Modular construction design concerns

Sudden collapse of 1850s stone balcony

Horizontal mains used as a solution to meet vehicle access requirements

Overloading of older multi storey and underground car parks

Share knowledge to help create a safer built environment
In the early hours of Tuesday 26th March, a large container ship veered off course and struck a supporting pier of the Francis Scott Key Bridge in Baltimore, USA. The bridge collapsed into the Patapsco River and six people lost their lives. The time of the day, a mayday call from the ship, and the immediate closure of the bridge to traffic prevented the tragedy from being even greater.

What more do we know about the structure and the incident so far? The bridge was designed in the mid-1970s as a continuous steel truss with a central arch that suspended the road deck. The force of the impact destroyed a main pier which lead to the progressive collapse of the three-span truss and three approach spans. As with many bridges, its piers were a key element and the collapse of the whole structure was inevitable with the destruction of this support.

It is not practical to design bridge piers to resist such enormous forces. Measures, therefore, must be taken to protect the supports. This is usually in the form of an island around the pier, or the provision of dolphins and fenders. A modern bridge might have a longer span, so the piers are located further out of the shipping lane. It is worth noting that the size of ships arriving at Baltimore has increased significantly since the bridge and its protection measures were designed.

A detailed investigation by the National Transportation Safety Board in the US is underway and no doubt they will consider how these changes in risk have been managed.

In the face of changing and new risks, the need to undertake effective risk management is a continuous challenge for those who work in the design and management of the built environment. CROSS has many examples of where these changes need to be considered.

This evolution of risk over time is also evident in car parks for example. Vehicles have increased in size and weight since many of these structures were originally constructed. The process of ageing and deterioration also requires ongoing consideration and maintenance.

There are also different fire risks posed by modern cars, the larger size of vehicles results in tighter parking arrangements, allowing fire spread to occur more easily. Additionally, cars now contain much more plastic, increasing the fire load available. This includes the use of plastic petrol tanks, rather than steel, which can melt in a fire causing fuel to run to adjacent parked cars. A further emerging hazard is electric cars which can burn for longer, with a higher intensity, and are more difficult to extinguish.

All these changing risks need to be assessed for new and existing car parks, impacting the structural design loads to be considered and the fire protection methods employed.

To give another example, fire and structural engineers must also be aware of how risks and hazards have altered when considering the ongoing requirement for safety cases for existing Higher Risk Buildings in England, many of which are now over fifty years old. These structures may have deteriorated or been poorly maintained, their use may have changed, or they may have been significantly altered or extended.

Design codes are likely to have developed since the original construction and, while this does not necessarily infer an increased risk, those undertaking the assessments should be aware of significant changes. These include requirements introduced in the early 1970s to prevent disproportionate collapse, updates to wind loading design, and modifications for the design of punching shear in flat slabs.
One of CROSS’ roles is to undertake horizon scanning to identify changing and emerging hazards that could impact the safety and resilience of structures. A key part of this is the receipt of fire and structural Safety Reports outlining incidents, occurrences, and your concerns. Several similar reports could be considered a precursor to a more significant event and therefore every report is important.

If you have seen or experienced a fire safety or structural safety issue, please submit a report.

This issue of our Newsletter contains Safety Reports that demonstrate the importance of sharing lessons learned and I hope you find it a valuable read.

Help to improve safety by submitting a report

Reports are the oxygen of our work here at CROSS. Our secure safety reporting system promotes a no blame culture, and all reports are anonymised and de-identified to ensure confidentiality.

The reporting process is straightforward, and we encourage anyone with information to share to submit a report. By sharing knowledge, you will help to create a safer built environment.

Find out more >

More from CROSS

New bridge precursors partnership launched between BOF, UKBB, ICE and CROSS

Bridge collapses around the world happen with alarming regularity. In the 21st Century alone, there have been 66 reported fatal collapses claiming over 1,200 lives. The near misses, close calls, and precursor events are often not reported. If captured, these can be vitally important to forecasting and preventing more serious incidents in the future.

Through this new partnership, launched in May, the UK Bridges Board (UKBB), the Bridge Owners Forum (BOF) and the Institution of Civil Engineers (ICE) hope to highlight the importance of identifying precursor events and encourage those in the bridges sector to report to CROSS-UK.

Read more about the partnership on CROSS’ News & Events page.

CROSS-UK on the Fire Science Show podcast

In April, episode 149 of the Fire Science Show podcast featured CROSS-UK’s fire consultants Peter Wilkinson and Neil Gibbins as its guests with the discussion touching upon the ethos of CROSS, confidentiality, and the legacy of Grenfell as well as a deep dive into a couple of recently published CROSS Safety Reports.

You can listen to the episode via the Fire Science Show’s website, on Apple Podcasts or on Spotify.
Modular construction design concerns

A reporter highlights concerns regarding fire travel in a modular floor cassette with inbuilt services.

Key Learning Outcomes

For designers and manufacturers:

- Where designs use innovative techniques to build a premises, there should be available methodologies to enable the maintenance of incorporated systems for the lifespan of the building.
- If fire resisting compartmentation has to be removed at a later date to enable access, then there should be a methodology available to replace the fire resistance REI values (defined as capacity (R), integrity (E) and insulation (I)) as originally designed.
- Compartmentation lines should include the vertical plane of a floor cassette.

For building control/ approved inspectors:

- Understanding new methods of construction is critical to safe design. Many modern methods of construction cannot be regarded as a common building situation and therefore guidance such as Approved Document B or BS 9991 may not be adequate.

R Full Report

A reporter describes a light gauge steel floor cassette, constructed offsite, with preinstalled services. The cassette consists of a floor, then structural elements below forming a void with various services, and then the fire-resisting ceiling of the unit underneath. It is intended to be used for student accommodation.

The reporter has identified that only the underside of the ceiling system is fire resisting and no cavity barriers are located within the cassette void. The reporter believes this system has a number of flaws that have not been addressed:

1. In the event of a fire in the void space, combustion products would be able to spread extensively, laterally, via the void space. As the floor is not fire resisting, the fire could affect the floor structure and possibly get into the structural framing system.

2. There would be a concern for the persons escaping above any fire. In addition, if there is a fire in the void space, the fire and rescue service would find tackling it at the source difficult due to the floor structure and smoke and flame travel through the void.

3. There is a concern over the maintenance of the services above the fire rated ceiling, as there is no access to them. This may result in a contractor cutting the fire rated ceiling to access the services without an adequate system/methodology for rescaling the ceiling’s fire resistant integrity. Given that the lifespan of the building would be expected to be around forty to sixty years, this scenario could very well occur.

The reporter believes modular construction must be looked at further and in much greater detail. In their view, there is inadequate guidance as to how to build using modular constructions. They believe...
Modular construction design concerns

that the use of modular construction, such as the one in this report, has moved too fast with little supporting fire safety consideration.

Expert Panel Comments

The Expert Panel acknowledge that information regarding the fire safety of modular structures is limited, and many ongoing projects are actively trying to address this matter.

Below are a range of design objectives that should be addressed and which would apply whether the framing of the modules is timber or light gauge steel.

Internal Fire Spread

The system must not facilitate the spread of fire or products of combustion through concealed areas. This is a fundamental design requirement of the building regulations. Although Approved Document B (ADB) is not specifically tailored for modular structures (and a modular building may not be regarded as a common building situation), there is guidance such as ADB Volume 1 Section 8 that should be considered.

Additionally, there is a BRE study discussing the spread of flames through roofing. It should be said that the study is not specific to modular systems, yet it offers valuable insights into fire behaviour through voids and the necessary design considerations.

Suitable design detailing can mitigate this issue, including:

- **Cavity barriers.** These are a critical design solution to reduce the risk of concealed fire spread. Designers of modular construction products should provide robust details of cavity barrier construction. The Expert Panel share the reporter’s concern that the industry is forging ahead with increased use of modular systems without having fully engineered the necessary details.

- **Lightweight cassette’s internal structural webbing.** If a fire gets into the cassette cavity, the system may fail rapidly. This is due to its lightweight construction as compared to traditional construction.

- **Fire Compartment lines.** These should not be bridged by voids under a floor.

- **Protected escape routes.** The reporter is referring to a panelised system covering a significant portion of the entire floor area. In such cases, if cavity barriers through the void are not provided, this type of detailing could elevate the risk if a fire reaches the cavity, potentially compromising escape routes and the structural stability of the floor. However, even under current regulations for these types of constructions, the floor should be designed as a compartment floor. Thus, it is critical that this issue is addressed through appropriate structural design and detailing.

Maintenance

Concerning the maintenance of the system, it is the duty of the Responsible Person to ensure that all relevant information regarding the installed system is retained. This ensures that any modifications made do not compromise the overall performance of the system.

If the concern is around the durability of the product and its expected lifespan (i.e. a separate concern), the responsible person should seek advice from the product manufacturer. For buildings in-scope for the Building Safety Act, this is part of the Golden Thread.

Such maintenance work should only be carried out by competent persons, and it should be recertified on completion.

Part of the design criteria for such modular systems should include ‘approved maintenance and repair techniques’ to ensure works required to access the void are carried out and completed in accordance with the manufacturer’s instructions. Such maintenance work should only be carried out by competent persons, and it should be recertified on completion.

The GIRI Design Guide – a robust approach to the design process

Research by the Get It Right Initiative (GIRI) showed that a significant proportion of errors in construction are rooted in the briefing and design processes. The GIRI Design Guide is a best practice document intended to instil in all parties an understanding of the importance of taking a robust approach to the design process. It makes recommendations across eleven key themes: briefing, culture, collaboration, investment in design, planning the design work, information, stakeholder management, opening up and closing down, contractor input, design gateways, and guiding the design process.

Endorsed by the ICE, RICS, and IStructE, the Design Guide is available to download as a pdf. A short film introducing the Design Guide is available on GIRI’s YouTube channel.

Visit: www.cross-safety.org/uk

Email: team.uk@cross-safety.org
on completion. The challenge to achieving this is the building owners/managers understanding a.) that they have a building with a modular system and b.) the importance of maintaining the structural and fire protection integrity.

Relevant information on the maintenance of critical safety systems should be contained in the building information pack i.e. Regulation 38 information, the fire strategy, Golden Thread information, safety case and other relevant information. Experience has shown in the past this data is often lost or rarely referred to even if provided. Responsible or Accountable Persons should ensure this information is retained and used appropriately throughout the lifetime of the building.

For most buildings, this centres on having a suitable management structure and policies in place, to prevent unauthorised or unplanned works. Controls such as following The Construction, Design and Management Regulations> (CDM 2015) permits to work, and quality assurance should be used.

**News Roundup**

In every interval between CROSS Newsletters, failures of some kind or incidents related to structural and fire safety are reported in the press. Here are some accompanied by a brief comment:

1. **Baltimore Bridge collapse**

   In March, a dramatic bridge failure occurred in Baltimore, USA, when an errant vessel hit one of the piers and brought about a complete collapse. Bridge and pier impact is a generic hazard which has caused many previous failures, such as the Tasman bridge (1975), Sunshine Skyway Bridge (1980), and the Erskine Bridge in Glasgow (1996).

   The National Transportation Safety Board (NTSB) published their preliminary report on the Baltimore collapse on 26 March. It is available to read on their website.

2. **Fire at the Copenhagen stock exchange**

   The destruction of the historic stock exchange in Copenhagen exemplifies the risks of working on historic building refurbishments, such as the fires at Windsor Castle (1992) and Notre-Dame (2019).

3. **Crane topples over in Wigan and ‘slices through house’**

   Safety on construction sites is only achieved by constant attention to potential hazards. A crane toppling incident in Wigan illustrates what can happen when due care is not taken.
Sudden collapse of 1850s stone balcony

A stone balcony collapsed without warning from first floor level onto steps below. Reassembly of fragments led to the conclusion that a cementitious layer and bituminous covering may have contributed to the deterioration of the stone structure.

Key Learning Outcomes

For property owners:
- Balconies can fail without warning and should be treated with caution
- Inspect regularly for water accumulation and leakage at the critical juncture of the balcony with the building face

For designers and inspectors:
- The condition of the structure of cantilever balconies may not be obvious if the structure is covered. Such covering should be removed to enable an assessment to be produced with confidence

Full Report

The property comprises a Grade II listed, four storey mid-terrace house built circa 1850 with solid external walls and a pitched roof.

The balcony was original and constructed of 60 millimetre thick stone, possibly York stone and projected 600 millimetres from the face of the building. The balcony had a cast iron balustrade around its perimeter, connected to the main house, which fell with the stone balcony and fractured into multiple sections. Many properties in the area have similar balconies.

The stone balcony failed at the abutment with the main house. It was observed that the embedded section of the balcony was intact.

By reassembling fragments from the collapsed balcony as shown in Figure 2, the reporter was able to determine the construction.

It was observed that the balcony had a surface bitumen cement coating of varying thickness between 20-30 millimetres. This overlaid a cement/mortar bed of thickness around 10-15 millimetres. The cement and bitumen layers had mostly debonded from the original stone. The reporter

Figure 1: Image of balcony on adjoining property

Figure 2: Reassembled fragments of the collapsed balcony

4. Multiple ceiling collapses reported in the UK

Since CROSS started, the failure of ceilings and hanging systems in general have been regularly reported. Recent occurrences suggest ceilings are still not being given sufficient engineering attention.

The first in the link above, concerns the death of a woman after an air conditioning duct fell on guests at a Pontins resort in Somerset. In another incident, patients were evacuated from Stockport hospital after the ceiling fell in>. Whereas in North Tyneside, two schools closed after concrete fell from the ceiling>. The council said the issues are not related to the RAAC crisis.

CROSS has published multiple reports connected to this issue and Allan Mann’s article in TSE from 2019, Safety of hanging systems: lessons from CROSS reports> provides a valuable overview.

5. Fourteen killed in Mumbai billboard collapse

At least 14 people have been killed after a large billboard collapsed during strong winds in Mumbai, India. The billboard, measuring 70m by 50m, fell onto houses and a petrol station in the city on 13 May. A further 74 people are reported to be injured.

CROSS has published a number of Safety Reports and Topics Papers regarding concerns about temporary structures, which can include large billboards and large external TV/video screens.

CROSS Safety Report 979 - Safety concern for outdoor video screens>, published in October 2020, gives details of how high winds can destabilise outdoor screens, and CROSS Topic Paper - Risks with large screens at public events> examines the use and assembly of large screen technology from a structural safety perspective.
observed that while the upper surface of the stone was uneven with signs of delamination, the upper surface of the mortar bed was flat suggesting that it had been laid to level the surface of the deteriorated stone.

Furthermore, the cement mortar bed was painted on its top surface indicating that it had been applied many years before the bitumen layer, which the reporter understands was itself in position by 1966 when the current owner moved into the property. The current property owner is not aware of any previous balcony failures to adjacent properties.

After further investigation by the reporter, it was observed that on the left hand end the original stone was 40 millimetres thick and so too thin to function in bending.

The reporter concludes that the surface bitumen layer may have obscured cracks to the stone below or, alternatively, caused stress fractures over time as the thermal properties of the cement/bitumen and stone differed leading to weakening of the projecting stone and its eventual collapse.

**Expert Panel Comments**

Balconies (and their failure) have been a regular feature of CROSS Reports. A search of the website will show several relevant Reports to this case, in particular CROSS Safety Report 1001, Risks associated with historic stone balconies> from December 2021.

Stone balconies are a common detail on properties of this age and type in the UK. They are often painted, although they would have been originally unpainted. Painting stone can accelerate decay (preventing drying out and assisting possible frost damage). One might also expect paintwork to cover up any mortar repair to the stonework and resultant lack of structural performance from such repairs.

Ironwork railings were traditionally set in holes filled with molten lead within the stonework. This detail should allow differential thermal expansion between the metal and stone. If ironwork is bedded in holes filled with mortar (a common recent practice), then this could crack the stonework.

This report highlights the need to inspect and maintain balconies and that coatings can obscure faults.

**6. Ongoing failures and issues due to RAAC>**

Reports of failure due to RAAC continue to be recorded in inspections. In Aberdeen, hundreds of people had to be moved out of their council homes over RAAC fears. The media are also reporting that the cost of repairing Bury Market, which closed in October over safety fears when RAAC concrete was discovered in the structure, is likely to reach £6 million>.

**7. Update on the Valencia Fire>**

Ten people are now known to have died in the massive fire that ripped through two joined apartment blocks in the Spanish city of Valencia. The blaze engulfed a 14 storey block in the Campanar neighbourhood and spread to an adjoining building. Investigations are still ongoing however it is reported that highly flammable cladding on the building enabled the fire to spread rapidly.

**8. South Africa Building Collapse>**

At least 33 people have died in a building collapse in George, South Africa. The building was under construction and local news reports have said that “though structural engineers appointed by the development company were, according to the municipality, supposed to supervise the implementation of structural designs during construction, the collapse of the building gives rise to questions as no safety issues were identified”.

9. Co-op Arena incident could have been ‘catastrophic’

The boss of Manchester’s new Co-op Live Arena has described how an incident, in which part of a ventilation system fell from the ceiling, could have been ‘catastrophic’ if it had happened 15 minutes later. This was reportedly caused by a failure of fixings, in this case small bolts which should have secured the component but were simply missing.

Failure of fixings, including missing fixings, are common issues raised by reporters to CROSS. We have had many reports about fixing concerns and failures over the years which can be viewed on our website.

10. Fears of new UK cladding crisis after timber-frame blaze

A London council has warned of a potential new national fire safety crisis after it discovered hundreds of low-rise timber-frame homes had been fitted with plastic cladding that can spread fire. Barnet council has warned the government that other homeowners in similar properties across the country could be affected. It said the 580 homes that needed fixing in its area were ‘the tip of the iceberg’.

11. ‘Life-critical’ cladding problems affect 2,000 social housing blocks

Nearly 2,000 social housing blocks in England have life-critical problems with their external cladding, government figures reveal. The data released in March show that 1,911 social housing blocks above 11 metres in height had been assessed as having ‘life-critical fire safety defects’ linked to the materials in their external walls.

Cantilever balconies present a particular hazard as, when they fail, they tend to do so both catastrophically and (to the untrained eye) without any obvious warning.

This report highlights the need to inspect and maintain balconies and that coatings can obscure faults. If the upper surface is covered (as in this case) removal of the covering is required to check the integrity of the structural material below. This is especially relevant with this type of construction which is approximately 170 years old and likely not designed for such a lifespan – if indeed it was ever designed at all!

Property owners need to be aware that balconies represent a potential risk not only to themselves but also their neighbours.

As no injury is reported, it seems the failure is not necessarily under added load from persons or planters on the balcony but rather due to deterioration of the balcony structure which may not have been immediately obvious at the time. Regular inspections (and potentially maintenance) should be undertaken. Owners particularly should inspect regularly for water accumulation and leakage at the critical juncture of the balcony with the building face. If unsure, owners might consider the need for an inspection by a suitably qualified person.

It is fortunate that no one was injured either from being on the balcony at the time of collapse or being beneath it. Property owners need to be aware that balconies represent a potential risk not only to themselves but also their neighbours.

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Clients are proposing horizontal mains as a solution to meet the firefighting vehicle B5 access requirements of Approved Document B (ADB). Building control bodies are increasingly accepting these proposals.

Key Learning Outcomes

For designers, planning authorities and building control bodies:

- The use of horizontal mains as a compensation feature for the lack of fire engine access should not be routinely used
- Guidance regarding fire brigade access is not only to limit hose distances. It also enables a range of factors including quick deployment of firefighting personnel and essential equipment

Any proposed use of horizontal fire mains should be discussed and agreed with the local fire and rescue service

Full Report

A fire and rescue service has reported the increasing use of horizontal mains by developers and designers to meet fire engine access requirements, as stated in Approved Document B, B5, Section 15, Volume 2 - Buildings other than dwellings.

Fundamentally, a fire vehicle should be able to access a defined percentage of the building perimeter, or it should be able to park within a 45-metre hose laying distance of every point in the building.

Any proposed use of horizontal fire mains should be discussed and agreed with the local fire and rescue service. Horizontal dry fire mains (no vertical pipework) are typically not a practical design solution.'
Horizontal mains used as a solution to meet vehicle access requirements

The reporter describes how these designs are increasingly being accepted by planning authorities and building control bodies, against fire authority advice during consultation stages.

The acceptance appears to be based upon the view that the horizontal main mitigates the extended hose laying distances. This position takes no account of whether the main would actually be used by attending firefighters, nor any other aspects of firefighting that underlie the reasons for adequate vehicular access to a building, such as:

• Preventing delays due to increased travel distances for firefighters, particularly carrying breathing apparatus
• Preventing delays due to having to carry rescue equipment such as breaking in gear, hose lines, and ladders
• Preventing the restriction of the full use of facilities provided by a pumping appliance, for example hose reels. Horizontal mains tend to be designed for connection to lay flat (70-millimetre hose) which is more cumbersome to work with and may delay firefighting

Once signed off by building control, there is little a fire service can do to address the issue, without utilising the Regulatory Reform (Fire Safety) Order 2005.

Furthermore, once the horizontal main is installed it needs to be regularly maintained and tested by the building owner and kept well drained to reduce legionella risks. This can be difficult for long sections of horizontal main.

The reporter suggests that building control bodies be made aware of the issues for fire services in using horizontal mains to address vehicle access requirements. They also suggest that ADB should be updated to address this issue.

The provision of horizontal mains is often seen as a solution to compliance; however, it is only as far as considering the provision of water. This completely misses other factors, as the reporter identifies.

It is worth highlighting functional requirement B5 of the Building Regulations 2010 (as amended) and what is actually said:

‘Access and facilities for the fire service B5. (1) The building shall be designed and constructed so as to provide reasonable facilities to assist fire fighters in the protection of life. (2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building’

It is clear this is more than just the provision of water. Of additional note, is the Secretary of State’s view on the intention of B5 from ADB:

‘Provisions covering access and facilities for the fire service are to safeguard the health and safety of people in and around the building. Their extent depends on the size and use of the building. Most firefighting is carried out within the building. In the Secretary of State’s view, requirement B5 is met by achieving all of the following.

a. External access enabling fire appliances to be used near the building. b. Access into and within the building for firefighting personnel to both: i. search for and rescue people ii. fight fire. c. Provision for internal fire facilities for firefighters to complete their tasks. d. Ventilation of heat and smoke from a fire in a basement.

If an alternative approach is taken to providing the means of escape, outside the scope of this approved document, additional provisions for firefighting access may be required. Where deviating from the general guidance, it is advisable to seek advice from the fire and rescue service as early as possible (even if there is no statutory duty to consult).’

This provides further clarity that access and facilities for the FRS are there to fight the fire and conduct search and rescue activity. It also clarifies that they need to be ‘near the building’.

C Expert Panel Comments

This is, unfortunately, a regularly encountered issue by fire and rescue services (FRSs) when conducting statutory consultations with building control bodies (BCBs), and the reporter identifies some key points.

More CROSS reports

The following CROSS reports have also been published since our last newsletter:

Poor electrical safety standards in fire alarm installation (Report ID 1158)

A reporter raises concerns regarding electrical safety practices associated with a fire alarm system installation.

Concerns about solar PV installation (Report ID 1272)

The reporter, a chartered engineer, was surprised to be advised by a potential supplier of the panels that there was no need for a building regulations application in respect of Part A because the installer has National Inspection Council for Electrical Installation (NICEIC) and Microgeneration Certification Scheme (MCS) certification.

Who should submit designs to comply with building regulations (Report ID 1208)

A reporter received a set of plans for a domestic modification and found that, despite being developed by the architect alone, they contained specific structural information such as steel member sizes and connection details. The structural layout was questionable and fell outside of the parameters set out in Approved Document A (ADA) of the Building Regulations.

Fire safety concerns in a residential building (Report ID 1213)

A reporter, who is engaged as a regulator, carried out a fire safety audit of a residential building and found several points of concern. It is interesting to note that CROSS is receiving a greater quantity of this type of report.

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Where a horizontal main is provided for water, this does not address the need for firefighters to then travel the extended distances from their appliances and having to carry and locate all equipment that may be needed.

As identified by the reporter, this places additional resource limitations on attending crews, increases the physiological effects on the firefighters, and delays firefighters being able to establish safe systems of work to commence operational activity to those that need it most.

Not all buildings have firefighting shafts on their face. There is some inevitable horizontal section to get from the inlet, at the face of the building, to the rising/falling main in the firefighting shaft. However, normal vehicular access (that is, at a maximum of 18 metres to the riser inlet, ADB vol I Clause 13.5a) and limiting the internal travel distances to the firefighting shaft at access level (as in BS9999 20.2.2>) reduce the distances firefighters and gear have to travel.

It should also be noted that horizontal mains are an acceptable feature included in the design of many healthcare buildings incorporating a hospital street. Notwithstanding this, the use of horizontal mains should not be routinely used to compensate for poor vehicular access. The maintenance issue is also of importance where these additional measures are considered, as in the FRS experience, these measures are generally the first to fall foul of a lack of regular testing and maintenance, be it through a lack of understanding of their provision or due to budgetary pressures. In addition, if the dry main is buried in the ground, there may be no way to drain it. This creates a corrosion and Legionella risk.

As the enforcing authority of the Regulatory Reform (Fire Safety) Order 2005 (as amended), the FRS can take action under Article 38, Maintenance of measures provided for protection of firefighters. However, this is not much use when identified at an operational incident.

Also of note, is that the variation instead of sprinklers was put in for dwellinghouses in BS9999> for backland developments. The sprinklers are there to offset the additional time for FRS intervention due to the longer travel. One FRS has held firm on its position regarding the use of extended horizontal mains, but it is concerned about the expansion of permitted development which may result in more schemes with poor FRS access provisions due to commercial to residential change of uses.

Building regulations determination SB-007-001-007> discusses a similar issue. While determinations are specific to their respective circumstances and cannot be applied as if a precedent has been set, the wider issues are identified and discussed.

The dry main is buried in the ground, there may be no way to drain it.

This creates a corrosion and Legionella risk

Chemical attack on structural enclosures (Report ID 912>)

A reporter has witnessed instances where the corrosive atmosphere created by wastewater treatment and refuse recycling plant being enclosed has caused the structure to become initially unserviceable and, in due course, hazardous.

Compartmentation issues found in premises converted to residential flats (Report ID 1184>)

A fire safety audit of a premises that was converted from commercial premises to residential use, identified that there were potential fire compartmentation and other safety issues.

Engineer asked to provide calculations for dangerous refurbishment (Report ID 1295>)

This is about the refurbishment of a historic, traditional build house and the difficulties encountered by a reporter when interacting with the owner over the construction of a new basement adjacent to the existing east wing. There had been a partial collapse and there was an excavation adjacent to the wall.

Performance of acoustic separation in a floor system (Report ID 1238>)

The reporter started to investigate the performance of standard details for acoustic separation in the floors between flats and is concerned about the structural, and possibly the fire safety implications.
Overloading of older multi storey and underground car parks

CROSS Safety Report  Report ID: 1257

A reporter notes that for over 80 years multi storey car parks (MSCP) have been designed for vehicles with a maximum gross weight of 2,500kg, which equates to a uniformly distributed load of 2.5kN/m². They add that the maximum gross weight has now increased to over 3,000kg, necessitating the design loading to be increased to 3.0kN/m² in the IStructE’s recently published Car Park Design guidance.

The average gross weight of vehicles has also increased from 1,500kg to 2,000kg requiring the impact force on rigid vehicle restraint barriers to be increased from 150kN to 200kN. The reporter is concerned that the significant increase in size and gross weight of vehicles may impact the safety of some older car parks.

Key Learning Outcomes

For car park owners:
- Consider the suitability of car parks for the size and weight of modern vehicles
- Seek advice from suitably qualified and experienced engineers with regard to any remedial measures that may need to be taken
- Consider entry control by electronic means for example automatic number plate recognition
- Consider parking heavy vehicles on non suspended levels

For designers and structural engineers:
- Consider the effects of modern vehicles on older structures and how these can be accommodated e.g. by limiting their spacing or access before adopting strengthening of the structure

Full Report

The reporter notes that over the last 20 years there has been a significant increase in size and gross weight of vehicles that are able to use MSCP, leading to fears over the safety of some older car parks.

The reporter explains that, for over 80 years, structured car parks have been designed for vehicles with a maximum gross weight of 2,500kg, which equates to a uniformly distributed load of 2.5kN/m². The maximum gross weight has now increased to over 3,000kg, necessitating the design loading to be increased to 3.0kN/m² in the IStructE’s recently published Car Park Design guidance.

The average gross weight of vehicles has increased from 1,500kg to 2,000kg, requiring the impact force on a rigid restraint barrier to be increased from 150kN to 200kN. The gross weight includes passengers and luggage which can add around 400kg to the kerb weight of the vehicle.

Older car parks, and particularly those of the 1960’s and 1970’s, were designed and constructed to design standards that have since been found inadequate, for example punching shear in flat slabs when designed to BS CP 114: Part 2 1969 - The structural use of reinforced concrete in buildings. During the 1960’s and 1970’s there was a construction boom resulting in a shortage of materials and labour, and a fall in the quality of the finished product.

The reporter shares that many, but not all, of these car parks were demolished due to structural fears around premature corrosion and loss of strength. Some have been subject to repairs, but these may have been cosmetic patch repairs with incompatible materials and may not have restored the structural integrity. The reporter highlights that repairs to cantilevers are particularly vulnerable, as the reinforcement is in the top of the deck where the risk of corrosion from penetration of chlorides is a maximum.

There are still a number of specialist system build car parks in service which are sensitive to structural deterioration and the manner in which repairs were undertaken. The reporter believes these car parks need to be assessed for modern vehicles.
should slip occur in the joints suddenly, at or close to serviceability limit state (SLS) loads, significant additional dynamic forces could be generated

Outlining common areas of concern, the reporter believes drainage should be an integral part of the design but notes it can be installed after coring the structure (sometimes in structurally sensitive areas such as punching shear zones) thus affecting the continuity of the reinforcement. They add that some car park decks have no falls or internal drainage, which leads to increased chloride penetration in areas where ponding is taking place.

Having highlighted common areas of concern, the reporter adds there are many others and advises engineers to study the structural morphology and interrogate the history of a car park before carrying out any strength assessment.

They also recommend older car parks be assessed in accordance with the ICE’s Recommendations for Inspection, Maintenance and Management of Car Park Structures> using the loads recommended in the IStructE’s Car Park Design> guidance. The reporter concludes that strengthening may have to be carried out should the structure be incapable of withstanding the increased loading or, if this is prohibitively expensive, a weight limit should be imposed to restrict entry to the suspended levels.

New construction

To build bigger and faster, construction has moved in the direction of off site manufacture and design has adopted Lean Design principles where the use of materials has been minimised. The reporter highlights that the curvature of long-span precast deck units can impose high bearing stresses on the seating and that, if the seating is concrete, high bearing stresses can cause spalling and reduce the bearing area - especially where the interface has no slip membrane.

Overloading can cause instability of steel frames and bolted connections especially where the structure has been designed to maximise the efficiency of the components. The performance and longevity of permanent metal formwork is dependent on the ability of the deck membrane to prevent water ingress and internal corrosion at the interface with the concrete. The reporter notes that when permanent metal formwork is used structurally and the membrane has not been regularly maintained, the strength of the deck can be reduced in proportion to the magnitude of the corrosion. Decks that have bolted units or constructed from Glass Reinforced Plastic (GRP) components often suffer from the bolts working loose and falling out under repeated loading.

The reporter also shares that the ability of a restraint barrier to withstand impact loading can depend solely upon the performance of the holding down bolts, some of which are incapable of withstanding repeated loading from vehicles nudging the barrier.

The reporter concludes by highlighting that Eurocode and National Annex for the UK implies the design loadings are for vehicles of maximum gross weight up to 3,000kg. However, this figure defines only the category in which the vehicle sits and the loadings are applicable for vehicles of maximum gross weight of 2,500kg and average gross weight of 1,500kg which is no longer compatible with the IStructE’s recently published Car Park Design guidance.

**Expert Panel Comments**

This is a timely warning for the industry, as vehicles get heavier and particularly with the increase in popularity of electric vehicles. The Panel notes that flammability and fire load are increasing concerns as much as structural load.

Picking up on the reporter’s last point about weight limits, digital methodologies could be part of a solution. Structures can already be automatically monitored for the development of structural distress, perhaps digital number plate recognition could link to vehicle curb side weight and thereby exclude vehicles above a given weight. Drivers of heavy vehicles would have to get used to being excluded from some car parks, just as drivers of high ones are now or be restricted to ground supported floors. This approach may be a cost effective alternative to strengthening.

Automatic Number Plate Recognition (ANPR) could also provide an excellent opportunity to gather data on the distribution of kerb weights of vehicles using a car park. The technology is already in use, as one’s number plate is often read on entry and again on exit to decide whether one has paid and the barrier can be lifted. A statistical analysis similar to those routinely used for Bridge Specific Assessment Live Load (BSALL) studies on long span bridges is possible to define a suitable level of live load, and how it might change with the population of vehicles.

CROSS has previously published Safety Reports concerning potential structural issues with car parks:

- Safety Report 119 - Multi storey car park defects>
- Safety Report 224 - Structural assessments of multi storey car parks>
- Safety Report 265 - Multi storey car parks - structural condition concerns>
- Safety Report 267 - Multi storey car parks demolished due to structural defects>

More recently, CROSS has issued safety information concerning fire risks:

- Safety Report 857 - Fire resistance of multi storey car parks>
- Safety Report 940 - Fire risks in multi storey car parks>
- Safety Report 1007 - Fire protection to car park steel frame>
- Safety Alert - Fire in multi storey car parks>

Submit Report

Submit Feedback
Use of Table B3 of Approved Document B for loadbearing external walls

CROSS Safety Report  Report ID: 1264

A reporter is concerned about the apparent selective reading of Table B3 of Approved Document B> (ADB) by some designers.

**Key Learning Outcomes**

**For designers and engineers:**
- Loadbearing walls, whatever their location or use should have the most onerous fire resistance guidance applied from Approved Document B Table 3
- When considering the guidance of Table B3, the user should always consider their particular building situation, including the type of construction and associated sensitivity to heat exposure
- The potential type of fire exposure a construction may face must also be considered

**For building control bodies:**
- Ensure the guidance in Table B3 is only applied within its scope and in situations where it can be demonstrated that the overall functional requirements of the building regulations will be met, and stability will be maintained for the required period in ADB Appendix B

When amended in 2022, this wording was updated to: ‘Loadbearing wall (for a wall which is also described in any of the following items, the more onerous guidance should be applied)’.

<table>
<thead>
<tr>
<th>Part of building</th>
<th>Minimum provisions when tested to the relevant European standard (minutes)</th>
<th>Method of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loadbearing capacity</td>
<td>Integrity</td>
<td>Insulation</td>
</tr>
<tr>
<td>1. Structural frame, beam or column</td>
<td>See Table A2</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2. Loadbearing wall (which is not also a wall described in any of the following items)</td>
<td>See Table A2</td>
<td>Not applicable</td>
</tr>
<tr>
<td>3. Floor</td>
<td>See Table A2</td>
<td>See Table A2</td>
</tr>
<tr>
<td>4. Roof</td>
<td>See Table A2</td>
<td>See Table A2</td>
</tr>
<tr>
<td>5. External walls</td>
<td>See Table A2</td>
<td>See Table A2</td>
</tr>
<tr>
<td>6. Compartment walls (other than in item 8)</td>
<td>See Table A2</td>
<td>See Table A2</td>
</tr>
</tbody>
</table>

Figure 1: Table A1 from ADB, 2006

Figure 2: Table B3 ADB, current (part 1)
Designers should be aware that ADB is for common building types, and this includes the type of construction technology being used. When considering the guidance of Table B3, the user should always consider their particular building situation, including the type of construction with associated sensitivity to heat exposure. This must be considered against the potential type of fire exposure that the construction may face.

Overall, a user of ADB must ensure the guidance in Table B3 is only applied within its scope and demonstrates that the overall functional requirements of the building regulations will be met so as to ensure that stability will be maintained for a reasonable period.

This update provided further clarity on the use of Table B3 in situations where building elements could be described by more than one item, for example, a loadbearing wall (item 2) that was also an external wall (item 5).

The concern is that some designers have been misapplying (and some still are) the guidance and selectively applying the items in Table B3. For example, in the case of an external loadbearing wall, by solely applying the external wall recommendations in ADB (item 5) and disregarding the loadbearing wall recommendations (item 2), then the recommended fire resistance exposure would be from the inside only, and not from the outside.

In the absence of any engineering justification, there is a risk that a lack of exterior fire resistance could compromise the stability of an external loadbearing wall at an early stage should there be an outside exposure (for example, from a fire plume projecting from a window – see illustration, Figure 4 below). This risk is especially apparent for loadbearing wall systems that rely on outer sheathing to protect internal elements.

Another separate but related matter is that ADB guidance for loadbearing walls (in item 2) is for exposure from each side separately. A potential realistic exposure condition is for both sides to be simultaneously exposed e.g. where a projecting fire plume exits from an opening. Some newer construction technologies are particularly sensitive to the type of heating, and simultaneous exposure could significantly decrease the overall structural performance.

### Expert Panel Comments

The Expert Panel agreed with the general comment that designers should consider fire safety matters on a case-by-case basis rather than just assuming the applicability of relevant guidance to every scenario.

### Construction and testing

There are a couple of points to highlight from both the construction and the testing perspectives.

From a construction standpoint, in midrise light frame construction, the walls are typically affixed to a fire rated floor system, and the load path transfers the load through the floors.

This means that the walls are not exposed on both sides because the load path of the system will be separated at each floor level. In low rise construction where the loading from the roof is taken by the perimeter walls, detailing becomes crucial and is material dependent. For example, in a lightweight steel system under fire conditions, fire from either side might not be as onerous as fire from one side due to loading and bowing considerations. In timber construction, the situation differs because bowing is limited, but charring would be more significant if the exposure is on both sides. Separate considerations should be applied to concrete and masonry systems.
Therefore, the Expert Panel advise that, depending on the method of construction of the external wall and the designed load path, the loadbearing resistance of the wall and overall detailing of the construction method should first be considered.

From a testing perspective, it should be noted that the Expert Panel are not aware of any test houses in the UK that conduct fire tests on partition systems with fire from both sides. If fire resistance from two sides is required, this evaluation would primarily rely on performance-based design evaluation rather than direct fire test evidence. In addition, the designer needs to assess which scenario is more onerous from a structural perspective to determine whether the provided data is acceptable or if further calculations are required.

**Loadbearing walls - most onerous guidance**

The report highlights an important point on the application of Table B3 - elements must comply with all relevant requirements, not just one requirement.

In Table B3, item 2- loadbearing walls, makes clear that for any subsequent type of wall from then on, that is also loadbearing, then the most onerous guidance should be applied. The Expert Panel agree that this includes the type of exposure, and not just the R value required. Thus, it should be clear that for any loadbearing wall performing any other functions (for example, item 5- external wall, item 6 and 7-compartment wall) the exposure to each side separately is the exposure type required.

**External walls (Table B3, item 5)**

For an external wall, if it is loadbearing and more than one metre from a boundary, it must comply with item 2 and item 5b, that is exposure from either side separately, not just from the inside. This is the most onerous condition in the guidance.

Fire exposure to external walls can also occur for many reasons, for example from adjacent buildings within one metre of a relevant boundary (item 5a), or from below, for example from an adjoining podium, car park, roof, and other areas where a fire might develop and run up the side of an external wall. The risk is that an exterior fire attack on an exterior, loadbearing wall, may cause a premature collapse.

The Expert Panel further agrees that for an external wall over an opening (for example, a window), a both-side exposure is feasible. However, normally for this example, the external exposure would be nowhere near as severe as the internal exposure.

**There is perhaps an opportunity for evidence-based research, utilising existing studies, to inform this issue**

Typical construction typologies, that is common building situations, are likely to be such that the two sided exposure would be less onerous than a single sided exposure, as loadbearing capacity would be governed by asymmetric heating and buckling as opposed to material strength. Thus, in practice, this aspect might not be a problem for the structural design. Flames might emerge from windows, but the areas directly above a window are not usually loadbearing, even on the level above the window (as that would require a transfer structure above to take the load on either side). In addition, there tends to be insulation on the outside of the external wall which might protect the structure, if it meets BS EN 13501-1 Class A2.

Although the risk might be lower in this case, the Expert Panel agree it should be considered. There is perhaps an opportunity for evidence-based research, utilising existing studies, to inform this issue, considering the specific design issues highlighted above and the development of improved guidance within ADB.

A related point is with item 1 of Table B3, which states that the method of exposure for elements such as beams and columns should be the exposed faces. It is feasible that the external faces could be exposed. As such the external faces of columns and beams should be adequately protected and often this is not considered.

**Table B4 Continued**

<table>
<thead>
<tr>
<th>Purpose group of building</th>
<th>Minimum periods of fire resistance (minutes) in a</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basement storey including floor over</td>
<td>Ground or upper storey</td>
</tr>
<tr>
<td></td>
<td>Depth (m) of lowest basement</td>
<td>Height (m) of top floor above ground in a building or separated part of a building</td>
</tr>
<tr>
<td></td>
<td>More than 10</td>
<td>Up to 10</td>
</tr>
<tr>
<td>b. car park for light vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. open sided car park&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>ii. any other car park</td>
<td>90 min</td>
<td>60 min</td>
</tr>
</tbody>
</table>

**Internal walls**

For most internal walls, the most onerous should be taken and where the requirement of B3 is less than that of B4, the fire should be considered from both sides.

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<sup>a</sup> For single storey buildings, the periods under the heading ‘Up to 5’ apply. If single storey buildings have basements, for the basement storey, the period appropriate to their depth applies.

<sup>b</sup> For compartment walls that separate buildings, the period is increased to a minimum of 60 minutes.

<sup>c</sup> For any floor that does not contribute to the support of the building within a flat of more than one storey, the period is reduced to 30 minutes.
For compartment walls, the lesser REI is taken unless it is loadbearing. This is because in some occupancies in Table 4, up to eleven metres can have 30 minutes fire resistance, for example, sprinklered offices unless the compartmentation separates buildings.

In the case of structural concrete walls or columns in enclosure walls, unless the enclosure has the same fire requirement as the structural requirement, a designer should assume that the fire escapes the enclosure at some point and “attacks” the structure from both sides.

For example, a structural lift wall may only need thirty minutes under ADB Table B3 but could require up to 120 minutes under Table B4. This assumes that the lift doors are not 120 minutes rated. If this is the case, then the fire will at some point enter the shaft. Consequently, the wall (at least for R) should be checked for 120 minutes for both cases, fire on one side and fire on two sides.
Fraudulent use of calculations from another engineer

CROSS Safety Report  Report ID: 1298

A reporter was informed by building control of attempts made by another engineer to pass off the work of the reporter’s firm as their own. These were specific disproportionate collapse calculations related to a roof top extension.

Key Learning Outcomes

For consultants:
- Report any similar actions to the building control authorities
- If appropriate, report such actions to the relevant institutions
- Consider the need to protect work from unauthorised copying

For clients:
- Ensure that only trustworthy consultants are employed

Full Report

A reporter was informed by building control of attempts made by another engineer to pass off the work of the reporter’s firm as their own. The calculations related to a roof top extension.

The engineer was trying to pass off as their own, disproportionate collapse calculations that the reporter’s firm had originally prepared. A contractor, with whom the reporter’s firm had previously worked, was copied into a building control submission which contained the reporter’s work; this had been passed to the engineer.

The project involved the change of use of an existing non-compliant structure. It was, therefore, a high-risk building, and the reporter says that the plagiarised calculations were copied and pasted from the original work without due consideration of the specific requirements.

The original calculations had been issued as unprotected PDFs and could be easily edited with suitable software. The engineer in this case had proceeded to change the font and the name of the reporter’s firm across each page of the document.

Ignoring the moral and ethical issues here, the outputs (PDF files) were too easy to replicate and alter. The copier re-badged the document as their own. This can be relatively easily done with any decent PDF software. However, the name of the original firm remained on the copied work in the form of an image that had not been corrected. Logos and other typed name references had been covered up.

Whilst many in the industry use standard software there are still instances where bespoke calculations are needed. These naturally attract interest and should be protected to avoid dubious copies being made. Thankfully, in this instance the copy attempt was picked up by a competent building control officer. As this was a high-risk building, the consequences could have been serious if the attempted copy had not been noticed.

Ignoring the moral and ethical issues here, the outputs (PDF files) were too easy to replicate and alter. The copier re-badged the document as their own.

The reporter recommends that all firms apply additional security to outgoing documentation to mitigate the risk of copying by unscrupulous individuals.
The reporter says that proceeding to full court action against the copier would cost circa £40,000 to £50,000 and even if the reporter’s firm won there would be no guarantee of recovering their costs. Consequently, the member’s firm now protect all building control calculations and reports prior to issue.

Drawings will remain unprotected as the benefit of being able to mark up and collaborate is a much greater benefit than the risk of someone copying a drawing template.

Going forward the reporter is going to ask for contact information and trading addresses of all organisations within the project team (where an obvious online presence does not exist) to enable contacts to be traced if necessary. Finally, the reporter recommends that all firms apply additional security to outgoing documentation to mitigate the risk of copying by unscrupulous individuals or firms.

Expert Panel Comments

Sadly, this is not an unfamiliar story. Plagiarism, corner cutting due to pressure to deliver quickly and cheaply, and now Artificial Intelligence (AI) create ethical dilemmas that some find difficult to resolve. It is acceptable, even to be encouraged, to learn from another’s work but it is not acceptable to ‘copy and paste’ such work and pass it off as one’s own.

In this case, the reporter’s details were included as part of the fraudulent submission. This could have led to others mistakenly believing that the reporter had contributed to the work and that cannot be right. We are all familiar with standard conditions set out on drawings and at the bottom of emails cautioning others against unauthorised copying, but these will not deter the unscrupulous.

If appropriate those involved should be reported to the relevant institutions with a view to having the person(s) who did this being sanctioned

The ‘passing off’ of the work of others as their own implies that the person making the submission to building control lacks the ability, time and/or energy to do the job properly and thoroughly. They are not taking their responsibilities seriously and this is concerning as it potentially compromises safety. Designs should be specific to the realities of each situation. Designers need to carefully consider each design - copying a previous design means the implicit assumptions have probably not been considered and that any potential errors get copied into other designs. If appropriate those involved should be reported to the relevant institutions with a view to having the person(s) who did this being sanctioned.
A reporter shares that, while involved with the fit-out works of a building, they came across an unusual steelwork connection during the inspection of the existing structure.

Key Learning Outcomes

For clients, building owners/managers and the project team:

- Where an existing building is subject to change of use or refurbishment, it is good practice to carry out an intrusive structural inspection
- Be aware that historic as-built drawings may not reflect what has been built and should be supported with inspections
- If there is doubt, arrange for structural inspections and risk assessments to be undertaken by engineers who are suitably qualified and experienced persons (SQEP) – normally chartered structural engineers

For civil and structural design engineers:

- Connections can often be the weak link in structures and attention to detail is required, particularly at interfaces between different materials. The role of tolerances should not be overlooked
- Connection designs should be carried out by suitably qualified and experienced persons (SQEP) to ensure sufficient redundancy, longevity and compatibility

Full Report

When involved with a fit-out in a high specification building, a reporter found an unusual steelwork connection during the inspection of the existing structure. The structural form was steel frame supporting composite concrete decks, with reinforced concrete (RC) core walls. When exposing the end of a main 9m long floor beam to check its connection into the RC stair core, the reporter found that an approximately 600mm deep floor beam (plate girder compositely designed with floor slab) was supported off a 203UC trimming beam. This, in turn, was supported off a single M30 bolt, and small fin plate into the RC core (see Figure 1 and 2).

The reporter questions how this connection came to be a) constructed, and b) signed-off and accepted?

Figure 1: single M30 bolt supporting beams to fin plate
Figure 2: 3D sketch of connection detail

The reporter believes the connection might be okay under the original design loading, which they assessed to be around 240kN of shear (ULS), as a single M30 bolt could potentially carry 215kN in single shear. Therefore, depending upon original loadings and design, it is not impossible for the design reaction to be within the bolt’s capacity.

However, the detail is not shown on the as-built drawings and there are many other checks to consider such as the plate bending and weld capacity. Also, the reporter holds concerns about single bolt fixings in primary structural elements, even if the calculations stack up.

The reporter adds that in the example described in this report, the connection detail was observed on two floors that they were working on and a more robust remediation detail was implemented on site.

**C Expert Panel Comments**

All steel structures are only as strong and reliable as their connections. CROSS has previously stated that the weak link in any structure can often be the joints or fixings. Yet, in many ways, these are the parts that receive least attention in design.

Industry standard connections are designed in standard formats proven adequate by testing and long experience, therefore special design care is required in unusual connections because load paths and exact performance are very difficult to predict.

Single points of failure are never best practice, and many consulting engineers and steel connection designers often specify a minimum of two No. M20 bolts be adopted for each connection. Two bolts are also often required to aid with, and ensure, the safe installation of steel beams.

The reporter rightly expresses concern over the use of a single bolt, and they should be commended on not relying on as-built drawings and instead carrying out a thorough site inspection of the existing structure. The more we are encouraged to repurpose old buildings, the more we need to be aware of historic practice and the quality of as-built drawings. This report exemplifies the importance of carrying out an intrusive site inspection.
Student accommodation occupied before critical safety features commissioned

Newly built student accommodation was occupied before critical safety features were commissioned, based on a letter of comfort from the building control body.

A fire safety audit identified numerous fire safety failures and urgent enforcement action had to be taken by the regulator.

Key Learning Outcomes

For student accommodation providers/developers:

- Given the desire to occupy student accommodation at a specific time of the year, it is important to ensure construction programmes are realistic to avoid partial occupation and/or occupation prior to the building being finished.

For construction contractors:

- It is not acceptable to list major unfinished aspects of construction as ‘snagging’ items in order to facilitate occupation.

For Responsible and Accountable Persons:

- Responsible and Accountable Persons should understand that, as soon as a building is occupied, fire safety failures may become life safety issues, and therefore immediately enforceable. These may result in prosecution if serious failings are found.

Full Report

This report from a fire and rescue Service (FRS) protection team, relates to a new student accommodation building.

The fire strategy, which in the reporter’s view appeared to follow performance-based fire engineering, had received building regulations approval via Approved Inspectors (AI). Comments at the building control consultation stages by the FRS were not taken into account by the design team during the qualitative design review stage (QDR). This, in the opinion of the reporter, resulted in multiple fire safety issues when the building became occupied.

The Approved Inspectors had issued a letter of comfort. The reporter describes this letter as an unofficial approval document provided to the Responsible Person (RP) to highlight the additional work required before occupation. The RP interpreted this document as a partial approval and deemed it appropriate to occupy the buildings at the beginning of the term whilst there were still many safety features uncommissioned or under construction.

Issues identified by the reporter included:

- Incomplete fire stopping and fire compartmentation, including missing fire resisting doors leading to the possibility of unpredictable smoke spread throughout the building in the event of a fire
- Life safety features such as uncommissioned or turned-off fire detection systems. Whole zones of fire detection were disabled and not switched back on when work was complete, and contractors left the site
- Lack of external hard standing for firefighting measures
- External escape routes that passed through construction sites
- Firefighting lifts that were unavailable for use in the event of a fire

The RP interpreted this document as a partial approval and deemed it appropriate to occupy the buildings whilst there were still many safety features uncommissioned or under construction.
Once the FRS became aware of the occupation, several urgent interventions were undertaken by the protection team. These included prohibition and enforcement notices, and meetings with the contractor, AI and other site representatives to agree on immediate action to make occupants safe.

It was not until several months later that a final certificate was issued and a satisfactory fire safety audit outcome was received from the FRS.

**Expert Panel Comments**

**Rush to occupy**

This building being occupied too early, while safety critical works were still to be completed, put the residents at an unacceptable level of risk.

It is common for contractors to ask for (or even demand) letters of comfort or practical completion certificates from building control. Neither have legal status and, sometimes, the only purpose of them is to allow the contractor to be paid under their contract, to which building control is not party. These contractors seem to not understand that it is their responsibility to comply with building regulations.

In addition, it appears there was commercial pressure to occupy the premises at the beginning of term. Whatever the motivation behind the partial occupation this chain of events produced a building that:

- Did not comply with building regulations
- Did not have a suitable and sufficient Fire Risk Assessment
- Put relevant persons at risk of death or serious injury

These events also exposed the Responsible Person to the risk of prosecution for these failings. This Report indicates that the journey to raising standards across the industry is going to be longer than initially thought. Alongside regulations, regulators and enforcement, we need considerable education of those within the industry to deliver the required outcomes as well as those commissioning such developments, such that the former understand the standards to which they are expected to perform, and the latter understand what performance they should be demanding.

**Failure in the consultation process**

It appears that the events leading to inappropriate occupation were not entirely the AI’s fault, but rather the RP’s for going ahead and occupying before sign off. The consultation process however is a vital factor. The AI and the FRS do not appear to have agreed on aspects of the scheme during the initial building control consultation process.

**Building Regulations**

With regards to legislation, regulation 16 of the *Building (Approved Inspectors etc.) Regulations 2010*> (as amended) applies.

This section of regulation was amended on October 1st 2023 to add more detail referencing the notification to building control bodies for occupation before completion. In the case of this Report, the earlier regulations from June 2018 applied. The new relevant section, S16(5)(5) says: ‘Where a building is being erected to which the Regulatory Reform (Fire Safety) Order 2005 applies or will apply after the completion of the work, and that building (or any part of it) is to be occupied before completion, the person carrying out that work shall give the local authority at least five days notice before the building or any part of it is occupied.’

Whichever amendment of the regulations is applicable, the Responsible Person was obligated to inform the building control body of the intention to occupy. This would have allowed for a pre occupation survey and early consultation with the FRS before persons were put at risk.

From April 6th 2024, any Building Control Body intending to carry out regulated building control activities in England or Wales, which are assessing plans, inspections and/or giving advice to building control bodies that carry out regulated functions must be registered as a building inspector with the BSR. The BSR code of conduct and complaints procedures will then apply.

**In scope premises and future compliance**

This was a systemic failure at multiple levels by the contractor, the RP and to some extent the AI. Hopefully, the new Building Safety Regulator (BSR) will prevent this happening for buildings in scope and persons subsequently being put at risk. In the case of this Report, gateway 3 would have acted as the final checkpoint, the decisive stop/go point before asset owners could start moving residents in.

Furthermore, the Expert Panel suggest that, if these risks were discovered now in an in scope premises, a *mandatory occurrence report*> for both the occupation and the construction phase may be required.

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CROSS-UK Newsletter 73  |  June 2024  |  www.cross-safety.org.uk
Corrosion of heritage railing leads to a fall and a near miss

CROSS Safety Report Report ID: 1278

A severely corroded railing on a seaside promenade gave way and a member of the public fell four metres onto the beach below.

Key Learning Outcomes

For inspectors:
- Defects may be difficult to identify and load testing may be appropriate

For owners:
- Consider instigating an inspection regime that may need to include load testing
- Consider adopting temporary barriers behind the balustrade and stewarding to avoid any direct loading on the balustrade from audiences during events

Full Report

A reporter describes how a member of the public was leaning on the iron railings along the promenade at a seaside town when a section gave way, causing them to fall four metres onto the beach. This incident was doubly a near miss as another member of the public below was almost struck by the person and the falling railing.

Figure 1 shows the collapsed section of balustrade on the beach as found by the reporter.

The railing was found to be severely corroded and looked as if it had not been inspected or painted for some time. It is thought that the railings may be a heritage asset, which has prevented or complicated repair or replacement. Similar levels of corrosion and cracking were seen on the railings along the promenade, and this represents a potentially fatal hazard for both members of the public walking along this popular tourist site and those lying on the beach below.

Figures 2 and 3 show details of the corroded sections.
Asset owners should have a maintenance plan in place for high risk assets, like iron safety railings in a coastal environment, and there must be better measures in place to ensure this plan is followed through, particularly if they are also heritage assets.

**Expert Panel Comments**

Balustrades are a safety critical asset. Cast iron balustrading in a marine environment can present significant problems due to accelerated corrosion and its brittle nature. It often cracks at the base and the defect may remain undetected for a considerable time.

CROSS is aware of a balustrade that collapsed where five of the seven posts were fractured for some time before the incident. Repairs had been attempted to some, but not all the fractures. If the defect is seen, the specialist nature of weld repairs to cast iron means that those capable of undertaking the repair are difficult to find, which increases the risk of poor quality repairs.

If a comprehensive inspection regime is not in place, then it might be sensible to consider controlling the risk by providing temporary barriers if public events are held on the beach, for example concerts, fireworks celebrations or aerial displays, there are likely to be people wishing to view them from the promenade, increasing the risk to the public. If a comprehensive inspection regime is not in place, then it might be sensible to consider controlling the risk by providing temporary barriers some distance from the balustrade with stewards to prevent the audience from approaching it and potentially overloading it laterally.

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an inspection regime may require an element of testing to give confidence that the balustrade remains adequate
A Responsible Person (RP) registered a defect relating to an eleven-storey residential building with a single protected firefighting staircase on the fire and rescue service (FRS) portal. After this however, they did not act upon the defect.

As the issue involved life safety systems throughout the building being defective, the evacuation strategy (stay put) was not believed to be appropriate until the defect was rectified. In the event of a fire, this could have potentially put residents at risk.

**Key Learning Outcomes**

**For Responsible Persons/Accountable Persons:**
- Where essential fire safety provisions are compromised, a competent person must undertake an urgent assessment of the risk the failure presents. This should include a review of the Fire Risk Assessment
- After this, appropriate risk reduction/mitigation measures should be taken

**For regulators receiving defect reports:**
- Fault or defect reports to portals should generate a message stating that, when logging a fault, the RP should ensure that their Fire Risk Assessment has been reviewed and remains suitable and sufficient, or is amended to reflect any corrective actions needed

**R Full Report**

The Responsible Person (RP) for an eleven-storey residential building with a single protected firefighting staircase, registered a defect on the fire & rescue service (FRS) portal. This was as required by the Fire Safety (England) Regulations 2022, specifically regulation 7, which relates to essential firefighting equipment.

The defect reported was that the automatic opening vents (AOVs) of the mechanical smoke extraction system were stuck in the closed position. An engineer had been out to see the system, but was unable to carry out the repair due to the failure of the power supply unit. This power supply powered the interface for the AOVs on all floors. The engineer stated they were waiting for a part and could not fix the system for several days.

A FRS officer contacted the RP to raise concerns over the risk the report presented to residents. Due to this fault, the building’s escape route could be compromised in the event of a fire. The officer discussed the risks and advised that the Fire Risk Assessment (FRA) needed an urgent review with mitigation action taken. As the systems in place to support a stay put strategy had failed, the mitigation discussed was a change of the evacuation strategy from stay put to simultaneous evacuation until repairs were able to be carried out.

Following significant work by the FRS, the RP eventually expedited a review of the FRA and put in place a waking watch until the smoke control system was fixed.

**C Expert Panel Comments**

This report highlights the need for RPs to be fully aware of their responsibilities under the Regulatory Reform (Fire Safety) Order 2005 (FSO), as clarified by the Fire Safety Act 2021, and for England amended under the Fire Safety England Regulations 2022. Further information can be found at the government’s collection page, Fire safety: guidance for those with legal duties.
It is important to highlight that the defect reporting process to the FRS does not alter or amend the need for the RP to have in place a suitable and sufficient fire risk assessment that reflects the premises as it is. As soon as such a significant defect was identified, the RP should have instigated an immediate review of the FRA by a competent person.

The legal duty to maintain the FRA as a ‘live’ document applies throughout the UK. In England and Wales, these requirements are imposed by the Regulatory Reform (Fire Safety) Order 2005 (as amended). In Scotland, similar requirements are imposed by the Fire (Scotland) Act 2005> in conjunction with the Fire Safety (Scotland) Regulations 2006>. In Northern Ireland, the requirements are imposed by the Fire and Rescue Services (Northern Ireland) Order 2006>, in conjunction with the Fire Safety Regulations (Northern Ireland) 2010>.

This review should assess the overall risk now posed, considering all fire safety measures holistically. The FRS officer was correct in highlighting this to the RP. What is of concern, is that it took the FRS officer to identify this via the report made to them, rather than the RP being aware of their responsibilities and acting accordingly.

It is good to note the FRS identified the risk and questioned the RP, ultimately persuading the RP to take appropriate mitigation measures. The Expert Panel assume some of these conversations included the possibility that enforcement action might be taken if the RP did not undertake mitigation measures.

It is ultimately the responsibility of the RP to ensure the FRA of the premises is reviewed.

RPs should be aware that when the FRS (where they are the enforcing authority of the FSO) think the risk is high to relevant persons, they may issue an Article 31 Prohibition Notice> for part of or all of the premises. Enforcing authorities do not take these decisions lightly and are fully aware of the impact this has on residents and other stakeholders. However, where the risk is so high, and cannot be mitigated, this may be an appropriate course of action.

It is ultimately the responsibility of the RP to ensure that the FRA of the premises is reviewed. When that review identifies that a change from a stay put to a simultaneous evacuation policy is required as interim mitigation, it is also the responsibility of the RP to make sure this is carried out. Advice on how to support such a temporary change, can be found on the National Fire Chiefs Council’s page, Simultaneous Evacuation Guidance (High-rise)>.

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