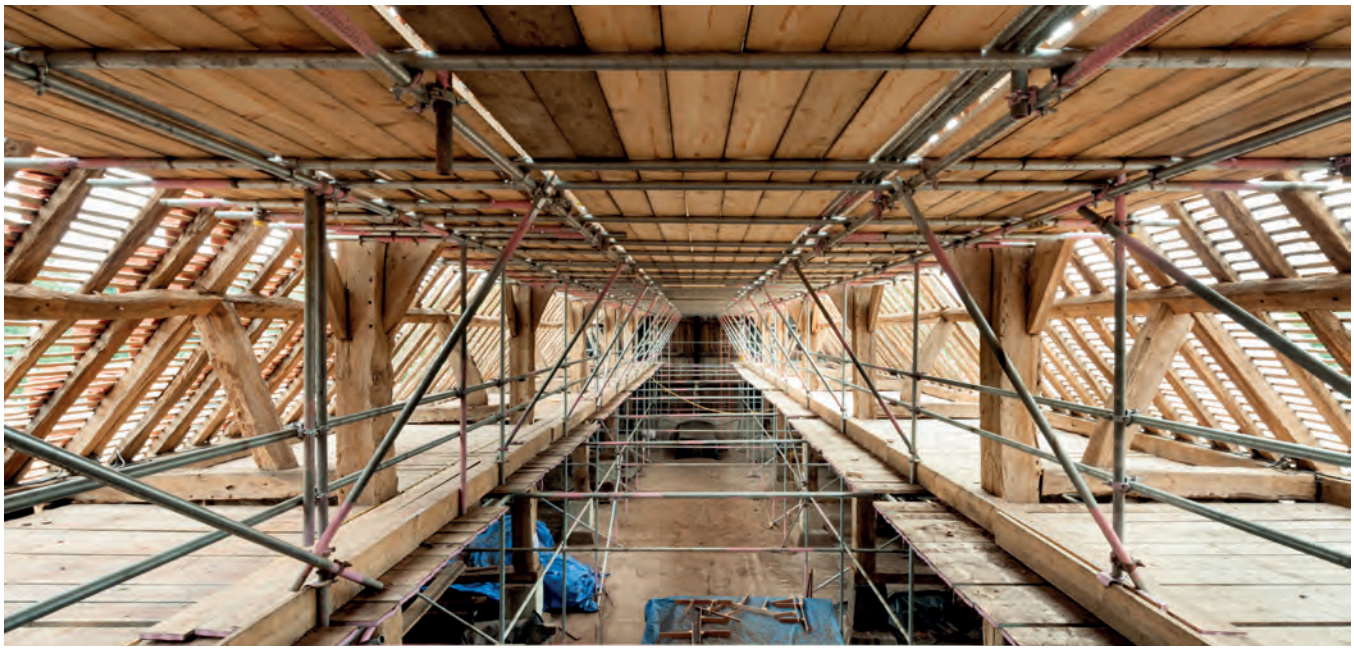
SCAFFOLDING

BRIDGET DRAKE-WILKES



A birdcage scaffold providing access for the repair of roof timbers from the inside: no fixings to the existing structure are needed because of the width. (All photos copyright Historic England)

SCAFFOLDING IS often an essential tool to gain access to areas of a building or structure, yet where a historic building is concerned it must be used with caution. It is necessary to have detailed plans and scaffolding designs in place as erecting such a structure could harm the historic fabric of a building, such as when a scaffold is secured with drilled fixings. This type of damage increases incrementally each time a scaffold is erected.

Considerations for this can often be overlooked when plans for works are temporary, but it is vital that the necessary steps are taken to avoid any maltreatment of the historic structure. Aspects such as selecting a scaffolding system, listed building consent, planning for electrical earthing, and scaffolding tie types to use should be carefully planned before any works commence.

PRINCIPAL TYPES

Tubular and proprietary system scaffolds are commonly used to provide access for the inspection, maintenance and repair of historic buildings.

The vast majority of tube and fitting scaffolds do not require bespoke design other than an assessment of site-specific wind loading. These types of scaffold are generally referred to as 'TG20 compliant', which is a reference to guidance produced by the National Access and Scaffolding Confederation (NASC). Scaffolds which do not conform to this guidance require site-specific analysis and design.

Another form of independent scaffolding erected around Walsall Cenotaph for masonry cleaning and restoration work

The most common arrangement is tied independent scaffold. This consists of a double row of standards (vertical members), each parallel to the building, and rules regarding loading, bracing and tie spacing must be adhered to. The inner row is set as close to the building as possible or offset to accommodate one or two scaffold boards inside the standards adjacent to the building face.

There are also proprietary system scaffolds developed by individual manufacturers with standardised components and proprietary design guidance.

Historic buildings most commonly require the following types of scaffolding:

- temporary propping or shoring
- temporary enclosures
- scaffold remaining in situ for an extended period
- external free-standing towers (including buttressing to reduce a scaffold's height to width ratio)
- birdcage (internal access) scaffolds that are heavily loaded or free-standing with a slender height to width ratio
- suspended scaffolds or cantilever scaffolds
- aluminium scaffolds.

Where works cannot start immediately, a temporary enclosure, propping or shoring may be necessary to prevent further deterioration or even collapse of the building fabric. This can provide protection or stabilisation until a full programme of repairs is implemented.

If a temporary enclosure is envisaged, the performance requirements should be stated in outline in the pre-construction information. If there are heavy or awkward items to be installed under an enclosure, gantry beams may need to be incorporated into the scaffold for moving them.

Lateral stabilisation achieved with a through-tie (left) and a lip tie (right)

CONSENTS

Structures which are listed may require listed building consent for works including temporary fixings to the building. The control of works affecting scheduled monuments are more stringent and it is likely that any work to the monument requiring scaffolding will require scheduled monument consent. In both cases there is likely to be a preference against drilled anchor ties, particularly so with scheduled monuments where there is a greater emphasis on the control of works.

ARCHAEOLOGICAL AND HISTORIC SITE CONSIDERATIONS

To make the installation of scaffolding as easy as possible, the delivery vehicles need to be parked as close as possible to the site to minimise carrying. On historic sites, access may be limited due to narrow passages, archaeological remains or soft ground, particularly if installation or removal is proposed in the winter. For short distances it may be possible to unload using a lorry fitted with a small crane, but consideration would have to be given to the location of its outrigger legs. For longer distances and where slopes are steep, scaffold walkways can provide safe access for the workforce, allow the transport of materials, and reduce damage to the ground from footfall.

As part of the pre-construction information, existing drawings and archaeological investigations in the area where scaffolding is proposed should be supplied. This ideally should identify shallow buried structures incapable of carrying load, buried voids or projecting uneven ruinous walls. The scaffolding can then be designed to avoid areas of weakness, or back-propping may be used to reduce the bearing. If the latter, the conservation team should undertake a risk assessment to determine the consequences of insufficient bearing capacity.

Where there is a risk to archaeology or buried structures with inadequate load bearing capacity, the principal contractor will need the advice of a structural engineer in determining an acceptable maximum allowable bearing capacity. There is limited guidance on this subject and engineering judgement must be used, based on the type and scale of likely archaeology, depth and relative compressibility of the surrounding ground.

Scaffolding may need to be supported from historic fabric. Where this is understood in the design phase, it should be included in the pre-construction information showing where load can be carried, together with information on allowable loads or back-propping requirements.

TEMPORARY FOUNDATIONS

Where scaffold legs bear on historic fabric, the contractor will need to ensure the scaffold does not cause damage. This is achieved by adequate load spreading and protection to the historic fabric. If proposed scaffold legs are initially poorly positioned, there may need to be several iterations of design to resolve this.

Where appropriate, foundations will need to be designed to resist uplift or the additional weight from any ballast (kentledge). The options for this are:

- excavation to provide substantial (heavy) foundations to resist uplift directly (which may require archaeological supervision)
- spreading of the additional weight of kentledge at ground level
- installing temporary piles (which risk unknown archaeological damage).

Where excavation is required for foundations on a scheduled monument, consent will be required. If concrete foundations are proposed on a historic site, the design should consider how they will be removed without harming the historic fabric following completion of the project.

If a TG20-compliant scaffold is proposed and the temporary foundation design indicates significant load, spreading of load will be required, either to avoid archaeology or reduce the applied bearing pressure. It may be beneficial to instruct the scaffold designer to undertake a site specific analysis of the scaffold, which may reduce the scaffold leg load and therefore the amount of load spreading required.

Where the scaffolding is likely to remain in place for a number of years traditional timber sole plates are unlikely to have sufficient durability. In these circumstances, concrete foundations may need to be considered.

TIE TYPES

The damage caused by ties is a key issue when scaffolding is used adjacent to historic fabric. They are needed where the height of the scaffold is less than four times its width, so the need to tie the scaffold to the building may be avoided by keeping the height down, or by using rakers (inclined poles) to brace the verticals against the ground, increasing the width at ground level.

Putlog scaffolds, where one end of each horizontal pole is supported by the wall of the building, may be used where a wall is being built, but they are generally not used against existing fabric.

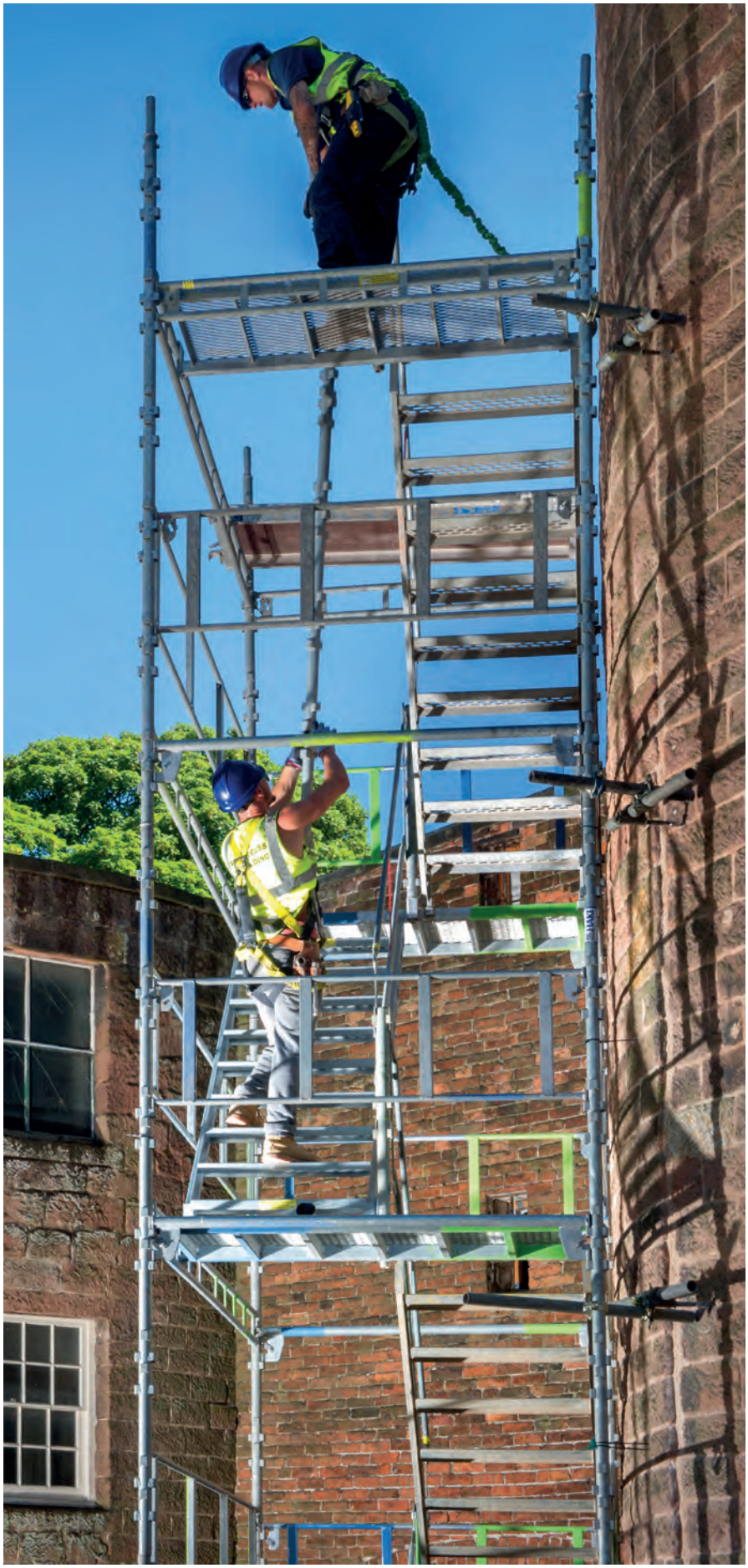
Types of scaffolding ties include:

Return ties These are installed around the corner of the building, restrained one bay beyond the return.

Through ties or lip ties These generally pass through window openings to prevent outward movement of the scaffold. Provision should be made in the pre-construction information for the removal and reinstatement of either the window or the glazing by a suitably qualified person. These types of ties may present a security issue and if the building is to remain occupied, the openings may affect the internal environment of the building.

Reveal ties These are equivalent to light duty ties. TG20:13 permits the use of reveal ties which rely on friction, but recommends that only 50 per cent of ties to a façade should be reveal ties. Due to the need to frequently check reveal ties throughout the life of the scaffold, these are not appropriate where scaffolding is likely to remain in situ over an extended period.

Drilled anchor ties There may be instances, for example an occupied building at the rear of a pavement, where there is insufficient width to reduce the height to width ratio to achieve a free-standing scaffold and where the other types of ties are unable to provide sufficient coverage for the scaffolding. In such instances a compromise may be required and drilled anchor ties which cause permanent damage may need to be considered. The design should be developed carefully to minimise the number of anchor ties and to locate them in areas of less significant material. If anchor ties must be fixed into historic fabric, it would be helpful if the scaffold designer could provide a statement explaining why they cannot be avoided.



A modular access tower being constructed at Cromford Mill, Matlock: in this case the height to width ratio meant that fixings into the masonry were unavoidable.

USING DRILLED ANCHOR TIES

In some instances the need to positively anchor scaffolding to historic fabric will be impossible to avoid. The appropriate system will depend on a number of factors and on a protected building or monument the proposal should be agreed in advance with the statutory authorities (see page 25). Guidance about drilled-in anchor fixings, their suitability for different substrates, installation and testing are provided in TG4:17 *Anchorage Systems for Scaffolding.*

If scaffolding is likely to remain in situ for an extended period, ties should be avoided. Where they are unavoidable consideration should be given to upgrading fixings to stainless steel and ensuring that appropriate separation barriers are in place to avoid a reaction between the stainless steel fixings and the scaffold (bimetallic corrosion). Mild fixings are not recommended as corrosion may cause staining on the building fabric and damage associated with expansive 'rust-jacking'. This may also reduce the capacity of the fixing.

Temporary lateral compression loads, which should be detailed in the scaffold construction information, are either applied via ties or by the butting ends of structural transoms. The contractor will need to install plastic caps as a minimum. The load may be further spread by timber pads and additional protection provided by carpet tiles.

COMMON TYPES OF ANCHOR TIE

'Drop-in' expanding socket anchors are only suitable for structural concrete and hard natural stone away from free edges due to the expansion forces exerted on the fabric. They are unsuitable for most other walling materials including brickwork due to the risk of cracking the structural elements.

Self-tapping screws are suitable for concrete, steel, hard masonry and (subject to manufacturer's recommendations) timber. When used externally, they are only suitable for durations up to a few years, dependent on exposure conditions. On completion of the project, the screw can be removed. Consideration should be given as to how the hole is made good on completion.

Nylon plug anchors with screw-in eyes are suitable for concrete, masonry and (subject to manufacturer's recommendations) timber to carry a tensile load. They only have the capacity for light duty ties, so more fixings may be required. They are only suited for durations up to a few years.

Resin fixed socket anchors are suitable for concrete and masonry and have the benefit of not exerting expansion forces on the building fabric. These types of anchors are only able to carry a tensile load. Resin socket anchors cannot easily be removed.

Through bolting with spreader plates may be the only way to achieve an adequate pull-out force on poor quality masonry or timber structures. It works by spreading load across a greater area of the fabric. It would however be better to avoid loading historic fabric in such poor condition.

PROTECTION

Electrical earthing of a scaffold is another important consideration for the conservation team. The pre-construction information should identify whether the building to be scaffolded has an external lightning protection system, and whether there are any specific requirements for earthing the scaffold.

In addition to the usual variability of resistances of different soil types, there may be areas of significant archaeology, landscaping or garden features associated with the historic environment which may lead to difficulties in achieving a sufficiently low electrical resistance with conventional terminals. If the scaffold is on a scheduled monument, consent would be required to drive even temporary earth terminations into the ground.

Locations for disposal of rainwater from a temporary roof should also be included in the pre-construction information, taking into account any archaeological sensitivity, particularly if saturation or erosion may result. Where discharge is onto land that is a scheduled monument, the work proposed should be included in the application for consent.

If scaffolding is to be in position for an extended period it is important to prevent unauthorised access, such as removing or preventing access to ladders when not in use, removing boarding from scaffold lifts, installing an alarm system, or enclosing the scaffold with fencing proportionate to the perceived risk of trespass.

ERECTION AND DISMANTLING

Erection and dismantling of scaffolding generally takes little time and can involve a high number of scaffolders in a relatively small area. Impact damage to historic fabric most frequently occurs during erection or striking scaffolding, mostly due to the long lengths of the tubes involved.

It is important that the principal contractor is adequately briefed on the significance of the historic building and the level of care that is expected, so that they can adapt their site rules, inductions and toolbox talks accordingly, and brief the workforce to ensure they are engaged in undertaking their work in a way that minimises risk.

Recommended Reading

BSI 2011 *Code of practice for temporary works procedures and the permissible stress design of falsework,* BSI Standards Publication BS 5975:2008+A1:2011, Incorporating Amendment No 1., London: BSI

BSI 2003 Temporary works equipment. *Scaffolds – Performance Requirements and General Design,* BSI Standards Publication BS EN 12811-1:2003, London: BSI

Health and Safety Executive Scaffold checklist www.hse.gov.uk/construction/safetytopics/scaffoldinginfo.htm

Historic England 2008 *Conservation Principles, Policies and Guidance,* Swindon

Historic England 2015 *Piling and Archaeology; Guidelines and Best Practice,* Swindon

Historic England 2019 *Lightning Protection,* Swindon

Ed Morton, 2008 'Scaffolding Historic Buildings' *Journal of Architectural Conservation*, pp 23–42

National Access and Scaffolding Confederation (NASC) TG20 suite of guidance https://nasc.org.uk/information/tg20-suite/

National Access and Scaffolding Confederation (NASC) TG4:17 *Anchorage Systems for Scaffolding* https://nasc.org.uk/information/tg20-suite/

John Ruddy, 2015 'Conservation compendium Part 12: Scaffolding of historic structures' *The Structural Engineer* pp 40–44

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