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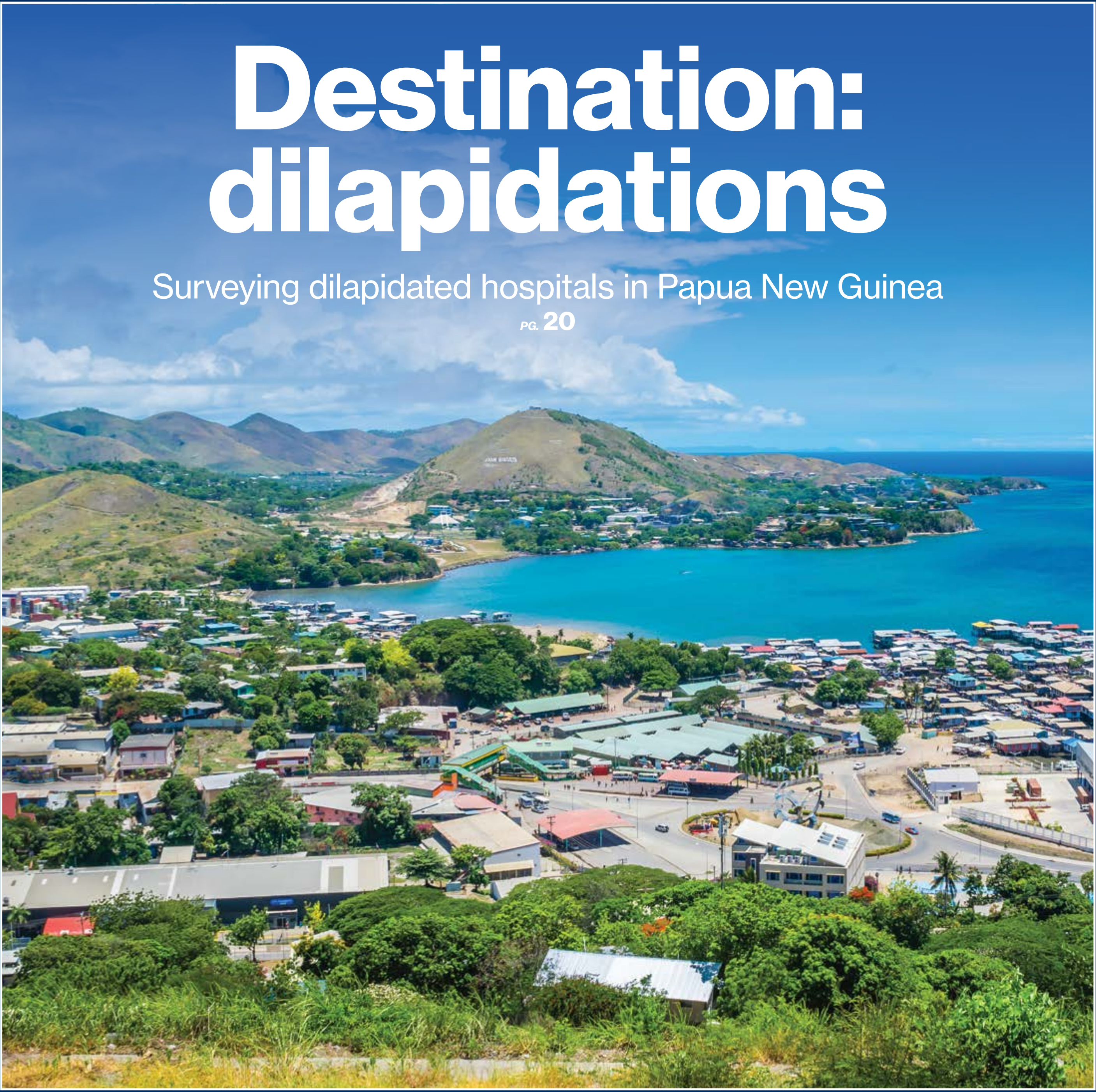

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July/August 2018
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The *Building Surveying Journal* is available on annual subscription. All enquiries from non-RICS members for institutional or company subscriptions should be directed to:

Proquest – Online Institutional Access E sales@proquest.co.uk
T +44 (0)1223 215512 for online subscriptions or

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BUILDING CONSERVATION JOURNAL

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Published by: Royal Institution of Chartered Surveyors, Parliament Square, London SW1P 3AD
T +44 (0)24 7686 8555 W www.rics.org
ISSN 1750-1032 (Print) ISSN 1759-3387 (Online)

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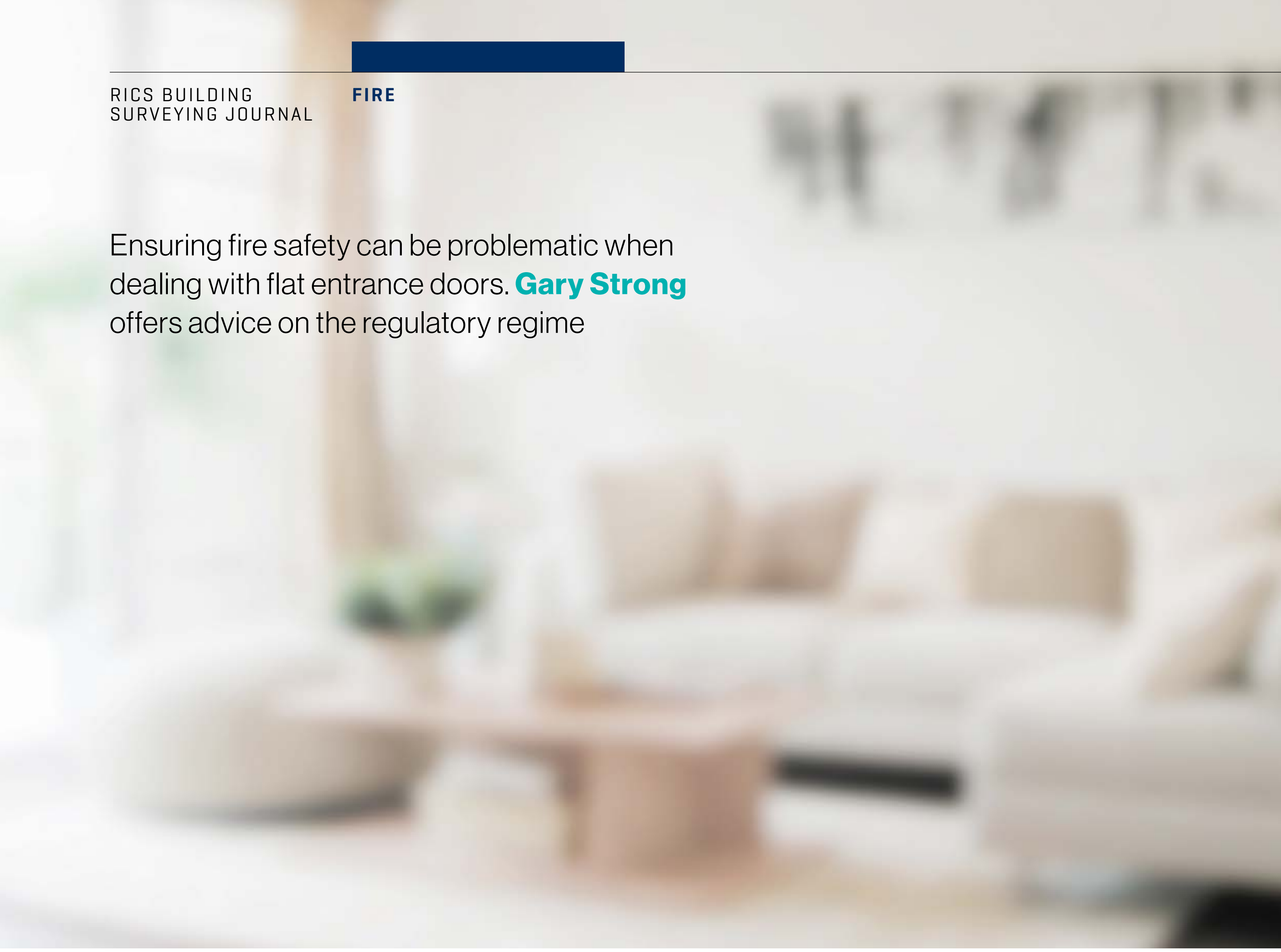
Design by: **Redactive Media Group** Printed by: **Page Bros**

BUILDING CONSERVATION JOURNAL



Ensuring fire safety can be problematic when dealing with flat entrance doors. **Gary Strong** offers advice on the regulatory regime

Cracking the door

Since the Grenfell Tower tragedy, responsible owners and managing agents have been carefully reviewing their fire risk assessments (FRAs), which are necessary under the Regulatory Reform (Fire Safety) Order 2005.

RICS now recommends that for all high-risk buildings – residential tower blocks and buildings more than 18m in height, care homes, hotels, student accommodation and hospitals – that an FRA is conducted annually, and in all other buildings the assessment is reviewed at least once a year, with no more than a five-year interval between new FRAs.

Fielding enquiries

RICS has been fielding enquiries in relation to entrance doors to flats that open on to common parts such as staircases or corridors, and how to deal with these during upgrading works or when door replacement is deemed necessary following inspection and the publication of an FRA.

In high-risk buildings, RICS now recommends that monthly visual inspections of the building are carried out to ensure that fire doors are not compromised. In some instances, leasehold owners of flats have replaced what were originally fire doors with new ones that are not fire-resistant, thus compromising the compartmentation of the block.

Enforcing the upgrade or replacement of doors can also prove difficult when the lease specifically refers to the entrance door of the flat as being within the demise of the flat – that is, it is the leaseholder's responsibility – and it is not under the control of the freeholder. So what can be done?

Basic principles

On 8 October 2017, all local authority chief executives were sent a letter by Neil O'Connor (*http://bit.ly/2ysOV3L*), the Building Safety Programme Director at the Department for Communities and Local Government, which is now renamed the Ministry for Housing, Communities & Local Government (MHCLG).

Although his letter primarily concerned potentially combustible cladding on the exterior of residential tower blocks, it is worth reminding readers of the basic principles it sets out that apply, as these may help in certain circumstances.

MHCLG's view is that local authority powers under this regime are available in respect of the external cladding systems of tall residential buildings. But it has also reminded authorities of additional enforcement powers that may be available in some circumstances, and they will need to consider the details of each particular case.

RICS would further remind readers of existing guidance such as that on the housing health and safety rating system (HHSRS; see *http://bit.ly/2lXzLvg*).

MHCLG's considered position is that the Housing Act 2004, the Housing Health and Safety Rating System (England) Regulations 2005, and both sets of statutory guidance made pursuant to the 2004 act – which together comprise the HHSRS regime – are clearly designed to ensure the safety of residents in relation to a range of prescribed hazards, including fire. Many of these hazards will derive from the construction of the wider fabric of residential buildings external to individual dwelling units.

The ministry's view is that the safety of any cladding system fitted to the common parts of a residential building, whether in respect of fire or structural integrity, is entirely in the scope of the HHSRS regime and amenable to statutory enforcement in appropriate cases, and the relevant powers can be considered and deployed with other potential enforcement action as identified above. It follows therefore that the internal common parts and fire doors of buildings also fall under this scope.

The provisions of the 2004 act are considered by MHCLG to be available in principle so local authorities can inspect and take enforcement action in respect of cladding where this poses a hazard under the HHSRS. RICS interprets this more widely, insofar as entrance doors to flats that are not fire-resistant could also be a hazard under the HHSRS.

MHCLG's view is that the regime is targeted more broadly than the individual units of occupation in a block. The legislation is designed with a number of different purposes in mind, not all of which are dealt with expressly in the guidance, and there are no grounds for considering that the external cladding on a building or any other aspects of fire hazard are not covered by the regime.

Taking samples for testing, if necessary under warrant, would fall under the regime, as well as housing authorities' enforcement powers under that regime at part 1 and 7 of the 2004 act.

There are many examples in the legislation and guidance supporting the view that this is the only sensible interpretation.

> “RICS now recommends that a fire risk assessment is conducted annually for all high-risk buildings

The 2004 act

Under the 2004 act, the section 1(4) definition of residential premises includes any common parts of a building containing one or more flats. The section 1(5) definition of common parts expressly includes the structure and exterior of the building, and therefore includes a cladding system on a residential block, which is part of the exterior of a building, and any doors in the common parts.

The definition of hazard at section 2(1) includes health and safety risks arising from a deficiency in a dwelling or in any building or land in the vicinity, which clearly goes beyond individual dwelling units.

The enforcement powers available to local authorities – in particular those at section 239 and section 240 of the act, among other relevant powers – must be interpreted in line with these earlier definitions in the act that include common parts; thus the powers are available in respect of anything that might pose a hazard.

Prescribed hazards

Regulation 3(1) and paragraph 24 of Schedule 1 of the Housing Health and Safety Rating System (England) Regulations 2005 define a prescribed hazard for the purposes of the 2004 act as including exposure to uncontrolled fire and associated smoke. Exposure to such a hazard is not confined to matters arising, for example, from the construction of elements in an individual dwelling unit, but will include aspects of the wider fabric of the building or structure in which the unit is located.

In Schedule 1, there are other examples of prescribed hazards that will likely derive from the wider fabric of a building, including paragraph 29, “Structural collapse and falling elements”. Such hazards clearly require consideration and inspection of a building's wider structural elements.

Indeed, if there were – for example – potential for cladding panels to fall from a building because of defects or deterioration in their fixings, this matter would be in the ambit of the hazards that are defined by paragraph 29. There can be no legitimate reason to exclude such hazards from consideration of any risk of exposure to uncontrolled fire and smoke that they might present.

Regulation 3(2) prescribes that the risk of harm arising from hazard may be at a dwelling or house in multiple occupation (HMO), or “in any building or land in the vicinity of the dwelling or HMO”. Again, it is clear that a hazard is not confined to circumstances obtaining in an individual dwelling unit, but is

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defined in much wider terms consistent with the provisions in the 2004 act mentioned above.

In relation to the requirement to consult with fire and rescue authorities imposed by section 10 of the 2004 act, regulation 4 prescribes that a fire hazard occurs where the risk of harm is related to exposure to uncontrolled fire and associated smoke. This duty is not restricted to circumstances that concern only an individual dwelling unit.

Even if there were ambiguity in the interpretation of provisions of the 2004 act and underlying regulations – and MHCLG does not consider that there is such ambiguity – the regime as a whole must be interpreted purposively so as to ensure the safety of residences in respect of fire hazards. In any event, MHCLG's interpretation of the primary legislation, as set out above, is also confirmed by the statutory guidance issued pursuant to section 9 of the 2004 act.

Operating guidance

At paragraph 1.12 of the HHSRS operating guidance it states: "the underlying principle of the HHSRS is that – Any residential premises should provide a safe and healthy environment for any potential occupier or visitor".

Paragraph 1.13 of the guidance makes it explicit that the materials with which a dwelling is constructed fall under the regime; it follows that flat entrance doors are in the scope of the rating system.

Paragraph 4.03 meanwhile makes clear that the external elements of the dwelling are expressly covered in the context of inspections.

At paragraph 5.03, the list of what should be in an assessment includes, at sub-paragraph (d), "the building associated with the dwelling"; that is, it encompasses the wider fabric of a building, which may contain several individual dwelling units.

Paragraphs B17 to B19 of Annex B of the Operating Guidance, "Inspections for an HHSRS Assessment", explicitly mention the exterior of the building. Paragraph 29.01 of Annex D of the guidance, "Profiles of potential health and safety hazards in dwellings", meanwhile requires assessment of the structure of the building. Although this is about the risks of fabric being displaced or falling, it shows that all aspects of the building fall in the scope of an assessment.

Enforcement guidance

In the HHSRS enforcement guidance, paragraphs 6.6–6.11 specifically contemplate deficiencies in any individual dwelling unit leading to enforcement action against the wider building owners. In particular, paragraph 6.9 deals expressly with a deficiency relating to the structure that should be addressed by serving a notice on the person who owns the building.

It follows from the above that MHCLG considers there should be no doubt about the ability to use the enforcement powers under the 2004 act to address deficiencies that may give rise to fire hazards.

In addition, there are other relevant enforcement powers, summarised below.

Building Act 1984

Where building work has been carried out in breach of the Building Regulations, especially where it has been recently completed, local authority building control bodies may take one of the following courses of action.

1. Enter any premises at reasonable hours for the purpose of undertaking their functions under the Building Act 1984 and Building Regulations. This includes ascertaining whether there is, or has been, a contravention of the act or of any regulations, and to take any action or execute works these require where the local authority is authorised or required to do so, under section 95 of the act. If admission to the premises is refused, a justice of the peace may issue a warrant under section 95(3) and 93(4).

2. Serve an enforcement notice on a building owner to require the removal or alteration of work that does not comply with the Building Regulations under section 36(1) of the act. Such a notice must be served within 12 months of the date of completion of the building works in question, as per section 36(4). If the owner does not comply with the enforcement notice, the local authority may itself take action to remove the offending work or effect such alterations to it as it deems necessary, under section 36(3) of the act.

3. Prosecute contraventions of the Building Regulations through summary proceedings in the magistrates' court under section 35 within six months of the breach being discovered, provided that action is taken within two years of completion of the building work that is in breach, under section 35A.

However, it is of course for each local housing authority, building owner and managing agent to make its own decision about what is lawful on a case-by-case basis, and to take legal advice where necessary. Approaches should always be made to the leaseholders about defective doors at first, but ultimately it may be necessary to ask the local authority to step in and take enforcement action.

Any enforcement action taken by local authorities under the 2004 act can be challenged on appeal to the First-tier Tribunal in the first instance, and it is for the tribunal and the courts to make any final determination about the application of these provisions on a case-by-case basis.

Further advice

I hope you find the above helpful in dealing with flat entrance doors that are not fire-resistant or any other aspects of a building representing a hazard. If you have any further questions, please contact *housingchecks@communities.gsi.gov.uk*.

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+info

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Categorically clearer

Questions about fire detection and alarms for buildings persist despite BSI's revised standard for systems. **Simon Sandland-Taylor** offers some clarification

In BS 5839–1: 2017, Fire detection and fire alarm systems for buildings: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises, the term "fire detection and fire alarm system" covers a range of types (see *Building Surveying Journal* May/June, pp.12–14).

These range from systems consisting of just one or two manual call points (MCPs) and sounders to those that are complex and networked and which incorporate a large number of automatic fire detectors, MCPs and sounders, connected to numerous intercommunicating control and indicating panels.

The term also includes systems that initiate the operation of other fire protection equipment, such as extinguishers, automatic ventilators and automatic door releases.

Domestic premises

The fact that BS 5839–1 does not cover domestic premises has been questioned, but this first part of the standard was never intended for application to domestic premises, which are covered by BS 5839–6: 2013 instead. Nevertheless, many designers and installers continue to ask the question.

In order to address this, when part 1 of the standard was updated in 2013, the title was amended to Fire detection and fire alarm systems for buildings – Part 1: Code of Practice for design, installation, commissioning and maintenance of systems in non-domestic premises. Despite this addition to the title of both the 2013 and 2017 standard, which specifically excludes domestic premises, the question is still raised.

Categories L and P

Category L and category P cover automatic electrical systems usually incorporated in a building design to satisfy one or in some cases two objectives; namely, protection of life, hence category "L", and protection of property, hence category "P".

An appropriate life protection system will satisfy the functional requirement of Building Regulation B1, Means of warning and escape. Such systems help to provide early warning of fire and can therefore afford occupants more time for escaping before conditions might become untenable.

Property protection systems, meanwhile, are required for a number of different reasons, including the need for business continuity, insurers' requirements, and safeguarding the fabric of listed and heritage buildings.

It is thus essential any fire detection and alarm system designed for a building satisfies all the fire safety objectives, supporting the overall fire strategy and not being considered in isolation.

As category L and P systems are designed to satisfy two different and distinct objectives, their design, installation and performance are quite different. Attempting to compare, for example, a category L1 system with a category P1 would like to comparing apples with pears, neither being an appropriate alternative to the other.

A fire strategy could in certain situations require provisions for the protection of both life and property. In such cases, a mixture of category L and P systems would be incorporated, being referred to as L1/P1, L2/P1, L2/P2, L3/P1, L3/P2 and so on, according to the subdivisions detailed below.

> "It is essential that any fire detection and alarm system designed for a building satisfies all fire safety objectives

Subdivisions

Category L systems are subdivided into category L1, L2, L3, L4 and L5 depending on the parts of the property that they cover (see Figure 1). Category L1 systems, shown in the area ringed in blue, are installed through all areas of the building. They offer the highest standard of life safety because they provide the earliest possible detection of fire, and therefore the longest possible time in which to escape.

Before explaining the features of category L2 and L3 systems it is first necessary to consider category L4. Included in the area ringed in magenta, such systems are installed in those parts of the escape routes comprising circulation areas and spaces, such as corridors and stairways.

Category L3 systems, ringed in green, are in turn designed to warn of fire at an early stage to enable all occupants, other than those in the room where the fire originates, to exit safely before the escape routes are impassable owing to the presence of flames, smoke or toxic gases. To achieve this objective, detectors are normally installed in rooms that open onto an escape route.

Category L2 systems are installed according to the same principles as those for an L3, with the additional objective of providing early warning of fire in specified areas – which are ringed in red in Figure 1 – where fire hazard, fire risk or both are at their highest.

Category L5 systems provide automatic detection to satisfy specific fire safety objectives other than those of category L1, L2, L3 or L4 systems. Protection might be provided as a compensatory feature to justify a departure from the normal guidance, as part of a fire-engineered solution, or

Figure 1

Category L life protection systems

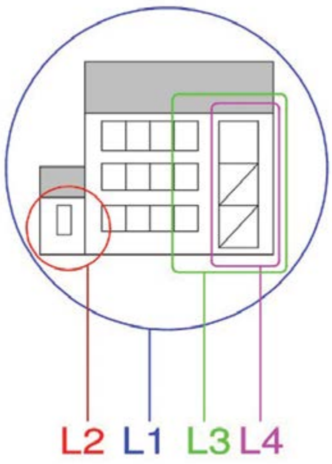
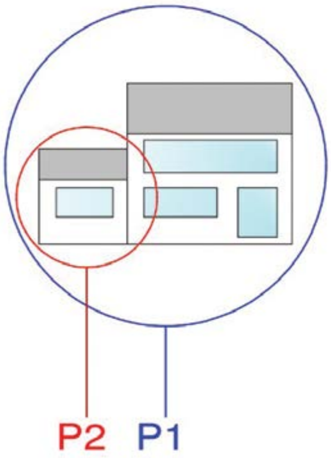


Figure 2

Category P property protection systems



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as part of the operating system for fire protection equipment.

The simplest form of electrical fire detection and alarm system for life protection is provided by a category M system. Unlike category L systems, these do not incorporate automatic fire detectors, but rely solely on manual activation to raise the alarm, hence category "M". Such systems are used in relatively simple buildings where occupants will not need to be woken from sleep to effect an exit. All category L1, L2, L3 and L4 systems should incorporate the features of a category M system as a minimum standard.

Category P systems are subdivided into P1 and P2 in turn (see Figure 2). Category P1 systems are installed through all areas of the building, thereby providing the earliest possible warning of fire so as to minimise the time between ignition and the arrival of firefighters.

Category P2 systems on the other hand are installed only in areas of high fire hazard or where the risk to property or business continuity is high, to provide early warning of fire. The parts of the building so defined might be as few as one or two rooms or may amount to an entire floor.

Where the fire strategy requires the provision of a category M in conjunction with a category P1, P2 or L5 system, the resultant combination should be described as a category P1/M, P2/M or L5/M system respectively.

Compliance

A common question posed by designers and installers is that, when considering a Building Regulations submission for compliance with requirement B1, is it acceptable for the agent or designer to include a standard note stating "Fire detection and fire alarm system to be designed, installed, commissioned and certified in accordance with BS 5389–1: 2017"?

At first glance, this would appear to be fine, as it refers to the necessity for certifying the design, installation and system commissioning as recommended in the standard.

However, such a note is in fact completely meaningless as there is no reference to the actual category of system to be used in the standard. Because a BS 5839–1 life protection system could be any one of the six systems to which clause 5 refers, it would be prudent for the building control body to seek clarification.

There would also be a need to verify the areas where detection is to be provided should a category L2, L3, L4 or L5 system be specified.

The acceptance or approval of an incomplete note could also result in confusion, and the wrong system may then be installed on site. For example, a contractor following the suggested note could install, commission and certify a BS 5839-1-compliant system to a category M standard, completely unaware that a category L system is needed to satisfy functional requirement B1.

MCPs

The rationale for MCPs to be located at exits on all storeys, whether or not these are specifically designed as fire exits, has also been queried. This particular recommendation was introduced in the previous version of BS 5839–1 in 2013.

It had always been the norm to provide MCPs on escape routes and at all dedicated fire exits. When drafting the 2013 standard, it was recognised that a building occupant might on discovering a fire choose to escape via a familiar, non-dedicated exit.

In such a situation, it would therefore be possible for someone to escape without having the opportunity to raise the alarm if they did not pass an MCP on their exit route from the building. To prevent such situations arising, it was decided to require the provision of MCPs at all exits from buildings.

Subsequent to the introduction of this recommendation, it was observed that MCPs were being provided at all exit doors, even if they did not lead to a place of safety. This led to instances where occupants unfamiliar with a building layout could on seeing a call point adjacent to an exit door try to escape via the door only to discover it did not lead to a place of ultimate safety. They would also have to re-enter the building to find a dedicated fire exit, having lost vital escape time in the process.

To overcome this problem, clause 20.2(a) of the new standard was amended to read: "MCPs should be located on escape routes and in particular at all storey exits and all exits to open air that lead to an ultimate place of safety (whether or not the exits are specifically designated as fire exits)".

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Related competencies include
Fire safety

Trial by fire

Following his review of different facade types, **Diego Alves** looks at the performance of modern systems during fires

There is no doubt that the repercussions of the Grenfell Tower fire have brought home to landlords and occupants alike the shortcomings of the building industry, particularly the performance of the modern facade with regard to fire.

The Building Regulations, principally Approved Document B, are intended to ensure that a building and its facade are designed to allow sufficient time for the safe evacuation of occupants if the property is exposed to fire.

Fundamentally, the regulations are there to preserve and safeguard life, rather than the asset. To this end, the design, components, selection of materials and installation of facade systems must provide assurance for occupants and owners throughout the life of the property.

Fire spread

In general, the Building Regulations require that external walls on all buildings adequately resist fire spread, and statutory guidance in Approved Document B sets out two ways that they can fulfil this requirement.

The first is for each individual component of the wall, such as insulation or filler, to meet the standard for combustibility. The second is to ensure that the combined elements of a wall, when tested as an entire, installed system, adequately resist the spread of fire to the relevant standard.

Until recently, another method for proving compliance has been to carry out desktop assessments in lieu of actual tests of the facade system. However, the government has undertaken a consultation process on the use of such assessments, though the responses are yet to be published at the time of going to press. The consultation is in line with the recommendations made by Dame Judith Hackitt in her interim report on Building Regulations and fire safety.

Dame Judith's advice should be read in conjunction with all sections of Approved Document B that outline test regimes, performance of materials, products and structures, and which establish the principle of assessments.

Approval standard

Currently, approval of cladding systems for tall buildings is carried out via full-scale tests in accordance with the requirements of BS 8414, which was introduced in 2002. These involve taking a 6m-high, right-angled sample of the cladding and placing it in a wooden crib comprising 395kg of softwood of specific cross-section and length, arranged in 20 layers. This crib is then set alight, and the behaviour of the fire is measured over 30 minutes.

The concern from various parties is that the prescribed test specimen and its construction do not represent the exact conditions into which the system will be installed. The materials used and construction techniques have changed considerably since the test was introduced almost 20 years ago.

These changes include a sizeable increase in plastic content, which contributes significantly to the fire load and even the height of flames. The test sample is invariably quite idealistic as well, devoid of penetrations such as ducts, pipes and even additional windows, let alone the architectural articulation of the cladding.

Plastic vents and ducts can precipitate fire into the void well before the cavity barriers can intumesce, and this possibility is not currently addressed in BS 8414. There are other factors of concern as well, including the oxygen supply that contributes to the chimney effect; this is a by-product of the need to include a ventilation void in rainscreen cladding systems.

All this and more suggest that testing to BS 8414 is too generic an approach, one that is dated and does not address many key industry concerns, and it therefore requires review. It is expected that the proposed BS 9414 will redress these concerns.

Facade types

Apart from the aesthetics, the prime function of a facade is to resist air and water infiltration, accommodating wind and other forces that act on it while supporting its own dead load. Above all, it must do this safely and without endangering life.

Different systems achieve this in different ways. The materials used in standard curtain walls are generally manufactured from aluminium and glass, both of which are non-combustible and comfortably comply with the primary requirement of Approved Document B to prevent the spread of fire through the external wall. Curtain walls are generally durable, need little maintenance and provide excellent aesthetics.

The rapid rise of rainscreen cladding globally in the past decade or two demonstrates that it is an economic and simple alternative to curtain walls for new properties or over-cladding older buildings, as detailed in my previous article (see *Building Surveying Journal* May/June, pp.16–17).

Image © CBRE

However, the relatively light nature of rainscreen cladding means that it predominantly comprises many components that are synthetic and combustible, such as the insulation, vents, pipes and panels, and in particular the polyethylene core of aluminium composite material (ACM) panels.

The cavity formed between the external skin and the supporting construction also creates a chimney effect by which fire can propagate rapidly if not controlled with properly installed fire-stopping, cavity barriers and controlling the supply of oxygen. The importance of effective compartmentation between floors, adjacent rooms, windows and penetrations cannot be overstated.

Depending on the design, specification and quality of installation, rainscreen systems can fail compliance tests because they do not satisfy the requirements of Approved Document B. In much the same way as buildings are required to be tested for air, all penetrations and gaps in the support wall should be sealed with intumescent caulking or sealant to ensure the construction will resist the spread of fire.

Central to a fully functioning rainscreen facade, including the structural integrity of the system, is the drive for an economic product, which is sometimes compromised by a general lack of knowledge about the requirements of the Building Regulations and their implicit objective of ensuring the safety of the persons occupying or using the building.

Aluminium composite

ACM cladding is a versatile product, and in the past two decades has been used increasingly in high-rise properties throughout the world. It is essentially two thin skins of aluminium or other metals bonded to a plastic core sometimes referred to as filler, forming a relatively rigid sheet some 3–4mm thick.

Unless specified otherwise the basic core material is highly flammable, with a heat potential comparable to that of petrol at more than 45MJ/kg, and it is ranked as class C or D in the European Reaction to Fire classification system. It must therefore be used with absolute discretion, particularly on high-rise properties. The insulation, cavity barriers and even the wall construction behind it must be designed and installed carefully to comply with the appropriate parts of Approved Document B.

ACM and rainscreen cladding have their limitations, which must be taken into account in terms of performance. But in the light of Grenfell Tower, compliance with the requirement and guidance in Approved Document B4 and the need for cladding materials to be of “limited combustibility” is very important. This, together with the need for proper installation of cavity barriers, compartmentation and fire-stopping, is fundamental to good installation and compliance characteristics, which are ultimately designed to preserve life in the event of a fire.

The method of installing cladding panels and retention of cavity barriers and fire-stopping is equally important since ineffective fixings and loose materials can be injurious if they become detached in high winds, and worse if they are ablaze and start secondary fires wherever they land.

ACM panels are available with a fire-retardant core and hence usually have the suffix “FR”. Additives in the core can reduce the heat potential in such panels by about 30% to less than 13MJ/kg, putting it in class B. Meanwhile, the better type A2 ACM can have a heat potential of less than 10% when compared to the standard polyethylene core, at less than 3MJ/kg.

Please note FR means fire-retardant rather than fire-resistant. There are also additional classes for smoke development, designated s1, s2 or s3, and the amount of burning droplets emitted, d0, d1 or d3. Thus, an ACM panel may be designated A2–s1, d0, for instance.

Cavity barriers

Such barriers are required because of the risk of fire spread in cavities behind rainscreen panels, which can occur rapidly, and out of sight, due to the chimney effect.

Note that cavity barriers are not fire-stops; fire-stops are located internally between the floor slab and the inner surface of the facade and are required to have the same fire rating as the compartment wall. Cavity barriers are located in the cavity of the rainscreen and are both horizontal and vertical, although the horizontal barriers must include a 20mm gap to allow the cavity to be drained and ventilated. However, they must also intumesce and seal in the event of a fire.

The two criteria for cavity barrier performance are that the correct type is used in the facade, and that they are installed correctly. Currently, there is only guidance on the requirement for inspecting the presence and quality of installation of cavity barriers, including those in existing buildings.

Acrylic render should also requires a mention since this and its backing material or insulation can be combustible and therefore non-compliant. Both are, however, available in non-combustible form. The fixing methods for attaching the insulation and render to the substrate must be selected carefully, and the materials must be fitted correctly to avoid the entire render detaching from the construction, for example during high winds or if the fixings cannot sustain the weight of the construction when wet.

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For the latest information, visit the Ministry of Housing, Communities & Local Government site
https://bit.ly/2s8TfBf

Related competencies include
Design and specification, Fire safety

Ewan Craig, a speaker at RICS' annual It's Your APC conference, looks at the optional competency of Maintenance management

In good care

Building surveyors are sometimes described as the doctors of buildings, caring for their health. Maintenance management is intrinsic to this care, and often incorporates other technical competencies as follows:

- **Construction technology and environmental services:** identification of the existing materials and components, as well as appropriate materials and components for maintenance
- **Inspection:** surveys of property to ascertain their condition and collect data
- **Contract administration:** running maintenance term contracts and inspecting completed maintenance works.

The levels

You will need to meet the requirements of the competency as follows.

At Level 1

Demonstrate knowledge and understanding of the nature of building maintenance, and principles and practice of building maintenance management.

At Level 2

Apply your knowledge to gather building maintenance information, formulate policies and implement maintenance management operations.

At Level 3

Prove that you can offer reasoned advice, prepare and present reports on maintenance management issues.

Your submission should demonstrate that you are familiar with the organisation and operation of maintenance on a portfolio of properties, and you should also be ready to address questions on them or related issues.

Questions

Actual questions are based on the candidate's experience, which should be at Level 2 but could exceed this. Two examples are given below.

You prepared the schedule of rates for maintenance on portfolio X. Would you explain the data you used for this.

This question is aimed at Level 2. It could, however, be extended to Level 3 if you provided advice by reporting on the cost estimates. The answer should explain pertinent issues to support your application of knowledge.

I prepared the schedule of rates for maintenance using several sources of data. Not all cost data can be used for such estimates because differences in approach to maintenance influence costs. For example, new-build can bring economies of scale, easier access and more efficient programming than maintenance, so a rate for the former would be lower than a similar item of the latter. I discussed the maintenance policy, prioritisation and existing maintenance contracts with the client, and developed a client-specific set of rates for the work covered by their contracts.

My practice uses GoReport survey forms, which produce planned and preventative maintenance reports from the initial survey findings via interlinked spreadsheets, charts and graphs. I modified my practice's standard schedule of rates for the form to incorporate the client-specific schedule; these rates were then used to calculate the maintenance costs for each building based on the inspection findings.

The schedule or rates covered the majority of the maintenance work. There were a few instances during the inspections of unusual components that were absent from the schedule, such as stone balustrades and specialist plant. Notes were made on site, and advice subsequently obtained on these components to enable the cost estimate.

Data from the inspections, such as the building elements, replacement costs and programme, was interlinked with a planned maintenance report generated for each property and summarised for the portfolio. I followed the practice's quality assurance and management processes, together with RICS guidance notes. My director checked the rates and our inspections, and also prepared the final report for the portfolio.

Please describe how you inspected the completed maintenance works to the offices in building Z.

This question is aimed at Level 2 candidates. The answer should show the issues that you considered in applying your knowledge, for example as follows.

The inspection was part of a long-term commission by the client to provide an independent inspection of works carried out by the maintenance contractor to its portfolio. I confirmed the instruction and brief with the client, which had provided the end user's contact details, copies of the works order, measured term contract and contractor information.

I arranged to inspect the works with the end user, completed a risk assessment, internal administration and quality assurance. I inspected the works to the offices and compared these with what was expected from the works order and the measured terms contract. I also discussed the works with the end user on the quality and service from this contract, part of its performance criteria. The works were satisfactory and I confirmed this with the client.

Care

Given the time constraints of the APC, your response should be brief but comprehensive. The answers given above are not exhaustive. Care should be taken to demonstrate your own skills, abilities and knowledge to the assessors. ●

Ewan Craig is an APC assessor, APC coach and consultant

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For details on the APC pathway guide for building surveyors, please visit **www.rics.org/pathways**

Related competencies include **Construction technology and environmental services, Contract administration, Inspection, Maintenance management**

Following the collapse of Carillion, **Daniel Hutchings** helps identify the early warning signs of contractor insolvency and advises how to respond

Insolvency solutions

In a post-Carillion world, the spectre of insolvency can haunt a project. Research carried out immediately after the major contractor's collapse indicated that the rate of UK construction insolvencies rose by some 8% in 2016/17, with more than 2,600 such companies falling into insolvency (*https://bit.ly/2JYZe1u*).

Insolvency can happen suddenly, but steps can be taken to avoid the most unpleasant of outcomes: an unfinished project, a building riddled with defects, no security for the developer's cross-claims, and an unhappy client looking to blame the contract administrator.

Any of the following patterns of behaviour or changes in the way the project is progressing may indicate that your client's contractor is in difficulty:

- contractor demanding swift payment, early release of retention or any other changes in payment patterns
- subcontractors contacting your client directly, seeking payment
- withdrawal of labour, including changes to key individuals on site
- less frequent deliveries or removal of various goods and materials from site
- a general slowdown in the progress of the works
- increased number of defects.

Meticulous planning

At the early warning stage you should exercise caution and establish whether your concerns are correct, because mistaken allegations will likely erode confidence and trust. Gather all relevant information, particularly with regard to payment and value of works – if the contractor is teetering on the edge, then denial of cash flow may result in the unwanted distraction of adjudication or push it into insolvency.

If you suspect that insolvency is impending, your client will be looking to you to help assess the situation. Do you advise it to terminate the contract, or think about ways it can encourage and assist its ailing contractor to finish the project? The following factors ought to be taken into account.

- How close are you to the end of the project? How many stages are remaining? Is practical completion imminent? Could there be an issue with the transfer of existing design liability to any new contractor?
- Is there a performance bond? Will your client have access to funds to cover the cost of completing the work? Ordinarily, this will depend on the nature of the event and the wording of the bond. Even on the occurrence of an insolvency event, it may not be possible to make a call without having first obtained the decision of an adjudicator. If so, proceedings may need to be instigated before the date of the relevant event, to avoid the prospect of them being stayed pursuant to insolvency laws.
- Is there a parent company guarantee? If so, what is the financial position of the parent? Is the rest of the group sound, in financial terms?
- How is the project financed? Is there a fund or lender that your client should involve in the decision-making exercise? Does the scenario that your client is facing constitute an event of default under any funding arrangements?
- Is the contractor in breach of contract, and does this entitle your client to terminate? This requires careful thought. If your client gets it wrong, the contractor may be able to claim there has been a repudiatory breach of contract and seek damages for wrongful termination.
- Can your client quickly build out the works? Is a replacement contractor available and can you keep trusted and reliable subcontractors by exercising step-in rights?

Steps to take

If you have immediate concerns you will need to:

- monitor the contractor's performance closely, both on site and financially
- consider regular site visits
- keep detailed records
- ensure compliance with payment procedures, so any payments are in line with the work completed and any "pay less" notices are served in time and to the correct address
- keep on top of defective work, consider issuing formal instruction to open up or test materials or goods, or remove defective work
- check the construction contracts and ask your client about funding arrangements as well.

Where there are defects, analyse whether your contract allows your client to engage others, should your instructions in relation to the same be ignored. Ensure you meet any deadlines in such a scenario.

This can be an effective strategy, especially if the contract provides that the contractor will be liable for all additional costs incurred by the client in connection with any such engagement.

A composed approach, taking into account the steps above, may not wholly avoid a tricky period for the project. But protecting your client's position and offering practical advice during a difficult time is unlikely to go unnoticed. You'll be rewarded, as calm heads are welcome in any team. ●

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Related competencies include
Contract administration, Works progress and quality management

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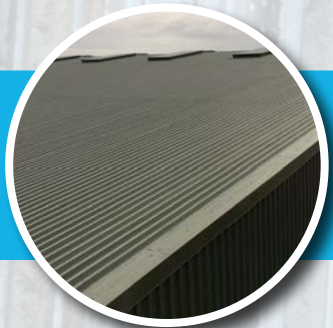

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Counter strike

Devices such as fridge-freezers are susceptible to damage caused by electrical surges, and in extreme cases can catch fire easily

Preventing electrical surges is crucial given the number of appliances used in most buildings today. **Gary Parker** summarises the relevant guidance

Expectations of electrical installations have grown over the years as the use of electrical and electronic devices has increased.

A typical dwelling 20 years ago would have had a single television, maybe a PC and some kitchen appliances. Now, the range of products that can be purchased at relatively low cost is astonishing, ranging from ultra-HD TVs to smart thermostats and even voice-controlled home assistants.

These devices make our lives more pleasurable and convenient, but they come at a cost: they are susceptible to damage caused by electrical surges, and in extreme cases can catch fire easily as they use the combustible insulation also common in fridges and freezers.

Electrical surges, or transient overvoltages, are spikes in the power supply that, for the briefest of time, increase the voltage that the equipment experiences. They are a natural phenomenon occurring during thunderstorms, when lightning can cause transient overvoltages to enter buildings and sensitive electronic and data equipment to become damaged and potentially combust.

> “These devices make our lives more convenient, but are susceptible to damage caused by electrical surges

Another cause of transient overvoltage is electrical switching. Whenever a conductor carries a current a magnetic field is formed around it, and when the circuit is de-energised then this field collapses and induces a voltage in the conductor.

Such voltages can, briefly, cause a transient overvoltage to occur, and their effect is increased when there are large inductive loads, such as motors. The electricity supply to a premises can be one source of such overvoltages.

Surge protection

There is only one guaranteed way to prevent transient overvoltages, and that is to use no electrical or electronic equipment. But as this isn't practical, electrical installations can be protected against transient overvoltages by the use of surge protection devices (SPDs).

SPDs are different to circuit-breakers and residual current devices in that they are specifically designed to protect the installation and components against the harmful effects of transient overvoltages.

Their role is to take the transient overvoltage and dissipate it to earth, safely away from the installation and the products they are protecting. They are therefore to be used to supplement circuit-breakers and similar devices to offer total protection for an installation.

Guidance

The primary electrical safety guidance in the UK is BS 7671: 2008 Amendment 3: 2015, on the requirements for electrical installations (*https://bit.ly/2Jn4CvV*). However, the impact of transient overvoltages and the risk of lightning is so specialist a subject that it is detailed in another series of standards, BS EN 62305 on protection against lightning (*https://bit.ly/2GEMJal*).

This series is split into four parts and totals more than 450 pages. It would not be possible to condense this information into a short article such as this, so the following summarises the requirements of BS 7671: 2008 Amendment 3: 2015. Please note that, at the time of writing, BS 7671: 2018 is at draft stage and will be published in July.

There are two distinct sections in BS 7671 relating to protection against transient overvoltages: section 443, protection against overvoltages of atmospheric origin or due to switching; and section 534, devices for protection against overvoltage. In essence, the first helps you assess whether you need overvoltage protection, and the second helps specify how you do so and what devices you might need.

Section 443 has two options for determining necessary protection against transient overvoltages. The first is by use of an AQ rating, a measure of the number of thunderstorm days per year in an area. However, this is for many an outdated concept as there is nowhere in the UK that the number exceeds the arbitrary figure of 25 quoted in the standard.

The second, more sensible approach is to undertake a risk assessment of the installation's consequential risk level based on the requirements of BS 7671 regulation 443.2.4.

Risk assessments

Risk assessments of this nature split installations into five categories:

- those that have consequences that concern human life, such as safety services and hospital medical equipment
- those that would affect public services, IT centres or museums
- those with consequences for commercial or industrial activity, such as hotels, banks, industries, commercial markets or farms
- those where there would be consequences for groups of individuals, such as large residential buildings, churches, offices or schools
- those whose failure would affect individuals, such as small or medium-sized residential buildings, or small offices.

> "It is vital that whatever devices are used they are suitably coordinated with one another

For the first three, protection against overvoltage shall be provided as per regulation 443.2.4. For the fourth and fifth categories, protection requirements depend on the result of a calculation detailed in regulation 443.2.4 of BS 7671.

The information needed to complete this calculation successfully is so detailed that it will not be considered here; however, it is clear that many installations fall under the first three levels of consequence and will therefore require SPDs to be installed. On top of this, BS 7671 regulation 534.2.3.4.2 requires that SPDs be installed where there is a structural lightning protection system fitted to a building.

Modern dwellings often use a number of appliances simultaneously

Once it has been determined that protection against transient overvoltages is necessary, section 534 comes in to play. This provides guidance on what device should be installed, and again makes reference to BS EN 62305 as well as to other relevant standards. This article will therefore simply summarise the requirements.

To help selection, SPDs are classified as one of three main types according to their location and use.

- **Type 1 SPD:** this will be located at the point at which the supply transfers from the distributor to the client, typically where electrical services enter a property, and offers protection against direct lightning strikes.
- **Type 2 SPD:** this will be located at sub-distribution boards throughout the installation, and offer protection against indirect lightning strikes or strokes and electrical switching surges.
- **Type 3 SPD:** this will typically be a separate device used with an outlet or appliance to protect circuits in sensitive equipment.

Many manufacturers make devices that incorporate multiple protection types, so a combined type 1/2 device can be used at multiple points in the installation.

However, it is vital that whatever devices are used they are suitably coordinated with one another to ensure that those in series provide the necessary protection and function properly. The easiest way to do this is to use devices from a single manufacturer throughout the installation to achieve selectivity; that is, to be certain they work in conjunction with all other SPDs in the system.

Another vital consideration is the maximum length of the conductors used to connect the SPD to the distribution board being protected. BS 7671 regulation 534.2.9 requires that the cables be as short as possible, preferably less than 0.5m in length but in no case exceeding 1m. This can be a restriction in installations that are to be refurbished, and should be considered before specifying where SPDs should be fitted.

According to BS 7671, there are many installations that require protection against transient overvoltages, but in reality even more could benefit from SPDs due to the increased use of sensitive electronic equipment.

While it would be wrong to say that when in doubt, fit a SPD – this would be extremely costly and would not always benefit the building owner or occupier – it would be sensible to increase the industry's awareness of such devices and the need to consider their use, where appropriate, to offer another level of protection for equipment and buildings.

RICS itself is aware of an increase in electrical fires caused by electrical surges, and a risk assessment approach is recommended.

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Related competencies include **Construction technology and environmental services**

The clerk's tale

Whatever their actual job title, clerks of works perform a vital role in construction projects writes **Rachel Morris**

The barrister and adjudicator Tony Bingham once declared that "the cost of a clerk of works per annum is cheaper than a day in court."

As the professional body that supports clerks of works and construction inspectors, the Institute of Clerks of Works and Construction Inspectorate (ICWCI) currently has around 1,000 members working in the UK.

In addition, it has members employed in the Republic of Ireland, Spain, China, Hong Kong, Malaysia and Australia as well as various African nations, among other countries.

Principles

Traditionally, building superintendence or site inspection is the role of the clerk of works. Although building practices and procedures have come and gone – and come again in some cases – the very principles for which clerks of works were first established remain as valid today as they have ever been.

The ICWCI defines the role of the clerk of works as: "A person whose duty is to superintend the construction and maintenance of buildings, or other works for the purpose of ensuring proper use of labour and materials" (*www.icwci.org*). In many cases, even though this traditional title has given way to modern alternatives such as construction inspector, site inspector and quality auditor, the principle remains the same.

Whether in the field of civil engineering, building, landscaping, tunnelling, electrical and mechanical engineering, new build or refurbishment, at home or overseas, these inspectors ply their trade and ensure value for money for the client through rigorous inspection of the materials in use and the quality of work.

Their skills are honed through study and years of practical experience. They have to remain up to date in terms of legislation and the many relevant regulations, including those relating to individuals – health and safety, race relations, disability discrimination and so on – as well as those concerning construction itself.

Cost savings

Through rigorous and detailed reporting and recordkeeping and thorough inspection of specifications and drawings, the work of these professionals without question adds value to any project, even though it may not be obvious at the time. The question that should always be asked is a very simple one: without the intervention of the clerk of works, how much would rectification, remedial action or both of these have cost?

Clients – including employers, local authorities, and housing associations – have to ensure that their construction projects achieve value for money and are completed to a high quality, in terms of the work itself, the materials used, construction standards and compliance with Building Regulations.

Outsourcing of services

Before the mid-1990s, most local authorities in the UK employed teams of clerks of works as part of architects and engineering departments. Under this regime, the clerks' role was valued, understood and respected.

As the country entered recession during the early 1990s, it prompted cutbacks, rationalisation and compulsory competitive tendering. This resulted in outsourcing of professional services to facilities management companies, and although clerk of works services were not immediately affected, it is clear that, over time, as local authority clerks have retired, they have too often not been replaced.

Forms of contract have changed over the years too, and the ICWCI's view is that design and build contracts have diluted the role of the clerk of works. Many clients consider it a saving if the contractor is carrying the risk, for instance, and they do not account for the cost of a clerk or understand the benefits of having one as part of the design team.

In the case of the JCT standard or traditional form contract, the architect is the lead and the clerk of works is named and reasonably empowered. Under the NEC3 engineering contract there is similarly inclusion for an engineering and construction supervisor, which also recognises the clerk of works' inspectorial role. Public projects, procured under the private finance initiative, however, are usually silent on the requirement for clerks.

Benefits

Independent third-party inspection by a clerk of works helps to protect the client's interests throughout the construction process. When employing or appointing a clerk of works or construction inspector, the client will not only benefit in terms of experience, they will also have the reassurance of knowing that their interests are being safeguarded.

Clerks of works have:

- a good general understanding of the specific construction inspection process, in particular around the inspection of materials and quality of work
- an understanding of the obligations of all parties, including requirements and boundaries
- the foresight to identify issues or potential issues and the ability to suggest alternative methods or mitigation techniques
- a focus on quality, reducing the need for reworking and double handling
- impartiality, offering a fair, considered and independent approach to ensuring value for money for the client
- an awareness of acceptable standards, benchmarking and identifying where work does not conform to regulation
- the ability to record findings concisely
- the ability to offer a professional opinion and recommend alternative approaches and corrective actions
- knowledge of construction materials and components, including their use, limitations and possible alternatives
- an understanding and knowledge of the practical and legal aspects of health and safety.

When a clerk of works is appointed, there are a number of factors on which they can focus, including the following.

- **Compliance:** buildings need to be inspected for safety and structural integrity to ensure that they conform to statutory regulations and laws.
- **Quality of work** needs to be monitored and inspected at regular intervals to minimise problems, defects and rework.
- **Materials** should be inspected to ensure that they are correct and of an appropriate quality to fit their purpose.
- **Defects** can be minimised and resolved when regular, thorough inspection is factored in to the construction process.
- **Recommendations:** clerks of works can make recommendations to the client throughout the construction process about materials, the quality of work and so on.

A clerk of works' ability to deal with all five factors, however, will vary according to the basis on which they are contractually employed.

Employment

A clerk of works should be appointed at the earliest possible stage of a project, starting before construction commences so they can work through each subsequent stage.

It is usual for a clerk of works to be employed as a representative of the employer or client, typically working under the direction of the architect, engineer or project manager. While employing a clerk of works is not mandatory, it is highly recommended.

Bear in mind that the construction industry continues to be perceived by both its clients and the general public alike as being fragmented, disorganised and unprofessional. Litigation, arbitration and continuing building failures reinforce this view.

The industry has become progressively management-oriented, and contractors increasingly often face the quality–cost–time conundrum – a challenge exacerbated by the decline in skill and resource levels, knowledge gaps and poor standards of work.

Clients and developers for their part demand value for money, cost optimisation and projects that are completed right first time. As a consequence, the quality of work on site has continued to deteriorate, resulting in numerous defects – many of a repetitive nature – as well as delays and additional costs. Employing a clerk of works can help obviate these issues.

Decline of quality

Yet government legislation along with industry trends such as compulsory competitive tendering for contracts, lack of training and the decline of public control have all exacerbated the reduction in quality in completed products. The burden of remedial costs and users' dissatisfaction have, conversely, increased.

The clerk of works, traditionally the individual responsible for setting, maintaining and policing quality standards on site, has been among those badly affected by these changes.

With falling numbers of experienced, qualified professionals currently available and few opportunities or incentives for training new practitioners, how will the industry reverse the decline in quality and ensure that the standards required and expected are achieved?

Many of these issues can be mitigated by educating construction industry clients and the design team as to the value of systematic, regular and independent third-party inspection by qualified site inspection practitioners.

The ICWCI continues to push the government to acknowledge there is indeed a greater need to appoint more clerks of works and construction inspectors. Meanwhile, we have also received useful advice from the Construction Industry Council on skills pathways and reaching out to larger clients, and I am myself providing input on construction quality to the Homes for Londoners subgroup of the Greater London Authority. ●

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Related competencies include
Inspection, Works progress and quality management

Travel had already taken **Craig MacDonald** around the world before he had an opportunity to survey dilapidated hospitals in Papua New Guinea – which proved a memorable experience

SHAPING THE WORLD 150 FOR 150 YEARS

Destination: dilapidations

Growing up in Fife, Scotland, and getting my building surveying degree in Edinburgh before some years later moving to Brisbane, Australia, with all the travel in between, I can say my wanderlust is beyond doubt.

In my present position at KPMG's physical due diligence team, SGA Property, the opportunity to travel comes up regularly – often between states, sometimes overseas. It tends to be a question of who is available, but other times you raise your hand. So when the chance to survey a pair of hospitals in Papua New Guinea came up, my hand went up as well.

On my return, I had received an RICS email inviting members to submit their nominations for the Pride in the Profession initiative, which showcases the significant, positive impact of surveyors in society to mark the organisation's 150th year (*www.rics.org/150*). With my experience still fresh in my mind, my submission wrote itself.

Travel and transfer

I would first be travelling to Port Moresby, meeting colleagues based there, then transferring to Madang, near the two sites I was visiting. I was heavily relying on my local colleagues for their insight, advice and coordination. I was told the city was considered something of a bubble in contrast to the rest of Papua New Guinea, especially the rural areas. Between the Madang Airport shed and my accommodation, the drive on the hotel bus was my first real glimpse of it.

On approach to the hotel, it was hard to miss the high perimeter wall topped with razor wire. But despite the security concerns, people were still welcoming to outsiders. I pulled out my phone to take a photo, and just as I did two young men at the side of the road entered the frame, gave great smiles and waved. The Papa New Guineans I spoke to were friendly, and also keen to let me know that generally everyone else in the country is as well.

Off the beaten track

The hospitals' locations presented their own challenges, the second of the two sites being on a semi-active volcanic island no less. The first hospital at Yagaum was about a half-hour outside Madang. Our security escort drove us down the highway for a short while before turning off onto a track, which quickly became dense rainforest. After about 20 minutes of ascent, driving past people traversing the same route on foot alone, we arrived.

It was clear right away this was not like any inspection I had undertaken before. I learned from the staff that the hospital was constructed by volunteers around 1948, using buildings and materials left over from the Second World War.

As I inspected, I walked past babies born only moments earlier, in a structure that was not weathertight or even clean to the standard of my own home, let alone those required for the hygiene of a western hospital. It didn't matter: these buildings continue to serve a critical function for the local community, and without them there would be devastating hardship. I won't forget the client – the Australian Lutheran World Service, which runs the hospital – telling me it is their faith that keeps them going.

Having a good understanding of the buildings' use was critical for the finished condition reports, and in this case it was to support a business case for a grant. I knew particular care was needed in the way I would report the condition of these properties. It was a context I had never encountered before.

My approach was to declare that the condition of buildings had not been assessed against criteria used for Australian buildings; for example, an

Gaubin Health Centre


Yagaum Health Centre

assessment to an Australian standard, or most western standards for that matter, would conclude that the majority of buildings inspected should not be occupied or in use.

Instead, by ensuring I had provided in the report a good understanding of the buildings' context – their location, age and use – I could still apply condition ratings and risk ratings, which would ultimately be of value to the client.

A sceptic may have observed that I couldn't have reported on these buildings and they should have been demolished. In fact, I was able to produce a condition report, which was more valuable given the property's remote location.

Second site

Site number two was at Gaubin, located on Karkar Island. Initially, we had chartered a dive boat for the two-hour sail there. However, an up-to-date weather report indicated that there would be rough conditions so we went instead for plan B – a helicopter.

I'd been on a helicopter before as a tourist, though it did feel different boarding one for work – another kind of excitement, maybe. The weather had deteriorated, so the pilot had to follow the coast for as long as he could before crossing to the island by the shortest distance, to minimise the time spent over the ocean.

On our approach, the volcano's peak was shrouded by raincloud and all I could see of the hospital was a white dot just off the beach, nestled among green palms. There was a clear paddock in the middle of the site, presumably for helicopters to land.

As we got lower, people looked up, running and lining the perimeter fence. The rotors were still whirring loudly as we stepped out, and the main doctor emerged through the fence to greet me and ask what I wanted to do first. The pilot reminded me that a storm was coming in and if we wanted to fly back without any problems, it would best be done inside the next couple of hours.

Doctor's diagnosis

I interviewed the doctor alongside a few others familiar with the site, recording our conversations with their permission.

I reeled off standard requests, asking for information about site problems, keeping it strictly to physical condition each time the doctor veered into operational issues, and I made note of water leaks, wall cracks, general damage and so on. Then I asked him to show me these issues, following which I began the usual methodical approach to ensure that I'd viewed each part of the site as I walked through it.

It had already started to rain lightly. My camera was continually snapping all building surfaces, first getting wide, contextual shots, then identifying defects to be photographed in more detail later. My site contact walked and talked.

With my camera in one hand, my other was operating the recorder app on my phone while I dictated my observations and listened to the wealth of information the doctor had to offer. A wall in what used to be a ward had apparently been critically damaged by tremors from the volcano. These weren't cracks you would measure. Cracks and openings were evident around the whole site, and a future tremor would surely destroy it. Fortunately, we made it out before the storm hit, having collected sufficient information for the client to engage a local consultant who would coordinate and undertake necessary rectifications.

Streamlined workflow

With all the images I had taken on both sites, and with the output format in mind, my workflow was key. I used Beyond Condition to streamline my data entry and export pre-formatted condition reports; essentially, raw spreadsheets including the data I'd entered, image metadata with filenames linking back to the photo appendix and a thumbnail included automatically on each line.

With more than 200 items in each report, this approach saved an incredible amount of time, and provided excellent context. The client is a faith-based organisation, and a key requirement was for the reports to be as clear and non-technical as possible.

I still had to explain what a soffit was – the underside of any of the architectural elements – even though it could be viewed in the adjacent thumbnail, so I included a standard building definition diagram in the appendix. Being able to refer to the RICS practice note on condition reports and give examples was refreshing, because I am used to providing reports to people who already work in property.

Broadening the mind

Since my move to Australia, I've been lucky enough to visit all eight states and territories, getting to know the main cities down the east coast. Every now and then I get to travel inland, which presents its own challenges.

My experience visiting Papua New Guinea has taught me to speak to as many people as I can who are familiar with the local conditions: some things you can't learn online or from a textbook. My trip to Papua New Guinea is easily my most memorable inspection experience to date. I look forward to the next opportunity to top it.

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Related competencies include
Building pathology, Inspection

Dr Chris Cocking argues that trust rather than panic is a better model for behaviour in emergencies

Follow the crowd

At a conference earlier this year, I was asked whether building surveyors should give special consideration to academic research on crowd emergency behaviour over and above current guidance. My short answer was an emphatic "Yes".

It is vital to think about human factors in emergency evacuations, as no matter how well buildings and their alarm systems are designed for safe egress we must also consider how people will behave in such situations.

If we do not, we will only partly be able to ensure safe and efficient emergency evacuations. In this article, I hope to show how the study of crowd emergency behaviour can inform the current debate on how we can improve safety in high-rise buildings and prevent avoidable tragedies such as the one at Grenfell Tower from happening again.

Panic model research

Research into crowd behaviour by psychologists over the past 40 years has produced a significant body of work to show that traditional views of crowds as irrational are not supported by evidence.

Research conducted by myself and others has shown that the assumptions of the "panic model" of emergency behaviour are not borne out by reality. So, for instance, the fear that is often associated with being in an emergency does not usually overwhelm people's reason to the extent that they engage in selfish or irrational behaviour. Furthermore, if individuals start behaving in selfish or irrational ways, rather than others mindlessly joining in – as is often expected – bystanders tend to intervene to calm the individuals concerned or regulate their behaviour.

> "Panic is not a useful or accurate term for crowd behaviour in emergencies, and should not be used to describe such incidents

While crowd disasters are often reported in the media as "mass panic" or "stampedes", detailed examination of events afterwards rarely supports such irrationalist conclusions. Indeed, panic is often noticeable by its absence. An analysis of human behaviour during the World Trade Center attacks of 11 September 2001 based on published survivor accounts found that less than 1% of the behaviours observed could be classified as panic, and people who tried pushing past others on the stairwells were told to wait in turn by others.

There are also quite serious implications to approaching emergency planning and response based on a panic model. So, for example, if planners assume that crowds cannot be trusted to behave rationally in emergencies, they will be more likely to adopt paternalistic or even coercive strategies to protect people from their potential worst excesses. The 1989 disaster at the Hillsborough football stadium in Sheffield is now widely accepted as a tragic example of the consequences of viewing crowd management as a public order rather than a public safety issue, and of how victims can be wrongly blamed for being responsible for a tragedy. The authorities may also withhold information in a misplaced attempt to prevent the possibility of panic when people discover the scale of the threat they face. There is therefore a consensus among academic researchers that panic is not a useful or accurate term for crowd behaviour in emergencies, and that it should not be used to describe such incidents.

Crowd resilience

In response to these problems with the panic model approach, the Social Identity Model of Collective Resilience (SIMCR) was developed by John Drury, myself and Steve Reicher in 2009. This suggests that disasters foster a common identity among those affected – "we're all in this together" – that tends to result in orderly, altruistic behaviour as people respond to and escape from a shared threat.

Cooperative rather than selfish behaviour predominates, and any lack of cooperation is usually because of physical constraints, especially in densely packed crowds, rather than a result of any inherently selfish behaviour on the part of the crowd.

The SIMCR is supported by evidence from recent emergencies. Research that I did with Drury into the 7 July 2005 London bombings (*https://bit.ly/2dvi2Lr*) found that while witnesses reported individual fear and distress, this did not become mass panic.

Instead, there tended to be a sense of general calm and cooperation as a common identity emerged in response to a shared threat. Therefore, we concluded that people in emergencies behave in a much more resilient manner than is often expected, and we should focus on crowd resilience rather than vulnerability in emergency planning and response.

Practical steps

The SIMCR suggests a variety of practical steps that can be taken to ensure safer and more efficient emergency evacuations. For instance, the emphasis should always be on providing more rather than less information, because if people are presented with clear, practical information on which they can act to escape threat or keep themselves and their loved ones safe, then they will usually do so.

There is minimal evidence that people panic if made aware of a threat; in fact, the evidence there is from such situations tends to show the opposite. Furthermore, deliberately withholding information could delay evacuations and may cause problems in future emergencies, as people may not entirely trust messages

from the authorities if they believe these are not sufficiently forthcoming.

It is also not a good idea to include the phrase “Don’t panic” in public messages, as this can create an expectation that there is a possible cause for panic that is not being revealed, thus potentially engendering public mistrust.

However, it is not just a simple case of providing information; it is also important to think about the content of any safety messages and the way they are constructed. Information needs to be delivered confidently in a clear and unambiguous way, and be from a credible source with which people can identify.

Trained fire wardens

As well as having good public address and fire alarm systems, it is crucial that there are also trained fire wardens on the ground during emergency evacuations who are familiar with the location, the reasons for the evacuation and the closest possible route of escape.

This is particularly important when there are fires because people don’t often use fire exits equitably during evacuations, tending to try and leave via the way they entered, especially if they are unfamiliar with the venue. However, this may not be the quickest or simplest path to safety.

Planning priority

If I were asked to prioritise one message for emergency planners to consider, it would be that they should be aware that crowds tend to behave better than expected, and that the concept of mass panic is largely a myth. Therefore, paternalistic panic models should not be used in emergency planning and response. Instead, perspectives that encourage greater crowd resilience are likelier to result in safer and more efficient emergency evacuations.

This is particularly important when considering fires in high-rise buildings, as the time in which people can safely evacuate is often limited. It seems clear that there will be numerous recommendations in Dame Judith Hackitt’s review of the Building Regulations and fire safety as to how building safety can be improved; as part of this process, I would argue that considering the role of human behaviour during evacuations could also help contribute to safer and more efficient emergency evacuations in future.

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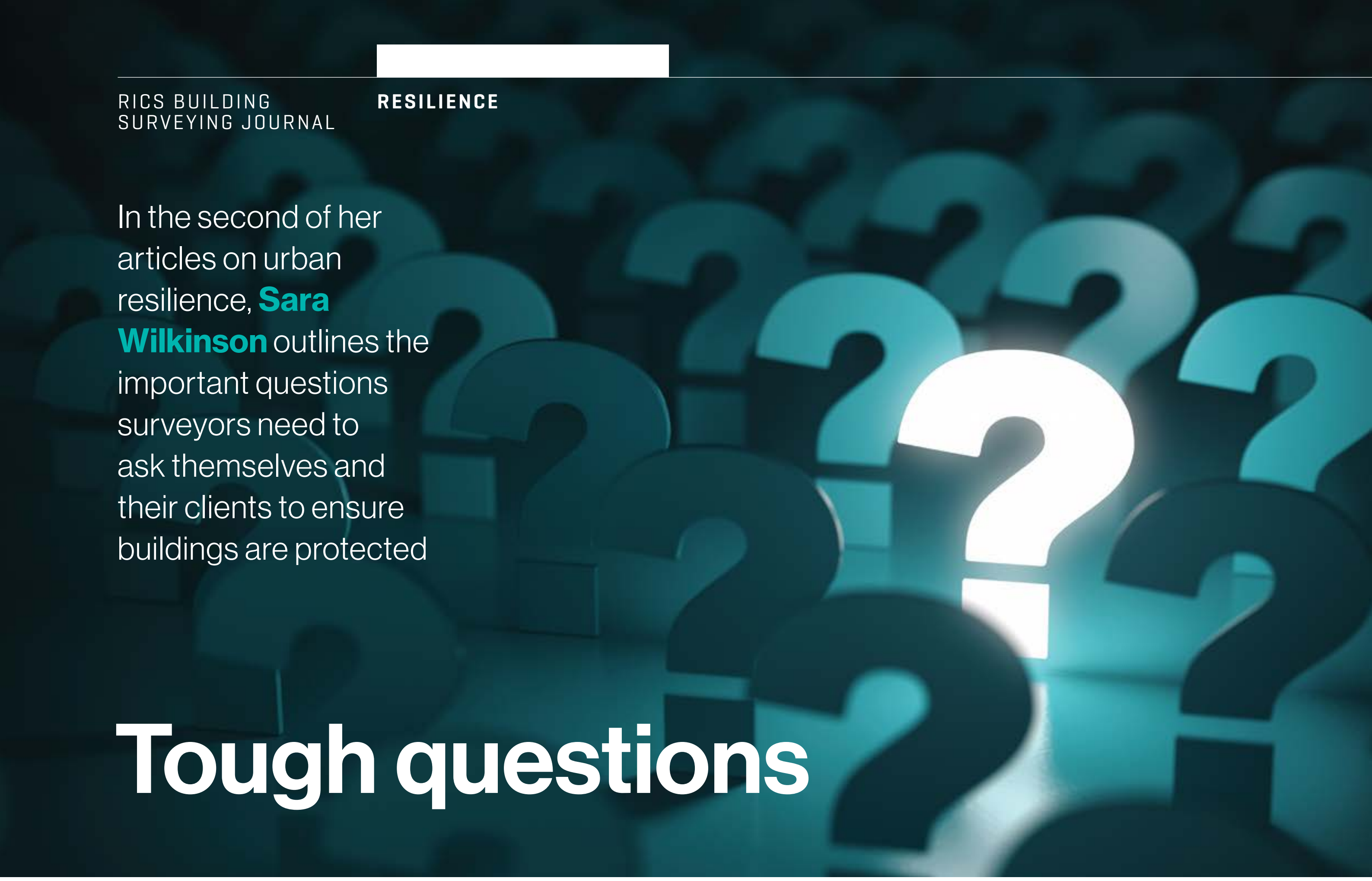
Related competencies include
Fire safety



In the second of her articles on urban resilience, **Sara Wilkinson** outlines the important questions surveyors need to ask themselves and their clients to ensure buildings are protected

Tough questions

Resilience is a complex concept, with multiple attributes and levels of interpretation. However, we can get a better understanding of it by asking ourselves the following five questions.

- **Who** determines what is desirable for an urban system or building? Whose resilience is prioritised, and who is included or excluded?
- **What** should the system or building be resilient against? What networks or sectors are included in the urban system, and is the focus on generic resilience or resilience to a specific threat?
- **When** – is the focus on rapid or on slow-onset disturbances; on short-term or long-term resilience; and on the resilience of existing generations or future ones?
- **Where** are the boundaries of the urban system? Is the resilience of some areas prioritised over that of others, and does building resilience in some areas affect others?
- **Why** is there a need for resilience? Is the focus on the intended outcome, or on the policies and strategies used to achieve this?

These questions are a good framework to inform decision-making and professional advice. A built environment's physical, institutional, economic and social capability to keep adapting to existing and emergent threats means the focus is on coping with dynamic changes, so we must keep asking these questions throughout a building's lifecycle.

Typically, there are no right, or easy, answers, but it is imperative that we understand and debate these issues as we endeavour to develop resilient cities and buildings.

Advice to clients

Building surveyors' skills lie in numeracy, communication and problem-solving, and we also have a deep understanding and knowledge of building technology, pathology and management, to name a few qualities.

We can advise clients throughout the whole property lifecycle on matters relating to adaptation, repair and maintenance, and risk, at building and portfolio level. Importantly, at key stages in the lifecycle, we advise clients in respect of the numerous ways buildings could, and should, be built or adapted to be resilient.

Public clients value advice on improving amenity for the community, and this may be of greater value than the actual capital expenditure. Commercial clients, on the other hand, want advice to add economic value and minimise risk and loss throughout the building lifecycle.

Understanding the value of resilience sits well with our professional knowledge base and skill set as building surveyors. Being able to comprehend, identify and communicate the options for a particular building in terms of adaptation for resilience, and to consider both initial costs and the ongoing long-term maintenance and lifecycle costs of potential resilience measures, are both skills we possess.

There is a major role for building surveyors in property management and advising clients about existing buildings, to ensure that measures to provide greater resilience to future events are considered during retrofitting. We can also advise clients that inaction could lead to lower property values and higher maintenance and repair costs.

Eight resilience issues

Eight key issues for London are identified in the Rockefeller Foundation 100 Resilient Cities Network (see *Building Surveying Journal* May/June, pp.18–19), though some will apply to other cities in the UK and beyond.

1. Coastal and tidal flooding

We should consider coastal and tidal flooding when providing environmental due diligence services. Using information in flood mapping data, we can raise the issue with clients and consider appropriate measures in the building and

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on the site to mitigate water damage, thereby ensuring a swifter return to operation after future flooding.

Design and build requirements need to be improved in coastal areas to address potential inundation, and we can also advise clients on the risks and opportunities to retrofit measures to reduce potential flood damage.

RICS can advocate for action at government level as well. With coastal or riverine flooding, sea walls, where they are provided, are the last barrier protecting buildings and structures from coastal erosion. Inspection of such sea walls should form part of a maintenance regime to ensure that erosion is not washing away their foundations, which affects their structural integrity.

2. Crime and violence

We can recommend measures ranging from better building and site lighting, use of cameras and CCTV technology to engagement of an on-site concierge or security personnel. Such measures are applicable to residential and commercial property and implementation will be influenced by costs, as well as possibly by insurers and the potential severity of the issue.

3. Disease outbreak

We can raise clients' awareness of the role of building services as a disease vector in buildings. Opportunities arise during regular maintenance and refurbishment to recommend new and innovative air conditioning systems and to consider prudent maintenance and upgrades for existing systems, particularly commercial office applications where environments are densely occupied.

4. Infrastructure failure

We may be providing building maintenance services, so should consider infrastructure as part of strategic planned preventative maintenance, lifecycle costing and planning as well.

> "Understanding the value of resilience sits well with our professional knowledge base and skill set

We can advise on project design, and note potential impacts on property value. Where possible, designs that take buildings partially or fully off the grid of energy or water services will be more resilient to infrastructure failure.

5. Lack of affordable housing

This needs direction from government, for example to set affordable housing quotas, but we can offer advice on technologies that reduce operational and maintenance costs and on security measures that may lower insurance costs. RICS can lobby government on the need to provide a certain percentage of affordable housing in developments to encourage more diverse, inclusive communities.

6. Poor air quality

Given the ageing population it is likely that more people will spend more time indoors, increasing the risk of exposure to poor-quality air, which will affect their health. Some environmental assessment tools include air quality on a voluntary basis, and we can advise clients to raise their awareness and perception of risks.

In areas where housing affordability is a particular issue, there is likely to be undocumented overoccupation of property. By this I mean that a building is designed based on predicted occupation levels of, say, four people per flat, but due to subletting as many as 12 may be living there. Clearly, window design is based on a certain number of air changes per hour for a given number of people, which may be greatly exceeded in such situations.

For commercial property, recommending end-of-trip facilities such as showers and bike storage will discourage use of polluting vehicles and contribute to better external air quality.

7. Rainfall flooding

This can lead to inundation of lower and ground floors in properties, and we can raise client awareness of this risk at all points the property lifecycle. Measures that ameliorate rainfall flooding include increased on-site collection of water to reduce inundation of the public sewers and this can be used for watering garden areas, lowering occupier water bills.

8. Terrorist attack.

We can advise clients on ways to make properties safer and more resilient to acts of terrorism. At city scale, advice on planning of retail, social and venue space where people meet in crowds is required, with more separation from traffic and fewer large open spaces. At building scale, consideration of lighting, access and use of CCTV will be necessary.

Key role

Resilience is an issue that clients will need to take into account to protect people and investments. Building surveyors have a key role in this process. For instance, the above list of issues is not exhaustive and I am sure you will be able to add to it, which shows how much we have to offer to clients.

To give you an idea of how relevant London's issues are to other cities, the Rockefeller Foundation 100 Resilient Cities lists 26 metropolises facing the same problems, ranging from Melbourne to Melaka and from Boston to Bangkok.

We need a long-term view and a broad perspective when advising clients. For example, we must look at refurbishments specified to withstand future weather events, particularly rainfall flooding.

There will be times when it is not immediately commercially viable to invest in resilience measures for a building, and professionals need the relevant knowledge, skills and understanding of risk assessment and probability to advise clients when this is the case, and how long they might defer action.

We have to be proactive. With our deep understanding of technical, legal and planning issues relating to property as well as building pathology and value, we are in a strong position to guide and advise on resilience. ●

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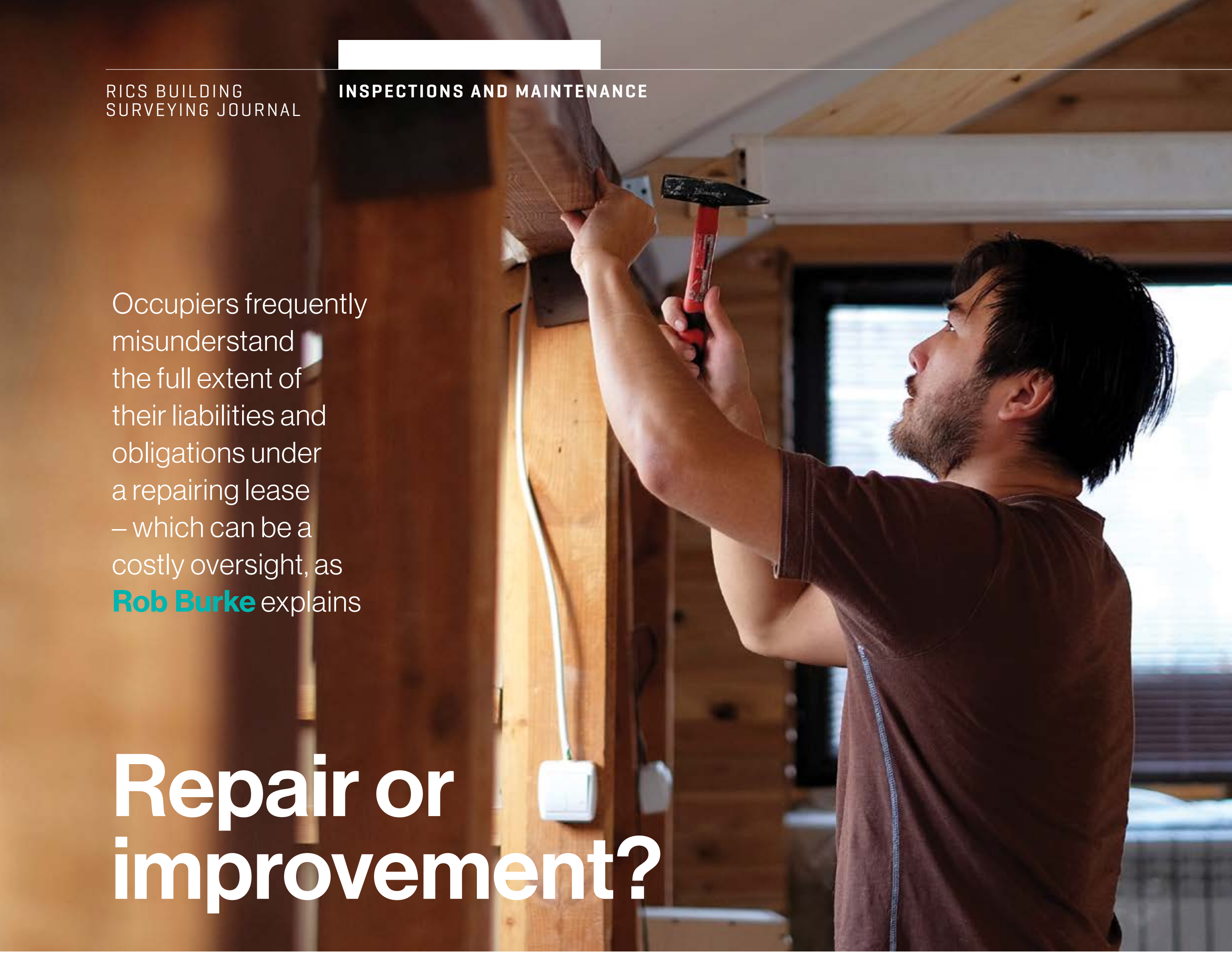
Some content in the article is taken from the book *Building Urban Resilience through Change of Use*, edited by Sara Wilkinson and Hilde Remøy and published by Wiley.
https://bit.ly/2J7IFVs

Related competencies include
Construction technology and environmental services, Design and specification, Design economics and cost planning, Maintenance management



Occupiers frequently misunderstand the full extent of their liabilities and obligations under a repairing lease – which can be a costly oversight, as **Rob Burke** explains

Repair or improvement?

One of the questions we address on a regular basis as a commercial property specialist is "What is the exact meaning of repair?"

The *Oxford English Dictionary* definition is "restore (something damaged, faulty, or worn) to a good or sound condition after decay or damage". In the context of a commercial lease, however, the words "good condition" may be ambiguous. Repairing obligations can be cited in terms that are open to interpretation.

The obligation to repair is set out in the Landlord and Tenant Act 1927 and covenants can be expressed by using wording such as "put the property into repair" or "keep the property in repair". Sometimes, covenants are also modified by the use of words such as "forthwith" or reference to a specific date or period of time.

Some leases link the repairing covenant to the tenant being given notice of the disrepair. Where this is the case, the tenant will not be in breach unless such notice has been given – occasionally with a specific time frame – and repairs have still not been carried out. Some covenants also provide for the landlord to enter the premises, carry out work and recover the cost from the tenant.

All this can lead to expensive misunderstandings. As a result, it is important that tenants are fully familiar with the terms of their own lease and whether or not it is limited in extent in some way, for example by reference to a schedule of condition or a side letter.

Identifying disrepair

Identifying whether or not a building has fallen into disrepair is arguably the most complex aspect of dilapidations. In *Dilapidations: The Modern Law and Practice* – something of a Bible for dilapidations practitioners – authors Nicholas Dowding and Kirk Reynolds set out five steps that can be used to establish the existence of disrepair. These come in the form of the following questions that owners, occupiers and their advisors should ask themselves.

- What is the physical subject matter of the covenant?
- Is the subject matter in a damaged or deteriorated condition?
- Is the nature of the damage or deterioration such as to bring the condition of the subject matter below the standard contemplated by the covenant?
- What work is necessary in order to put the subject matter of the covenant into the contemplated condition?
- Is this work nonetheless of such a nature that the parties did not contemplate it would be the liability of the covenant party?

A common misconception is that, if a particular part of a property is in disrepair at the start of a lease, repairs are not required for that element of the building:

> “It is important that tenants are fully familiar with the terms of their own lease

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this is rarely the case, and a tenant is sometimes required to make good that element or put it into repair. Wording will vary depending on a number of factors, but particularly the age of the lease.

Repair or betterment?

Unfortunately, putting an element into repair may not be as simple as it sounds. Tenants should therefore be alert to the difference between repair and improvement, and know which of these is required for their lease.

As Simon Allison, a barrister specialising in landlord and tenant issues with Hardwicke Chambers says, "the motive for landlords carrying out many works that might go beyond repair has changed over time, with the advent of changes in insurance terms, Building Regulations, health and safety, government grants and litigation culture".

He also makes the point that "building technologies have advanced significantly, particularly in the past 10–20 years – new forms of roofing systems, and vast increases in energy-efficient products such as glazing, insulation and cladding being most notable".

Repair can for example unthinkingly become improvement when it comes to the concrete elements of a building. Take an industrial premises: the concrete floor slab has, over time, become damaged by spills and wear and tear, and at lease-end, the property must be put into repair.

This does not mean replacement of the whole slab but rather repair of the concrete. So is patching up the damaged areas enough, or should a new screed be laid? Suppose the Building Regulations have changed, though, and the new screed is of a higher specification than the old one?

Of course, the appropriate approach depends on the extent of damage, the lease terms and the type and use of the building. The tenants will almost certainly be obliged to ensure that the finished flooring is suitable for any incoming tenant's use. Compliance with the current regulations is generally necessary as well.

Dowding and Reynolds recognise that on occasions such as this repair may, by necessity, include an element of "improvement" or betterment". That is, if a modern material is the only way to "repair" because previously used materials are no longer available, tenants cannot usually avoid responsibility by merely claiming the remedy is inappropriate because it would result in improvement or betterment.

Roof coverings are another instance where tenants may be forced to make improvements, because the Building Regulations now call for insulation and coverings of a better quality than those previously required; Postel Properties Ltd v Boots the Chemist Ltd [1996] 2 EGLR 60 illustrates this point.

However, the reverse may be true when considering possible obligations under the Minimum Energy Efficiency Standards (MEES), which came into effect on 1 April.

A tenant who has obligations to repair under their lease may be able to show that the landlord would need to make such significant changes to the property to satisfy the MEES that any repairs for which the tenant would be responsible would become null and void. Repairs would thus be a waste of time and money with no value under the new regime, so any works would be superseded.

Despite relating to a residential block rather than commercial premises, the recent case of Waaler v London Borough of Hounslow [2015] UKUT 0017 (LC) raises many of the same issues, and demonstrates the range of grey areas between repair and improvement (*https://bit.ly/2rASeBc*).

> "Tenants should be alert to the difference between repair and improvement

Grey areas

The case of De Havilland Studios Ltd v Peries [2017] UKUT 322 (LC) illustrates just how difficult it is to negotiate these grey areas, even for legal experts.

At a factory converted into 41 flats, the windows were in need of work. The lease allowed for either repair or replacement, and the dispute arose over which was more appropriate. The freeholder opted for repair because it was cheaper, but the leaseholders disagreed and wanted new windows. When the freeholder refused, the leaseholders took the matter to the First-tier Tribunal (Property Chamber).

The tribunal initially determined that replacement was the most reasonable option due to the long-term benefit of new windows. However, on appeal the Upper Tribunal ruled that, while either option was reasonable, replacement rather than repair was "more reasonable".

This is a perfect example of how complex an issue repair can be, and where professional advice comes into its own; although assessing the legal costs against the costs of simply replacing the windows is perhaps the subject of another article.

One theoretical situation that illustrates the issues surrounding repair concerns a grade II listed residential block that also includes a single commercial unit.

In this case let's assume the block is in receivership. The top-floor penthouse is being sold at the same time as negotiations are under way to agree a new lease on the commercial unit. The leaseholders are largely not permanent residents and mainly let their flats via an online hospitality platform.

They are still paying service charges, but the landlord is not meeting its obligations to undertake repair work while it tries to keep expenditure to a minimum, finalise the lease on the commercial unit and sell the vacant penthouse.

As a result, the standard of internal and common parts is poor and the building doesn't look the way the leaseholders wish so they can promote it to potential tenants. The landlord is clearly failing in its contractual obligation to keep the building "in repair" so the receiver may find it has to fill the gap in the block's finances, at least in the short term.

Limiting liability

Each party to the lease clearly has a part to play in ensuring that claims are avoided at lease-end. Occupiers should familiarise themselves with the repairing obligations, and landlords should also ensure they are fully and correctly advised and cognisant of what the lease as a contract obliges their tenants to do, how they plan to enforce this, and indeed whether this is what they intend.

Both parties should fully understand their liabilities, and property advisors could usefully suggest that tenants do the following.

- The property's state of repair prior to the lease commencement should be recorded in a schedule of condition, agreed by both parties and annexed to the lease. However, it is important to note that the level of detail provided by this schedule and subsequent deterioration during the term will determine liability in line with the wording of the lease.
- When drafting schedules of condition, project yourself towards the lease-end date and ensure that they are as detailed and as useful as you or another surveyor would want to see them at that time.
- Plan for repairing obligations ahead of lease expiry. Develop a proactive approach to managing repairs before lease-end by establishing a planned preventative maintenance schedule and keeping the property in good repair for the duration of the lease.
- Clarify whether any surfaces require specialist cleaning to maintain finish or warranties. Respond to a quantified demand within the 56-day period that the Dilapidations Protocol recommends.

Occupiers need to decide how much money it would be prudent to set aside during the term of the lease to finance repairs on termination. Dilapidations are a relevant matter under International Accounting Standard 37 and International Financial Reporting Standard 12, which is being updated and currently allows for future repairing liability to be treated as an expense (see *https://bit.ly/2Az3xgo* and *https://bit.ly/2GX0yVS*). This means it can be included in the firm's profit and loss account and will be excluded from its tax computation until it is incurred. ●

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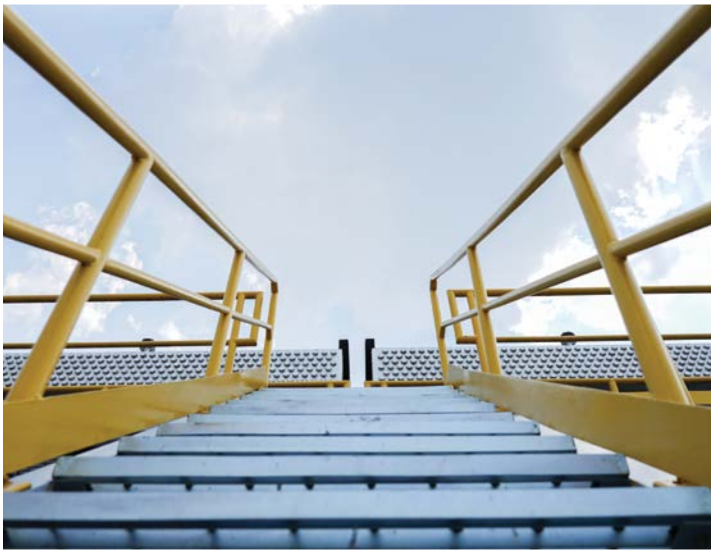
Related competencies include
Legal/regulatory compliance

Good news for duty holders

Mike Appleby reviews a Supreme Court decision on appeals against health and safety enforcement notices



The inspector served a prohibition notice on a stairway on a Scottish offshore installation, as he was of the opinion that this was unsafe. Chevron sent the metalwork from the stairway to be tested. It passed the British Standard strength test, meaning that there was no risk of personnel falling through it and injuring themselves. At the appeal, Chevron sought to rely on expert evidence.

The appeal to the Supreme Court arose because there were different approaches north and south of the border. The issue was whether a tribunal is confined to the material that was, or could reasonably have been known to, the inspector at the time that the notice was served – as is the approach in England or Wales – or whether it can take account of additional evidence that has since become available – which is the approach taken in Scotland. In this case, the Scottish approach prevailed.

> "Expect more appeals in the future

This is good news for duty holders because it widens the scope for appealing enforcement notices, and they are now able to rely on evidence that was not available to the inspector at the time of service, including expert evidence. Therefore, we can expect more appeals in the future.

The ruling will also be relevant to challenges to fee for intervention invoices where the inspector's opinion that there has been a material breach is disputed. Under the disputes scheme, the Health and Safety Executive has sought to limit the evidence for determining the dispute to that available to the inspector at the time of writing the notification of contravention. Given the Supreme Court's decision, it follows that evidence becoming available at a later date will also be relevant. ●

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Image © iStock

UPDATE

Views sought on corruption and safety drafts

Consultations on the RICS *Surveying safely for property professionals* second edition guidance note and *Countering bribery and corruption, money laundering and terrorist financing* professional statement run until 20 and 31 July respectively.

- **www.rics.org/sspgn**
- **www.rics.org/amlps**

Correction: designated body requirements

Revised rules for RICS' designated professional body (DPB) scheme were reported in *Building Surveying Journal* May/June (p.23); however, some changes were made as the journal went to press.

The new rules were due to apply from 23 February, but after a request from the European Parliament and 16 member states, the European Commission proposed a seven-month postponement to 1 October, to ensure that the scheme complies with new requirements in the EU's Insurance Distribution Directive (IDD). However, RICS will need the rules to be in place by the 1 July transition date.

The new IDD's key requirements are:

- **increase in professional indemnity insurance cover:** minimum cover for firms in the scheme rises to €1.25m for single cases and €1.85m for annual aggregate
- **new insurance product information document (IPID) requirements:** firms in the scheme will also have to obtain and provide their clients with an IPID, which is available from the insurance provider. The firm will be required to issue this together with the demands and needs statement to clients before they place the insurance.

- **regulatorycompliance@rics.org**
- **www.rics.org/dpbscheme**

EVENTS

RICS Fire safety conference
18 September, Doubletree by Hilton – Tower of London Hotel
- **www.rics.org/firesafetyconference**

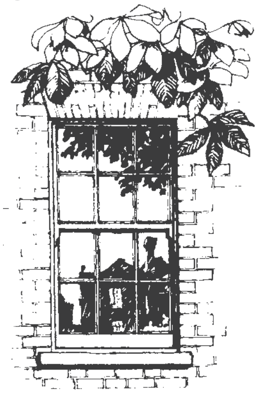
RICS Dilapidations Forum conference
27 September, Victoria Park Plaza Hotel, London
- **www.rics.org/dilapsconference**

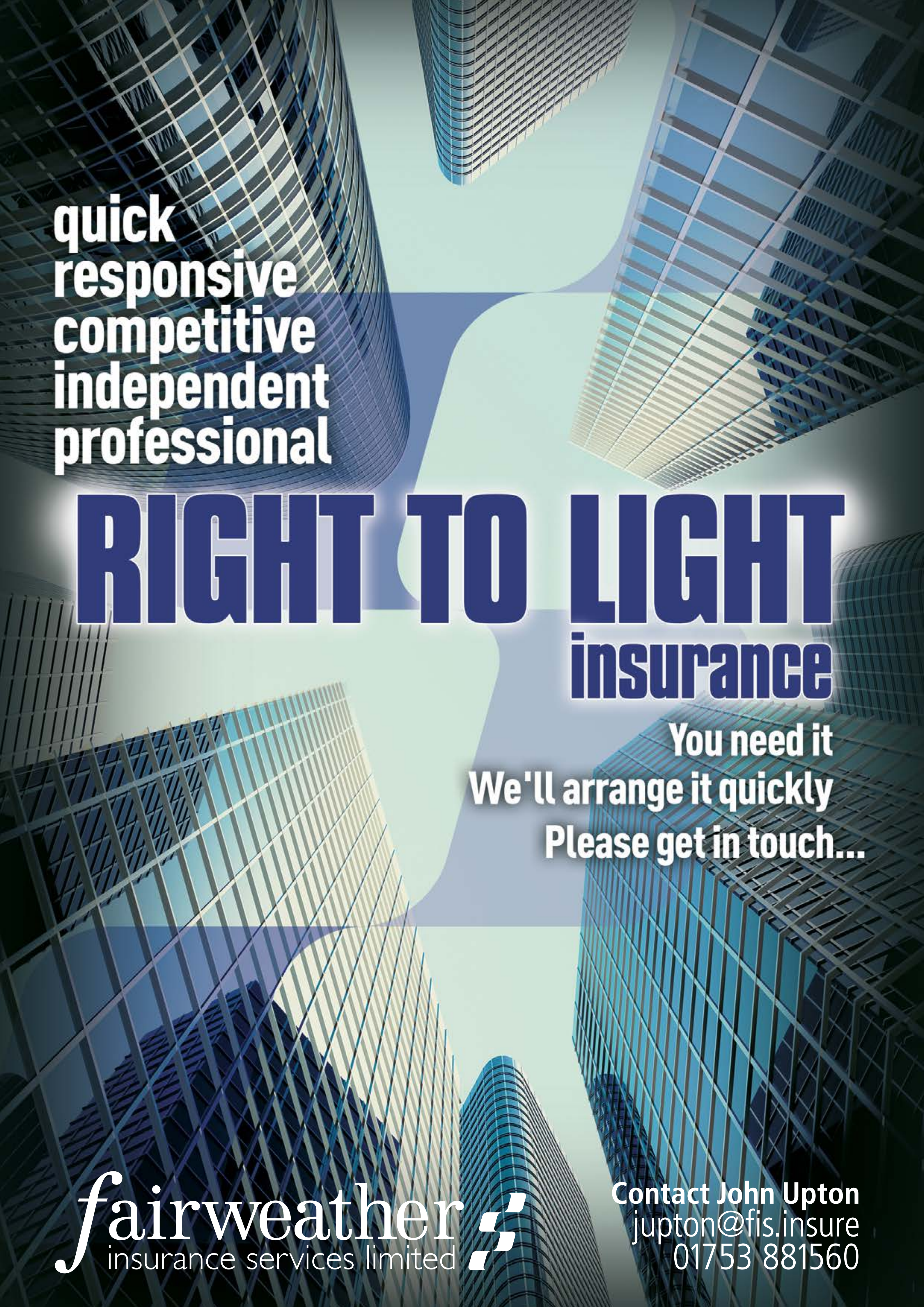
Subsidence Forum training day
17 October
Back to basics
- **www.subsidenceforum.org**

New website provides flood guidance

A new website has been set up to offer free, impartial flood guidance for householders and businesses.

- **www.floodguidance.co.uk**

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RICS

Building Conservation Journal

OPINION

Sustaining our story

Alison Richmond is Chief Executive of Icon, the Institution of Conservation
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This is a year of celebrations: 100 years since women first gained voting rights in the UK and the end of the First World War; the European Year of Cultural Heritage; and the 150th anniversary of RICS.

I have enjoyed exploring the Pride in the Profession case studies on the RICS website, which showcase surveyors' diverse impact on society. Throughout history we have contributed to our heritage by creating stories, and also helping to preserve those of others.

As Chief Executive of the Institute of Conservation, I often think about the wellbeing of the workforce – not just in terms of conservators, but all professionals looking after heritage. Consequently, reading about the careers of these exceptional people, an important question comes to mind: how do we ensure that, in another 150 years, the profession will have yet more to celebrate?

The answer lies in supporting a sustainable and skilled workforce.

Entry routes

I am a firm believer in developing new career pathways. A diverse and accessible range of entry routes is fundamental to attracting talent and creating a workforce fully representative of society. Apprenticeships, for example, have the potential to remove economic barriers to entry by allowing students to earn a salary while studying for a recognised qualification.

Sustainability does not just depend on increasing the number of students enrolling on courses. All entry routes, whether established or new, need to provide entrants with the skills, knowledge and behaviours that are expected in employment.

I am thrilled that professional bodies – RICS and Icon included – are supporting employers in the development of Trailblazer apprenticeship standards. Employers will be able to rely on this pathway for qualified candidates, while adherence to standards can pave a student's way to professional accreditation, boosting competitiveness on the job market.

CPD

The current labour force also needs investment and training to retain its quality in an evolving sector.

Technological progress is changing the profile of the conservator – an effect more profound in the built environment, where new tools are revolutionising working methods. Meanwhile, a challenging funding environment has led to expanded job descriptions in the heritage sector. Generalist capabilities, for example in business and management, are in increasing demand.

I wonder whether CPD has ever been more important. This process supports professionals in advancing their skills by reflection and planning, while training can address development requirements and skills gaps.

It is difficult to write an article today without mentioning Brexit. Indeed, the potential loss of EU professionals from the UK labour market intensifies the need to foster and hone domestic talent.

This age of extreme political and technological change is placing even greater responsibility on professional bodies to equip the existing and emerging workforce with relevant skills and competencies. Our successes will be measured in the future workforce, the high quality of which I hope will be reflected in Pride in the Profession 2.0. ●

CONTENTS

rics.org/journals

Baked goods

Terracotta is a durable building material that has been widely used, but suffers when poorly maintained. **Clara Willett** looks at its history and how to ensure its upkeep

Well-produced terracotta is an extremely robust construction material, which can last centuries. However, lack of maintenance and misjudged interventions can result in accelerated deterioration. Understanding its composition and uses can be helpful in tracing the causes of any deterioration, as well as informing appropriate maintenance and repair.

Composition

Terracotta means "baked earth", and it has been produced for thousands of years by moulding and firing clay to create roof and floor tiles, bricks, statuary and a range of other clayware. It is specifically defined as a fine textured earthenware that lends itself to fine detail, being particularly suitable for decorative embellishments. Glazed terracotta is called faience (see image 1).

Clay itself comprises a variety of phyllosilicates – hydrous aluminium silicates – and other minerals such as quartz, feldspar and metal compounds. Common clays used in British terracotta include china, ball or fireclays, each with different constituents that impart certain qualities and characteristics:

- china clay consists primarily of kaolinite, which has a low plasticity and can only be fired at low temperatures, coming out white
- fireclays have a much higher quartz content, and can be fired at higher temperatures to dark red or brown.

Historically, clays were extracted close to the manufacturer's premises or sourced for their particular properties, but manufacturers learnt to blend different clays to produce a variety of terracottas that differed in texture and colour. Modern terracotta production uses a blend of different clays that provide consistency in the end product.

To refine the clay, it is ground and tempered with various compounds and fluxes, which reduce the melting point of the clay, and then mixed with water to make it more malleable so it can be manipulated into the required form. The clay is then pressed or poured – slip-cast – into a plaster mould (see image 2). Other mechanised processes such as extrusion and stamping are used to produce large numbers of the same element. Bespoke pieces can also be sculpted by hand.

The resulting greenware is hollow and ideally has an even wall thickness; its hollowness minimises the firing time and lightens the piece considerably. The greenware is air-dried and then fired in a kiln – traditionally coal-fired, although modern manufacturing uses gas.

Firing at typical temperatures of 800–1,250°C, the material fuses and, to variable amounts, vitrifies; this is a process that increases the mechanical strength and reduces the porosity of the terracotta. The extent of vitrification depends on the properties of the raw material and the firing temperatures. The surface closest to the heat vitrifies first and creates a narrow boundary that is known as the fireskin.

Until the 19th century, kiln technology was not a precise science; maintaining a constant temperature was difficult and the resulting terracotta was often variable in colour and size. Modern kiln technology has eradicated these problems, producing even-coloured pieces, and improving accuracy of size and colour. However, this also eradicates any aesthetic imperfections, making it virtually impossible to match historic terracotta accurately.

The colour of the raw material, the temperature and the length of firing all affect the final appearance of the terracotta, and the drying and firing processes reduce the size of the piece by between 5% and 12%. Once fired, the terracotta is a brittle material composed of around 75% silica – silicon oxide – with a porosity of 5–10%. Faience, being glazed, has an even lower porosity at less than 1%.

❶ Detailed coade-type mouldings at St Pancras New Church, London, a building designed by William Inwood and son Henry William Inwood, completed in 1822

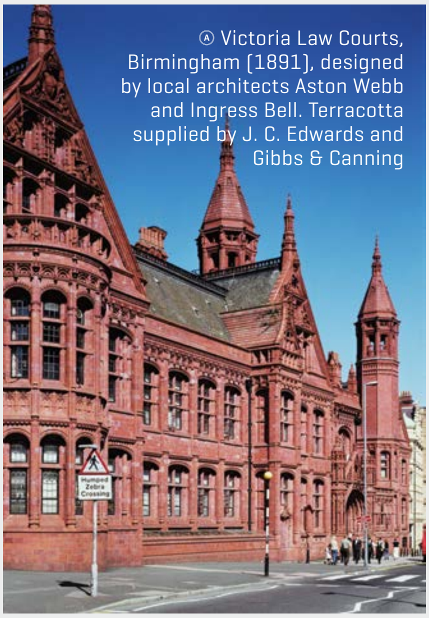
❷ Clay being applied to plaster mould. This process, called slip-casting, is designed to shape the clay into the required form before firing

❸ The grade II listed Covent Garden underground station, 1907, designed by architect Leslie Green. Its tiles use twice-fired oxblood faience, manufactured by the Leeds Fireclay Company

Terracotta's changing use

Though there are examples in the UK of terracotta use from the 16th century, such as Hampton Court Palace and Richmond and Sutton Place, the terracotta we see most frequently today dates from the 1870s to the 1930s (for example, in image A). Victorian terracotta was the product of the Industrial Revolution, with units mass-produced and transported by train across the country and overseas to be constructed quickly on site.

Terracotta is often used as a decorative element on brick buildings, but some architects became more confident, using it for entire buildings. As early as 1845, Edmund Sharpe designed three "pot" churches in Lancashire, so called because they were made entirely from terracotta, with clay sourced from nearby coal seams. Iconic cultural and educational buildings of the Victorian era such as the Royal Albert Hall, the Natural History Museum and Victoria and Albert Museum in Kensington, London, also used terracotta as their main construction material.

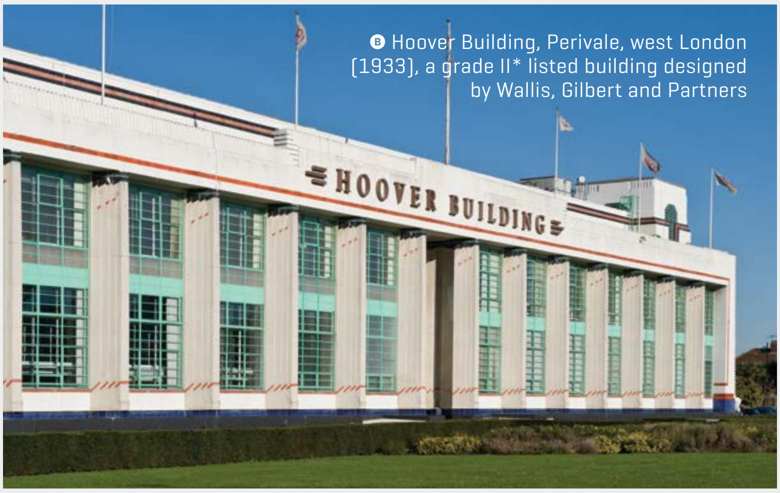


Ⓐ Victoria Law Courts, Birmingham [1891], designed by local architects Aston Webb and Ingress Bell. Terracotta supplied by J. C. Edwards and Gibbs & Canning

As terracotta gained popularity, companies were set up throughout the north of England and Wales, where there was good access to clay, which was often a by-product of coalmining. Companies such as the Leeds Fireclay Company, Dennis Ruabon Tiles of Ruabon, Denbighshire – the village was even nicknamed Terracottapolis – and Gibbs and Canning in Tamworth, Staffordshire were just a handful. One exception to this tendency for companies to be located in the north and Wales was Doulton and Company in Lambeth, London.

The terracotta units were delivered to sites where some were filled with rubble or clinker – the waste from coal-fired furnaces – to increase their density, while others were left empty to minimise the weight for extensive cornices. Construction followed a variety of techniques, some using only masonry, but with the rise of buildings brought increased use of steel, others included beams and supports.

Faience and glazed tiles became popular for pubs and shops and anywhere colourful surfaces could be easily cleaned. Ceramic glazed veneer tiles of 1–4in thick became popular with art deco buildings of the 1920s, such as in the Hoover Building (see image B); these were fixed to concrete or steel frames and their simple, clean forms contributed to the streamlined designs.



Ⓑ Hoover Building, Perivale, west London [1933], a grade II* listed building designed by Wallis, Gilbert and Partners

Images © Historic England

Terracotta is very strong in compression, being able to withstand 40–55.2MPa, but weak in tension, withstanding 5.7MPa. Its thermal expansion coefficient is lower than that of steel, near which it is often located – to disastrous effect, given that any thermal or corrosive expansion in the embedded steel can cause cracking in the terracotta.

Application of a glaze allows a larger range of surface hues and textures, using a clay-based binder with a flux and colourants. This glaze is generally applied before firing but occasionally afterwards, resulting in a twice-fired terracotta. Modern health and safety requirements prevent some traditionally used compounds being incorporated into terracotta, which makes exact replication extremely difficult (see image 3).

Decay and decomposition

Well-fired terracotta is highly resilient, with several examples from the 16th century still in excellent condition in the UK, such as Hampton Court. Conversely, some examples have deteriorated considerably even though they date from a much later period. There are a number of reasons for this discrepancy.

Poorly manufactured terracotta often deteriorates through the weathering and breakdown of the surface and the substrate beneath. Inherent manufacturing defects such as contaminants and inadequate firing result in the deterioration of the terracotta substrate and can account for its failure.

However, water is the main enemy of terracotta. Leaks from faulty rainwater goods such as back gutters and internal downpipes, which are frequent detailing on terracotta buildings, as well as through open joints can result in deterioration due to freezing and thawing. This can also lead to the failure of other construction materials, with disastrous consequences for adjacent terracotta. Moisture ingress can cause the expansion of infill material, mobilisation of salts that can crystallise and disrupt structural integrity, and corrosion of embedded metalwork that causes terracotta to crack and break.

Environmental conditions are also a significant factor in the deterioration of terracotta, with the climate, precipitation and colder temperatures leading to freezing and thawing damage. Sulphation does occur on some terracotta, but is mostly found on that made from kaolinite clays containing calcium carbonate; this reacts with sulphurous acid in the

❹ Terracotta blocks etched by poorly controlled acid cleaning, leaving the substrate vulnerable to further decay

❺ Terracotta with drill holes that may or not be filled afterwards, and if they are it is often done poorly

atmosphere to create calcium sulphate, forming a skin that can exfoliate and thus remove surface detail.

Irreparable impact has also been caused by cleaning methods such as sandblasting and the use of acid or alkali, which leave the surface pitted or etched. Removal of the fireskin often leaves the more permeable substrate exposed and vulnerable to further decay (see image 4).

Installation of services pipes and cables often leads to access holes being drilled with little thought given to their positioning, and the repeated removal and re-installation not only affects the homogeneity of the facade but can allow moisture penetration (see image 5).

Maintenance and repair

The priority for maintaining terracotta is to prevent water penetration by keeping rainwater goods and flashings functioning and joints pointed. Repointing should be carried out using a mortar that suits the type and condition of the terracotta, and the degree of exposure. Hydraulic lime mortars should not just be used because they offer the convenience of a quicker, chemical set; other more permeable mortars based on lime putty with pozzolanic additives can offer the required properties.

Although in the 19th century terracotta was promoted as a self-cleaning material because it did not soil in the same way as natural stone, it does in fact soil and suffer pollution damage. Sensitive cleaning is a useful prelude to initial assessment of building condition and for colour-matching for any replacement terracotta units.

It is essential that an initial assessment is made of the condition of the terracotta and the nature and extent of soiling, followed by trials to identify the most suitable cleaning level and method. Abrasive methods are an option, but the selection of aggregate and pressure needs to be carefully considered since the risk of damage is high. Chemical cleaning agents based on alkalis or acids can be effective, but misuse can cause irreparable damage.

Water-based cleaning can also be effective, but excessive water should be avoided to prevent further deterioration. In a similar way, steam cleaning can be very effective, while minimising the amount of water used. The most appropriate cleaning method and extent of cleaning should be determined after discreet trials are undertaken and assessed. It is essential to select a practitioner who has demonstrable experience in dealing with the material.

Structural defects are sometimes caused by corrosion of the supporting metalwork. This will require opening up to investigate the extent of this deterioration, and further dismantling of the terracotta to treat the metalwork, which often leads to its destruction.

Terracotta is not yet given the material significance that stone facades of comparable age receive – it is seen as a manufactured product that can be replicated and is therefore more replaceable than natural stone. Although some replacement may be necessary for structural reasons, repair methods are often dismissed because they are not deemed sufficiently durable, either physically or in terms of appearance, to provide a lasting solution.

It can be difficult to repair successfully, however, as surface repair materials can be difficult to match in terms of colour and texture. However, some techniques have been shown to perform well over a 20–30-year span, and have the advantage of being less invasive, preventing the loss of original fabric. Furthermore, surface patch repairs are often cheaper to carry out, and replacing them over the longer term may be an option as part of the maintenance of a building.

Once a terracotta unit is broken, it can be difficult, though not impossible, to carry out structural repair using similar techniques as those used to repair natural stone, through pinning and indents pieced in with matched reclaimed terracotta.

Where replacement is required, new units can be commissioned and produced by specialist companies, although the lead times can be lengthy. Correct specification should ensure that the technical details of the replacements match the original accurately, and this will include size – taking shrinkage into consideration – compressive strength, porosity, colour and texture. New architectural units also have to comply with the European standard specification for clay masonry units, BS EN 771-1: 2011.

With the sensitivity and expertise afforded to other historic fabric, terracotta can be maintained and repaired so that it functions as originally intended and can be appreciated for the outstanding material it is.

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BUILDING MATERIALS INFORMATION SHEET 5

Concrete

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This Materials Information Sheet was compiled by **Phil Banfill**, Professor of Construction Materials in the School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh
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Summary

Concrete is universally used in building and civil engineering and consists of aggregates – sand, gravel and crushed rock – bound together by cement and water. Of almost infinitely variable composition, it can be extremely strong and durable, but users need to know its limitations.

Composition and performance

Cement reacts with water to form tiny particles of hydration products, which interlock with the aggregates in the concrete mix to form a hard, strong mass. Because plain concrete is weak under tension, steel is used as reinforcement, enabling resistance to stresses of all types. Concrete is normally made from local materials, so it can have too wide range of properties to describe in detail here; there is more information in the data sources below.

The commonest binder, Portland cement, is produced by firing limestone and clay in a kiln at temperatures up to 1,400°C. The clinker is then ground into a fine, grey powder consisting of calcium aluminates, which react fairly quickly with water, and calcium silicates, which react much more slowly. Initial contact with water coats the grains with a hydration layer that slows further reaction, allowing the mixed product to be worked before setting, when the reaction accelerates.

The product hardens into a porous mass; a simple hardened cement–water mix shrinks as it dries out, but the aggregate restrains that shrinkage to give better dimensional stability. The hydration reactions also produce calcium hydroxide, which dissolves in the water in the pores to form an alkaline solution that protects any embedded steel from corrosion. Reinforced concrete is thus an effective composite: its two main constituents have similar thermal expansion characteristics, with complementary chemistries, mechanical properties and fire resistance.

Decay and degradation

In use, concrete's desirable features can be degraded. Because it is porous it can be penetrated by water, which can freeze, expand and fracture it. This water may also carry dissolved sulphate ions, which can react with the hardened calcium aluminate hydrates and again cause expansion and fracture. It may carry dissolved chloride ions and carbon dioxide as well, which can both break down the protection that the calcium hydroxide solution gives the embedded steel. The steel can then corrode and expand, cracking the concrete and allowing more of the aggressive environment to accelerate the process (see image 1). Such corrosion of reinforcement has been the major cause of concrete's deterioration throughout its history.

❶ Extensive steel corrosion in this soffit has caused rust stains, spalling of the concrete and reduced strength

❷ All the steel should be covered to the right depth, not just the main bars

The principles for creating durable concrete were not appreciated at first. More water is needed to make casting and moulding easier, but this also increases the porosity, reducing strength and durability. Formulating a concrete mix is therefore a process of compromise, and it must be just right. Water content can be lowered by using chemical admixtures, which disperse the cement particles better, while porosity can be reduced with supplementary cementitious materials such as fly ash, ground granulated blast-furnace slag, microsilica or other materials. These react chemically with the calcium hydroxide to produce more calcium silicate hydrates, which fill the pores that have already formed and make the concrete less permeable. Being industrial by-products, these materials also reduce the overall carbon dioxide emissions associated with concrete production.

Finally, the reinforced concrete must be detailed to ensure sufficient depth of cover over the steel: if the surface zone is too thin, the time taken for the carbonation zone or the chloride ions to reach the steel and cause corrosion may be only a few years. Depending on the conditions, at least 30–50mm of concrete is needed over the steel to ensure a reasonable lifetime, and it is important to note that this applies to all the steel and not just to the main bars (see image 2).

Research and development has led to a range of concrete repair methods, and continuing global efforts to improve materials.

Additional data sources

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Scans of heritage buildings that used to take weeks can now be done in hours thanks to mobile mapping technology. **Jamie Quartermaine** relates his experience of scanning three such buildings in Israel in just two days

Ancient and modern

Courtyard of the orphanage with its distinctive onion-dome tower

I was invited to undertake a very rapid 3D survey of the large Schneller orphanage in Jerusalem (see the photo, left), using a handheld ZEB-REVO laser scanner manufactured by GeoSLAM, which I had hired in the UK. To minimise the cost of the hire charges, I had to get in and out in just two days.

While I was there it was suggested, if I had a little spare time, that I might also survey a 12th-century monastery and an elegant 19th-century merchant's house in Jaffa; the latter has been largely redeveloped and is now covered in scaffolding. At that stage I should have backed away, but I didn't.

I arrived in Jerusalem at 1.30am, and the clock was ticking. I went to the orphanage at 7am, and realised what I had let myself in for: it was huge. It had four floors and a roof, 130 rooms, an outer courtyard and a number of stables.

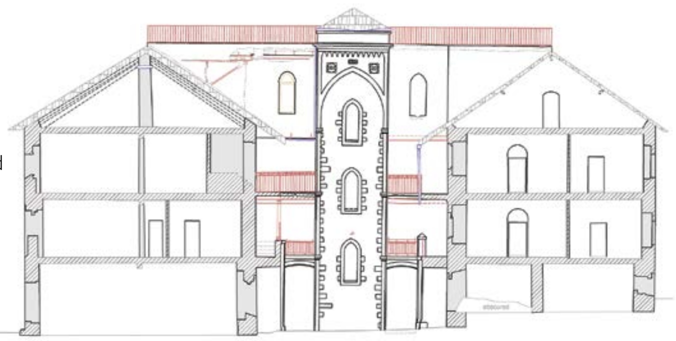
A colourful history

Through my Israeli colleague, I discovered a little more about the history of the orphanage. Built in 1855, it was one of the earliest and largest buildings to be constructed outside the walled Old City of Jerusalem.

It was built by a German missionary to the Holy Land and intended to propagate the influence of Christianity among the local Muslim population; it also had massive outer walls for protection. During its 80 years of service, the building had housed children from across the Middle East, who had engaged in activities that included printmaking, carpentry, pottery and stonemasonry.

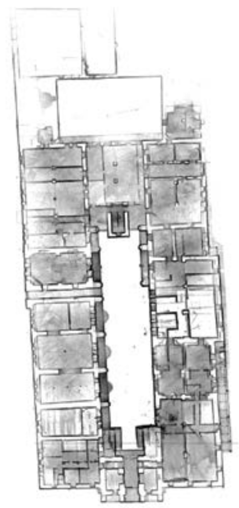
In the 1948 Arab–Israeli war the site was occupied by the British, who had it modified into a barracks. It was believed to have housed the largest ammunition arsenal in the Middle East, and was repeatedly attacked by Jewish paramilitary force the Irgun. The site then operated as an Israeli army barracks for the next 60 years until 2008, when it was vacated. Just last year, an archaeological team unearthed the remains of a Roman bath house and winery underneath the site. The next stage of the building's long and eventful history is conversion into a museum of Judaism – hence the requirement for a complete, high-accuracy survey of the site.

Having used the ZEB-REVO scanner back in the UK, I was already well aware of its simplicity, efficiency and ability to conduct large-scale surveys in minimal



Cross-section through the orphanage courtyard in CAD format, from collected scan data

815m above sea level



CAD plans of the orphanage from scan data

time. This was just as well because time was not on my side. I quickly got to work with the first scan of the building, accompanied by the incessant noise of a drone above me being operated by an Israeli colleague. With the laser scanner in my hand and the battery storage in the backpack on my shoulder, I walked and scanned each and every one of the 130 rooms in the space of one morning.

Whereas a traditional static scanner would have required multiple set-ups over many days, I managed to survey the entire building complex with just three, 30-minute scans. Alongside the mobile scanning, I put in survey control at various points around the building so the data could be geo-referenced to the local co-ordinate system. My colleague also undertook a photographic record of the building's existing state. By 2pm the last scan had been completed, the last photograph taken, and it was time for building number two.

Benedictine monastery

I sensed a more relaxed working environment when I was ushered by the robed abbot into an elegant and beautiful 12th-century Benedictine monastery, surrounded by a peaceful garden. But I was wrong: I was informed that I had no more than 30 minutes between the end of the Vespers – the evening service – and the time when the public would be allowed into the monastery. Usually I would have baulked at this timescale, but with the ZEB-REVO, I knew that the job could be done.

After a quick reconnaissance of the building to plan the best scanning route, I rushed to scan the entirety of this unique, and immensely beautiful, domed building. The only frustration was that, although I examined every inch of it, I could not dwell on any part and consider its architectural charms. With the opening of the gates that heralded the public's admission, our brief sojourn in the monastery came to an end, as did my first 24 hours of scanning.

Jaffa

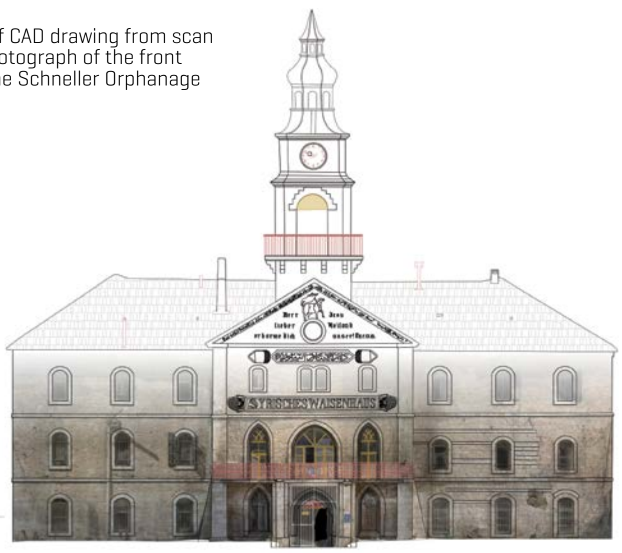
The next morning I found myself in Jaffa, an ancient Arab town on the Mediterranean that has been engulfed by the urban sprawl that is Tel Aviv, to face my third and final scan challenge – a merchant's building that, although it was once majestic, has now been redeveloped. The challenge was to record the building while construction works were in progress, with hoardings and scaffolding obscuring structures.

This was an almost impossible task, but the ZEB-REVO was still able to collect survey-grade data in a matter of hours, which formed the basis of a working record of elevations, sections and plans.

Mission accomplished

The ZEB-REVO scanner had proved itself to be the most remarkable tool to survey large, multi-storey buildings for the purposes of renovation. It had enabled the creation of a detailed 3D record of a building in just 30 minutes – a fraction of the time that it used to take to create a simple 2D record.

While the Jaffa house was not on a par with the glamour of the other two buildings, the fact that the scanner was able to produce such a record in these extreme circumstances was one of its most astounding achievements.



Overlay of CAD drawing from scan data and a photograph of the front elevation of the Schneller Orphanage

815m above sea level

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This project was undertaken for conservation architect David Zell and architect Elias Anastas

Related competencies include **Analysis of client requirements, Building information modelling (BIM) management, Measurement of land and property**

UPDATE

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Heritage Agenda is compiled by **Henry Russell** OBE FRICS, Department of Real Estate and Planning, University of Reading and Co-chair of the Heritage Alliance's Spatial Planning Advocacy Group. He is also chair of Gloucester Diocesan Advisory Committee for the Care of Churches and a member of the Church Buildings Council.
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Welsh exemption under review

The Welsh government is currently consulting on the ecclesiastical exemption from the requirement to obtain listed building or conservation area consent for works to historic places of worship in the principality.

Wales operates under the Ecclesiastical Exemption Order 1994, but the proposed revisions would bring this in line with the Historic Environment (Wales) Act 2016. The main changes would be:

- removal of the exemption from conservation area consent, which is currently only necessary when the building is to be demolished; if this were the case, the building would not be in use as a place of worship and consent would be required, so it is argued that there is no point in retaining this exemption
- clarification of the buildings covered by the exemption, to eliminate occasions when both secular and denominational consents are needed; currently, separately listed curtilage structures must obtain listed building consent as well as ecclesiastical consent for some work, and the requirement for the former will be removed
- removal of the United Reformed Church from the exempt denominations, as it has expressed its desire to return to secular control in Wales.

The consultation closes on 13 July.
https://bit.ly/2rrmX3K

Revised NPPF due for publication

The revised National Planning Policy Framework (NPPF) is due to be published in the summer, following consultation on the draft.

Like the first edition of 2012, it needs to be read as an integrated policy of sustainable development. That said, the chapter on the historic environment has only had slight changes, although the introductory sections on defining sustainable development have had more significant alterations; for example, the nine core planning principles, which included conservation of the historic environment, have been removed.
https://bit.ly/2Fr9Vvu

Scottish guidance suite launched

Historic Environment Scotland (HES) has published Managing Change in the Historic Environment, a series of guidance documents covering topics from roofs and renewables to engineering structures and access. HES has long had an excellent set of advice and guidance. While the law, policy and vernacular traditions are different north of the border, the technical advice travels well (*https://bit.ly/2K1wvJE*).

Likewise, Cadw, the Welsh heritage agency, offers a range of guidance providing basic advice on traditional materials, although this would benefit from being expanded and illustrated (*https://bit.ly/2wo3SEC*). Cadw also provides advice on conserving rural buildings, chapels and micro-generation (*https://bit.ly/2wmcBa6*).

Two funding programmes announced

The UK government is giving £2m to conserve farm buildings in national parks under the Historic Building Restoration Grant, which will offer up to 80% of the cost of repair and is open for applications until 31 January 2019. It is being piloted in five national parks: Dartmoor, the Lake District, Northumberland, the Peak District and the Yorkshire Dales.
https://bit.ly/2Im2zup

Another pilot scheme is funding expert advisors to support listed places of worship becoming more sustainable. The pilot areas are Manchester and Suffolk, with the grant of £1.8m being administered by Historic England. It follows the publication of the Taylor Review of the sustainability of England churches and cathedrals.
https://bit.ly/2H0hOc0

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