference between winning or losing a tender.

1.1.4 Roles and Responsibilities for Temporary Works

Roles and responsibilities for construction works are generally defined in the Construction (Design and Management) Regulations 2015 but it should be noted that these regulations make no separate distinction regarding roles and responsibilities for temporary works or mention of the roles and responsibilities of a Temporary Works Co-ordinator or Supervisor. These latter roles are specific to BS 5975.

The key roles ("Duty Holders") contained within the CDM Regulations are:

Client (Organisations for whom the works are carried out)

- Make suitable arrangements for the project, including sufficient time and resources
- Appoint competent persons to carry out the Principal Designer and Principal Contractor roles
- Ensure other designers and contractors appointed by them are competent
- Ensure relevant information is compiled and provided to other duty holders
- Ensure welfare facilities are provided
- Ensure the Principal Designer and Principal Contractor carry out their duties

Principal Designer (Designer appointed by a Client on projects having more than one Contractor)

- Plan, manage, monitor and co-ordinate health and safety in the pre-construction phase of a project
- Identify, eliminate or control foreseeable risks in construction & maintenance
- Ensure other designers carry out their duties
- Prepare and provide relevant information to other duty holders
- Liaise with the Principal Contractor and help in the planning, management and co-ordination of the construction phase of the project.

Designers (Those who as part of a business prepare designs relating to construction work)

- When preparing designs, identify, eliminate or control foreseeable risks in construction & maintenance (This applies equally to designs for Temporary works)
- Provide information to other members of the project team to help them fulfil their duties

Principal Contractor (Contractor appointed by the Client where more than one contractor is involved)

- Plan, manage, monitor and co-ordinate health and safety in the construction phase of a project
- Liaise with the Client and Principal Designer

- Prepare the construction phase plan
- Organise co-operation between contractors and co-ordinate their work
- Ensure suitable site inductions are undertaken
- Take reasonable steps to prevent unauthorised access
- Ensure workers are consulted and engaged in securing their health and safety
- Provide welfare facilities

Contractors (Individuals and companies who carry out actual construction work)

- Plan, manage and monitor the construction works under their control.
- Ensure that works are carried out without risks to health and safety
- On projects involving more than one contractor, co-ordinate their works with others.
- Comply with directions given to them by the Principal Designer or Principal Contractor.
- On single-contractor projects, prepare a construction phase plan

Workers (Persons working under the control of a contractor on a construction site)

- Be consulted about matters that affect their health and safety
- Take care of their own health and safety and that of others who may be affected by their actions
- Report anything which may endanger their own or others' health and safety
- Co-operate with their employer, fellow workers, contractors and other duty holders

1.1.5 The relationship between Permanent Works and Temporary Works design

R.9 of the CDM regulations requires permanent works designers (PWD) to:

- eliminate risk, or, if not reasonably practicable, to reduce risk so far as is reasonably practicable (SFARP).
- provide information on significant residual risks to others (specifically to the principal designer, but also to the contractor) frequently through a Design Risk Assessment.

To be able to do this, a PWD needs to have a good understanding of likely construction techniques and associated temporary works solutions, and awareness of likely construction sequences and potential interim stages where there may be instability, or reliance on adjacent structures, or restrictions on movement or deflection to prevent the permanent works being compromised during construction.

BS 5975 also considers this issue, stating: "The permanent works designer can be expected to have considered the buildability of the structure. The overall design should have taken account of the methods of construction and the space required for the temporary works. The permanent works designer should provide the relevant information – particularly the significant risks involved in construction. The temporary works designer should take this into account in the preparation of the design."

As CDM 2015 does not make any distinction between temporary and permanent works, temporary works designers (TWD) also have to follow these requirements. To do this, TWDs need to have an understanding of the permanent design (i.e. in the pre-construction information) and the means to co-ordinate the temporary works design with the permanent works. To discharge this duty, the PWD must:

- understand how the structure can be constructed and any temporary works erected, used and dismantled safely.
- Determine if by altering or supplementing the permanent works design in some way (SFARP) risk arising from the construction, use or dismantling of the temporary works can be eliminated or reduced
- Consider what useful information should be provided to the contractor

Examples of the ways a PWD can help to reduce the need for temporary works include:

- Consider alternative ways to facilitate lifting and avoid working at height.
- Provide moment connections (even if not required for the permanent design) to provide inherent lateral stability during construction rather than relying on the installation of temporary bracing.
- Make provision for foreseeable cast-in elements to assist the installation of temporary works, avoiding the need to access areas to install fixings retrospectively, particularly when working at height or when access may be difficult.

- Provide enhanced strength above that required for the permanent condition to accommodate predictable interim conditions that may exceed permanent loads, rather than relying on temporary support.
- Ensure adequate space is provided for necessary temporary works activities.
- Consider issues associated with demolition or alteration of existing structures, and the likely interim states of the structures before the permanent condition is achieved.
- Seek advice from the TWD or TWC (if appointed in time) to explore alternative solutions enabling the most effective (safety, cost, time, resources) solution to be adopted.

PWD's should also be aware that where appropriate, the TWC is required to make any resulting temporary works designs available to interested parties, including the designer of the permanent works. Whilst the design may have already been independently checked for compliance with the Design Brief, the permanent works designer is strongly advised to review any designs they receive from the TWC to satisfy themselves that the temporary and permanent works designs are compatible.

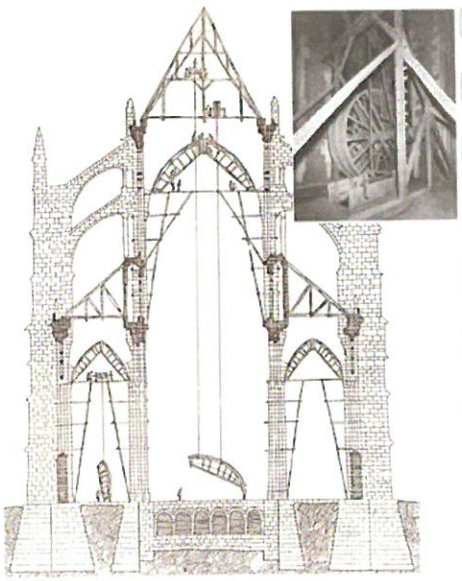
PWD's should also note that even if their appointment from the client does not require them to consider temporary works, the judge in the case of *Hart Investments vs Fidler [2007] EWHC 1058 (TCC)* where a party wall collapsed during the construction of a basement made it clear that:

"If an engineer is involved in the implementation of his design, and he sees something on site which is obviously dangerous, e.g. a wall which is on the verge of collapse, it is his duty to speak up and warn of the danger. Such a duty may not be written into the engineer's brief. It arises as a consequence of the engineer undertaking to provide professional services in a professional manner."

Such a position could equally be created if a PWD could see shortcomings in a temporary works design but failed to voice their concerns.

1.2 An historical perspective of Temporary Work

From the earliest civilisations to the Industrial Revolution, ancient builders used human muscle power and ingenious mechanics to lift weights that would be difficult even with modern cranes today. Typical stones in the Egyptian pyramids weighed only 2-3 tonnes each, but all have occasional individual stones weighing 50 tonnes or more. The temple of Amon-Ra at Karnak contains a labyrinth of 134 columns standing 23 metres tall and supporting cross-beams weighing 60-70 tonnes each.



The 18 capital blocks of Trajan's column in Rome weight more than 53 tonnes and were lifted to a height of 34 metres. The Roman temple to Jupiter at Baalbek contains stone blocks weighing over 100 tonnes, raised to a height of 19 metres. All these examples required extensive temporary works to construct them; from ramps and levers, to complex timber structures with compound pulley systems.

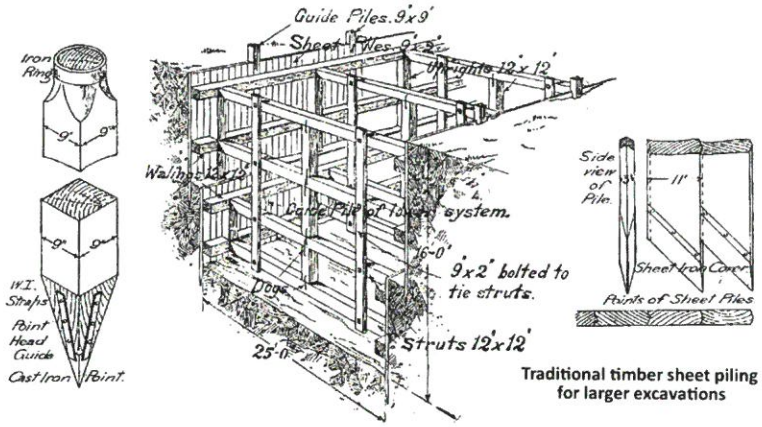
Work at height also seemed to pose little problem – the Alexandria Lighthouse (3rd century BC) stood more than 76 metres tall, with Egyptian pyramids rising to 147 metres, topped in the Middle Ages by 80 large cathedrals and larges churches that reached 160 metres. These were generally constructed with internal timber "treadmill" cranes that were raised with the building, one of which remains in the roof of Canterbury Cathedral.

Undoubtably, there were many disasters in these early days, with collapses and death common, but through the Middle Ages and into the Industrial Revolution, their methods relied on the tried and tested skills of the Master Carpenter, and the structures we see today a testament to their success. With the dawning of the Industrial Revolution steam came to the fore, replacing man- and horse-power, with the first cast-iron crane constructed in 1834, with the breakthrough technology – wire rope, far stronger than previous alternatives – patented the following year. Finally, in 1851, the first steam-powered crane was patented. However, except for unusual projects, the timber remained the staple material for the construction of temporary works well into the third quarter of the 20th century, including scaffolding systems using timber baulks and tied

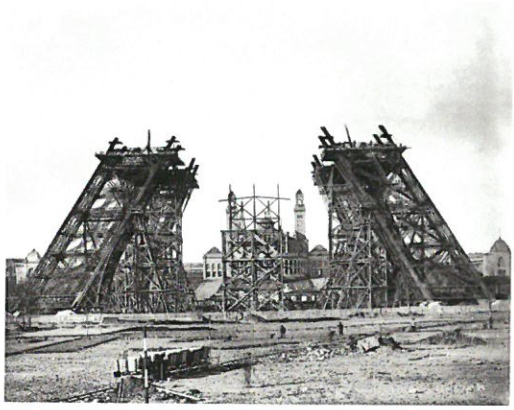
roundwood
poles, although "scaffolding" had started to be replaced with modern metal tubes and fittings during the second world war.

Excavation works had made similar progress. Up to the end of the 19th century, steel-shod wood was exclusively used for the construction of sheet piled walls, driven into the ground by mechanical effort including, in later years, steam hammers. Whilst suitable for shallower excavations, its use was limited by the length that could be driven in one pass, and deeper excavations had to be stepped and extensively strutted. Timber sheet piles also had one major drawback – they did not interlock fully, so piles could easily "wander" if they struck obstructions and had limited resistance to water ingress.

Whilst traditional timber construction continued to be extensively used well into the 20th century, cast iron was quickly trialled and rejected due to its brittle nature, and manufacturers began to look to steel, especially after development of the Bessemer steel process when mills started hot-rolling I-beams, channels, angles, and other structural sections.



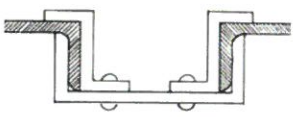
Traditional timber sheet piling for larger excavations



Around 1890, Friestadt-type piling emerged, closely followed by a "universal" clutch system in Great Britain in 1895 that utilised I-beams and special clips to join the flanges of the I-beams together. However, the efficiency of both forms of wall was low as the sections were aligned about their weaker axis. In 1899, Gregson in the United States patented the first bulb and jaw interlock, but again it's success was limited as it had a flat section with little ability to resist lateral loads.

The problem of lateral strength was addressed by Tryggve Larrsen, the State Chief Engineer for the City of Bremen in Germany in around 1902 with the development of a u-shaped section, although the earliest versions had separately-fabricated interlocks that had to be rivetted onto the main section before use. By 1914, the "Larssen Sheet Pile", a rolled steel section with an integral interlocking system, made its debut in Germany, and formed the basis of sheet pile development for many years to come.

By the latter half of the 20th century, the UK construction industry was in it's heyday, with motorway construction in full swing, but it carried a risk of considerable physical danger for those working on its' sites. Health and safety was often a secondary concern, and many temporary structures, for which there were no "design standards", were being erected by less-skilled tradesmen, often without the once-traditional apprenticeship to an experienced master carpenter.


Friestadt Sheet Piling


Universal Sheet Piling


Larssen Sheet Piling

1.2.1The Bragg Report

Following the spate of collapses in the early 1970's, in 1973 the government commissioned Professor Steven Bragg to investigate the technical, safety and other aspects of the design, manufacture, erection, and maintenance of temporary load-bearing falsework. His report, commonly known as the "Bragg Report" (see 6.4) made 27 recommendations that helped to set the standard for design and management of temporary works design and management in the UK.

Bragg's recommendations may be summarized as follows:

1. Recording of all falsework collapse required by Statute
2. Extend the regulations for periodic examination of access scaffold to falsework
3. Lateral stability must be considered in all directions with a minimum considered horizontal load equal to the greater of: the calculated horizontal loads plus 1% of the vertical load, or 3% of the vertical load
4. Overall factor of safety for falsework should not be less than 2.0
5. Design to allow for erection tolerances
6. All falsework must be designed. A proper written brief should be produced
7. Special attention to beam grillages and failure due to rolling over or web buckling
8. Field study of actual applied loads
9. Research into falsework
10. Suppliers of proprietary equipment to provide basis of testing as well as safe working loads
11. More vigilance on materials; testing of new and used to check properties
12. Designed to consider effect of second-hand equipment on the design
13. Design to be approved by a fully qualified engineer
14. Novel designs to be checked by an independent assessor
15. Falsework designs to be reviewed by permanent works designer
16. Rigorous design and check procedures
17. Appointment of Temporary Works Coordinator
18. Improve communication between designer and site
19. Include safe working procedures in all falsework courses
20. Falsework should form part of all civil engineering and architectural courses
21. An understanding of falsework should be part of professional reviews
22. Short courses on falsework should be available to practicing engineers
23. Practical courses in falsework should be available to site operatives
24. The standard and content of the courses should be controlled by the Health and Safety Executive (HSE)
25. Construction organisations directly responsible for falsework must keep a register of certified operators they employ on each site
26. The government should insist that all falsework used on public sector projects is carried out by companies with an adequate training system
27. A falsework handbook and falsework textbook should be produced

1.2.2 BS 5975:1982 and its subsequent development

Although the terms of reference for a new code of practice for falsework had already been set out by the time the Bragg Report was published, it's recommendations were largely adopted, together with a falsework report prepared by the joint committee.

The impact of this new standard, BS5975:1982, was profound: since its adoption, there have been no failures of falsework or excavations on the scale of those experienced in the 1960's and 70's. Subsequent revision of the standard in 2004 and its rewriting in 2008 to formalise the management of a wide range of temporary works and introduce the role of Temporary Works Co-ordinator, has led to its widespread acceptance as a Best Practice document for the management of Temporary Works on construction projects.

Whilst this document has no legal standing – it is an optional "Code of Practice" which can be implemented (or not) by choice rather than a mandatory "Statutory Instrument" which industry is legally obliged to obey – it's widespread acceptance as a Best Practice document means that persons falling short of its recommendations and procedures whilst carrying out temporary works activities are at the risk of being considered to not have taken all reasonable steps to fulfil their legal obligations to prevent harm to their workforce and others.

1.3 Legal compliance and the BS 5975 Temporary Works approach

Under the Health and Safety at Work etc Act 1974 everyone has to ensure, so far as is reasonably practicable*, the health and safety of themselves and others who may be affected by what they do or do not do. Section 2 of the Act

states:

(1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.*

(2) Without prejudice to the generality of an employer's duty under the preceding subsection, the matters to which that duty extends include in particular—

(a) the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health;

(b) arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;

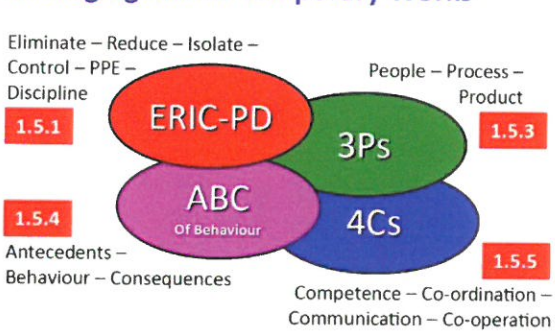
(c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of his employees;

(d) so far as is reasonably practicable as regards any place of work under the employer's control, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of means of access and egress from it that are safe and without such risks;

(e) the provision and maintenance of a working environment for his employees that is, so far as is reasonably practicable, safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.

*HSE definition of "reasonably practicable": Balancing the level of risk against the measures needed to control the real risk in terms of money, time or trouble. However, you do not need to take action if it would be grossly disproportionate to the level of risk. (HSE website)

The Management of Health and Safety at Work Regulations 1999 also apply to every work activity and workplace, including temporary works, and require all risks to be assessed and, where necessary, controlled. It also requires employers to appoint one or more competent people to help them meet the measures they need to take to comply with the legal requirements.



1.3.1 The Construction (Design and Management) Regulations 2015 (CDM)

Regulation 2 generically and exhaustively defines all forms of temporary works as a "structure" falling under the auspices of the CDM Regulations as follows:

"Structure" means:

(a) any building, timber, masonry, metal or reinforced concrete structure, railway line or siding, tramway line, dock, harbour, inland navigation, tunnel, shaft, bridge, viaduct, waterworks, reservoir, pipe or pipeline, cable, aqueduct, sewer, sewage works, gasholder, road, airfield, sea defence works, river works, drainage works, earthworks, lagoon, dam, wall, caisson, mast, tower, pylon, underground tank, earth retaining structure or structure designed to preserve or alter any natural feature and fixed plant;

(b) any structure similar to anything specified in paragraph (a);

(c) any formwork, falsework, scaffold or other structure designed or used to provide support or means of access during construction work,

Regulation 4 requires a client to make suitable arrangements for managing a project, including the allocation of sufficient time and other resources. Arrangements are suitable if they ensure that the construction work can be carried out, so far as is reasonably practicable, without risks to the health and safety of any person affected by the project.

Regulation 8 establishes the competencies of the various parties stating *"A designer (including a principal designer) or contractor (including a principal contractor) appointed to work on a project must have the skills, knowledge and experience ... necessary to fulfil the role they are appointed to undertake, in a manner that*

secures the health and safety of any person affected by the project." and goes on to state *"A designer or contractor must not accept appointment to a project unless they fulfil the(se) conditions."*

Regulation 9 requires designers to eliminate as far as reasonably practicable foreseeable risks to the health and safety of any person carrying out or liable to be affected by construction work. Where risks cannot be eliminated, designers are required to reduce or control risks through the design process, to provide information about those risks, and to ensure appropriate information is included in the health and safety file.

Regulation 12 requires the drawing up of the construction phase plan setting out the health and safety arrangements sufficient to ensure that the construction work is carried out, so far as is reasonably practicable, without risks to health and safety.

Regulation 13 requires that the principal contractor plan, manage and monitor the construction phase and co-ordinate matters relating to health and safety during the construction phase to ensure that, so far as is reasonably practicable, construction work is carried out without risks to health and safety.

Regulations 14 to 16 deals with the general requirements and duties of the principal contractor, but **Regulation 15(7)** specifically requires that a contractor must not employ or appoint a person to work on a construction site unless that person has, or is the process of obtaining, the necessary skills, knowledge, training and experience to carry out the tasks allocated to that person in a manner that secures the health and safety of any person working on the construction site.

Regulation 17 requires that, so far as reasonably practicable, there must be suitable and sufficient access and egress from every construction site and every place construction work is being carried out, and construction sites must be made and kept safe for, and without risks to, the health and safety of a person at work there.

Regulation 19(1) requires all practicable steps to be taken to ensure that any new or existing structure does not collapse if due to the carrying out of construction works it may become unstable or is in a temporary state of weakness or instability. **Regulation 19(2)** further states that any buttress, temporary support or temporary structure must be of such a design and installed and maintained so as to withstand any foreseeable loads which may be imposed on it, and only used for the purposes for which it was designed.

Regulation 20 requires demolition or dismantling of a structure to be planned and carried out in such a manner to prevent danger or, where it is not practicable to prevent it, to reduce danger to as low a level as is reasonably practicable and requires that arrangements for carrying out such demolition and dismantling be recorded in writing before the demolition and dismantling work begins.

Regulation 21 deals with explosives and requires that steps are taken to prevent harm to persons from planned explosions or from projected or flying materials caused by the explosion.

Regulation 22 recognises the danger inherent in excavation works and deals in some detail with the control of risk. **R.22(1)** requires all practicable steps to be taken to prevent danger to any person including where necessary the provision of supports or battering to ensure that no excavation or part of an excavation collapses, no material forming the walls or roof of, or adjacent to, and excavation is dislodged and falls, and that no person is trapped in an excavation by material which is dislodged and falls. **R.22(2)** further requires that persons, plant and materials are prevented from falling into excavations, and **R.22(3)** requires steps to be taken to prevent an excavation or ground adjacent to it being overloaded. **R.22(4)** establishes inspection requirements before construction work is carried out, and **R.22(5)**

prohibits the carrying out of construction works if a R.22(4) inspection finds the arrangements to be unsatisfactory.

Regulation 23 requires cofferdams and caissons to be of suitable design and construction, appropriately equipped so that workers can gain shelter or escape if water or materials enter it, and that it is properly maintained. The regulation further requires the works to be inspected and prohibits the carrying out of construction works if the inspection finds the works to be unsatisfactory.

Regulation 24 requires that a report is prepared for any unsatisfactory inspections carried out under Regulations 22 and 23, and that the report is made available for inspection by the HSE for 3 months after completion.

Regulation 25 deals with requirements when working on or adjacent to energy distribution installations to prevent the risk of electrocution.

Regulation 27 requires construction sites to be organised in such a way that, so far as is reasonably practicable, pedestrians and vehicles can move without risks to health or safety.

1.3.2 The Work at Height Regulations 2005 (WAHR)

Regulation 4 requires that every employer shall ensure that work at height is properly planned, appropriately supervised, and carried out in a manner which is so far as reasonably practicable safe. The Regulation further requires that work at height is only carried out when weather conditions do not jeopardise the health or safety of the persons involved in the work.

Regulation 5 requires all persons engaged in the organisation, planning or supervision in relation to working at height to be competent, or supervised by a competent person.

Regulation 6 requires risks to be minimised by: Taking account of a risk assessment carried under Regulation 3 of the Management Regulations

- Ensuring that work is not carried out at height if it is practicable to carry out the works otherwise.
- Taking suitable and sufficient measures to prevent, so far is reasonably practicable, any person falling a distance liable to cause personal injury.
- Ensuring the work can be carried out safely, or otherwise providing sufficient work equipment to prevent,

  so far as is reasonably practicable, a fall occurring.
- If the risk of a fall cannot be eliminated, employers shall provide sufficient work equipment to minimise the distance and consequences of a fall, or if it is not reasonably practicable to minimise the distance, to minimise the consequences of a fall, and to provide training in the use of that equipment.

Regulation 7 gives collective protection work equipment to take priority over personal protection, taking account of:

- Working conditions and risks to safety at the place where the equipment is to be used.
- In the case of equipment for access and egress, the distance to be negotiated
- The distances and consequences of a potential fall
- The duration and frequency of use
- The need for easy and timely evacuation and rescue in an emergency
- Any additional risks associated with the installation and removal of the equipment, or evacuation

and rescue from it.

Equipment selected for working at height should be the most suitable to comply with Regulation 6, appropriate to the nature of the work to be performed and the foreseeable loadings and allow passage without risk

Regulation 8 sets down how work equipment should be used, and **Regulation 9** how to deal with fragile surfaces.

Regulation 10 sets down requirements to prevent harm from falling objects:

- So far as reasonably practicable, falls of materials or objects that may harm persons should be prevented
- Where not reasonably practicable, steps must be taken to prevent a person being struck falling materials or objects liable to cause injury.
- Materials or objects should not be thrown or tipped from height where it is liable to cause injury to a person.
- Materials and objects should be stored carefully to prevent risk to any person from collapse, overturning or unintended movement.

Regulation 11 requires that where there is an area where a person may fall a distance or be struck by a falling object, the area should be equipped with devices preventing unauthorised access, and appropriately signed.

Regulations 12 and 13 requires work equipment to be inspected after installation and before use, and at specified times and circumstances for different types of work equipment.

Regulation 14 requires persons to report to their supervisor any activity or defect which may cause injury to any person, and to use the safety devices provided.

1.3.3 Provision and Use of Work Equipment Regulations 1998 (PUWER)

PUWER applies to the provision and use of all work equipment, whether it is new, existing or second-hand, and applies to all work situations where the Health and Safety at Work Act applies, including specified offshore areas and activities. In addition to the Regulations themselves, the HSE has published an Approved Code of Practice (ACOP) clarifying how the Regulations are to be applied.

Regulation 4 requires all work equipment to be suitable for the purpose for which it is used or provided, taking into account the place where it will be used and the way in which it will be used, including ergonomic risks to operatives, and any resulting emissions from its use.

Regulation 5 further requires such equipment to be maintained so that it remains safe.

Regulation 6 deals with inspection of work equipment and requires that when work equipment is first installed, and when it is moved or relocated it is inspected by a competent person to make sure that it has been correctly installed and is operating safely.

Where it is possible that the equipment is exposed to conditions that could cause it to deteriorate, the Regulations require it to be inspected regularly.

Where the use of work equipment is likely to involve a specific health and safety risk,

Regulation 7 requires that only people trained in the use of that equipment use it. The ACOP (Para 107) gives priority to removal of such risks, rather than control through training.

Regulation 8 builds on the HSW Act requirement that employers to provide workers with the information and instruction necessary to protect their health and safety including the way and conditions in which the work equipment can be used, and any foreseeable difficulties and how to deal with them. This can include written information, signage, warning labels, training manuals, other instruction, and courses.

Regulation 9 requires employers to ensure that persons who use, or supervise persons using, work equipment have received appropriate training in the use of that equipment. The ACOP (Para 132) makes specific reference to the need for driver training for self-propelled work equipment.

Regulation 10 builds on the obligations placed on everyone associated with the supply of new work equipment by the HSW Act to ensure that it is safe by extending this obligation to the users of new work equipment.

Regulations 11, 12 and 13 deals with the prevention of persons entering any danger zones associated with work equipment, such as guards or other protection devices, but also identifies the need to control specific hazards including articles or substances falling or being ejected from equipment, and the use of high or very low temperature equipment that has the potential to burn, scald or sear.

Regulations 14 to 19 deal with the need to have appropriate controls and control systems to ensure safe operation of equipment.

Regulation 20 places an obligation to ensure that work equipment is stable for the purposes of health and safety, so that it cannot topple over, overturn or collapse in use. Para 210 of the guidance notes makes specific mention to the use of outriggers for access platforms, and that such equipment should always be used within the limits of its stability at all times.

Regulation 21 requires adequate lighting for the safe use of work equipment,

Regulation 22 safe conditions for its maintenance, and

Regulations 23 & 24 dealing with safety markings and warning signs.

Regulations 25-30 deal with mobile work equipment and require:

- No-one is carried on mobile work equipment unless it is designed for carrying persons and it incorporates features to reduce AFARP risks to safety including from wheels and tracks. Guidance clause 249 makes specific reference to Falling Object Protective Structures (FOPS).
- That the risk of rolling over is minimised, and that risk is controlled by restraint should this happen.
- That it should be prevented from unauthorised start-up, for example by key, provided with devices for stopping and braking, including readily accessible or automatic stop systems in the event of failure, have adequate fields of vision for the driver, and if provided for night use or use in dark places, adequate lights.
- That remote-controlled mobile work equipment automatically stops when it leaves the control range.

1.3.4 The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)

LOLER and its Approved Code of Practice builds on the requirements of PUWER with respect to the use of lifting equipment provided as work equipment and applies in all places and situations covered by PUWER. Lifting equipment is defined as:

"Work equipment for lifting or lowering loads and includes its attachments used for anchoring, fixing, or supporting it"

The Management Regulations require risks to be identified. When considering the risks from a particular piece of lifting equipment or lifting operation, the following should be considered:

(a) The type of load being lifted, its weight, shape and what it consists of.
(b) The risk of a load falling, moving, breaking up or striking a person or object and the consequences
(c) The risk of lifting equipment striking a person or an object and the consequences
(d) The risk of the lifting equipment failing or falling over while in use and the consequences
(e) The risk of damage to the lifting equipment that could result in failure

New lifting equipment must satisfy certain essential Health and Safety requirements laid down in Article 100a Product Safety Directive. Existing equipment is not required to meet this level of protection, but this will depend upon the degree of risk and the steps necessary to control it.

Regulation 4 requires the employer to ensure that the load they are planning to lift does not exceed the limits for strength or stability of any part of the lifting equipment. ACOP Para 107 clarifies that mobile lifting equipment including equipment that can be dismantled and reassembled at different locations is used in such a way to ensure stability during use in all foreseeable conditions including the nature of the ground and other surfaces on which the equipment might be used. Such equipment might include: mobile cranes, forklift trucks, telescopic handlers, tower cranes, construction site hoists and mast-climbing work platforms.

Regulation 5 applies to lifting equipment used to lift people (such as MEWPs) to prevent them being crushed, trapped or struck, and to ensure that any person trapped in a carrier is not exposed to danger and can be freed.

Regulation 6 requires lifting equipment to positioned to minimise the need to lift loads over people, and if traveling or slewing to prevent trapping points, or to take effective measures to prevent people gaining access to trapping points. The regulation further requires measures to prevent a freely suspended load from moving an an uncontrolled manner and fitted with suitable devices to prevent a load from falling freely. Where a load is in danger of falling in an uncontrolled manner because of power failure, measures must be taken to avoid consequential risks to people. Regulation 6.2 requires employers to ensure a person cannot fall down a shaft or hoist way, with ACOP Paras 180 & 181 requiring gates or interlocking control devices to ensure access and egress can only be gained when equipment is at a landing, for example on a site hoist.

Regulation 7 requires the safe working load to be clearly marked on each piece of lifting equipment or accessory, and that where lifting equipment is not designed for lifting people but it could be used for this purpose, it should be clearly marked that it should not be used for lifting people.

Regulation 8 requires that each lifting operation ("*an operation concerned with lifting or lowering a load*") should be properly planned by a competent person, appropriately supervised, and carried out in a safe manner. The ACOP at this point makes particular reference to exclusion zones around lifting operations to protect people from injury as a result of any failure during the lifting operation. To comply with the ACOP, only a competent person should sling a load and act as a signaler on a lift. Where affected, weather and other environmental conditions including ground conditions should also be taken into account.

Regulation 9 requires all lifting equipment to be subject to "thorough examination" at various points, the frequency of which depends on the degree of deterioration the equipment might be subject to, and risks associated with the purpose for which the equipment will be used including:

- After assembly and being put into service for the first time
- After assembly and being put into service at a new site or in a new location
- At least every 6 months where lifting equipment might carry persons
- At least every 12 months for other lifting equipment
- Each time that exceptional circumstances might jeopardise the safety of the equipment.

The regulation further requires that if appropriate, the equipment is inspected by a competent person between thorough examinations, and that no equipment from any source is used for lifting unless it is accompanied by physical evidence that the last thorough examination required under this Regulation has been carried out.

Regulation 10 requires a person carrying out a thorough examination to notify the employer of any defect in lifting equipment which is or could become a danger to persons. As soon as is reasonably practical, a written and signed report of thorough examination should be produced, and in the event of a defect being noted that involves an existing or imminent risk of serious personal injury, a copy of the report should be sent to the relevant enforcing authority. A person carrying out an inspection between thorough examinations should also make a report in writing and notify any defects to the employer. Where an employer has been notified of a defect, he shall ensure that the equipment is not used before the defect is rectified.

Regulation 11 requires employers to retain information relating to thorough examinations, inspections, etc. until they cease to use the equipment or for a period of two years from the date of the record, whichever is later.

1.3.5The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR)

A key recommendation of the Bragg Report was that all failures of falsework should be recorded by Statute. This, and more, has been included in **Regulation 7** (Dangerous Occurrences) of RIDDOR as follows:

Schedule 2 Part 1: Collapse of Scaffolding

18. The complete or partial collapse (including falling, buckling or overturning) of -

a) a substantial part of a scaffold more than 5 metres in height

b) any supporting part of any slung or suspended scaffold which causes a working platform to fall (whether or not in use); or

c) any part of any scaffold in circumstances such that there would be a significant risk of drowning to a

person falling from a scaffold.

Schedule 2 Part 2: Structural Collapse

23. The unintentional collapse or partial collapse of -

a) any structure, which involves a fall of more than 5 tonnes of material; or

b) any floor or wall of any place of work

24. The unintentional collapse or partial collapse of any falsework.

Should such an occurrence take place, the responsible person must notify the relevant enforcing authority of the incident by the quickest practicable means without delay and send a report of that incident in an approved manner to the relevant enforcing authority within 10 days of the incident.

1.4 Contract law and the BS5975 Temporary Works approach

A contract is a voluntary arrangement between two or more parties that is enforceable at law as a binding legal agreement. A contract arises when both parties agree that there is an agreement. Formation of a contract generally requires an offer, acceptance and a consideration (ie payment) and a mutual intent to be bound.

The majority of construction works in the UK are carried out under some form of standard or bespoke contract, setting down the agreed obligations and responsibilities of all parties to the contract. Whilst this is a legal document, it is a private legal agreement that must act within the bounds of the UK's legal framework (Statutory Law), the requirements of which will always take precedence over contract law and cannot be used to defend against a failure to comply with a Statutory obligations such as those contained in the preceding section.

Statutory law **ALWAYS** takes precedence over contract law!

However, contracts may contain specific roles and responsibilities for designers, contractors and subcontractors regarding their role in the management of Temporary Works. For example, a specialist subcontractor may be required to provide an experienced and competent Temporary Works Supervisor to assist the Temporary Works Co-ordinator in the checking of their works, or the permanent works designer may be required to check and approve temporary works designs prepared by other parties.

Regarding this latter point, irrespective of the terms of the contract and whether or not it was agreed in good faith, if the permanent works designer is not competent to check the temporary works design, Regulation 8 of the CDM Regs prevents them from fulfilling this function, and the Temporary Works Co-ordinator must ensure that a competent person checks the temporary works design ... although the permanent works designer may find them paying the cost of this if it was agreed in their contract!

1.5 Avoiding failure – managing risk in temporary works

The original purpose of Bragg report in 1975 was to understand the events that led to the spate of failures in the early 1970's, and to develop a set of rules that would help to control the risk of such failures being repeated in the future. The Bragg recommendations, codified in BS 5975:1982, gave the construction industry a robust risk management approach to managing temporary works that if properly implemented, should lead to safe working practices and minimise the risk of further major failures. Whilst this is primarily a "safety management" approach, adhering to it is also a sensible commercial / business management approach, as well as demonstrating "best practice" in the event of a temporary works incident.

1.5.1 Risk reduction & "ERIC"

Risk management for temporary works should follow exactly the same principles as that for permanent works, including the preparation of Risk Assessments and Method Statements (RAMS) covering assembly, use, maintenance and dismantling of the temporary works using the familiar NEBOSH "ERIC" approach: **Eliminate – Reduce – Isolate – Control**, often expanded as "ERIC-PD", adding PPE and Discipline. Variants on this theme include:

Avoid (E) – Minimise (R) – Engineering controls (I & C) – Administrative controls (P & D) but essentially, they are all the same thing.

Eliminate – change the activity to remove the hazard whilst maintaining end product

Reduce – reduce exposure, or substitute with a less hazardous one
Isolate – physically separate the hazards from those at risk, for example machine guards or edge protection
Control – install additional machinery to control the risk, such as local exhaust ventilation, safety netting, or implement other safe systems of working.
PPE – the last resort, personal rather than collective protection
Discipline – clear communication of site rules, signage, setting a good example to others.

1.5.2 The "3P's" - People, Process and Product

Managing activities to minimise the risk of failure in many situations frequently relies upon three key elements, the first two of which are the commonest causes of unsafe working on a construction site:

People: competent people, confidently and effectively carrying out their role

Process: robust, logical processes, to help people manage tasks effectively

Product: the right equipment for the job, properly designed, used, and maintained.

The latest version of the CDM regulations recognises five elements to judge the competence of an individual to carry out a role: skills, knowledge, training, experience and organisational ability, giving the construction industry clear guidance to assess that project teams, including those involved in temporary works, as having the right attributes to deliver a safe and healthy project. Ensuring the right people in the right role is an essential step to a successful project, with the competency of the TWC a key factor.

To help a competent TWC be effective, they need to be supported by robust procedures that give them the responsibility and opportunity to effectively manage the works, to help them identify issues and plan ahead, and enforce a strategic process through design, including design reviews, checking, installation, use and removal of the works on completion. This process should ensure adequate time, definite actions, good documentation recording compliance and progress, and clarity and assurance that the works have been performed in accordance with the original brief. The BS 5975 process forms the basis of such a procedure.

The third element, product, is the actual physical manifestation of the works on site, whether a standard, off-the-shelf solution using readily available commercial components, or a bespoke design specifically constructed for the project. A key issue to be addressed, especially with off-the-shelf components that may have been use many times before, is the condition of the equipment provided and assurance that it complies with the original specification with regards to size, grade, strength, proof load etc. Ensuring this is so is a key role for the TWS for the works in question, as is the assembly to the approved design. Of the three elements, due to the supervision and control exercised on today's construction projects, the "product" itself is the one least likely to cause concern.

1.5.3 The ABC of Behavior

However, no matter how well the "3P" elements are put into place, the appropriate behavior of the individuals concerned is paramount for success. The *ABC Model of Behavior* is one way of representing this:

Antecedents: Causal events or triggers that precede the behavior
Behavior: The observable thing that someone does or doesn't do
Consequences: Outcome of the behavior that influences whether the behavior will be repeated

Psychological research has shown that behavior is linked to the most positive consequence for the individual exhibiting the behavior, irrespective of the consequences to others. Safer behavior can be promoted most strongly by positive reinforcement (positive feedback, recognition, praise, prizes, incentives) rather than negative feedback (avoidance of disapproval, loss, pain or other penalty), and far more effectively than punishment (blame, loss of benefits, disciplinary action, pain, injury, guilt)

By communicating the positive consequences of managing temporary works properly, the behavior of those involved is likely to result in better compliance with management systems, and a safer site.

1.5.4 The "4C's" - Competence, Co-ordination, Communication and Co-operation.

A "competent person" is defined in BS 5975 as:

"a *person with sufficient knowledge of the specific tasks to be undertaken and the risks which the work will entail, and with sufficient experience and ability to enable them to carry out their duties in relation to the project, to*

recognise their limitations, and to take appropriate action in order to prevent harm to those carrying out construction work, or those affected by the work."

One of the key activities of the TWC is to identify and manage the interfaces between the Permanent Works team (Client, Design team, Contractor, etc) and the Temporary Works team (Designers, Checkers, Specialist contractors, etc) to ensure that there is adequate communication, co-ordination and co-operation between the different parties. Such a role requires specific competencies in a TWC (covered in detail in Section 3.2) and it is essential that the DI satisfies themselves that a proposed TWC is competent to carry out this aspect of the role before appointing them.

Co-ordination of the temporary works is a key role of the TWC, performing an essential CDM Principal Contractor responsibility in the management of the project. It is not uncommon for one organisation to perform a design, another to supply the necessary equipment, and a third to assemble the equipment on site. This requires co-ordination not only of all elements of the temporary works themselves, but also their interactions with other activities that need to complete to permit temporary works to progress, other activities in progress whilst the temporary works are installed, used, and dismantled and those following that may have been affected by the temporary works, such as groundworks affected by temporary works foundations left in place on completion.

One of the main aims of any method of work should be to minimise the chance of errors being made and to maximise the chance of errors being discovered if they are made. To this end there needs to be effective communication of information and requirements between all levels of construction organisations involved in the scheme, irrespective of whether they are concerned with permanent or temporary works. With temporary works, communication tends to be a key issue due to the many separate activities and interactions that may be separated by time and place, and a robust system with deliberate check and hold points (such as the issuing of Design Check Certificates, and the Permits to Load / Unload in the BS 5975 methodology) tends to support broad communication between interested parties in order to progress the works in a timely manner.

Ensuring co-operation between contractors working on a site is a key function of a Principal (or Main) Contractor, and the TWC as a member of the PC's site team performs an essential role in achieving this with regards to the temporary works and their interactions with other site act activities. This can include the need to carefully schedule and plan the works to ensure that the works progress in a timely manner, that all the necessary information and preparations are in place to allow the issuing of certificates and permits at the various hold points, and that all the TWS's and operatives from the various parties understand the plan for the installation and use of the works, and the need to cooperate with each other to achieve a safe and satisfactory outcome.

SECTION 2 – BS 5975: Temporary Works Procedures

BS 5975 temporary works procedures apply to "engineered solutions" used to support or protect existing and new structures, items of plant or equipment, the sides of excavations during construction, or to provide access. The purpose of the procedures is to minimise the chance of errors being made in design, installation, use, maintenance or dismantling, and to maximise the chance of errors being discovered if they are made.

The procedures are a methodical approach to the management of temporary works to ensure that the works on site are the subject of careful direction, supervision and checks to ensure that the temporary works structure is constructed safely in accordance with the agreed design with materials of agreed quality, and that only when all checks have proved satisfactory is the structure first loaded, and later dismantled to an agreed procedure.

Temporary works activities may be widely

separated in time and place and therefore
it is essential that lines of communication and responsibility are explicit. The BS 5975 procedures represent a methodical approach to temporary works enabling comprehensive records to be maintained.

Whilst these procedures are an optional "code of practice", statutory legislation (see 1.3) does require certain actions of anyone carrying out temporary works including:

a) clients to provide pre-construction information
b) principal contractors to prepare a construction phase plan (which should include appropriate rules and reference to relevant risk assessments and any method statements)
c) designers to provide adequate information about any significant risks associated with the permanent works, e.g. drawings, specifications and site investigations used in the design of the permanent works, data sheets, suggested construction sequences and other information showing particular constraints to the construction process
d) Principal Contractors / Principal Designers to take reasonable steps to ensure co-operation between permanent works and temporary works designers
e) the co-ordination of design work, e.g. design reviews
f) appointment of a competent adequately resourced principal contractor
g) appointment of competent and adequately resourced contractors
h) the production of job-specific risk assessments, as required, for specific structures
i) the erection, use, maintenance and dismantling of the temporary works in a co-ordinated sequence and controlled manner

Adoption and implementation of the BS 5975 approach to temporary works, either as written by by incorporating it into a company's own works procedures, fulfils these requirements.

2. 1 Organisational arrangements

Every organisation involved in temporary works should have a designated individual (DI) responsible for the establishment, implementation and maintenance of a procedure for the control of temporary works for that organisation and ensuring that any sub-contractors who carry out temporary works have adequate temporary works procedures; for example, the Chief Engineer, or the Engineering / Operations Director. The procedure should cover the management of the design process and include measures for ensuring that the design function and the roles of the temporary works co-ordinator and temporary works supervisor are carried out by competent individuals

On every site it is important to establish the lines of responsibility and the scope of works for all organisations and individuals who will be involved in any aspect of temporary works, and it is expected that principal contractors under the CDM Regulations (or main contractors otherwise) will appoint a Temporary Works Co-ordinator responsible for the implementation of the organisation's Temporary Works procedures, and those of all other contractors directly or indirectly employed on the site. One or more Temporary Works Supervisors may be appointed to assist the Temporary Works Co-ordinator.

The contractor's procedure should ensure that responsibilities are clearly defined and specifically allocated, particularly in the case of the Temporary Works Co-ordinator (See Section 3) and Temporary Works Supervisor(s) (See Section 4), and that documented records of responsibilities allocated, instructions given, and actions taken are maintained. In practice, this is likely to result in a written letter of appointment for each of these roles, setting down duties and responsibilities, and written confirmation of acceptance of that role by the person appointed.

2.2 Organisational interfaces

The Temporary Works Co-ordinator is responsible for identifying and managing the organisational interfaces that result from the various designers', suppliers' and contractors' involvement in the various stages of the development of a temporary works scheme, from ensuring adequate communication, referral and discussion during the design stages, to managing the physical interfaces between different trades during the installation of the scheme. In managing these interfaces, the Temporary Works Co-ordinator is expected to retain an overview of the whole scheme to ensure that the contractor's temporary works procedures are properly applied, and each step properly completed, and that the interfaces do not adversely affect the scheme.

Details of the interfaces should be included in the contractor's Construction Phase Plan.

2.3 Arrangements for small sites

Where work is being carried out at several small sites, a Temporary Works Supervisor with an appropriate level of authority may be appointed for each individual site, under the overall responsibility of a single Temporary Works Co-ordinator.

2.4 Temporary Works Register

BS 5975 refers to a Temporary Works Co-ordinator having to "*ensure a temporary works register is established and maintained*" as one of their duties but is not specific about the content or format of the register – the implication being that it can be structured and formatted to suit the organisation's or project's operational requirements. The purpose of the temporary works register is to ensure that all temporary works on a project are identified, and properly managed.

Information that should be recorded in a Temporary Works Register includes:

- A brief description each element of Temporary Works
- The BS5975 design check category for each element
- Records of temporary works drawings, calculations and other relevant documents
- The name of the TW designer and the TW design checker
- The name of the Temporary Works Supervisor for each element of the works
- Dates when each of the various milestones have been passed

... etc., to suit the project or organisation.

Temporary works registers are not "static" documents – once started they should be regularly reviewed and updated as necessary as the project progresses.

TEMPORARY WORKS REGISTER

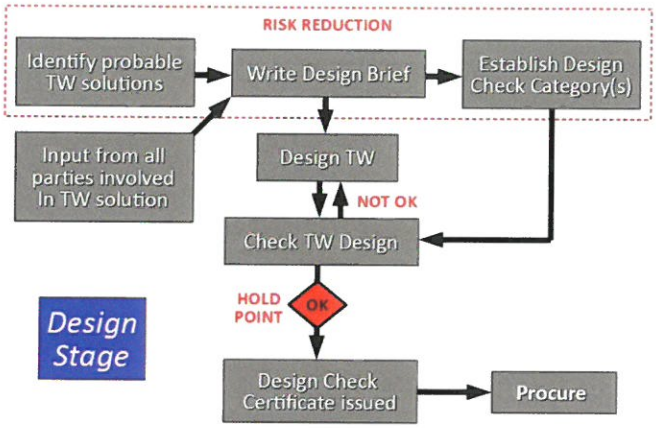
PROJECT:	Chichester Festival Theatre	PREPARED BY:	PWR	CHECKED BY:	AM	DATE:	20/5/2013	TWC:	PWR. (TITAN)

				DESIGN							SITE							
REF	DESCRIPTION	RISK (H/M/L)	START ON SITE DATE	BRIEF BY	DESIGN REQUIRED BY	BRIEF SENT TO TWD	TW DESIGNER	TWD CHECKED BY	DATE CHECKED	TWD RECEIVED ON SITE	RAMS CHECKED	TWC BRIEF TWS / SUPERVISORS	TW INSPECTED	USE PERMIT ISSUED	ALTER PERMIT ISSUES	DISMANTLE PERMIT ISSUED	MATERIALS CHECK (RE-USE)	COMMENTS
1	SCAFFOLD ACCESS TO BASEMENT.	L	26/5	PWR	28/5	20/5	SGB CUMBRIA	Andrew SMART	23/5	24/5	26/5	26/5	29/5	29/5	N/A.	6/6	6/6	CUMBRIA MOVED TO FIRST FLOOR.
2	HOIST IN SCENERY LIFT SHAFT	L	8/7	AG (Mitchell)	30/6	15/6	H.E. LIFTING	Tony Boyle	28/6	28/6	9/7	12/7	12/7	15/7	N/A	28/8	N/A.	LOLER T.E. 15/7
3	HIGH LEVEL ACCESS G+1	L	5/10	AM	30/9	5/9	AMBER SCAFFOLDING											
4	HOIST G+1 TO HIGH LEVEL ACCESS	L	5/10	AM	30/9	5/9	H.E. LIFTING											
5	SILO BASE (N.E CORNER)	L	28/5	PWR	21/5	21/5 MEET ON SITE	C.P.I.	Eugene HOLT	23/5	24/5	23/5	23/5	27/5	28/5	N/A	IN-SITU DEMOLITION AFTER USE.	N/A	BASE TO BE BLOCKED UP
6																		
7																		
8																		
9																		

t: 0115 8970 529
e: training@essentialsiteskills.com w: www.essentialsiteskills.co.uk
Monarch House ▪ Chrysalis Way ▪ Eastwood ▪ Nottingham ▪ NG16 3RY

2.5 Design Brief

The design brief is the starting point for all subsequent decisions regarding a temporary works scheme, and all concerned with its construction should contribute. The brief should include all data relevant to the temporary works, and it should be prepared in sufficient time to enable all subsequent activities such as design, design, check, procurement, installation and checking to take place before the works are needed on site.



Information may need to be drawn from many sources to prepare a design brief, such as in page 106 of this handout:

The design brief should be provided to the temporary works designer irrespective of which organisation they belong, and when the design has been completed, the design brief should be included in the package of information provided to the design checker.

2.6 Design of Temporary Works

The design should be based upon the design brief, but it should be recognised that the designer may not be able fully accommodate the design brief due to alterations, modifications, or the final details for the permanent design or construction operations. Under these circumstances, the designer should draw to the attention of the TWC any proposed modifications that are necessary.

The design of temporary works should be carried out with the same rigour as the design of the permanent works, and should encompass issues such as:

- Requirements for foundations, positions of components, and the nature of connections.
- Limitations for loading and sequencing of operations.
- Residual risk assessments and design statements.
- The variability of materials, workmanship, site conditions and tolerances.
- The ease and safety of erection and dismantling of the temporary works.
- Issues of buildability or compatibility brought to the designer's attention by the PWD.

A number of different arrangements or solutions are likely to satisfy the design brief and should be considered on merit prior to selection of the preferred option, for example whether to proceed with a bespoke design or adopt a "standard solution" - a decision that may be influenced by such matters as availability of material and the experience of the supervisory and construction workforce.

If a standard solution is adopted, those responsible for making the final choice should ensure that they understand and take full account of the limitations of these designs so that they ensure they will only be used under appropriate circumstances. Those who select a particular standard solution should also be aware that they attract the responsibilities and duties of a "designer" under the CDM Regulations 2015.

Designers should also be aware that temporary works by their nature consist of a great many components, junctions and connections. Careful attention should be paid to the way such connections and junctions are detailed to reduce dependence on workmanship and checking on site. Detailing should also be such as to avoid the risk of progressive collapse should a local collapse occur.

2.7 Design Checks

Prior to the commencement of construction work, a design check should be carried out by a competent person. The ability of the checker and their remoteness or independence from the original designer should be greater where designs are complex or involve new ideas. Table 1 in BS 5975 (below) illustrates this principle.

BS 5975+A1:2019 Table 2: Categories of design check			
Category	**Scope**	**Comment**	**Independence of checker**
0	Restricted to standard solutions only, to ensure the site conditions do not conflict with the scope or limitations of the chosen standard solution. These may be included in standard trench boxes	This applies to the use of standard solutions* and not the original design, which will require both structural calculation and checking to category 1, 2 or 3, as appropriate.	Because this is a site issue, the check may be carried out by another member of the site or design team.
1	For simple designs. These may include: formwork; falsework; needling and propping to brickwork openings in single storey construction.	Such designs should be undertaken using simple methods of analysis and be in accordance with the relevant standards, supplier's technical literature or other reference publications.	The check may be carried out by another member of the design team.
2	On more complex or involved designs. Designs for excavations, for foundations, for structural steelwork, for reinforced concrete.	Category 2 checks would include designs where a considerable degree of interpretation of loading or soils' information is required before the design of the foundation or slope.	The check should be carried out by an individual not involved in the design and not consulted by the designer.
3	For complex or innovative designs, which result in complex sequences of moving and/or construction of either the temporary works or permanent works.	The designs include unusual designs where significant departures from standards, novel methods of analysis, or considerable exercise of engineering judgement are involved.	The check should be carried out by another organisation.

** A "standard solution" is an off-the-shelf tried and tested design supported by existing calculations or from safe load information, for example a standard scaffold configuration from TG20:21.*

The HSE, in their internal guide to Temporary Works for their own staff (SIM 02/2010/04) have also provided examples of relative risk, but categorised as Low, Medium and High risk:

Low (Cat 0-1)	Standard scaffold. Formwork less than 1.2m high. Hoarding and fencing up to 1.2m high. Simple propping schemes (1 or 2 props). Internal hoarding systems and temporary partitions not subject to wind loading. Shallow excavations less than 1.2m deep/high.
Medium (2)	Falsework up to 3m high. Formwork for columns and walls up to 3m high. More complex propping schemes (multiple props at a single level). Needling of structures up to 2 storeys high. Excavations up to 3m deep/high. Safety net systems fixed to robust primary members. Hoarding and fencing up to 3m high. Simple designed scaffold. Temporary roofs.
High (3)	Falsework and formwork over 3m high. Trenchless construction, including headings, thrust bores and mini-tunnels. Working platforms for cranes and piling rigs. Tower crane bases. Facade retention schemes. Flying and raking shores. Complex propping schemes (multiple props and multiple levels). Needling of structures greater than 2 storeys high. Ground support schemes greater than 3m deep. Complex designed scaffold. Cofferdams. Bridge erection schemes. Jacking schemes. Complex structural steelwork and precast concrete erection schemes. Hoarding and fencing over 3m high.

For checks in Category 2 or 3, the check should be carried out without reference to the original designer's calculations, using only the design brief, design statement, drawings and specification and associated information

not produced by the designer. In certain situations, it may be appropriate to apply different categories to different parts of the design.

2.8 Design Check Certificate

On completion of the check a design check certificate should be issued for all categories of check, confirming that the design complies with the design brief and associated documents. The certificate should identify any documents and methodology that form part of the design and signed by the designer and design checker. The package of information issued to the TWC should include this certificate.

2.9 Procurement of Temporary Works

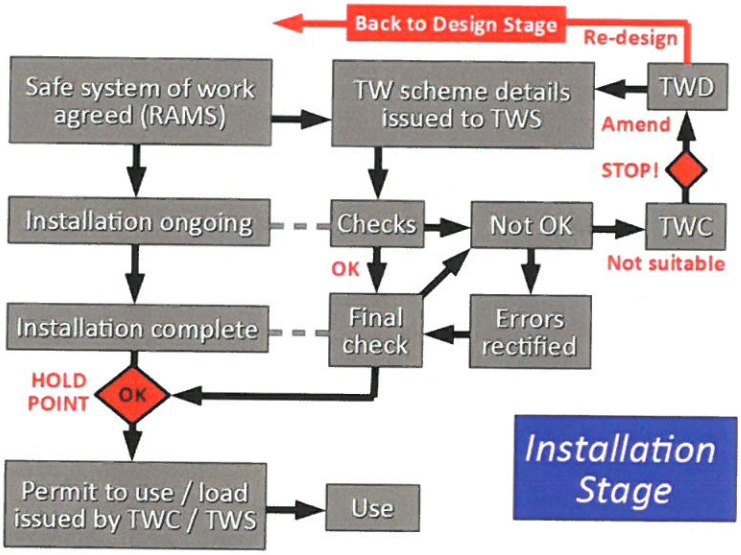
It is essential to correctly identify and specify the properties of the materials and components that it is proposed to use in the temporary works scheme, and to ensure that these are correctly delivered to site. Particular care should be taken to ensure that terms to define capacity are understood, for example whether a load is a "safe working load" (allowable stress design) or a "characteristic strength" (limit state design). If equipment is intended to be used in situations not specifically intended by the supplier, the supplier should be consulted for specific advice about the proposed method of use.

Where compliance testing is required, for example weld testing, this should be clearly indicated with the design information.

2.10 Safe systems of work

Work on site should be the subject of careful direction, supervision and inspection to ensure that the temporary works are constructed safely in accordance with the design and specified materials. The design documentation and agreed method statement should be followed but those responsible for work on site should bear in mind the need to compare conditions experienced on site during construction (for example, foundation or other support conditions) with those assumed in the proposed design to ensure that appropriate action is taken to modify the design if it becomes apparent that this might be advisable.

The TWC should ensure that any guidance on the implementation of the design provided by the designer and supplier is incorporated into the site- specific method statement by those responsible for site supervision.



2.11 Alterations or modification of Temporary Works

Any alterations to the temporary works scheme proposed by the site team or required by conditions on site being at variance with those assumed in the design, should be referred by the TWC to the designer for confirmation that they are acceptable

Any changes to the requirements of the design brief should be recorded in writing, with reference to the original brief and confirmed to the designer. The designer should then check the proposals against the original design and incorporate any alterations into the design and drawings. If there is no significant change to the design, the designer should confirm in writing the acceptability of the alterations.

The designer should also advise the design checker of any alterations, which should be checked in the same manner as the original design. A revised Design Check Certificate should be issued when considered appropriate by the designer and checker.

4.12 Checking and inspection of Temporary Works

At all stages during the installation, use and dismantling of temporary work, it is necessary to check that the information being used is correct, and that the work is being carried out in accordance with the design. From the information supplied by the designer, the TWC should establish a plan defining the points when checks on the temporary works should be carried out by either the TWC or TWS. The results of these inspections should be recorded, and variations from the design rectified or the designer informed to review and approve the alterations or instruct appropriate remedial works.

2.13 Issuing a "Permit to Load (Bring into Use)"

Prior to loading the temporary works, a final inspection should be carried out to verify that it has been constructed in accordance with the requirements of the design and any subsequent modifications. The results of these inspections should be recorded by the TWC / TWS together with any requirements for improvement.

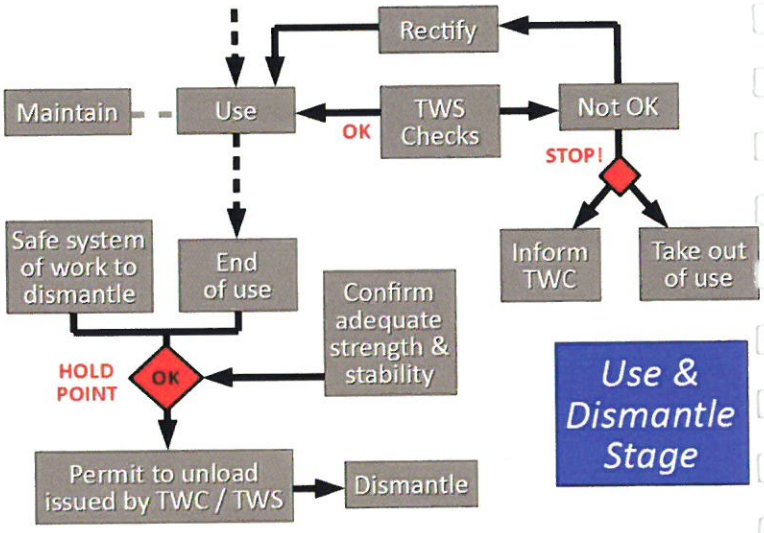
If the inspections show the installation is in accordance with the agreed design and details, the TWC should issue a "Permit to Load (Bring into Use)" to the site team before the temporary works is used. This may also be done by a TWS where the TWS has been authorised to do this. In this latter case, the TWC should identify any permits which may only be signed by the TWC, and those which may be signed by the TWS.

On complex projects, it may be necessary to issue staged permits for a specific scope and range of work, and permits may also be time limited – for example a permit to load falsework may only be valid for 24 hours, and if the load is not applied within this time (for example a concrete pour is delayed by bad weather) the falsework should be re-inspected and a new permit issued before the pour takes place. It may also be limited to specific activities, for example "installing reinforcement only" requiring a further inspection and permit before concreting takes place.

2.14 Checking and maintenance in use

The TWC should ensure that during the works, all appropriate maintenance of temporary works is carried out. This may include, but is not limited to, periodic checking and tightening of connections, or maintenance of plant and equipment associated with the temporary works and required under statutory legislation.

Where indicated by the permanent or temporary works designers or required by legislation (for example periodic checks on scaffolding during use), the TWC should establish a plan defining the points when checks on the temporary works should be carried out by either the TWC or TWS. The results of these inspections should be recorded, and variations from the approved installation rectified or the designer informed to review and approve any changes or instruct appropriate remedial works.



2.15 Issuing a "Permit to Unload (Take out of Use)"

Where the temporary works is used to provide support until a structure is self-supporting, the TWC should verify that the permanent works have attained the required strength and stability before issuing a permit for the removal of the temporary works. Verification may include, but is not limited to, determining that the required concrete or mortar strength has been achieved, that steelwork elements and connections are complete, or that any post-tensioning has been carried out. This may require consultation and confirmation with the designer of the permanent structure.

Prior to issuing a permit, the TWC should also ensure that a documented safe system of dismantling the temporary works has been agreed (for example a subcontractor's Method Statement), including any restrictions imposed by the permanent works, for example a particular sequence of removal to transfer loading and stresses from the temporary works to the permanent structure, including any stress / deflection checks that may be required by the permanent works designer.

Once the above issues have been confirmed, a "Permit to Unload (Take out of Use)" should be issued by the TWC to the site team before any temporary works are removed. Again, this may also be done by a TWS where the TWS has been authorised to do this. In this latter case, the TWC should identify any permits which may only be signed by the TWC, and those which may be signed by the TWS.

2.16 Dismantling the Temporary Works

Once a Permit to Unload has been received the temporary works may be removed in accordance with the agreed method statement, taking into account any specified sequences of works and checks required by the permanent works designer.

2.17 Information for the Health and Safety File

The TWC should ensure that relevant information for the Health and Safety File is transmitted to the Principal Contractor, and/or the Principal Designer if the temporary works scheme is being developed during the pre-construction phase of the project.

2.18

Company Logo	Permit to alter design/load/unload/strike temporary works

Section A

Contract Name _____ Contract number _____

Address _____

Description of works _____

Applicable drawings _____

Applicable method statements _____

The works described above have been constructed/installed in accordance with temporary works drawings and method statements. It is now ready for checking

Signed: _____ (Site manager/person responsible for temporary works construction)

Section B

This temporary works has been checked & I confirm that it is in accordance with the design details. I am familiar with the design restraints that have been imposed on the temporary works and have passed them to the site manager

Checked by: _____ (Temporary works coordinator)

Signed: _____ Date & Time _____

This permit is valid from: _____ **(Time)** _____ **(Date)**

Until: _____ **(Time)** _____ **(Date)**

If the operations below are not commenced/completed within this period, a further permit is required before work can proceed

Section C

Authorised to load/unload*
Authorisation to load/unload in this area*

Authorised to Alter/strike*
Authorisation to alter/strike* in this area

*Delete as appropriate

Is hereby given the above authorisation based on the following

Signed: _____ (Temporary works coordinator)

Date _____

KEEP PERMIT ON SITE TO BE RETURNED TO GROUP SAFETY UPON CONTRACT COMPLETION

2.18 **Design Brief exercise.**

TWD for the task is JRW Design and have 7 days to complete

Location is at Chichester Festival Theatre and the Contract Number is TWCTC SE:06

In the BOH there is a blockwork wall which is to be constructed to the same height as the external wall to a height of 6M, which is highlighted on the drawings

The wall in this area is 215x140x440 Paint Grade, 7kN Lignacite blocks, laid flat.

The joints are flush finished.

The floor slab is 300mm thick newly poured.

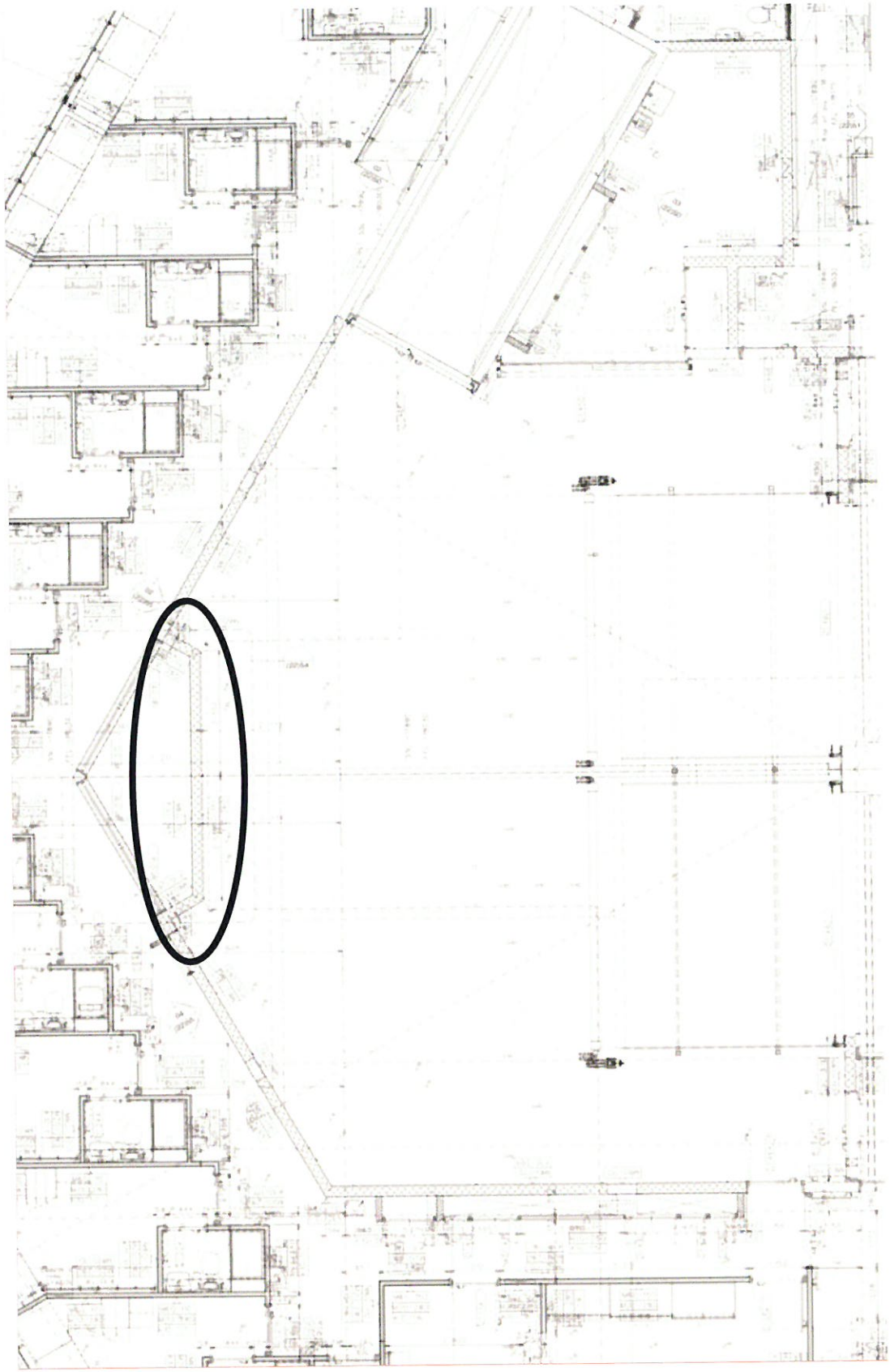
As the TWC for the project you are required to produce a Design Brief for the TW Designer to provide a safe access and workplace structure for the bricklayers to construct the wall.

Duration of task 12 working days.

Due to other trades, it is important that the access and working platforms for the bricklayers do not impinge into the floor area any more than is absolutely necessary.

There is an underground basement below your area of works.

You have a crane to bring in your stores/materials and the weather is fine with low winds.



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Monarch House ▪ Chrysalis Way ▪ Eastwood ▪ Nottingham ▪ NG16 3RY

Form Title: **Design Brief for Temporary Works Category of TW**
Revision: 2
Last Updated: **17/01/2021**

Project:		Contract No:	
Issue Date:		Return Date:	
Prepared by:			

Description of Temporary Works

Temporary Works design allocated to:
Name of organisation or individual undertaking the design check:

Information to assist the designer:
Drawings:
Specifications:
Design or Performance Standards:

Form Title: **Design Brief for Temporary Works**
Revision: 2
Last Updated: **17/01/2021**

Survey & Existing Information:

Construction restraints/sequence (including timing of striking/removal):

Duration/Programme:

Third Party conditions, licenses, approvals (Highways, Rail, Utility Services, Environmental)

Any preferred method/materials:

Extracts from Construction Phase Plan including any identified risks and requirements for Health & Safety File:

3.1 Case Study – 1972 – Lodden Bridge falsework collapse, Ashridge UK

On 24 October 1972, whilst a load of concrete was being poured, a 24 metre span of the falsework built to support the concrete deck of the A329 over the River Lodden failed, plunging the men working upon it into the river below. Three men died, ten more suffered serious injuries, and many more less serious injuries. A local newspaper reported:

"Like so many ants, rescue workers swarm over the wreckage feverishly searching for survivors. Every now and then there is a pause as they listen for cries from the injured. But there is silence except for the drone of generators as fire engines pump out brown, murky water to reduce the level of the river. So the search continues.

This was the scene at the Loddon Bridge disaster on Tuesday when three men died and 10 were brought out injured after being trapped in the tangled mesh of girders, rods and splintered wooden frames. Hundreds of tons of concrete, wood and steel had crashed 40ft down when the span between two concrete pillars was on the point of being concreted.

During the morning there were some 40 men working on the span, but it was lunch-time when the disaster struck and half of them were having their lunch-break. Mr. Tom Murphy of Finchampstead Road, Wokingham, was near the canteen 75 yards away. He heard the crash and turned around in time to see the span hit the water. His brother Joe was one of the men working in the other shift and was slightly injured as the scaffolding plummeted down.

In the canteen on the site, roll calls were taken. A group of men, covered in mud and grime, answered as their names were called. There were embarrassed coughs, and nobody dared look at each other as the foreman called out a name and there was no reply. A cross was put by the name and the foreman read on."

One worker said - "The span had been checked and the men on top were pouring concrete. "We've finished several spans which are exactly the same. I've worked on hundreds of them before. I can't understand it"."

3.2 Case Study – 2007 – John Moores University falsework collapse, Liverpool UK

Seven construction workers were lucky to survive when more than 250 tonnes of wet concrete collapsed at Liverpool John Moore's University, a court has been told.

The Principal Contractor and their subcontractor have been fined a total of £100,000 over the incident, which occurred during the construction of an atrium for a new Art and Design Academy at the university.

Liverpool Crown Court heard that workers had been pumping concrete onto the third floor of the building for most of the day on 19 September 2007 when the supporting scaffolding holding up the concrete collapsed.

The workers' injuries included cement burns to their skin and eyes, and bone fractures. The Health & Safety Executive (HSE) investigation found both the principal contractor for the project, and the concrete subcontractor, allowed the supporting scaffolding to be erected from a preliminary design, clearly marked 'for discussion and pricing purposes only'. The drawing did not include all the information needed to erect the scaffolding correctly or safely. The companies also failed to ensure the scaffolding was checked before allowing the concrete to be poured.

Both companies admitted breaching the Health and Safety at Work etc. Act 1974 by putting workers at risk. The Principal Contractor was fined £50,000 and ordered to pay £35,591 in prosecution costs on 10 April 2012. The concrete subcontractor was also fined £50,000 with costs of £35,362.

3.3 Case Study – 2016 – Didcot Power Station collapse, Didcot UK.

On 24 February 2016, during preparation for the demolition of the turbine hall at Didcot A, a section of the building collapsed killing one operative, leaving three others missing believed dead, and seriously injuring five others.

It is thought to have been caused by work to prepare two boilers for demolition. A spokesman for RWE Npower said workers would have had to weaken the building prior to its demolition, which was scheduled for March 2016. In the months following the collapse, the priority was to recover the bodies of the three men, buried beneath 20,000 tonnes of rubble, as quickly as possible.

Recovery work halted on 16 May when contractors reached a 50-metre exclusion zone and the company said it had come to a point where it was too dangerous to continue searching. Subsequently RWE developed two recovery options with demolition experts, as well as clearing material from the base of the remaining part of building and using laser scanning techniques to build up a 3D picture of the structure. A RWE spokeswoman said:

"The conditions caused by the collapse are unprecedented at this scale in the UK. Given these extraordinary circumstances, and to minimise the risk of any further incidents, it is necessary to bring down the remaining structure to be able to continue the recovery of the men. We have a clear recovery plan in place which has been aligned with all agencies involved and have already completed several stages of it."

Explosive demolition of the remaining structure took place on 18 July, and the final body, believed to be that of John Shaw aged 61, was recovered on 11 September 2016.

APPENDIX A – Formwork & Falsework

A1 Design Issues

A1.1 Roles & responsibilities for design

BS 5975 clarifies the various roles and responsibilities for design of falsework in Table 22:

Table 22 — *Roles and responsibilities of temporary and permanent works designers*

Permanent works designer	To provide all relevant information regarding assumptions made for temporary lateral and vertical loading of the permanent works by the temporary works. This may include assumed construction sequences, requirement for back propping, concrete strengths for striking etc.
Temporary works co-ordinator	TWC to collate all relevant information provided with the permanent works design and to add it to the design brief.
Temporary works designer	*Lateral support* – If it is evident that the design of the permanent works allows for the anticipated lateral loads imposed by the falsework (F_H), then the falsework can be designed as top-restrained. However, if there is any doubt over the adequacy of the permanent works, the falsework should be designed as free-standing. *Vertical support* – Irrespective of whether the falsework is designed as top-restrained or free-standing, if it is evident that the design of the permanent works allows for the anticipated vertical loads imposed by the falsework, then the falsework should be designed in accordance with the assumptions made by the permanent works designer.
Temporary works design checker	The checker of the temporary works should be provided with the design brief, the design and all of the relevant information relating to the permanent and temporary works and the extent to which they are mutually dependent.

A1.2 Design Checks on Falsework

Clause 19.4.1.1 of BS 5975 recommends four types of check on the design of falsework as follows:

1. The strength of the individual members and connections to ensure loads can be transmitted safely.
2. The lateral stability of both the individual members and the structure as a whole
3. Overturning of falsework as a whole
4. Positional stability of falsework as a whole.

Within these four checks, subsidiary checks may be necessary to allow for different phases of construction and loading, and varying stability and restraint conditions.

A1.3 HSE guidance on design check categories for falsework

Low (Cat 0-1)	Formwork less than 1.2m high.
Medium (2)	Falsework up to 3m high. Formwork for columns and walls up to 3m high.
High (3)	Falsework and formwork over 3m high.

A2 Site Issues

A2.1 When to carry out site checking of falsework.

There are several clearly defined stages when falsework could be checked, but not all may be necessary for simple arrangements when a formal check immediately prior to loading may be all that is required. These are:

a) When the proposed founding level for the falsework is in preparation
b) When the falsework is at 10m or a height equal to 1.5 times the minimum plan dimension
c) When the falsework reaches its support level
d) At intermediate stages when the strength or stability of the falsework may have been affected by environmental or loading conditions or unauthorised interference
e) Where equipment is being continually reused and periodic checks are appropriate
f) Immediately prior to loads being applied

A2.2 What to check when carrying out site checking of falsework.

Generally:

1) all the drawings and written instructions have been strictly complied with;
2)only the correct materials in serviceable condition have been employed, especially if specific types or qualities were required as will normally be the case with structural steel or timber;

At founding level:

1) the setting out is correct;
2)the ground has been adequately prepared and is at a satisfactory level (foundations appearing sound in dry or freezing conditions can be quite inadequate following rain or thaw);
3) suitable sole plates or other bases have been provided and have been properly levelled;
4) sole plates or other bases have not settled;
5) sole plates have been properly bedded down (no cavities underneath), and steps taken to prevent erosion;
6)sole plates and other load-distributing members laid on the slope are adequately prevented from movement down the slope;
7) any chocks or other supports are the correct shape, and are adequately secured;
8) baseplates have been used and are properly spaced and centred on the sole plates;
9) the extension of each screw or adjustable base is within the permitted limits, and braced if necessary;

Above founding level:

1)ties and/or rakers have been fitted, linking all uprights in two directions roughly normal to each other, or at a specified skew angle;
2)upright members are plumb (to do this, a few upright members should be checked with suitable instruments and marked; the remainder can be checked by eye) ;
3) joints in vertical members are properly butted and aligned, and reinforced if required;
4) the spacing and level of each lift of lacing members are correct;
5)the number and position of all bracing members (longitudinal, lateral and plan) are correct with connections close to node points;
6)the restraints are effective where falsework is stabilized by butting, wedging or tying of lacing members, instead of bracing;
7)forkheads are properly aligned, and any extension is within the permitted limits and braced where necessary;
8) bearers are correctly spliced, centralized in forkheads, and if required, wedged and nailed in the fork;
9) beams, including floor centres, have adequate seating and are secured against movement.
10) any necessary web stiffeners and lateral restraint have been provided;
11) all pins, bolts, clips and the like, have been fitted, are of the correct type and are secure;
12)scaffold couplers are properly tightened (it will usually be sufficient to physically check some at random, including the less accessible regions).
13)where access is required, ladders, platforms, guardrails, and toe boards are fixed and comply with the statutory requirements.
14)if the falsework has been designed with top restraint, otherwise known as "fixed at the head", that fixity has been provided in accordance with the drawings.

A2.3 Site tolerances for aluminium props and towers

Unless specified otherwise, the following installation tolerances are appropriate for aluminium props and towers:

a) Props should be undamaged and not visibly bent. Other components should be undamaged.
b) Verticals should be plumb within 10mm over 1m in height
c) Vertical members should be placed centrally under the members to be supported and over the member supporting them with no eccentricity exceeding 5mm.
d) In a partially braced system, the position of the frames can be critical to the capacity of the frame. They should be positioned within a tolerance not exceeding 50 mm.

APPENDIX B – Scaffolding and Access

B1 Design issues

B1.1Scaffolding Service Classes and loadings

SC1	0.75 kN/m^2	Inspection and very light duty access
SC2	1.50 kN/m^2	Light duty such as painting and cleaning
SC3	2.00 kN/m^2	General building work, brickwork, etc
SC4	3.00 kN/m^2	Heavy duty such as masonry and heavy cladding

B1.2HSE guidance on design check categories for scaffolding

Low (Cat 0-1)	Standard scaffold (i.e. TG20:21 compliant structures)
Medium (2)	Simple designed scaffold. Temporary roofs.
High (3)	Complex designed scaffold.

B1.3TG20:21 Compliant Scaffolds

In the forward to TG20:21, the Chief inspector of Construction for the HSE has written:

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

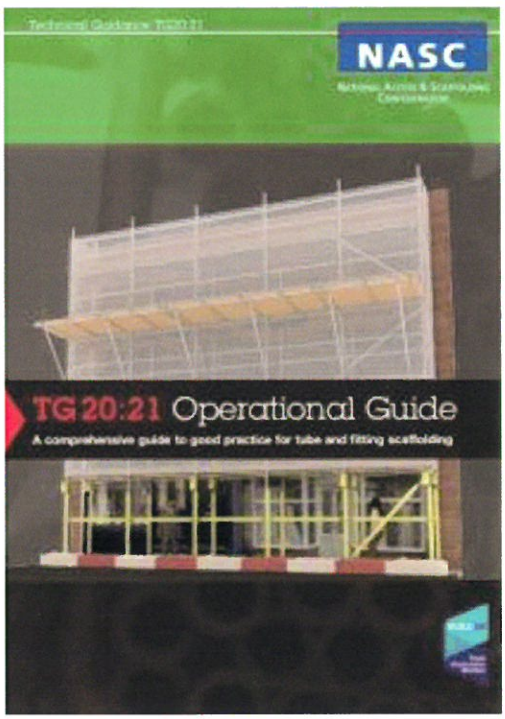
The Work at Height Regulations 2005 (WAHR) require that strength and stability calculations are carried out for all scaffold structures unless they conform to a recognised standard. The responsibility for ensuring that this duty is met falls to bot the scaffolding contractor and his client.

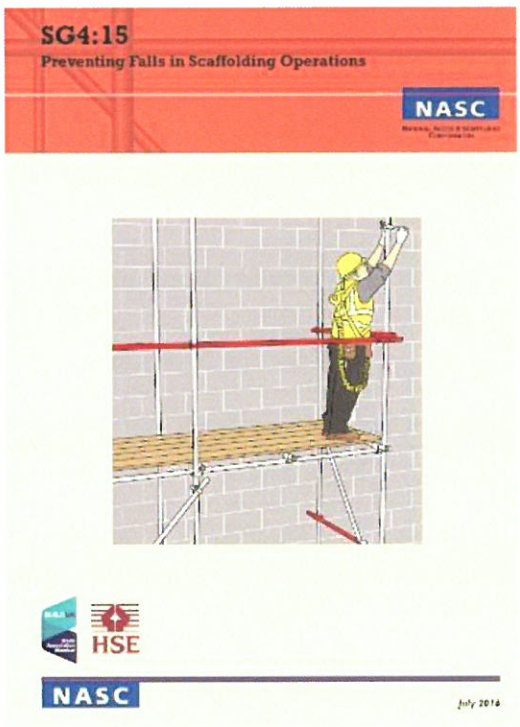
HSE is pleased to acknowledge that the NASC has written TG20:21 to provide a standard for traditional tube and fitting scaffolds to help industry manage safety risks effectively in scaffolding and the wider construction sector."

Scaffolding erected in accordance with TG20:21 is in accordance with a BS EN 12811 compliant structural design and does not require a bespoke design. For the purposes of BS 5975, it is a "Category 0 Standard Solution".

A TG20:21 compliant scaffold should be accompanied by a TG20 Compliance Sheet which specifies critical information that must be followed as a "site checklist" including required dimensions, tying requirements and maximum loadings. Once these have been confirmed by the responsible individual, the compliance sheet is signed off, and the scaffolding may be used.

TG20:21 is provided in 3 books: for contractors, for designers, and for operatives, supported by an e-guide for more complex solutions.





B2 Site Issues

B2.1 Site tolerances for tube and coupler scaffolds

When erecting and checking tube and coupler structures, the following factors should be considered:

a) Tubes should be undamaged, not visibly bent and have smooth square cut ends. Other components should be undamaged.
b) Verticals should be plumb within 15mm over 2m of height and not exceed 25mm displacement over the full height.
c) Vertical members should be placed centrally under members to be supported and over the member supporting them with no eccentricity exceeding 25mm.
d) Adjustable forkheads and baseplates should be adequately braced where their extension exceeds 300mm unless an alternative figure is specified. Bracing tubes should be attached close to the fork or baseplate and to an adjacent vertical member, close to the lacing.
e) Tubes should have end-to-end joints in adjacent tubes staggered. Sleeve couplers should be used in preference to joint pins for axial connections.
f) The centrelines of tubes at a node point should be set as close together as possible, and never more than 160mm apart.
g) Sole plates used to distribute falsework loads onto foundation soils should normally be set horizontally with a tolerance not exceeding 25 mm in a length of 1m.
h) Vertical members should be set within 50mm of the designed location.

B2.2 SG4:15 Scaffolders Safe Zone

Falls from height account for almost half of the fatal accidents in the construction sector – a significant risk faced daily by scaffolders as they erect, alter or dismantle scaffolding during most scaffolding operations. The aim of this document is to illustrate current preventative and protective measures which represent good industry practice when establishing safe systems of work.

This new edition continues to focus on the measures scaffolding contractors and scaffolders have to create a **scaffolders' safe zone** where they are suitably protected against the risk of falling. The key priority and objective for scaffolders is to establish collective protection by creating the scaffolders' safe zone, minimizing the time exposed to fall risk and reliance on personal fall protection equipment (safety harnesses).

The introduction of these collective measures does not completely remove the risk of fall, and therefore scaffolders will still be required to wear and use personal fall protection equipment.

In the latest edition of the guide, the HSE has said *"The HSE continues to work closely with the NASC and endorses this guidance which follows a sensible and proportional approach to managing health and safety. Please read this guidance and take appropriate steps to turn the advice into action."*

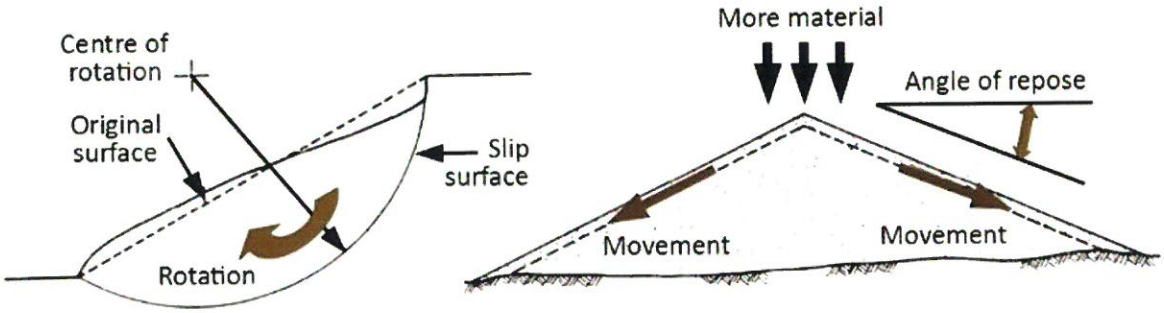
B2.3 Mast Climbing Work Platforms (MCWP)

Mast climbing platforms are becoming increasingly popular as they permit platform levels to be adjusted to work at waist height rather than the rigid levels of fixed scaffold, reducing ergonomic risks to operatives working in awkward positions. They can be of American or European design and their use can be expected to conform to the standards of the International Powered Access Federation (IPAF). Personnel engaged in the installation and use of these platforms are expected to have training and qualification by IPAF, and should be carrying an appropriate Powered Access License card (PAL card)

MSWP's can be "chassis" type, i.e. a mobile self-supported system, or a tied system whereby stability is provided through ties to the structure being accessed. Chassis types are usually single mast but tied systems may be single or twin mast. From a TWC point of view, both systems pose similar issues, i.e. adequate ground conditions, and sufficient stability, either inherently with a chassis system, or through the support of the adjacent structure in the tied system.

C1 Design issues

C1.1 Slope Stability



Cohesive soils (Clays) **Non-cohesive soils (Sands & gravels)**

There are two main forms of slope failure – rotational failure in cohesive soils (clays) and transitional or slice failure in non-cohesive soils such as sands and gravels. As soils are rarely either pure homogenous clays or equally "pure" sands and gravels, most slope failure mechanisms are a combination of the two. Similarly, most soils are bedded in layers, and slope failure mechanisms may cut through different layers with different properties, affecting slope stability and the likely failure pattern. Slope stability may also be affected by weak (slippery, saturated) layers underlying stiffer dryer layers - when these layers are inclined, excavating downslope can permit blocks of overlying materials to slide into excavations, especially during wetter weather.

For most soils, the natural angle of repose varies with angularity, moisture content and degree of compaction:

Clays : Liquid (mud) 0^{o}, very wet 15^{o}, wet 18^{o}, well drained / dry 30^{o} to 45^{o} (to vertical, very short term) Sand :

Wet 25^{o}, damp 33^{o} to 34^{o}, dry 35^{o} to 36^{o}
Earth : Dry 30^{o}, Moist 45^{o}
Gravel : Sandy gravel (excavated, loose) 26^{o} to 27^{o}, In natural deposit (compact) 50^{o}

Control of moisture in battered slopes can be very important for their stability, as can control and management of water flows above and down the slope face under flash storm conditions, factors which should be taken into account when designing batters. If an open excavation with sloping sides is practical, a designer should then take into account BS EN 1997-1, which defines three categories of geotechnical risk:

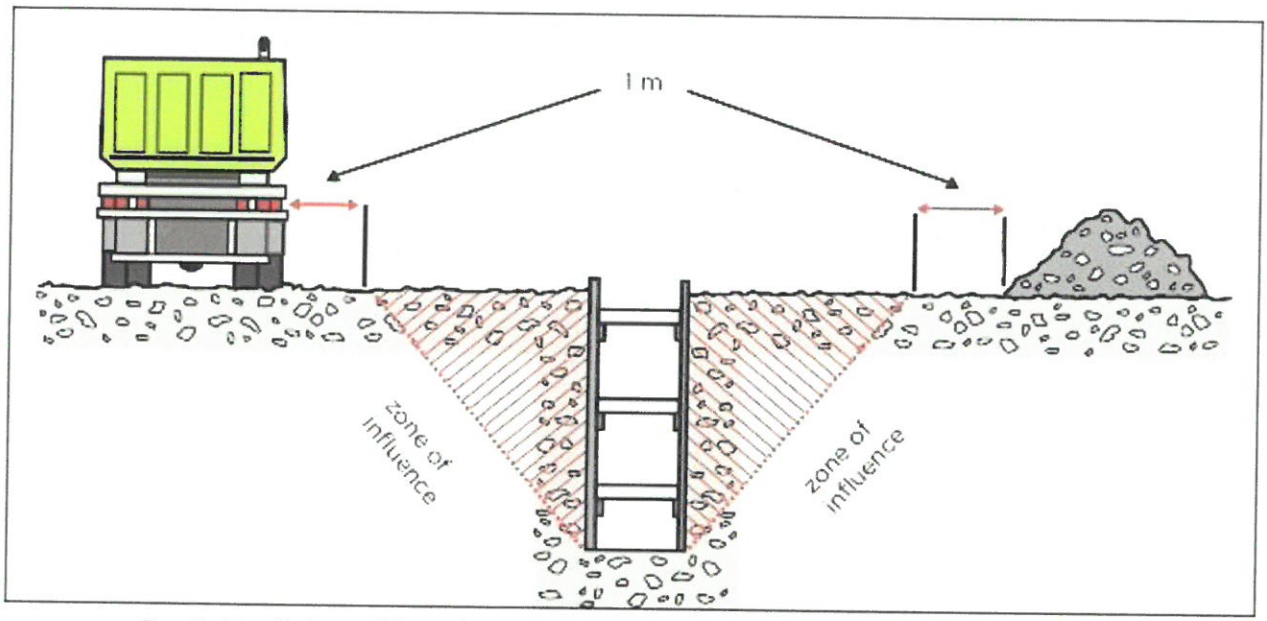
- **Category 1**: "Small earthworks" where experience and qualitative geotechnical investigation are sufficient as there is negligible risk of collapse
- **Category 2**: When there is no "exceptional" risk or difficult soil or loading conditions. (Most normal site
  batters should fall into this category)
- **Category 3**: Slopes beyond categories 1 and 2 where alternative engineering provision will be necessary (ie soil nailing or other retention systems)

C1.2 Information likely to be required for excavation design.

In order to establish the design constraints for excavation design, the designer will need to know not only what will be done, but also how it will be done. The information required for the Design Brief may include:

- Working space requirements (to establish practical dimensions)
- Safe access strategy
- Duration that support will be required
- Edge protection requirements, and whether they will interfere with the works
- Means of access for materials
- Means of spoil removal and storage arrangements
- Storage of other materials near the excavation
- Any other imposed loads in or near the zone of influence (see diagram below – angle of zone of

influence varies according to the soil strata and compaction – specialist assessment may be needed)



- Proximity of site traffic and any operations that may cause vibration
- Likelihood of fresh air being limited (confined spaces working)
- Any emergency rescue arrangements that may rely upon the temporary works

C1.3 HSE guidance on design check categories for earthworks

Low (Cat 0-1)	Shallow excavations less than 1.2m deep/high.
Medium (2)	Excavations up to 3m deep/high.
High (3)	Trenchless construction, including headings, thrust bores and mini-tunnels. Ground support schemes greater than 3m deep. Cofferdams.

C2 Site Issues

The section on "Controlling excavation risks" has a very useful table of issues to be considered when carrying excavation works as follows:

CONSIDER	EXAMPLE CONTROLS
Excavation hazards > placement of excavated materials, plant or other loads > influence on any nearby structure > previous disturbance of the ground > external actions causing instability > presence of or possible inrush of water or other liquid > hazardous substances (eg those present in the soil)	> identify safe and secure places for excavated materials, plant and other equipment > geotechnical information and competent person's input for stability and best method for support > processes for dewatering in place > assess hazardous substances and contaminated soil
Falls and falling objects > falls from one level to another > earth or rock falls	> edge protection in place > safe access and egress > catch platforms
Hazardous atmosphere in an excavation	> gas and fumes monitoring > respirators - fitted and maintained correctly
Manual handling tasks	> using lifting devices (eg hiabs, cranes, trolleys) > manual handling training
Natural hazards and weather	> geotechnical site assessment > inspecting to find out what might affect the stability of the excavation (an excavation face can appear stable for 24 hours, but may be unstable)
Overhead services	> identification and inclusion in safe system of work > minimum approach distances for mobile plant and work activity from overhead lines > minimum approach distances for excavation and earthworks from towers and support structures > consents or permits > applying required safety measures
Site safety > insufficient natural lighting	> traffic management plan > site security > safety fencing and signage > provide suitable artificial lighting

A useful checklist to aid site supervisors (and TWS's) when inspecting earthworks and excavations is as follows:

- Is the surface clear of plant, spoil heaps and materials for at least 1 m from the edge of the excavation?
- Are spoil heaps properly controlled and will they stay like this in wet weather?
- Is the trench clear of workers while the spoil heap is being worked on?
- Is the space between the trench and the spoil heap clear of pipes, bricks, stones, tools, etc?
- Is the work properly fenced off and 'signed' during the day? Is the work properly fenced off, 'signed', guarded and lit during the night?
- Is access adequate without anyone having to jump across? Are footbridges with guard rails available and being used?
- Are ladders available and being used?
- Is the supervisor making sure that no-one climbs on the timbering?
- Is the trench safe from exhaust gases from plant working in the trench or nearby?

- Does everyone know where the buried services are and are they clearly marked?
- Are the workers who are excavating and shoring the trench experienced in this sort of work?
- Are they working at safe distances from each other?
- Is the ground as the design assumed?
- Is there any movement or deterioration of the ground that may put adjacent services, roads or structures at risk?
- Is the area affected by blasting or other heavy vibrations?
- Is the ground water level as used in the design (i.e. not higher)?
- Are proper sumps provided?
- Does the pumping arrangement avoid drawing material from behind the sheeting?
- Is the work being done in accordance with the drawings or sketches? If not, is the variation permissible?
- Are unsheeted faces safe, with no sign of peeling away?
- Are materials of the correct design size and quality?
- Are wedges tight?
- Is timbering free of damage from skips?
- Are waling and strut spacing within +/-100 mm?
- Are deflections excessive?
- Are all struts horizontal and positioned squarely to the walings (within 1 in 40)?
- Are frames supported against downward movement (by hangers or lip blocks, puncheons and sole plates)?
- Have correct pins been used in steel trench struts?
- Is the method of withdrawing sheeting and support for the trench during backfill safe?
- Is the work area tidy?
- Are stops provided for mobile plant?
- Is visibility adequate in the trench?
- Is PPE available and being used?

APPENDIX D – Demolition, Propping and Shoring

D1 Design issues

D1.1 HSE guidance on design check categories for demolition, propping and shoring

Low (Cat 0-1)	Simple propping schemes (1 or 2 props). Internal hoarding systems and temporary partitions not subject to wind loading.
Medium (2)	More complex propping schemes (multiple props at a single level). Needling of structures up to 2 storeys high. Temporary roofs.
High (3)	Facade retention schemes. Flying and raking shores. Complex propping schemes (multiple props and multiple levels). Needling of structures greater than 2 storeys high.

D1.2 Planning for explosive demolition

Explosive demolition is a highly specialised task that needs to be planned and undertaken in a very controlled manner. Steps that are likely to be essential are:

- A desktop study of the structure based on available information such as existing construction drawings or surveys, condition surveys, asbestos registers etc.
- Assess the risks associated with the outline proposal, including air overpressure, impact on local infrastructure, and historic weather patterns (wind-borne dust etc)
- Determine those likely to be affected by the demolition event and identify exclusion zones

necessary to ensure third party safety on the day. Inform nearby residents through community liaison and newsletters.

- Confirm that the demolition can be carried out with current legislation, guidance and standards.
- Ensure synchronised communication between internal parties such as the Explosives Engineers and structural engineers, and external parties such as the local authority, service utility companies, police, fire services and any other emergency services that may be affected.
- Detect, isolate and certify all M&E services within and supplying the structure.
- Identify and implement any noise and vibration monitoring requirements.
- Survey the structure to identify any pre-weakening requirements.
- Carry out pre-demolition surveys of nearby properties (and post-demolition surveys after the event)
- Prepare the structure by soft strip, remove fixtures and fittings, deglaze windows.
- Establish category and strength of the explosives by an on-site test blast. This will determine charging patterns, detonation sequence, timings and blast-shielding requirements.
- Drill and cut to comply with agreed detonation pattern. Charge, place and stem the explosives.
- Implement the agreed exclusion zone for the Blow Down day.
- The Explosives Engineer fires the charges from a pre-established "safe" location with good lines of sight and communication.
- Following safety checks, the exclusion zone is lifted
- Debris is cleared.

It should be noted that the above list is indicative rather than exhaustive, and that every case needs to be dealt with on its merits with specialist advice.

D2 Site Issues

D2.1 Checking of purposely fabricated steelwork on site

The following tolerances (source: BS5975, cl.20.3.2.5) should be adopted for purposely fabricated steelwork and structures made from proprietary steel components, for example facade retention structures or propping schemes, unless other tolerances have been specified by the designer:

- Inclination of a strut or column from the vertical should not exceed height/600, or 5mm per metre, whichever is the greater, up to a maximum of 25mm
- Out of straightness of a strut or column should not exceed length/1000, or 3mm per metre, whichever is the greater, up to a maximum of 25mm
- Out of straightness of a beam should not exceed length/1000, or 3mm per metre, whichever is the greater, up to a maximum of 25mm.
- Eccentricity of a beam bearing should not exceed 5mm

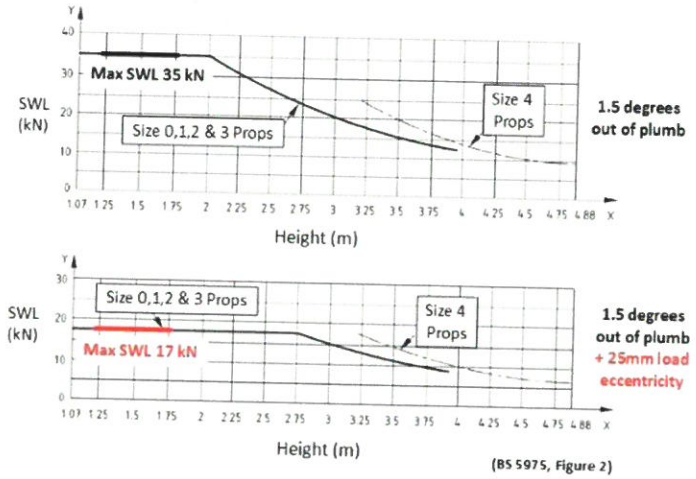
D2.2 Installation & checking of BS 4074 adjustable steel props

Adjustable steel props to BS 4074 come in four sizes (Size 0 to Size 4) to suit different installation heights as follows:

- Size 0: 1.04m to 1.82m (Safe working load at max. extension to BS 5975, Figure 2: 35 kN)
- Size 1: 1.75m to 3.12m (Safe working load at max. extension to BS 5975, Figure 2: 19 kN)
- Size 2: 1.98m to 3.35m (Safe working load at max. extension to BS 5975, Figure 2: 17 kN)
- Size 3: 2.59m to 3.96m (Safe working load at max. extension to BS 5975, Figure 2: 12 kN)
- Size 4: 3.20m to 4.88m (Safe working load at max. extension to BS 5975, Figure 2: 9 kN)

Whilst the safe working loads in the above illustration are those for a prop installed a maximum of 1.5° out of plumb, installing the props in such a way that the load is as little as 25mm off-centre causes a dramatic reduction of the safe working load, typically halving this at shorter prop lengths, and reducing it by a third at longer prop lengths. If eccentricities of loading have not been considered in the design, installing props at even small eccentricities can lead to unsafe conditions on site.

It is essential that prop positioning and alignment is carefully checked to confirm that they have been installed in accordance with the design before a Permit to Load is issued.



(BS 5975, Figure 2)

D2.3 High reach demolition

High reach demolition reduces the risk of operatives working at height and is the preferred solution for many of the UK's larger demolition contractors. Machines range in size up to ones with a dead weight of 130 tonnes with a 42 metre reach that can carry a shear weighing nearly 4 tonnes, making it extremely powerful, capable and adaptable. Available attachments include crackers, pulverisers, metal cutting shears, hydraulic breakers, grapples, grabs and re-handling buckets.

Such machines have a greater productivity and output compared to "top-down demolition" and are equipped with integral dust suppression reducing the need for hand-directed sprays. Demolition in this manner is exceptionally low noise compared to traditional methods – an advantage on busy or confined sites, especially in city centres.

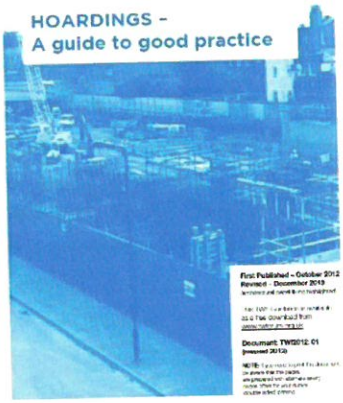
D2.4 Robotic demolition machines

Remote control excavators are an ideal solution to many of the environmental problems faced on today's demolition projects. They are extremely compact electro hydraulic machines that are remotely controlled, immensely powerful, produce no harmful fumes and very little noise, and alleviate hand-arm vibration issues compared to hand-held equipment. Smaller units weigh as little as 380kg, allowing access onto many floors, including scaffolds. The machines are extremely adaptable and come with a variety of interchangeable attachments from powerful percussive breakers, hydraulic crushing jaws, loading buckets and concrete milling heads. Larger machines are as powerful as a conventional excavator four times it's weight class.

Robotic demolition greatly reduces risk as the operator or supervisor doesn't need to stand near the work, and where this is unstable or subject to falling debris, the operator can stand in a "safe zone" up to 50m from where the work is being carried out. Machines such as these were used to remotely position the explosive charges for the demolition of the remaining highly unstable structure at Didcot A power station and are favoured by the Nuclear industry for all confined spaces working, and other difficult and challenging locations.

E1 Design issues

E1.1 TWf "Hoardings – A Guide to Good Practice"



Stability of site hoardings around the site perimeter is an important issue as toppling of a substantial hoarding either into the site or outwards into public areas has the potential to cause injury and death. This applies equally to internal hoardings and barriers, for example where solid barriers are erected between the site and compound to control access through turnstiles or gatehouses, etc. The HSE have recognised this issue, only accepting hoardings up to 1.2m high as low risk, with medium and high risk, and therefore a requirement for them to be checked, for those up to and over 3m respectively.

To assist designers, the Temporary Works Forum have produced a 42 page "Good Practice" design guide for hoardings, which, unless designed to alternative standards, forms a good and widely accepted basis for the design and installation of site hoardings. The guide is free to download on the TWf website

E1.2 HSE guidance on design check categories for site establishment and plant

Low (Cat 0-1)	Hoarding and fencing up to 1.2m high. Internal hoarding systems and temporary partitions not subject to wind loading.
Medium (2)	Safety net systems fixed to robust primary members. Hoarding and fencing up to 3m high.
High (3)	Working platforms for cranes and piling rigs. Tower crane bases. Bridge erection schemes. Jacking schemes. Complex structural steelwork and precast concrete erection schemes. Hoarding and fencing over 3m high.

E1.3 Design of ground-supported working platforms

Ground supported working platforms are critical for heavy equipment stability, such as heavy lift cranes and piling equipment, the latter becoming heavier with higher centres of gravity to cater for the increasing market for deeper foundations. Every incident that occurs, and every "near miss" involving inadequate working platforms is a potential fatality, either to workers on site or to the offsite public due to the height of the equipment and the distance it may fall if it becomes unstable.

The design, construction and maintenance of a working platform should be the responsibility of a single party – the Principal Contractor – as the platform may be used for a variety of trades using a wide range of plant, not just for piling. In 2012, the Federation of Piling Specialists (FPS) introduced a Working Platform Certificate (WPC) which is widespread use in the UK and has proved to be a highly effective way of overcoming the problems that existed prior to it's introduction.

In 2004, the Building Research Establishment produced BR470: "Working Platforms for Tracked Plant" which permits calculation of the thickness of the working platform using realistic figures for

the properties of both the platform material and the underlying stratum. The FPS have produced a paper discussing the relationship between platform thickness and the different parameters titled "Working Platform Design Sensitivity" and produced a simple spreadsheet based upon the BRE methodology to calculate realistic "in service" track pressures – often significantly higher than static dead weight pressures. All of these documents, including the WPC, are available to download free of charge on the FPS website.

E1.4 Weathervaning of tower cranes and luffing jibs

Tower cranes and luffing jibs are normally set free to "weathervane" at times of high winds, resulting in the jib orientating itself away from the wind (as it has the greater drag) with the counterweight facing the wind. In this position, out of use and with the hook positioned close to the mast, the overturning moment from the counterweight facing towards the wind opposes the moment created by wind forces, reducing the moment on the tower crane base considerably. If for any reason the crane cannot be permitted to rotate freely, or has restrictors fitted due to air rights, obstructions, etc. this must be taken into account in the foundation design.

E2 Site Issues

E2.1 Weather awareness

Weather conditions can severely affect construction operations, and especially so with temporary works as almost by definition they are often designed for short-term conditions, are less protected and hence more susceptible to extremes of weather:

- **High winds** – cranes, MEWPs, scaffold platforms, netting and sheeting on scaffold structures, site hoardings & signage, materials handling, security of materials, dust & debris.
- **Heavy rain** – erosion of temporary foundations and working platforms, washout of fines, cavitation.
- **Saturated ground** – can lead to reduced bearing pressures on surface soils – stability of cranes, working platforms for plant, outrigger safety (MEWPs etc.), scaffold bases, instability of excavation faces.
- **Frozen ground** – can lead to surface heave that recompacts under load as the ground thaws - stability of cranes, working platforms for plant, outrigger safety (MEWPs etc.), scaffold bases, instability of excavation faces.
- **Hot bright weather** – dazzling and glare – can affect banksman / supervisor visibility – crane lifts etc

BSI Standards Publication

Code of practice for temporary works procedures and the permissible stress design of falsework

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