Historic England

Scaffolding for Historic Buildings

Guidelines for Best Practice

Summary

Scaffolding is an essential tool for the construction, maintenance and conservation of buildings and structures. Scaffolding has been in use as long as people have been building. Modern scaffold structures can be larger and more complex than the buildings that they are serving, and the design and erection of scaffolding has become a specialist skill.

When scaffolding or other temporary works are used in, on, against or in close proximity to historic buildings or monuments there is a risk of damage from accident, carelessness or inappropriate working methods. Practices that are commonplace when scaffolding modern buildings are not always appropriate when scaffolding a historic building or structure. Temporary works need to be carefully designed to avoid unnecessary damage to historic fabric.

Contact points between the structure and the scaffold are the main area of concern, whether at supports, restraints or foundations. Drilled anchors are widely used across the industry, but are only acceptable in a heritage context if agreed in advance. Early consideration of alternatives is crucial, and early engagement with the Conservation Officer or Inspector of Ancient Monuments is strongly recommended.

This guidance provides an overview of the approaches and design issues that need to be considered when scaffolding or other temporary works is required for works to a historic building or structure. It is intended for building professionals and contractors involved in maintenance and repair projects, as well as planning and conservation officers involved with scaffolding proposals in a historic context. Reference is made to existing industry best practice and how this can be applied to historic buildings and structures. It focusses on building safe and stable scaffolding without damaging the historic structure.

Front cover: The dome of St Paul's Cathedral viewed through scaffolding. © Historic England Archive

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Note. Photographs are included to illustrate situations where scaffolding or temporary supports have been used in a historical context. They do not necessarily illustrate good practice and all proposed scaffolding should be designed and assessed on its own merit.

1. Introduction

A scaffold is a temporary elevated platform, usually supported by a grid of vertical, horizontal and diagonal tubes. For the purpose of this guidance we also include temporary structural supports, props and shores made from tubes and fittings or from other structural sections.

Scaffolding has been in use almost as long as there have been buildings. For most of their history scaffolds were temporary frameworks built from locally available timber, or bamboo in some parts of the world. Then, as now, their function was to provide a working platform for masons, carpenters and others engaged in construction. Scaffolding might also have provided protection from weather, or temporary support for floor beams, building frames or arch centring, or it might have supported walls that were leaning or carrying lateral loads.

Since the twentieth century steel tubing has taken the place of timber scaffolds. It is assembled using a growing assortment of specialised connectors and accessories.

Alongside 'tube and fitting' scaffolds are many proprietary systems. These systems are sometimes limited to specific functions e.g. edge protection or moveable temporary towers, or they might provide complete decks for access or to support formwork. Recent decades have seen increased use of aluminium, and features like prefabricated beams to increase the spans that can be covered.

Scaffolding is a useful, often indispensable tool for the management and repair of historic structures. It is not without risk however. Historic structures can be damaged by careless behaviour, thoughtless actions, or inappropriate methods of contact and restraint. Scaffolding can provide unintended access to thieves and vandals. It can provide a route by which fire can spread; timber boards and flammable sheathing can add fuel to that fire.

For these reasons the design and management of any scaffold in, on or adjacent to a Listed Building or Scheduled Monument needs special consideration. It should be considered at the earliest stage. In England the Local Planning Authority should be asked whether consent is needed for Listed Buildings; for Scheduled Monuments consult the Historic England Inspector of Ancient Monuments.

Listed buildings are buildings of special architectural or historic interest with legal protection.

Scheduled Monuments are nationally important archaeological sites. These sites can include standing stones, burial mounds, the remains of monastic buildings and more. They can be above or below ground and can consist of remains as well as structures that are still in use.

The record of all monuments on the Schedule of Monuments and each listed building is hosted on The National Heritage List.

Figure 1: Freestanding building enclosure. Apethorpe Hall. © Historic England Archive

Figure 2: Scaffolding shoring.
© Historic England Archive

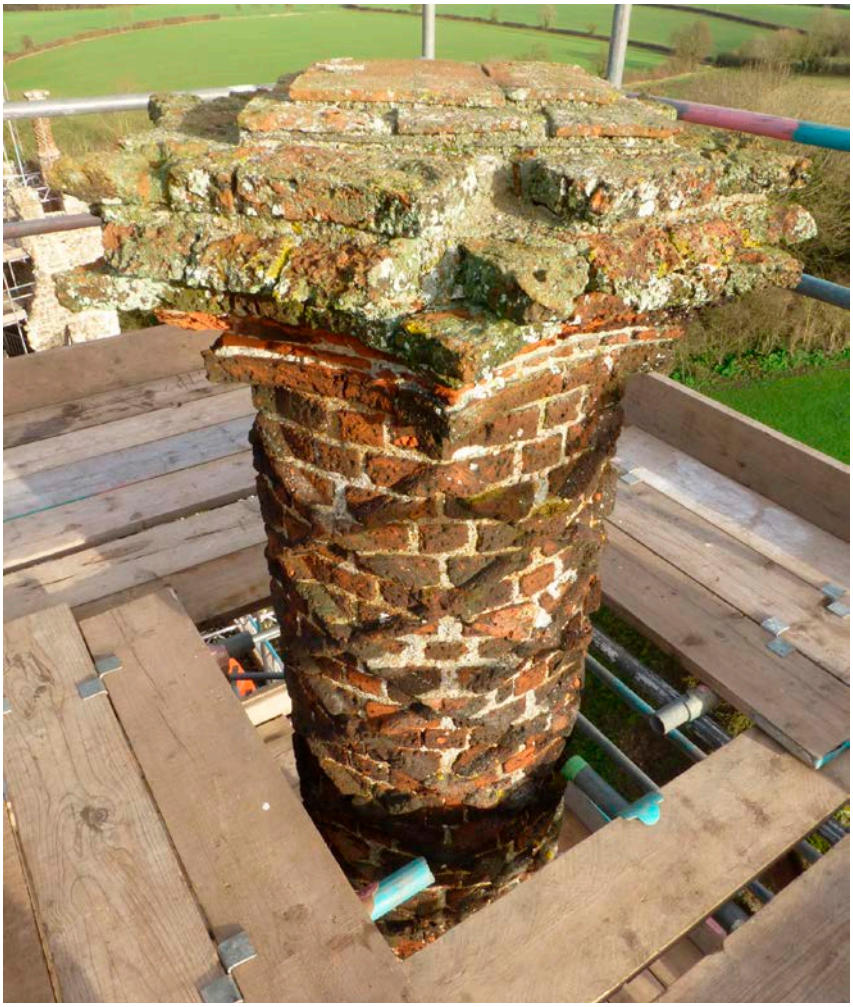

Figure 3: Scaffold around a chimney but not in contact. Ideally the gap should be protected.

2. Why use this guidance?

This document is not intended as a guide to the design or erection of temporary supports or scaffolding; authoritative guidance for these already exist. Instead, this document aims to highlight the different challenges presented when working with scaffolding at historic sites.

Temporary works designers and erectors are not always experienced in working on historic structures; heritage professionals are not always familiar with temporary works. Where gaps in understanding exist there is scope for confusion, delay, unforeseen costs, and unintended damage.

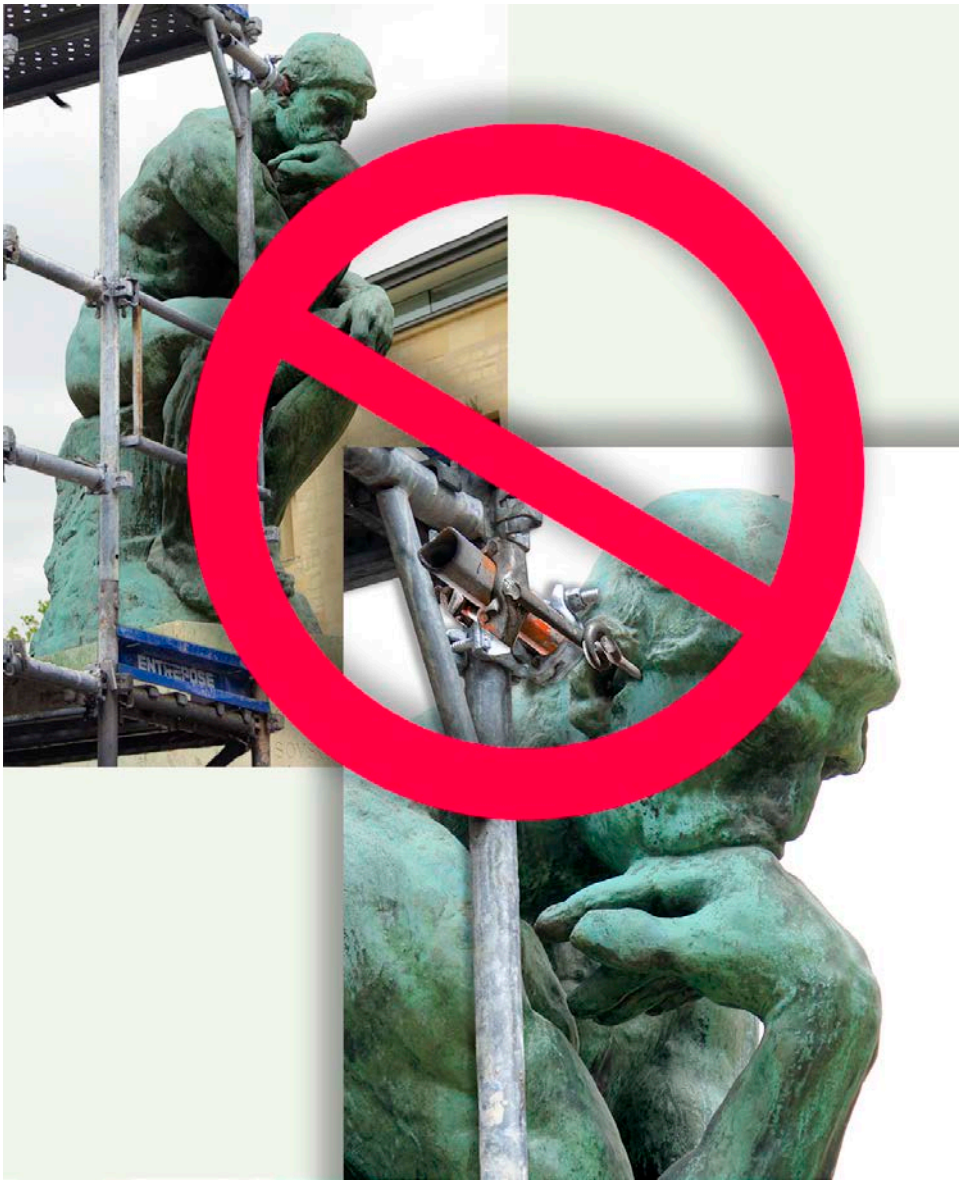

Figure 4: Historic structures should be treated with the same care and respect as works of art.

Few contractors would consider drilling a bolt into a sculpture in order to stabilise a temporary access platform. Historic buildings and monuments are not always treated with the same respect, and modern tools make it easy to cause a lot of damage. It may be possible to satisfactorily repair damage from fixings or other contact, but this should never be taken for granted and could result in enforcement action. Repeated damage by temporary works and repair incrementally degrades the historic fabric that we are trying to conserve. It is always better to avoid damage in the first place rather than trying to fix it afterwards.

Sometimes damage from temporary works is unavoidable, or the benefits outweigh the cost to the historic fabric. In this case any intervention should be carefully planned and agreed in advance unless emergency intervention is needed.

Whatever the circumstances the most important message is for early engagement and clear communication between everybody involved.

3. How are Historic Structures different?

Contact Points

One of the most important differences between scaffolding a historic structure and scaffolding other structures occurs at points of contact between the scaffold and the structure.

A lightweight access scaffold erected to allow maintenance or construction work on a non-listed building is usually stabilised by fixing to that building using drilled-in anchors. Filled holes or permanent sockets may be acceptable in a modern building, but in a historic structure this is unlikely to be the case. Successive phases of scaffold erection and disassembly over decades can leave a facade scarred by many fixing holes.

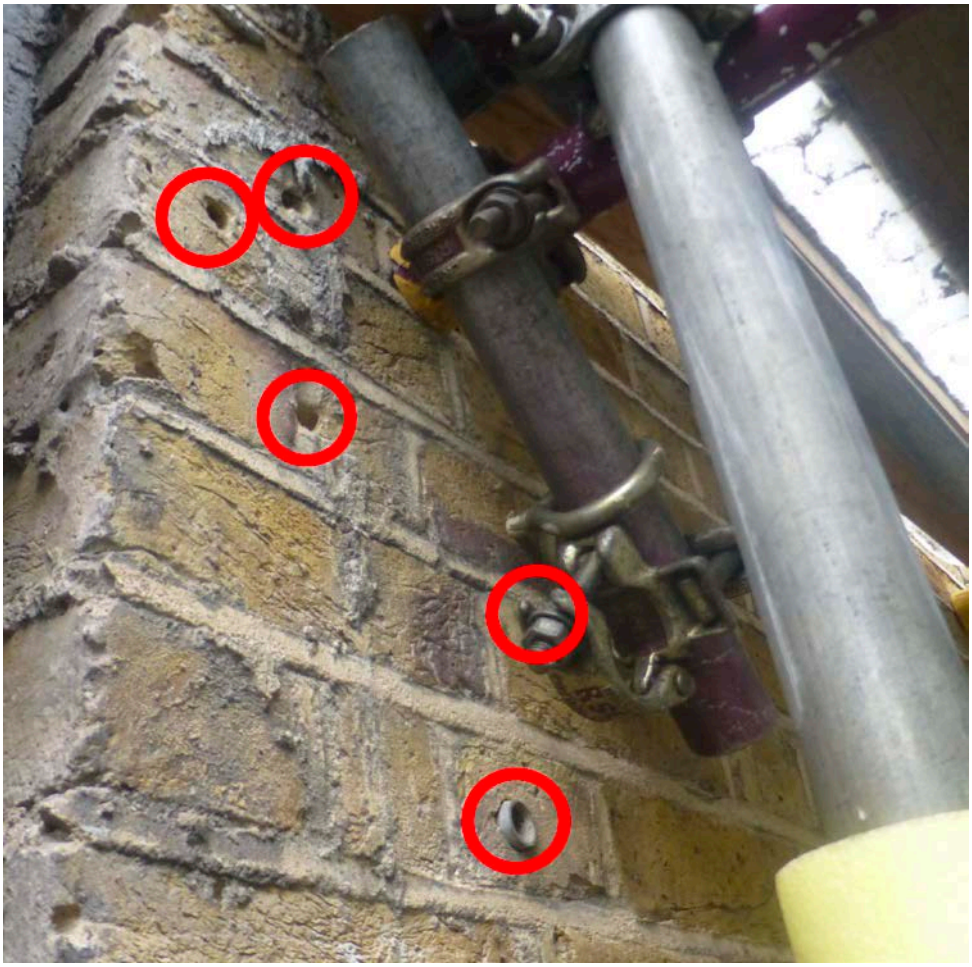

Figure 5: Drilled anchor tie and holes in masonry from previous scaffold interventions.

The presumption with historic structures should always be to design scaffolding to be truly independent of the structure. It should not rely on the historic structure for support or stability in any way. Any points of contact should be protected and cushioned to prevent damage.

If fixing to a historic structure is unavoidable for any reason, fixings should be removable. Any intrusive work for accommodation of fixings must be reversible and repaired such that there is no permanent loss or damage. Detailed advice can be found later in this guide.

Foundations

A large scaffold can transmit significant loads to its foundations, especially where that scaffold supports or stabilises the structure. Those foundation loads can damage historic surfaces, buried structures or archaeology.

Responsibility for scaffold foundations is sometimes poorly defined, leaving room for confusion and misunderstanding. Scaffolding foundations need to be specifically designed to avoid damaging historic substructures and archaeology, and to ensure that the scaffold remains safe to use.

Permissions

Consent is needed before erecting a scaffold or other temporary works in, on or against a Scheduled Monument. This includes sites where remains are below ground. Scheduled Monument Consent (SMC) is more onerous than Listed Building Consent (LBC) and takes precedence where both Listing and Scheduling apply.

The process differs between Listed Buildings and Scheduled Monuments. Scaffolding for Listed Buildings will often require consent (LBC) from the Local Planning Authority if it includes temporary fixings to the building to stabilise scaffolding or for any other purposes. Early discussion with the Conservation Officer is recommended over what measures might or might not be accepted.

Control of works is more stringent for a Scheduled Monument than for a Listed Building. Consent is determined by the Secretary of State for Culture, Media and Sport (DCMS). Applications must be submitted through Historic England and early discussion with the Inspector of Ancient Monuments is recommended. Throughout this document references to the ‘Inspector’ mean Historic England Inspector of Ancient Monuments.

Both of the above consents safeguard the historic fabric as well as its setting and significance. It also ensures that materials and methods used in repairs are appropriate. If temporary works are to be erected as a stand-alone project it may need its own application. For a larger scheme it can often be addressed as a pre-commencement condition.

Other licences, consents or permits maybe needed from the local highways authority, Natural England or the Environment Agency depending on the location of the scaffold and the presence of protected species.

Duration

Scaffolding is usually only intended to remain in place for a limited period to suit the construction or repair programme. Where it is erected to support an unstable building or to provide weather protection to a damaged structure it may need to remain in place for much longer.

It is common for scaffolding or props to remain in place on a historic building for months or sometimes years while repairs are investigated and funding arranged. This brings a number of considerations. There may be no contractor on site to manage the scaffold, to ensure that it is safe and does not present a risk from fire or unauthorised access. Steel tubes and fittings may start to corrode, timber boarding and sole plates may decay. Higher wind loads may also need to be considered for a semi-permanent scaffold. See NASC SG41.

4. Regulations and Guidance

National Access and Scaffolding Confederation (NASC)

The National Access and Scaffolding Confederation was established in 1945 as the UK's scaffolding industry trade body. It publishes guidance on all aspects of scaffolding design, management and procurement. The guidance most relevant to historic structures is as follows:

Guidance No.	Title
SG28	Safe System of Work for Scaffolding Associated with Timber Frame Building Construction
SG41	Long Standing Scaffolding Structures
TG4	Anchorage Systems for Scaffolding
TG16	Anchoring to the Ground
TG20	Guide to Good Practice for Tube and Fitting Scaffolding
TG21	A Guide to Commissioning Scaffold Design

TG20 Compliant scaffolds

In 2021 NASC updated their TG20 design and operational guides for 'tube and fitting' scaffolds. This guide and the associated software allow a scaffold to be designed by using pre-determined layouts, avoiding the need for a bespoke design with structural calculations. TG20 is intended to cover most access scaffolds in the United Kingdom, with electronically generated compliance sheets taking the place of design calculations.

Bespoke designs should be produced for complex scaffold structures even where they are TG20 compliant. This ensures the scaffold is feasible and fits around the structure and any buried structures, whilst also providing guidance for its erection.

All non-standard scaffolds need a bespoke design accompanied by structural calculations and drawings.

Slender, TG20 compliant, access scaffolds need to be tied to the building structure at regular intervals to eliminate the risk of the scaffold collapsing or overturning. Such fixings damage fabric and should be avoided on Listed Buildings and Scheduled Monuments. The alternative is a bespoke scaffold design, relying on other methods of stabilisation.

Scaffold structures that normally require bespoke design (from HSE's website):

- all shoring scaffolds (dead, raking, flying)
- cantilevered scaffolds
- truss-out scaffolds
- façade retention
- access scaffolds with more than the 2 working lifts
- buttressed free-standing scaffolds
- temporary roofs and temporary buildings
- support scaffolds
- complex loading bays
- mobile and static towers
- free standing scaffolds
- temporary ramps and elevated roadways
- staircases and fire escapes (unless covered by manufacturers instructions)
- spectator terraces and seating stands
- offshore scaffolds
- pedestrian footbridges or walkways
- bridge scaffolds
- towers requiring guys or ground anchors
- slung and suspended scaffolds
- protection fans
- pavement gantries
- marine scaffolds
- boiler scaffolds
- power line crossings
- lifting gantries and towers
- steeple scaffolds
- radial/splayed scaffolds on contoured facades
- system scaffolds outside manufacturers' guidance
- sign board supports
- sealing end structures such as temporary screens
- temporary storage on site
- masts, lighting towers and transmission towers
- advertising hoardings/banners
- rubbish chute

Additionally, any scaffold structure not mentioned above that falls outside the 'compliant scaffold' criteria in TG20 or similar guidance from manufacturers of system scaffolds will require a bespoke design.

Construction Design and Management Regulations (CDM)

The *Construction (Design and Management) Regulations* are a legal requirement that apply from inception to completion on all construction projects. They aim to ensure that no-one is harmed during the work, and that finished structures are safe to use and maintain. The Regulations also identify duty holders and outline what each must do. See box on next page. Guidance on the *CDM regulations* is provided by the Health and Safety Executive (HSE).

Scaffolding is classed as temporary works and is usually the responsibility of the Principal Contractor. Under the *CDM regulations* Designers have a responsibility to eliminate, reduce or control risks and to communicate to others involved in the project residual risks to the health and safety of any person. This means that Designers must consider how the work is to be undertaken and communicate any constraints that will affect temporary works design.

> Temporary Works is defined in *BS5975 Code of practice for temporary works procedures and the permissible stress of falsework* as "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."

Sometimes a scaffold may need to remain in place for a longer period of time with no contractor present on site, e.g. for weather protection. In this case responsibility under CDM regulations may need to pass to the Principal Designer or Client.

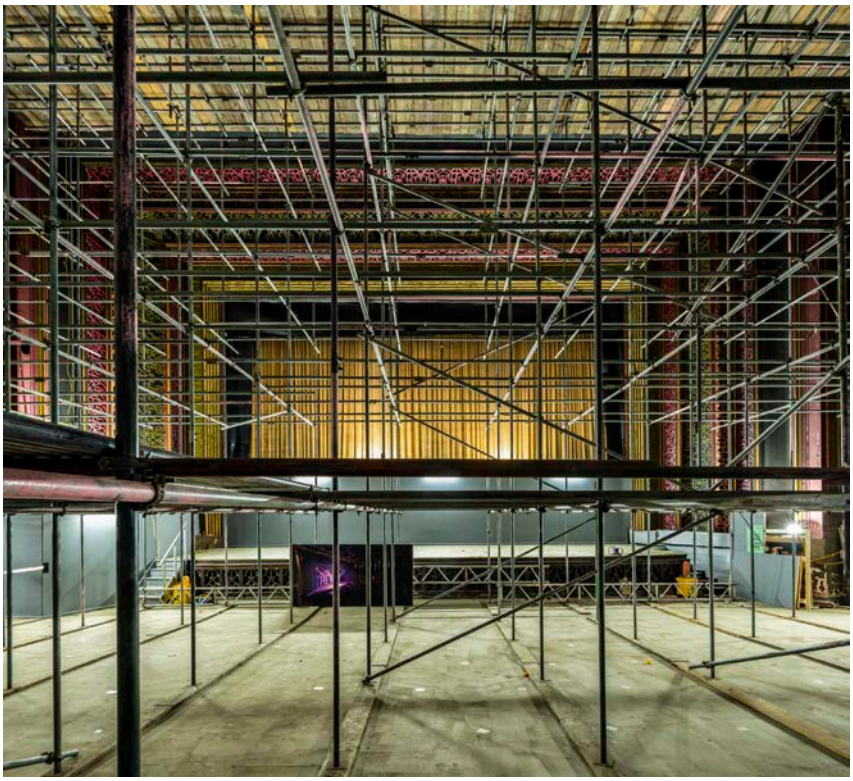

Figure 6: Birdcage Scaffold, EMD Cinema. © Historic England Archive

Construction Design and Management regulations (CDM)

The Construction Design and Management regulations were first introduced into the UK in 1994. The current regulations (2015) aim to minimise accidents and injuries during construction. It aims to do so through planning for and managing risks throughout the design and construction process.

Several key duty holders are defined in the regulations:

Client. The individual or organisation developing the project. Their main duty is to appoint the Principal Designer and Principal Contractor to manage the project.

On small domestic projects with only one Contractor, the client can pass their duties to the Principal Designer or Contractor by agreement.

Principal Designer. They are responsible for planning, managing, monitoring and coordinating health and safety prior to the start of construction. They also collate pre-construction safety information to be passed to the Contractor.

The Principal Designer is usually an Architect, Engineer, Project Manager or other design professional engaged on the project. Other designers must liaise with each other and the Principal Designer to minimise risk.

Principal Contractor. They are responsible for preparing the Construction Phase Plan to plan, manage, monitor and coordinate health and safety during construction. They also collate the Health and Safety file at the end of the project.

Other Contractors and subcontractors must work with the Principal Contractor to minimise risk.

Figure 7: Timber shoring. Winstanley Hall. Note these shores generally have out-of-plane bracing for stability.

Figure 8: Steel scaffold shoring. Crossways. Again these shores generally have out of plane bracing for stability.

Health and Safety Executive (HSE)

Any work on or from a scaffold comes under The Work at Height Regulations 2005.

The *Work at Height Regulations 2005* is a legal requirement to prevent death and injury caused by a fall from height. Responsibility lies with employers or people who control work at height (e.g. building owners) to ensure it is properly planned, supervised and carried out by competent people. Employees' responsibilities are to take care of themselves and others affected by their actions and to co-operate with their employer. Guidance on the Work at Height Regulations is provided by the HSE.

The Health and Safety Executive (HSE) is Britain's national regulator for workplace health and safety. HSE publishes a wide range of information, including a brief guide to the Working at Height Regulations. HSE's advice on scaffolding design and erection refers designers and contractors back to the National Access and Scaffolding Confederation guidance earlier in this section.

HSE also provide comprehensive guidance on the CDM regulations and the responsibilities of key duty holders.

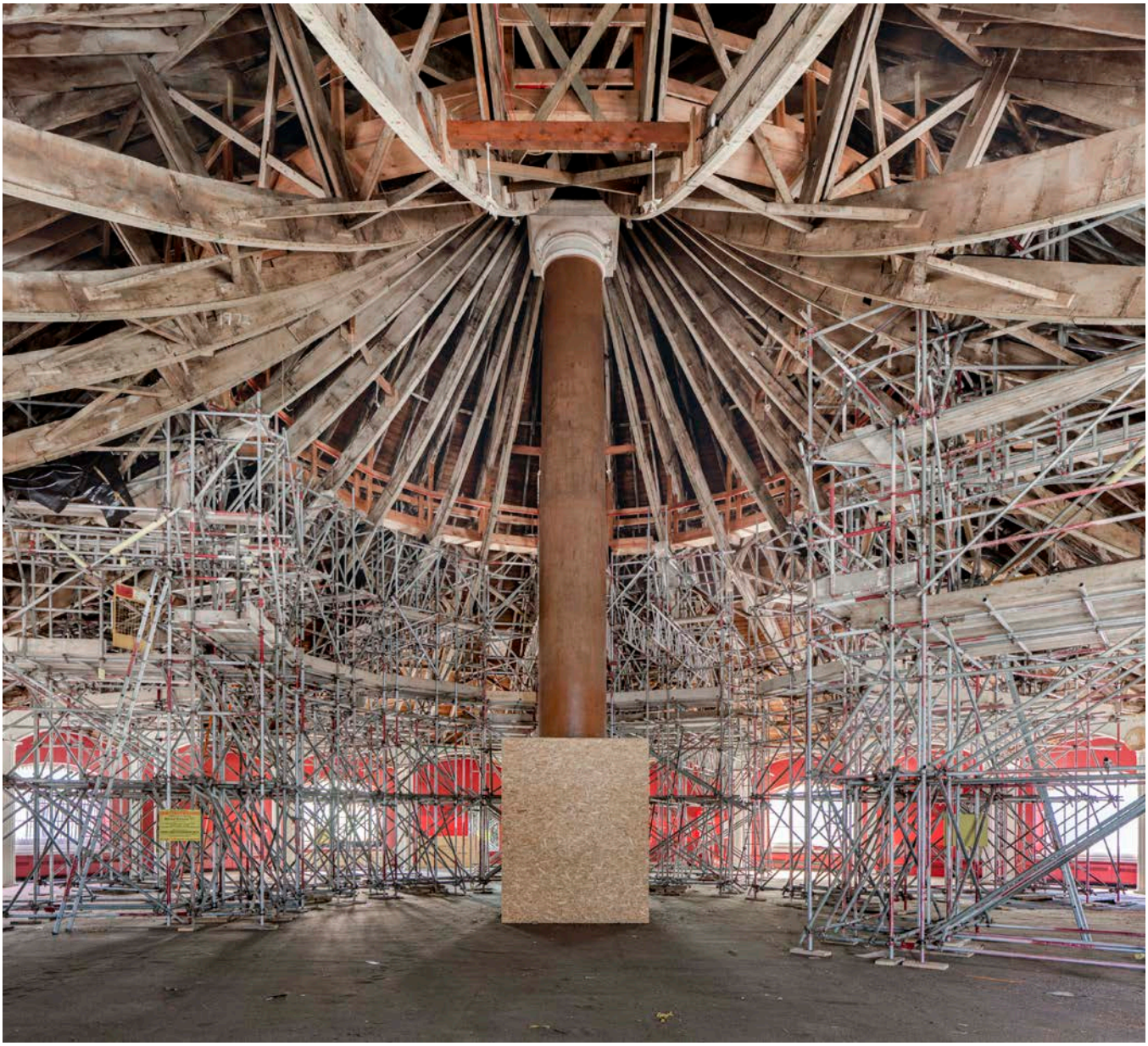

Figure 9: Support and access scaffold inside Woolwich Rotunda. © Historic England Archive

5. Design and Procurement

Pre-construction Information

Pre-construction information is collated by the Principal Designer, to allow the contractor to plan and price the works. It is defined under the CDM Regulations 2015 as:

> "information in the client's possession or which is reasonably obtainable by or on behalf of the client, which is relevant to the construction work and is of an appropriate level of detail and proportionate to the risks involved…"

The contractor and scaffolding subcontractor should be briefed on the aims and expectations for the scaffold, and precautions to eliminate damage to the historic structure. It should be clear whether fixings to the historic structure are permitted, and if so what type of fixings and what locations are acceptable. Other constraints such as the presence of buried archaeology or voids should be stated as clearly as available knowledge allows.

Scaffold Brief

In most cases the scaffold brief will be prepared by the Principal Contractor, who acts as the 'client' for the scaffold. Where no Principal Contractor has been engaged the building owner or manager, or the Principal Designer may need to prepare the brief.

The following documents detail what to include in the scaffold brief.

- *Scaffold checklist* by the Health and Safety Executive (HSE)
- *CG13 Pre-tender information from clients* by NASC.

The brief should clearly define who is responsible for each element of temporary works design. This is particularly important at the interface between the scaffold and the historic fabric to minimise possible damage. Responsibility for designing the scaffold foundation must also be clearly defined.

Constraints should be clearly stated in the brief, including type, position and acceptability (or otherwise) of restraint ties. Methods of resisting uplift and overturning, foundation design and ground conditions, electrical earthing, access for delivery and loading, and enhanced access e.g. for rendering should also be stated.

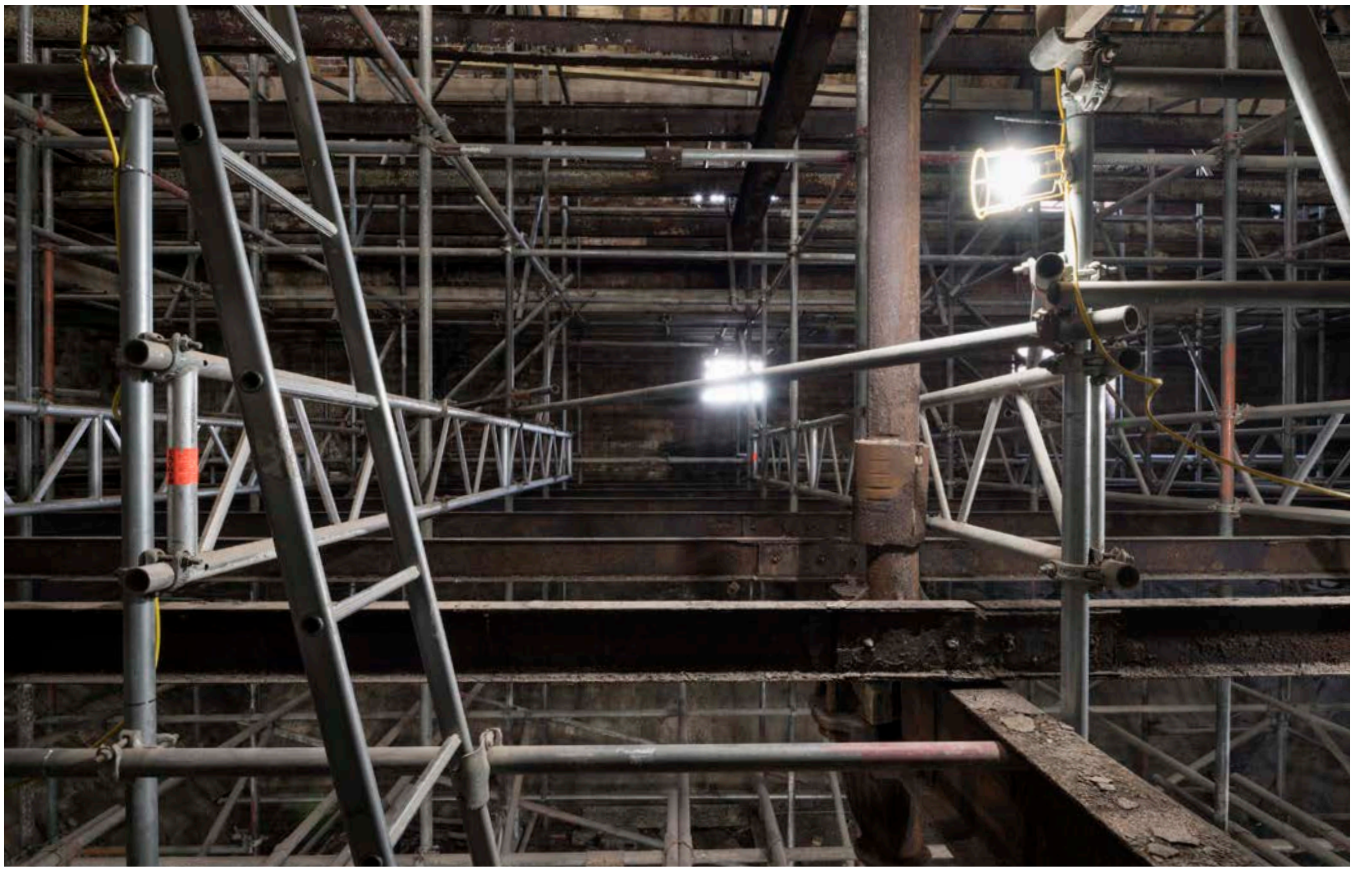

Figure 10: Birdcage scaffold. Note prefabricated beams are usually laced and braced for stability.
© Historic England Archive

Scaffold Design

A simple access scaffold may fall within the criteria for TG20 compliance without needing damaging ties. In most cases however a bespoke scaffold design is needed for historic buildings and monuments.

Scaffold design is usually carried out by the scaffolding contractor or their designer, and in most cases will be carried out during the main contractor's mobilisation period. If an urgent scaffold design is needed before a Principal Contractor has been engaged, the following should be considered:

- The scaffold designer must have appropriate Professional Indemnity Insurance
- The design should be checked and certified by a third party
- Tender documents for the role of Principal Contractor should clearly state that scaffold design responsibility will pass to them. Contractors can modify the designs provided, to suit their method of working, subject to approval. Modifications should be listed and priced separately for comparison.
- The Principal Contractor must submit a fully documented scaffold design, once appointed.

Scaffold Construction Information

The scaffold construction information should state the following and show where they are applied.

- Scaffold leg loads
- Bracing loads
- Butting loads to be transmitted to the historic structure (if permitted)
- Tie type and loads from ties to be transmitted to the historic structure (if permitted)
- Weight of kentledge (if required to resist uplift or lateral forces)

For free-standing scaffolds, the scaffold designer should quantify sway and deflection under loading. This information is needed to ensure adequate clearance between the scaffold and the historic structure.

Figure 11: Vertical and lateral temporary support to Madeira Drive, Brighton. © Historic England Archive

6. Practical Considerations

Scaffold Type

Tube and fitting scaffolding is very versatile and can be assembled in many ways to perform different functions. Some common types are:

Putlog or Supported scaffolding

A traditional scaffold type where one end of the scaffold ‘putlogs’ or ‘bearers’ are built into a pocket in the permanent structure. Putlog scaffolding is unlikely to be acceptable against a historic structure.

Independent scaffolding

‘Independent’ scaffolding consists of two parallel lines of standards (vertical tubes) connected by bearers or transoms (cross tubes), ledgers (longitudinal tubes) and bracing. This is the commonest form of scaffolding and is used primarily for access to the face of a building and to higher levels.

Although referred to as ‘independent’, when taller than two lifts they need to take restraint to the building for the scaffold’s stability.

Birdcage scaffold

Birdcage scaffolds are independent scaffolds consisting of more than two rows of standards in each direction. They are commonly used to provide an internal crash deck or working platform, for example to allow a ceiling or roof to be repaired.

Although referred to as independent, birdcage scaffolds are sometimes butted against the building for stability. Any contact points must be protected and cushioned to prevent damage.

Figure 12: Independent scaffold, Belsay Castle.
© Historic England Archive

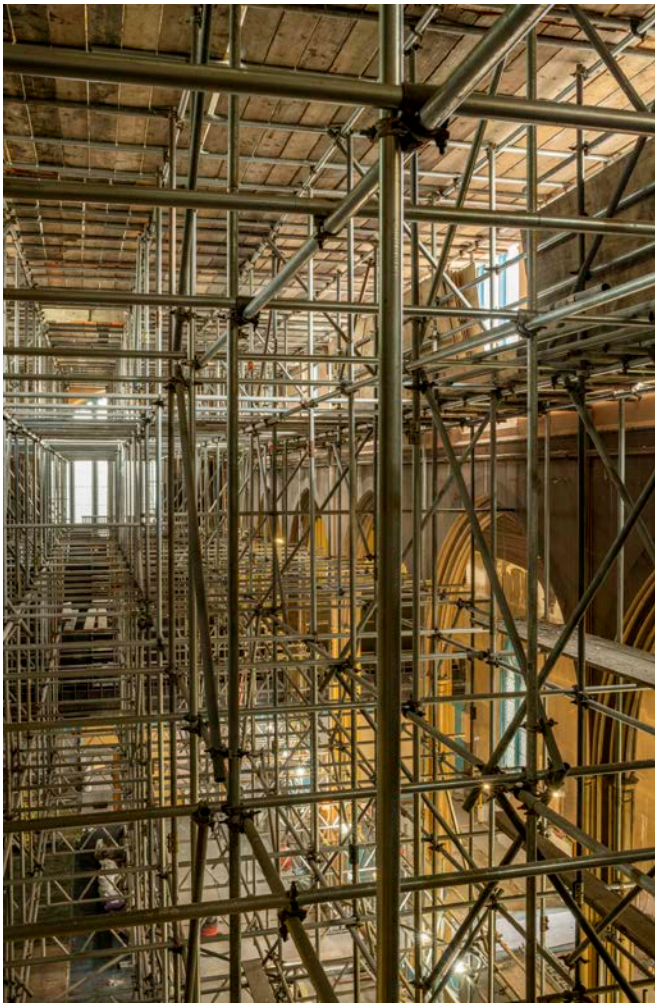

Figure 13: Birdcage scaffold, Cloudsley Centre.
© Historic England Archive

Temporary roofs and enclosures

Temporary roofs or enclosures are needed to protect vulnerable interiors or historic fabric from the weather during repairs or following a fire or other damage. They allow work to be carried out in a controlled environment, preventing further deterioration or collapse. Temporary enclosures can also maximize containment of dust, dirt or other potential nuisances produced during cleaning.

Temporary roofs and enclosures sometimes need to stay in place for an extended period while a damaged building dries out or funding is negotiated. This has implications for the scaffold design and how the scaffold is procured (hire vs purchase).

Rainwater disposal from the temporary roof must be considered. Discharging onto the ground might damage foundations or buried artifacts and may require Scheduled Monument Consent.

Figure 14: A fire damaged building, enclosed to aid drying out and subsequent repairs. Note ‘knee bracing’ may be required to temporary roofs to provide rigidity in high winds. © Historic England Archive

Slung or cantilever scaffolds

A slung scaffold hangs beneath an existing structure to provide a deck for inspection or repair. Hangers or cables are fixed to the structure or to a saddle passing over the structure. An example would be a platform hung beneath a bridge deck to allow inspection, maintenance or repair of the bridge beams.

A cantilever scaffold is used in situations where the scaffold cannot be supported on the ground. Here beams project out to support a working platform. Counterweights, kentledge or anchors are used to prevent the beams overturning.

Slung and cantilever scaffolds are complex structures that always need a bespoke design. Interfaces with the historic structure must be carefully designed and early engagement with the Conservation Officer or Inspector is essential.

Figure 15: Slung scaffold used for repairs to a tall chimney.

Figure 16: Slung scaffold beneath the Royal Albert Bridge, Saltash to allow inspection and repair.

Figure 17: Frame and metal kentledge for suspended scaffold.

At Framlingham Castle, Suffolk, access was required to the external elevations of the castle wall located at the edge of the motte. Rather than constructing additional bays of scaffolding to resist the scaffold sliding down the slope, a suspended scaffold (similar to a window cleaner's cradle) was used to provide light duty access for descaling and repointing. A steel gantry and kentledge were used for support, as there was limited space on the wall walk and the suspended scaffold required frequent re-location to access the different external elevations of the castle wall.

This approach would not be suitable for works requiring significant lateral force to be exerted to adjacent fabric, as the force would just push the cradle away from the wall.

Figure 18: Suspended scaffold. © English Heritage Trust

Figure 19: Modular stair tower being erected. © Historic England Archive

Freestanding towers

Freestanding towers come in different forms. At their simplest they can be proprietary aluminium mobile towers, used to provide quick access at high level for inspection, maintenance or repair. These do not usually need fixing to the historic structure and present little risk to the fabric.

Large tube and fitting towers can provide buttressing to large scaffolds to remove the need for ties to the historic structure. They can also serve as access towers or lifting and loading platforms.

Temporary propping and shoring

‘Props’ usually refer to vertical members supporting the weight of a structure that cannot support itself. ‘Shores’ usually refer to horizontal or diagonal braces used to prevent a structure from falling or overturning. Nowadays both are usually proprietary steel members, sometimes incorporating jacks to ensure a tight fit.

Propping to provide structural support needs to be designed independently from scaffolding for access or protection purposes and should be clearly identified. It is vital that there is no risk of structural props being removed accidentally when a general scaffold is altered or removed.

Structural props and shores inevitably make contact with the historic structure and may need substantial fixings. Structural propping and shoring always needs a bespoke design; early engagement with the Conservation Officer or Inspector is essential.

Figure 20: Substantial shoring at Wentworth Woodhouse.
© Historic England Archive

Figure 21: Propping.
© Historic England Archive

Figure 22: Façade support scaffold, with concrete blocks for kentledge.

Temporary Foundations

Responsibility for foundation design must be clearly defined from the outset, together with known constraints such as the presence of historic foundations and archaeology, and ‘known unknowns’ where ground investigations have not yet been carried out.

All archaeological information and the results of trial pits and ground investigations should be included in the pre-construction information and scaffold brief. Additional, specific investigations will often be needed once a preliminary scaffold design has been drawn up.

Pre-construction information should identify any known buried structures, voids or historic foundations. The scaffolding should be designed to avoid or bridge any remains, or back-propped to a suitable bearing if unavoidable.

Any excavation at historic sites is likely to be sensitive; at Scheduled Monuments it will require Scheduled Monument Consent. Any permitted excavation may need to either be carried out by archaeologists or under their supervision. Allowance should be made for both the cost and time needed.

Heavy loads placed directly on the surface can damage buried structures and artifacts. Spreading the loads will reduce the risk of damage. Where there is insufficient capacity at ground level to spread the load, it may be necessary to use small diameter steel piles to transfer load beneath the weak strata. To eliminate the risk of inserting a pile through significant archaeology it may be necessary for an archaeologist to hand excavate the proposed locations to the depth of the archaeological layers, before backfilling and piling. The chosen piling type should be reversible and removed on completion

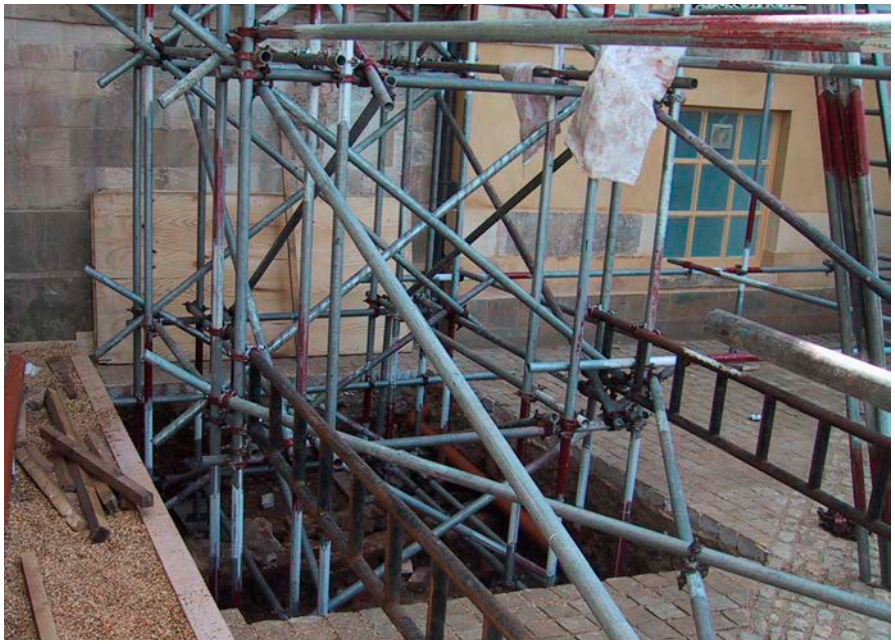

Figure 23: Excavation before casting a temporary insitu concrete foundation to resist lateral wind load and uplift. © Benchmark Scaffolding.

Figure 24: Laterally restraining timber eaves beam. Masters House. © Historic England Archive

Figure 25: Protective envelope. Bradwell Abbey. © Historic England Archive

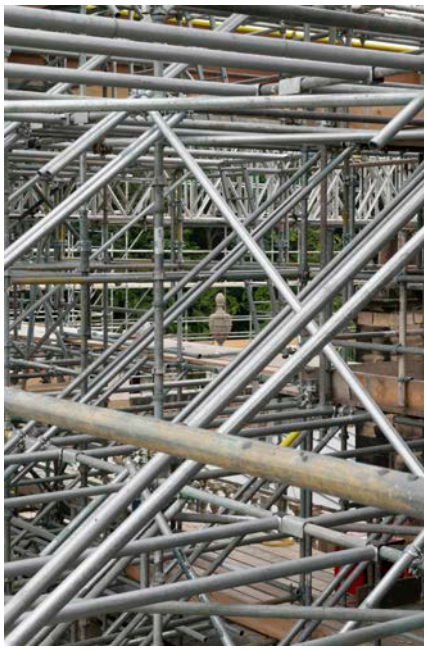

Figure 26: Birdcage Scaffold, Wentworth Woodhouse. © Historic England Archive]

At Dyrham Park in Gloucestershire a temporary enclosure was needed to provide a dry environment for roof repairs. As there were adjoining buildings the only viable location for the lateral stability system for the scaffold was on made ground, up to 5m thick, with very low allowable bearing pressures and significant archaeology. The agreed approach was to install screwpiles by hand to a specified torque. This reduced the risk of inadvertently damaging hidden artefacts.

A lightweight system scaffold was used to roof the enclosure. This left little room for installation error so an oversized pile top plate was supplied to improve tolerance. If the scaffold base plate did not sit wholly on the pile, a second pile was installed and a beam fitted to support the scaffolding between the piles.

Ratchet straps were used to resist uplift in preference to bolts, as they are more adjustable to fit between the piles and the scaffold. The straps were stress tested and clearly marked. The straps and the scaffold were inspected every seven days throughout the contract.

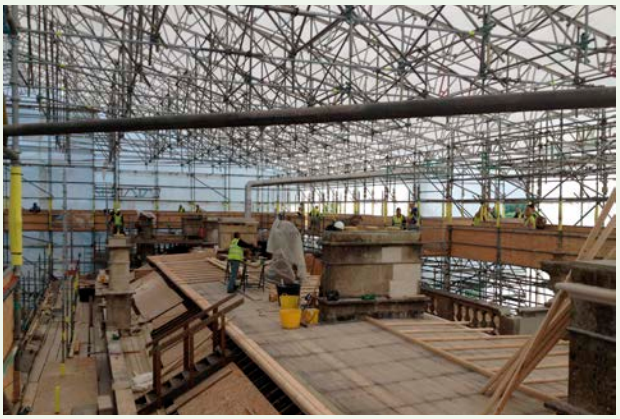

Figure 27 (top): Free standing temporary building enclosure.
Figure 28 (bottom left): Internal view.
Figure 29 (bottom right): Scaffold base screwpile connection detail. © Integral Engineering Design

Figure 30: Access ramp. © Mann Williams

At Kilpeck Castle, Herefordshire there was a need to undertake repairs to the standing walls on the motte. The sides of the motte were too steep for operatives to safely transport equipment and materials to the worksite. The solution proposed by the engineer and included in the pre-construction information was for a temporary scaffold ramp to be erected, to provide safe access to the worksite.

Figure 31: Rakers used for stability. © Mann Williams

Figure 32: Scaffold to two elevations of masonry building with raking struts on the garden elevation and ties on the street face.

Contact points

Wherever possible, scaffolding to historic structures should be truly independent, avoiding any contact with historic fabric. Where this is not possible, the contact points must be carefully designed to minimise any risk of damage. Early engagement with the Conservation Officer or Inspector is essential.

Contact points will take a number of possible forms:

Historic structure bearing onto the temporary works

Typically used where props or shores have been introduced to support or stabilise the historic structure. Contact is usually unavoidable. Design should aim to minimise damage at contact points through the use of appropriate packing material. All fixings should be reversible, removable and repairable.

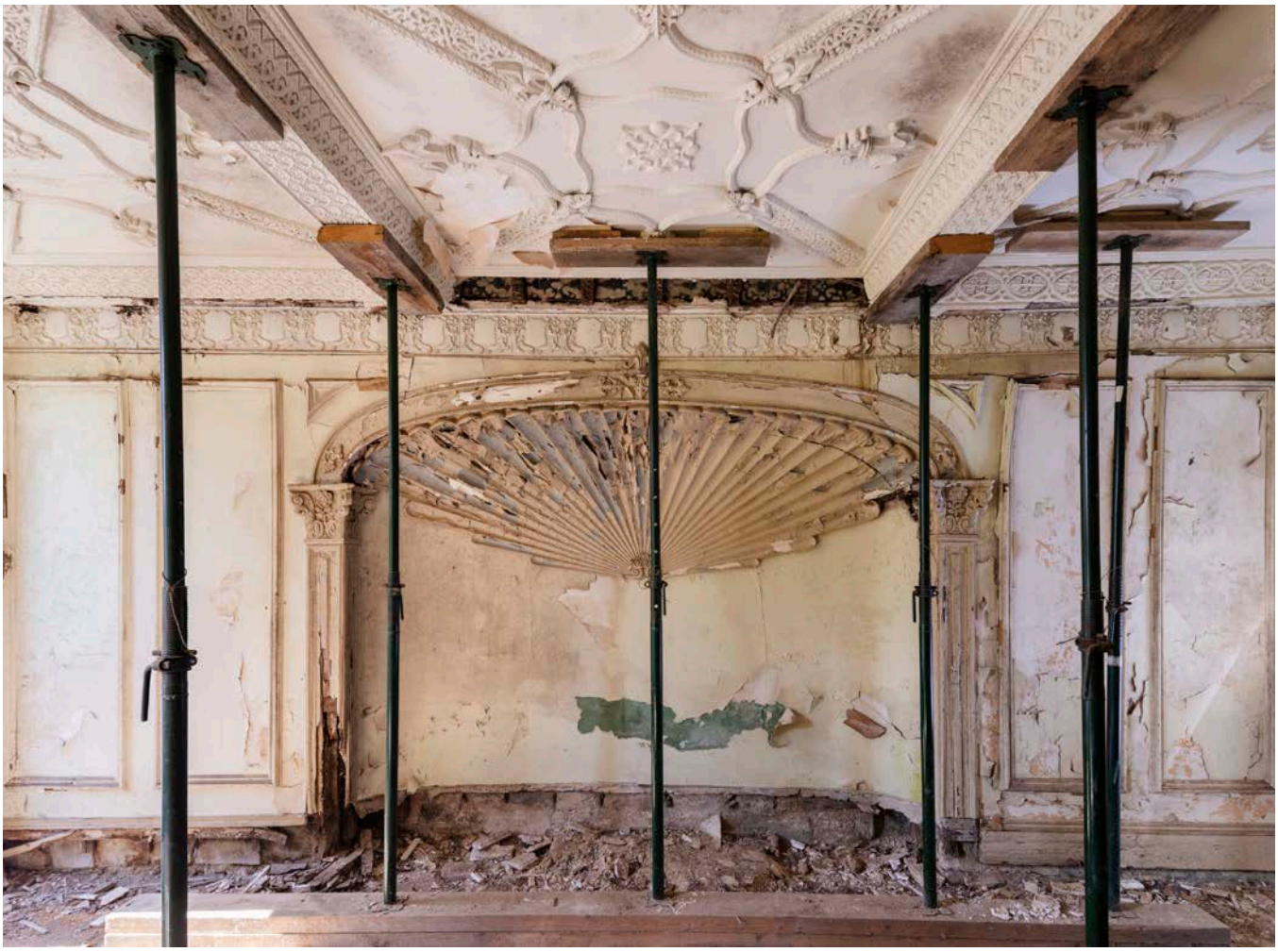

Figure 33: Ceiling support using timber bearing plates top and bottom at Withcote Hall. © Historic England Archive

Scaffold bearing onto the heritage structure

Supporting a scaffold on heritage structures should be avoided. However there are occasions when it is the only practical option or where the expense of doing otherwise might compromise essential repairs.

Point loads from standards must be distributed to avoid damaging the fabric. The design should aim to minimise damage at contact points through the use of appropriate packing material. All fixings should be reversible, removable and repairable.

Figure 34: Cantilevering scaffold access, supported on embrasure with soft underlay and hardwood cover.

Figure 35: Cupola temporarily suspended from the scaffold roof via a runway beam to assist positioning.

Scaffold butting against the historic structure

Typically used where an access scaffold relies on the historic structure for stability or vice versa. A 'butt' connection does not usually need any drilled fixings. Design should again aim to minimise damage at contact points using appropriate packing material. Examples might be a simple plastic end cap, an end plate with timber packs, rigid foam or carpet tiles for protection. The design should allow for individual butt tubes to be removed one at a time to allow conservation work to be carried out behind or around them.

There must be no risk of scaffolding tubes resting on any projecting fabric e.g. gargoyles and carvings, where fragments could snap off.

Figure 36: Proprietary steel support system with concrete kentledge. © Historic England Archive

Figure 37: Detail of scaffolding butting building fabric to transfer lateral compression loads with a timber plate and soft underlay. © Historic England Archive

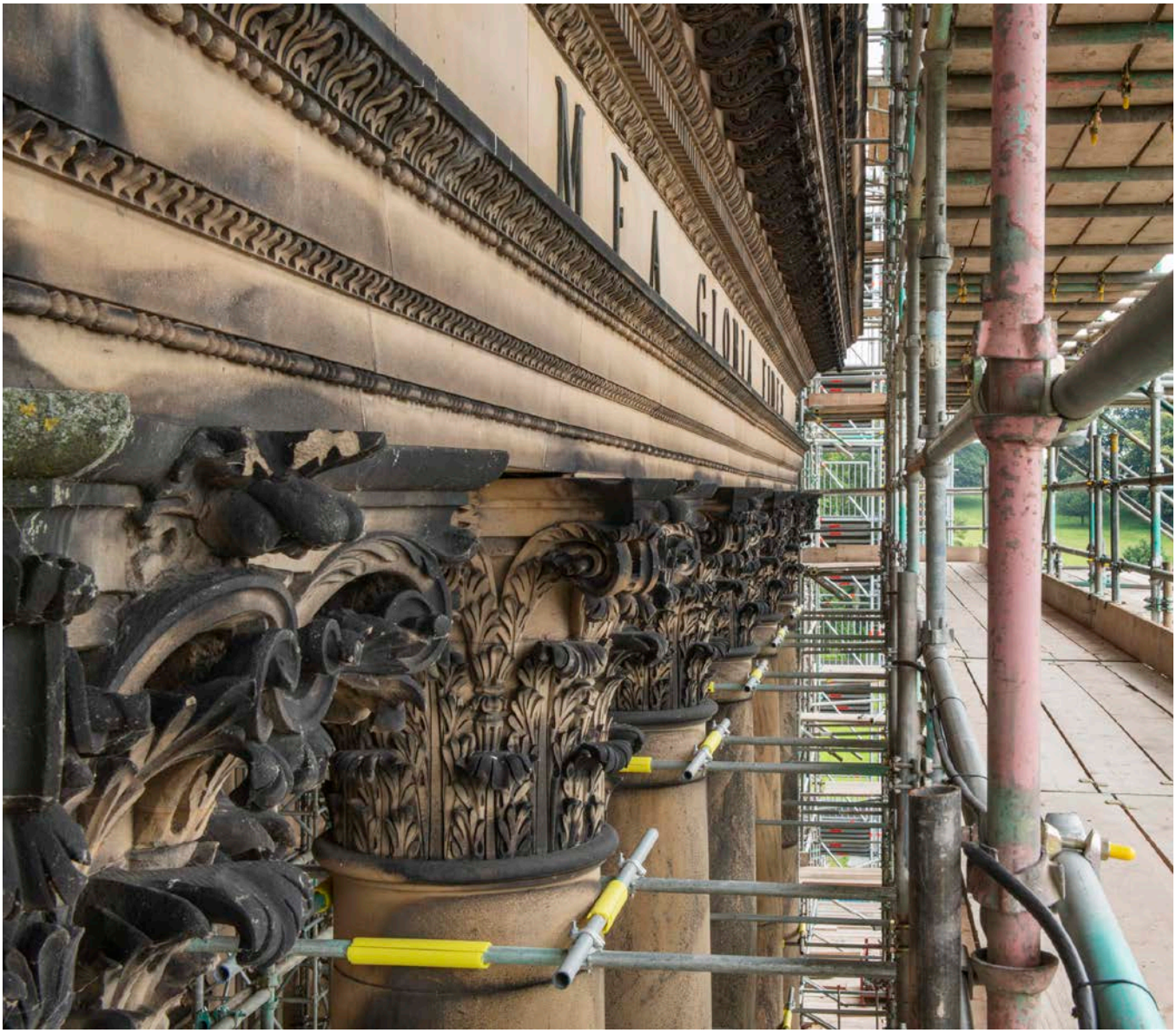

Figure 38: Scaffold restrained via column heads with padded tubes. © Historic England Archive

Scaffold tied to the historic structure

Typically used where an access scaffold relies on the historic structure for stability, but also when for example an unstable building façade is stabilised by the scaffold. Alternative methods of providing stability such as use of kentledge or buttresses should always be considered first.

Drilled fixings should be avoided wherever possible because they inevitably cause damage to historic fabric. Alternatives to drilled ties include:

Return ties

These are taken around the corner of the building and restrained one or more bays beyond the return.

Figure 39: In order to re-roof The Engine House, a scaffold was erected. Rather than using ties into the historic fabric, it was designed with return ties to other elevations and an additional buttressing bay to the centre of the elevation.

Through ties or lip ties

These are equivalent to standard duty ties. They generally pass through window openings to bear on one wall face, or to clamp both wall faces. The glass or the whole window should be carefully removed for later reinstatement by a conservation joiner, not a scaffolder. Openings need to be sealed against weather and against unauthorised access.

Figure 40: Through tie, Battle Abbey.

Figure 41: Lip tie on merlon, Battle Abbey.

Reveal Ties

Reveal ties are short scaffold tubes with a screw jack at one end, wedged across a window or door opening. They rely on friction between the masonry, packs and steel props, and provide the equivalent to light duty ties. TG20 recommends that no more than 50% of façade ties should be reveal ties. Reveal ties must be frequently checked for tightness so are rarely appropriate where scaffolding is likely to remain un-managed for a long time.

Figure 42: Reveal tie, Cirencester.

Use of drilled fixings in historic structures

If drilled fixings are proposed into historic structures, the reasons for their use must be clearly laid out in a statement. This statement should assess possible alternatives and explain why they are not suitable.

Where drilled fixings cannot be avoided the number of ties should be kept to a minimum. Removable ties should be used in preference to resin bonded ties. They must be positioned in mortar joints or located where the damage can be fully repaired on completion. The capacity of fixings in mortar joints may be less than in solid masonry; this must be considered in the design.

If anchor ties are likely to remain in place for some time, exposed to the weather, corrosion resistance must be considered. Rust jacking can cause considerable damage and the fixings customarily used for scaffolding have only light corrosion protection. An upgrade to a better standard of galvanising, or to stainless steel may be necessary. If stainless steel fixings are used with galvanised steel scaffolding, the two metals should be separated with isolating washers to prevent bi-metallic corrosion.

Some historic substrates can prove difficult to drill anchors into. Walls built from flint and other hard rocks set in weak lime mortar can be particularly challenging. Hard flints deflect the drill bit, which then loosens the friable mortar, weakening the wall and leaving a poorly anchored fixing.

Guidance about drilled-in anchor fixings, their suitability for different substrates, installation and testing are provided in TG4 ‘Anchorage Systems for Scaffolding’. An appropriate anchor for the tie duty and substrate should always be selected.

Early engagement with the Conservation Officer, or Inspector, is essential.

Tie classification

TG20 compliance sheets state a tie ‘duty’, i.e. the tensile force which ties must resist to prevent the scaffold moving away from the building. This depends on the load bearing capacity of the building fabric and the connection. If a lower duty tie is preferred (due to weaker fabric or to reduce the size of fixings and therefore damage to historic fabric), ties may need to be doubled up or their frequency increased. If a TG20 compliant scaffold is proposed, in some instances it may be beneficial to instruct the scaffold designer to undertake a site specific analysis of the scaffold, to reduce the tie duty.

Tie duty	Tie duty class
2.7kN	Very light duty
3.5kN	Light duty
6.1kN	Standard duty: A
9.1kN	Standard duty: B (with enhancements to scaffold)
12.2kN	Heavy duty

Expanding anchors

Expanding anchors are rarely suitable in weak substrates as the expansion forces can damage the historic fabric and potentially lead to failure of the tie. Expanding anchors can be difficult to remove on completion.

Self-tapping screws

Self tapping or ‘concrete’ screws can be used in most materials. It may be difficult to get a secure fixing in some substrates such as flint walls. Self tapping screws are usually easy to remove and reinstate on completion.

Nylon plug and screws

Nylon plug anchors are suitable for most substrates and only exert a small expansion force; this means that they are suitable for weak substrates, but also means that they are only suitable for light duty ties. Nylon creeps under load so should not be used where the scaffold will be in place for a long time.

Resin anchors

Resin anchors provide good anchorage in most materials. Where the substrate has a cavity, fissures or voids, the resin can be contained within a special ‘sock’ so that it is not lost. The disadvantage of resin anchors is that they cannot usually be removed and so are rarely acceptable in a heritage structure.

Where a maintenance scaffold needs to be erected in the same place periodically over a number of years, it may be acceptable to install permanent sockets. These can be grouted or bonded in place and sealed with a cap, allowing fixing bolts to be inserted whenever the scaffold is needed.

Figure 43: Scaffold ring bolt in a drilled resin anchor socket.

Through bolts

Through bolts pass through the historic wall to a back plate on the inner face. This may be the only feasible method of tying in weak masonry or timber framed structures. It can be relatively straightforward to reinstate on completion, however if the historic fabric is in poor condition it is best not to rely on it for stability.

Kentledge

Kentledge is dead weight, added to the scaffold to resist wind uplift or overturning. Kentledge is usually preferred over drilled anchors to provide scaffolding stability on historic sites, as it does not directly damage the historic fabric.

Deadweight can be provided in many ways. Additional scaffold tubes can be laid over the bottom row of ledgers; metal weights, precast concrete, masonry blocks, water containers and sand bags can all be used. Loose scaffold tubes may be attractive to thieves and should be secured.

The main considerations on historic sites are the effect on buried structures and archaeology. Weight needs to be distributed in a way that will not damage artefacts in the ground; access for delivery and removal must be carefully considered to avoid damaging buried heritage.

Where water containers are used, disposal of the water when no longer needed must be considered. They cannot be emptied onto the ground as this might damage buried artefacts. The risk of damage from freezing or vandalism should also be considered.

Figure 44: Precast kentledge to resist uplift. © Benchmark Scaffolding

Figure 46: Water tanks kentledge.

Figure 45: Sand bag kentledge.

Earth, Wind, Fire and Water

Protection against electric shock and lightning protection

There is a risk of electric shocks to workers or visitors when a scaffold supports electrical equipment (including power tools) or lighting. A separate earthing system is required by BS 7671 where the nominal voltage exceeds 50V; this usually takes the form of a common earth electrode (an '*earth spike*') driven into the ground. The installation should be tested on completion and every three months while the scaffold is in use.

Lightning protection may also be needed. The scaffold should be bonded to the earth and air termination network (lightning protection system) of the permanent building if one exists. A risk assessment will be needed using BS EN 62305 where connection to an existing network is not available.

Earthing and lightning protection both need earth electrodes to be driven into the ground; this must be considered early in the planning stage. Electrodes must be positioned carefully to avoid damaging below ground archaeology, structures or remains, or modern underground services. Consent is needed to drive earth electrodes at Scheduled Monuments.

Early engagement with the Conservation Officer or Inspector of Ancient Monuments is essential.

Wind

Site wind loading should preferably be provided in the pre-construction information, otherwise the scaffold designer must make an independent assessment. These loads are used together with the permanent and variable loads to design scaffolding elements and foundations.

Scaffolding is usually treated as a temporary structure and designed for lower wind speeds than permanent structures. If the scaffold is likely to remain in place for an extended time it will need to be designed for the same wind speed as a permanent structure. This should be identified in the pre-construction information.

Fire

Historic buildings are vulnerable to fire. Scaffolding can contribute to the spread of fire through flammable scaffold boards and material, it can also provide a means of access for arson.

Scaffolding must be designed such that it does not obstruct any fire escape routes or smoke vents, either on the historic structure or any neighbouring properties.

Fire prevention, containment and escape must all be considered at pre-construction stage, along with measures to prevent unauthorised assess. This is particularly important where a scaffold may be in place for some time, without a contractor on site to manage it.

Figure 47: Appleby Castle. © Historic England Archive

Figure 48: Naze Tower. © Historic England Archive

Water

A large scaffold roof will discharge significant volumes of water in a rain storm. Rainwater needs to be disposed of in a way that does not damage the historic structure or any buried archaeology, and does not cause a nuisance to the public or neighbouring properties.

Where the historic structure already has rainwater goods discharging into a below ground drainage network, that is the obvious place to discharge from the scaffold. Existing drains should be surveyed and if necessary repaired before receiving rainwater from the scaffold roof.

Where there is no existing drainage system on site the scaffold roof may need to discharge to a temporary soakaway, a nearby watercourse, or onto the ground if it will not cause damage or nuisance. At Scheduled Monuments, consent will be needed to discharge onto the ground or to dig a soakaway.

Draining to a watercourse or existing drain network will need consent from the drainage authority or local authority.

Figure 49: Balshall Heath Pool. Scaffold supporting viewing gallery . © Historic England Archive

Long duration

Scaffolding may be needed for a long time where a historic structure has been damaged, or needs to dry out, or is waiting for repair funding. The scaffold will need to be managed during that time, and if no Principal Contractor is engaged that responsibility falls to the building owner or the Principal Designer.

Where a scaffold will be in place for longer than usual the following should be considered:

- Inspection. Any scaffold needs to be inspected periodically to ensure that it is safe and stable. It should also be inspected after any serious storms or other potentially damaging events.
- Security. A scaffold can provide access to intruders. Measures may be needed to prevent unauthorised access and to minimise the risk of damage if intruders get in undetected.
- Corrosion and decay. Timber and steel elements are both vulnerable to deterioration when exposed to weather for a long time. They may need protecting, replacing or upgrading. Fixings are particularly vulnerable and may need to be upgraded to stainless steel.
- Wind loads. Wind loads will need to be assessed as a ‘permanent’ structure. Bracing, tie loads and foundation design will need to be reviewed.

Access scaffolding in use must be inspected every seven days under the Work at Height Regulations 2005, with additional inspections after extreme weather etc. Where there is no access to the scaffold inspections can be less frequent, but the remaining risks must be formally assessed.

Figure 50: Failure of temporary enclosure due to exposure to the elements.

At this site, it was initially intended that repairs to the building would happen within a couple of years of erection of the temporary enclosure, once the building had dried out. This did not happen, and the scaffold remains, without a provision for inspection or maintenance. This has led to degradation of the enclosure fabric (which only has a lifespan of a couple of years), which no longer provides the protection needed to prevent further deterioration of the historic fabric. If the building were adjacent to a right of way, the scaffolding in its current state might be considered a dangerous structure.

Figure 51: Corroding free standing scaffold.

Figure 52: Decaying oak sleeper sole plates.

Alternatives to scaffolding

A well designed scaffold provides a safe and stable platform for work to take place, protected from the worst of the weather. Scaffolding always presents a risk of damage, however small, to the historic fabric. In many cases there are no practical alternatives to scaffolding, but there may be cheaper, less intrusive options, that avoid any contact with the historic structure, particularly during investigations. Some alternatives include:

- UAV's (Un-manned aerial vehicles or 'drones') can be a quick, safe and effective way to inspect roofs and other difficult to access parts of heritage structures.
- Ladders, step ladders, hop ups or podium steps. Note that working from a ladder for longer than 30 minutes is discouraged on safety grounds and should be risk assessed.
- Trestles and temporary scaffold towers. Towers usually have integrated bracing and should not need to be tied to the heritage structure.
- Hoists.
- Rope access by specialist contractors. Note that fixing anchor lines for rope access will require the same permissions as fixing ties for scaffolding. Where possible drilled fixings should be avoided.
- Mobile elevated working platforms (MEWPs) or cherry pickers. Access for the MEWP and position of stabilising legs will need to consider the risk of damage to below ground archaeology, structures or voids. Compact, self-propelled platforms are available for locations that are difficult to access.

Figure 53: Hammerhead Crane.

On the Hammerhead Crane, Isle of Wight it was felt to be prohibitively expensive to construct an access tower initially to inspect the jib. A visual inspection was made by drone; on the basis of this the engineer ruled that it was not safe to hang a scaffold from the jib. For close inspection and to undertake repairs the brake was applied to the jib (to prevent it moving in the wind) and a free-standing scaffold tower was erected directly beneath the jib. The crane was then rotated 180 degrees so that the rear section could be inspected from the same tower

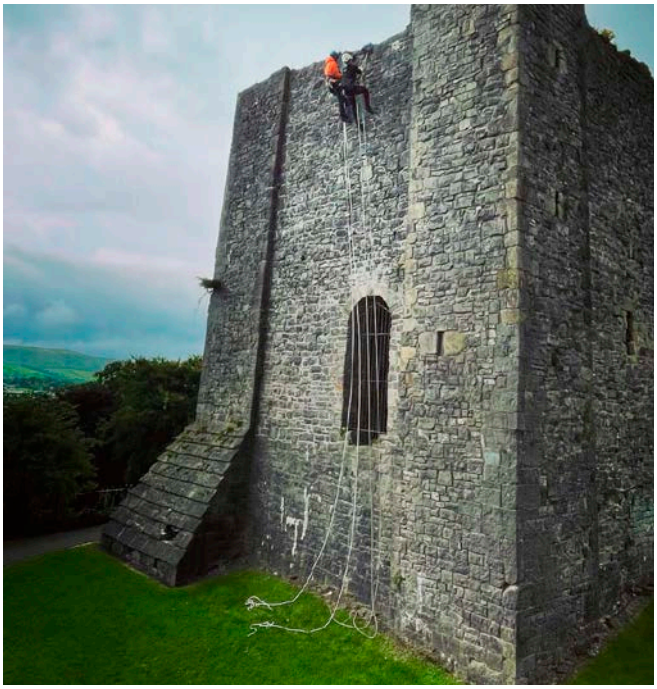

Figure 54: Rope access.
© Matthew Lavery, ORB Rope Access

Figure 55: Working from ladders is discouraged for extended duration. © Historic England Archive

Figure 56: Drones provide a safe way to inspect dangerous or inaccessible structures.

Figure 57: MEWP access for cleaning memorial. © Historic England Archive

7. Scaffold erection and dismantling

Impact damage from tubes during erection and dismantling is one of the biggest risks to a historic building from scaffolding. The Principal Contractor and scaffolding contractor should carry out a risk assessment to identify and protect any parts of the structure that may be damaged. Delivery routes for lorries need to be planned to avoid damage to below-ground remains, or to structures at gateways and pinch points. Temporary bollards, barriers or protective hoarding should be erected if necessary.

Routes for carrying scaffold tubes to their final positions should also be risk assessed to identify any parts of the structure that are at risk of damage. Protective hoarding or other measures should be put in place if necessary.

The Principal Contractor and scaffolding contractor must be adequately briefed on the significance of the historic building and the level of care that is expected. This need for care must be transmitted to the workforce through toolbox talks and adequate supervision. Risks to historic fabric should be reviewed whenever scaffolding is being altered or removed and additional precautions put in place when needed. Wherever valuable, fragile elements are at risk, e.g. statues or carvings, temporary protection is better than trying to retrospectively repair damage.

Figure 58: Crane lifting temporary roof into place.
© Laura Williams, National Trust

8. Security and access

Scaffolding can provide unintended access for intruders. Security should always be a consideration when scaffolding a building, but even more so when that building is a valuable monument.

Unauthorised access should ideally be prevented before reaching the scaffold, by secure site hoarding and security staff and/or cameras. Ladders should be removed when not in use or locking ladder guards fitted. Scaffold boarding can be removed from lower lifts when not in use and alarm systems fitted on high-risk sites.

When scaffolding occupied buildings or when neighbouring buildings are occupied, the security and privacy of those occupants also needs to be considered. Scaffolding must not be allowed to interfere with opening windows, smoke vents or fire escapes. Non-flammable sheeting may be needed to maintain privacy. Advertising shrouds may be contentious and are unlikely to be permitted on listed buildings or Scheduled Monuments; early dialogue with the Conservation Officer or Inspector is essential.

Figure 59: Hoarding enclosing scaffold and a dangerous building. © Historic England Archive

9. Checklist

The following are intended as prompts, not as an exhaustive list of considerations:

☐ Is the site a Scheduled Monument, Listed Building, Locally Listed or other heritage structure?	Consent may be needed. Discuss with Historic England for Scheduled Monuments or the Local Planning Authority for other designations
☐ Will scaffold erection be the only construction activity or is it part of a larger scheme?	If the only construction activity consent may be needed specifically for the scaffold.
☐ Have the duty holders under CDM regulations been appointed?	A Principal Designer must be appointed unless the client takes on that role (a domestic client and can pass their duties to the Principal Contractor by agreement). The Principal Designer can guide appointment of other duty holders.
☐ Will a Principal Contractor be engaged for the whole time that the scaffold is in place?	If not, who will manage the scaffold to ensure it remains safe and secure?
☐ What is the purpose of the scaffold?	Access for inspection or repair (with associated loading requirements), weather protection, structural support?
☐ Is it intended to store material on the scaffold?	Ensure this and the location is identified. Include the load and location of storage in the scaffold brief.
☐ Will a TG20 compliant scaffold be suitable?	Unlikely for historic structures as drilled ties into the structure should be avoided.
☐ Are there known or possible buried structures, voids or archaeology?	Carry out archaeological investigations and design the scaffold to avoid causing damage.
☐ Is the ground able to support the scaffold?	Carry out ground investigations. Distribute leg loads using sleepers or spreaders or consider screw piles to avoid damaging surfaces and archaeology in soft ground.
☐ How will the scaffold be stabilised?	Bracing, raking shores, buttresses, return ties, kentledge? Ties to the historic structure should be considered a last resort.
☐ If physical ties to the monument are proposed, what type will they be?	Through ties, lip ties, reveal ties, return ties, or drilled anchors. Try to use least intrusive option for historic structures.
☐ Are existing door and window openings to be used for through ties?	Carefully remove or protect historic glass and joinery before installing ties.

☐ How is the historic fabric protected at contact points?	Timber packs, elastomeric pads, rigid foam, carpet tiles, plastic tube end caps.
☐ Are drilled anchors proposed?	Drilled anchors into historic fabric should be considered a last resort. How will the anchor holes be made good on completion? Can they be fitted in mortar joints? Are they fully removable? Are there less intrusive alternatives that could be used?
☐ Is the substrate suitable for drilled anchors?	Weak, friable masonry, timber framing, terracotta, flint walling and masonry with voids are all problematic.
☐ Will the scaffold need electrical earthing?	Earthing spikes should be positioned where they will not damage archaeology. Consent may be required.
☐ How will rainwater be managed?	Discharge into existing system, watercourse, onto the ground or soakaway? Consent may be needed.
☐ How will security be managed when the site is not manned?	Security hoarding, remove ladders or fit guards, remove decking to lower lifts, security alarms.
☐ How will fire risk be managed?	Non-flammable cladding and decking. Alarms. Advanced measures? Ensure smoke vents and emergency escapes are not obstructed.
☐ Are building occupants impacted in any way?	Entry, exit and emergency routes, opening windows, privacy, noise.
☐ What heritage features are vulnerable to damage?	Remove or protect vulnerable carvings, decoration etc where they could be at risk.
☐ How will scaffolding be delivered to site?	Plan vehicle routes and crane positions to avoid damaging surfaces, archaeology etc and vulnerable structures such as gateways, or erect protective hoarding.
☐ How will scaffolding be transferred to its final location?	Plan walking routes to minimise risk of impact damage to walls, openings and features. Erect protective hoarding where there is a risk.
☐ Will the scaffolding need alteration during its life?	Plan transfer routes to minimise risk of impact damage to walls, openings and features. Erect protective hoarding where there is a risk.
☐ How will the scaffold be dismantled and removed?	The same precautions are needed for safe removal as for erection and alteration.
☐ Are props that are needed for structural support clearly identifiable?	Accidental removal of structural supports must be avoided during alterations.
☐ How long will the scaffold be in place?	If the scaffold is to remain in place for a year or more the durability of steel and timber components should be reviewed and the design checked for ‘permanent’ wind loads.

10. Brief glossary of terms

Bay	The space or distance between vertical standards.
Bracing	Diagonal tubes, fixed to the verticals to prevent sway and provide stability.
Couplers	Standard clamps designed to connect the scaffolding components together.
Decking	The horizontal boards forming a working platform.
Guard rail	Horizontal handrails to prevent falls.
Lacers	Members that tie parallel beams transversely.
Ledger or runner	Horizontal tubes running along the length of the scaffold below deck level, connecting the vertical standards.
Kentledge	Dead weight added to the scaffold to provide stability and to resist uplift. In the form of sandbags, water containers, extra scaffold tubes, concrete blocks or iron weights.
Putlog	Horizontal tubes connected to the vertical standards at the outer end, and built into the permanent wall at the inner end.
Scaffold boards	Timber boards used to form a deck.
Standard or upright	The vertical tubes acting as the legs of the scaffold.
Tie	Fixings to connect the scaffold to the permanent building or structure.
Toe board	Boards fixed to the edge of the deck to prevent anything falling.
Transom or bearer	Horizontal tubes connecting the inner and outer ledgers, to support the decking and restrain the standards.

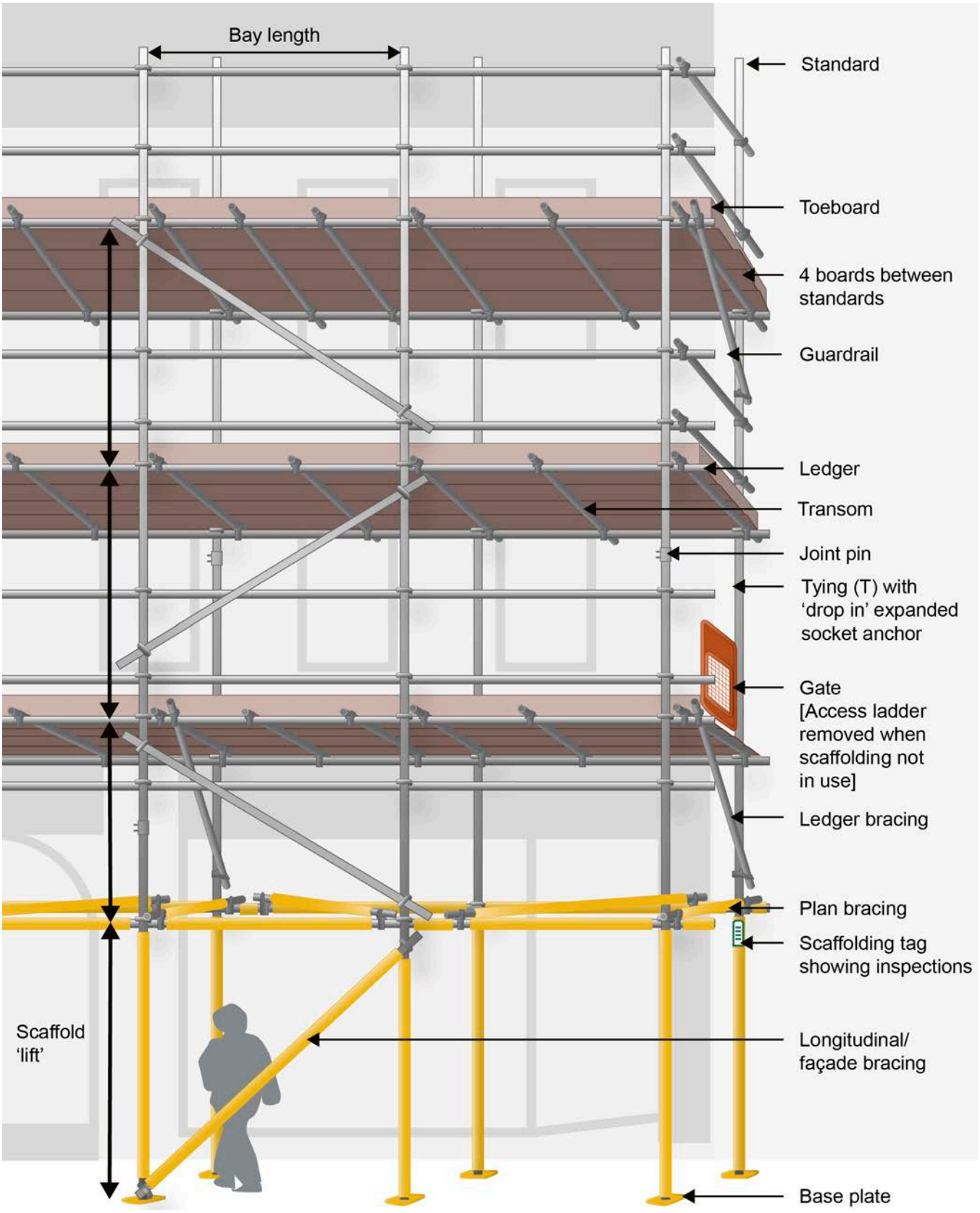

Figure 60: Common terms

11. Where to get advice

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The Work at Height Regulations 2005

The Provision and Use of Work Equipment Regulations 1998

Sources of Advice

Health and Safety Executive

Redgrave Court, Merton Road, Bootle, Merseyside L20 7HS
Website: www.hse.gov.uk

National Access and Scaffold Confederation

4th Floor, 12 Bridewell Place, London EC4V 6AP
Website: www.nasc.org.uk

Temporary Works Forum (TWf)

The Temporary Works forum was incorporated in 2010. It publishes guidance on all aspects of temporary works.
Website: www.twforum.org.uk

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