CROSS UK
COLLABORATIVE REPORTING FOR SAFER STRUCTURES

The Institution of Structural Engineers

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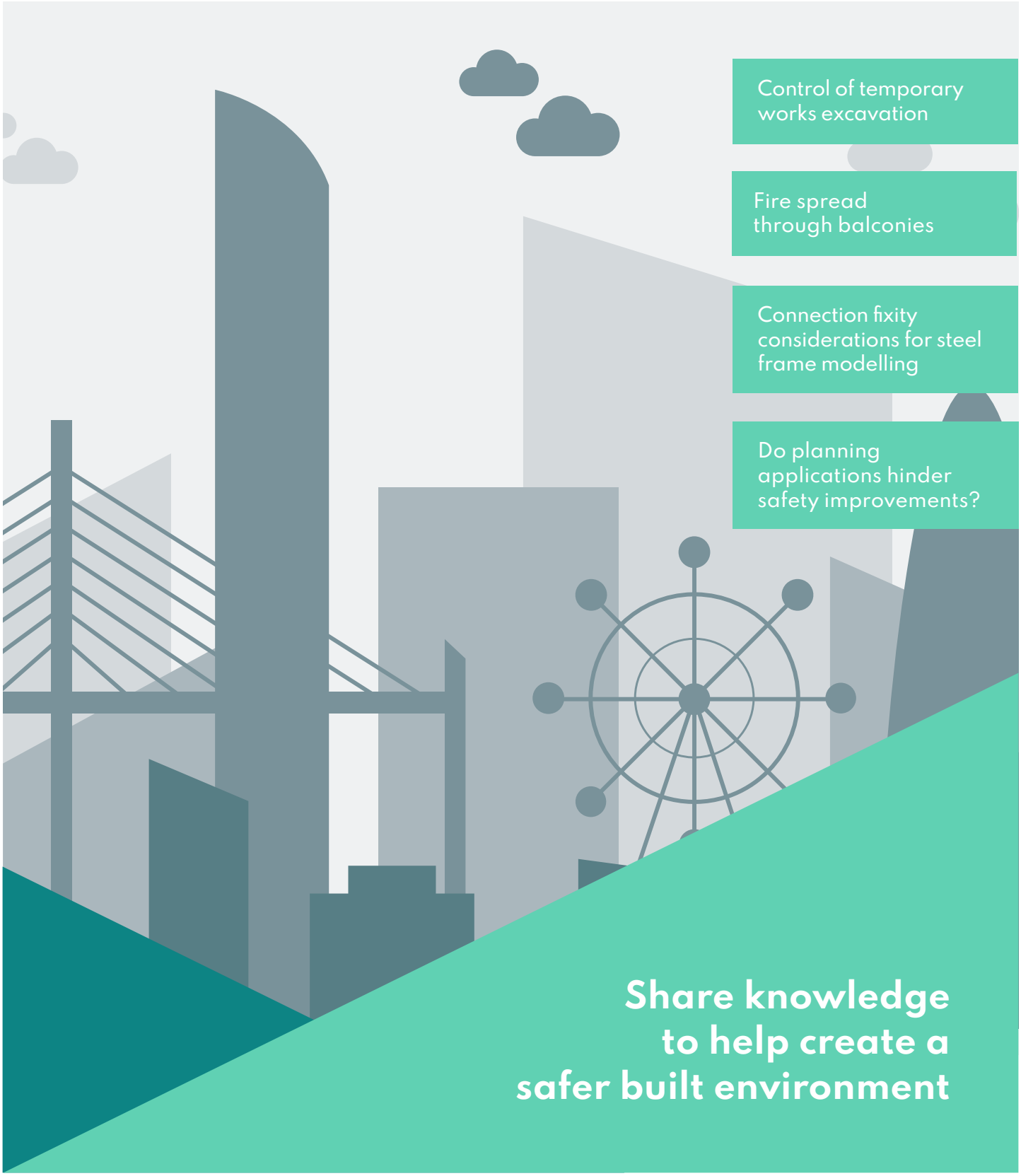
The Institution of Fire Engineers

CROSS Newsletter

CROSS-UK Newsletter 67 | **December 2022**



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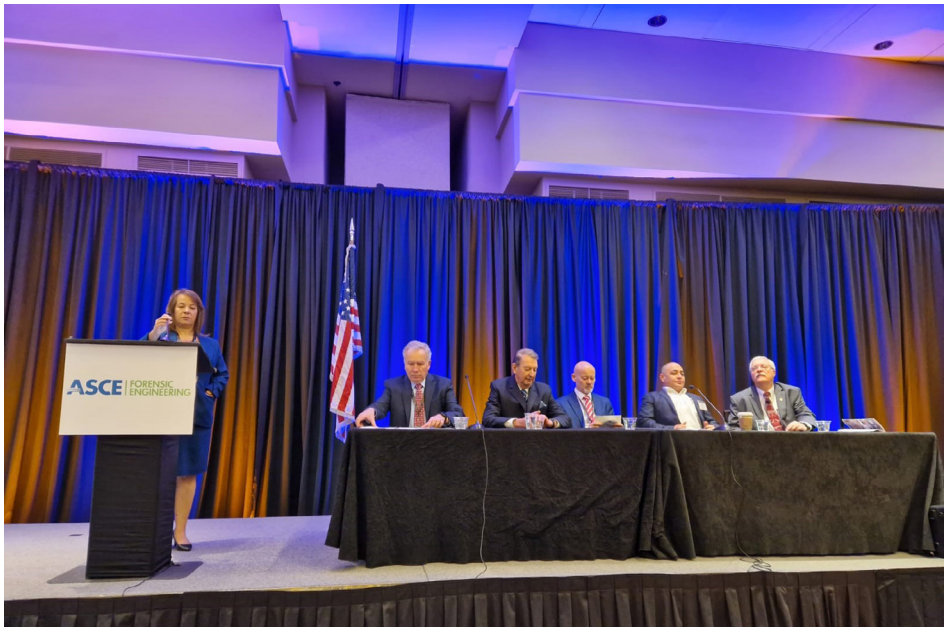

Photo of speakers from CROSS preparing for plenary sessions at ASCE's 9th Forensic Engineering Congress

November this year saw the return of the ASCE (American Society of Civil Engineers) Forensic Engineering Congress in Denver after a two-year absence due to Covid. It is a pre-eminent event in the world of forensic engineering and CROSS had major presence.

The Congress was attended by some 250 forensic engineers and others in related fields for three days of technical sessions. There were 131 presentations of which nine were devoted to CROSS, making this by far the largest single theme. The first CROSS session was a Plenary event and therefore had high profile. Presentations were made on the *Formation, Development, and Future of CROSS, CROSS-UK, CROSS-Australasia, and CROSS-US* by representatives from the regions. These covered the history of CROSS in each region and were curated to demonstrate the pattern of development and coordinated approaches for the future.

The themes were that CROSS helps make structures safer and ultimately save lives and reduce injuries. It promotes cultural change, identifies shortfalls, improves competence, enables lessons learned to be shared, informs regulatory and industry activities, and helps to protect the well-being of those who participate.

The need for CROSS in a world which will be dominated by mega cities, often in hazard prone locations due to the climate emergency, was stressed.

The second event was a technical session with five papers on: *The Decade of Disaster, Structural Safety and Failure Case Studies in Germany, CROSS-UK - Fire Safety, Fire Safety in the US,* and *Structural Safety Overview, CROSS Influence on Codes and Standards of Practice*. The presentations were well received with a good level of interest and questions from the audiences.

The overall themes of the Congress were: Natural Disasters and Extreme Conditions; Building Enclosures and Technologies for Forensic Investigation; Professional Practice in Forensic Engineering and Analysis, Design, Repairs, and Remediation; Construction Performance and Safety and Infrastructure Performance; Forensic Engineering and Material Performance. There were five concurrent streams covering professional practice, case studies, research, and the evaluation of buildings and structures in use. This limited the amount of information that could be picked up at a time but there were many opportunities to meet with other delegates.

Contents

Reporting to CROSS

Your report will make a difference. It will help us to create positive change and improve safety.

Find out more >

Photo of Alastair Soane receiving Forensic Engineering Award

The proceedings have already been published online in two volumes; one for CROSS and the other for everything else and these can be **purchased from the ASCE library>.** The intention is for these to be available on our website in due course.

Thanks are due to Glenn Bell and Andy Herrmann from CROSS-US, and to all those from ASCE who so ably managed the presentations and meetings.

Representatives from the regions, UK, Australasia, USA, and Germany held talks to consider future development of CROSS International with the aim to have:

- a global network of CROSS communities who exchange reports and safety information
- a resource for governments, owners, users, design practitioners, builders, regulators, academics and emergency services
- an international database of expert comment and advice
- an arena for global discussion, identification of trends, and the use of influence to improve on safety
- an international depository of knowledge about safety in the built environment.

Progress in each region was described with the UK taking the lead because of the extent to which CROSS-UK has expanded in the last two years, especially into fire safety. The Congress was successful in raising our profile and making valuable connections with many people and organisations who had not known of CROSS before. Common issues were identified, cementing the belief that global learning and sharing of lessons learned will help improve safety for us all.

In other news the CROSS-UK team are pleased to announce that the original seven fire panel members have now been joined by eleven more, representing the identified knowledge areas that comprise the fire "sector". To see who our panel volunteers are please see **here>** on our website and the article in this Newsletter.

Alastair Soane,
Principal Consultant

More from CROSS

Honours

Alastair Soane, a founder of CROSS and Principal Consultant, has been awarded the title of Honorary Fellow of the Institution of Fire Engineers in recognition of his exceptional work, over a sustained period of time, driving safety in the built environment.

He has been also presented with the 2021 Forensic Engineering Award from the American Society of Civil Engineers in recognition of his contributions to learning from structural failures through his leadership of the CROSS programme. This is the highest honour bestowed by Forensic Engineering Division, and the award ceremony took place during the Forensic Congress in Denver Colorado in November 2022. Alastair said: "I am very proud to have been given these awards which recognise the outstanding achievements of the CROSS communities in the UK, Australasia and the USA, including: the Directors, the Team at IStructE in London, the Consultants, the voluntary Expert Panels in each region, and of course the Reporters."

Peter Wilkinson has been announced as the IFE's next International President for 2022 – 2023. Peter is a Fire Engineering Consultant for CROSS-UK and acts as one of the designated people to handle all fire reports received. This strengthens CROSS's ties with the fire safety community and aids to spread the message of the work that CROSS does with professionals internationally.

Visit:
www.cross-safety.org/uk

Email:
team.uk@cross-safety.org

Control of temporary works excavation

CROSS Safety Report Report ID: 1146

Poor, high-water content excavated material, slipped into a 15-20m deep borrow pit. The material had slipped to the bottom of the pit partially burying excavation, crushing, and screening equipment. If this slip had occurred during working hours, the impact could have been very serious.

Key Learning Outcomes

For geotechnical, civil and structural design engineers:

- Assess what temporary states may exist and provide information via the principal designer

For resident engineer's staff:

- Assess what temporary works and temporary states may exist during the works

For contractor's supervisory staff:

- Adhere to the requirements of **BS 5975:2019 – TC Code of practice for temporary works procedures and the permissible stress design of falsework>**
- Be aware of responsibilities in your organisation to identify temporary works and temporary states
- Ensure a temporary works coordinator is appointed
- Be aware of TWf guidance **TW17.037 Principles for the management of temporary loads, temporary conditions and temporary works during the construction process>**

R Full Report

The construction project was a substantial dual carriageway scheme in the UK. Borrow pits were used to win quality rock material for embankment construction with the pits then used for disposal of unsuitable poor excavated material - this was done on a phased basis where the pit was filled in from one end as the excavation of rock progressed. Design requirements and compliance on the project were generally very good, both for permanent and temporary works, e.g., bridge structures, embankments, and materials.

However, neither the client, the client's advisor, the contractor, nor the contractor's designer paid proper attention to geotechnical design for the filling of borrow pits with poor materials.

One morning says a reporter, it was discovered that poor, high-water content excavated material, had slipped into a 15-20m deep borrow pit. The material had slipped to the bottom of the pit where excavation, crushing, and screening equipment was situated. The equipment was partially buried. The reporter confirmed that if this slip had occurred during working hours, the impact could have been very serious, potentially with fatalities or serious

New Experts join Fire Safety Panel

In line with the recommendation made by Dame Judith Hackitt, CROSS-UK expanded to include fire safety reporting in March 2021. The initial fire expert panel was kept to a minimum, to help consolidate the process that was new to the sector. The CROSS-UK team are now pleased to announce that the original seven panel members have been joined by eleven more, representing the identified knowledge areas that comprise the fire "sector".

Fire reports will continue to be received by the two *designated people*, Dr Peter Wilkinson and Neil Gibbins, who triage, anonymise and de-identify them. The expert panels then review the information provided by reporters, adding in their perspective, helping to identify lessons learned. The panels also meet four times per year to review the overarching information provided by the reports, creating a holistic view of developing issues and trends.

To see who our panel volunteers are please see **here>** on our website. We wish to thank our original panel members for helping us establish the fire reporting process and very much welcome our new members, who we know bring with them their vast knowledge and experience, to help CROSS help you to keep up to date, to help keep people safe.

Request a CPD talk from CROSS-UK >

The CROSS Team is available to give presentations to firms and organisations. These give insight into the work of CROSS on structural and fire safety which include examples of failures and the lessons that can be learned. To request a talk please complete the form> and we will be in touch to organise.

injuries. The incident was reported as a dangerous occurrence.

The underlying safety issue was the lack of sufficient attention paid to the stability of the excavated materials. The reporter argues there was a requirement for the contractor to undertake all temporary works design, however adequate geotechnical design and risk assessment of the borrow pits was simply missed by the contractor, their designers and the client's project manager. Procedures for the handling of the material should have been in place and monitored, continues the reporter, particularly because high-water content materials are inherently unstable. However, as a temporary works operation, it was missed.

The reporter concludes that even with the large professional team of people and several organisations involved in this project, the risk was not properly raised; the lesson would be to ensure that temporary works are designed and risk assessed as importantly as any permanent works.

C Expert Panel Comments

By bringing forward this report the reporter has very helpfully shone a light on an important issue that can be missed – that is, what temporary works will exist on a particular site? Had the excavations been recognised as temporary works, then control measures would likely have been in place and the incident prevented.

Excavations and adjacent materials must be adequately controlled. Legal safety requirements relating to excavations and stockpiles are clear. The Health and Safety Executive webpages **Temporary Works>** and **Excavations>** set down requirements that are relevant to the management of excavations, stockpiles and adjacent materials. **BS 5975:2019 – TC Code of practice for temporary works procedures and the permissible stress design of falsework>** sets down requirements that should be followed for the design of any temporary works which includes excavations and other earthworks. Risk assessment of all excavations is required. The risk assessment would highlight a requirement for geotechnical design. In cases similar to that reported, a geotechnical engineer would perform as the 'designer' of the works. A design check as required by BS 5975: 2019 would also follow. The design and check would contribute to the risk assessment required for the adequate management of the excavation and associated operations.

> **risk assessment of all excavations is required**

The **Temporary Works forum>** has published much relevant guidance including **TW17.037 Principles for the management of temporary loads, temporary conditions and temporary works during the construction process>**. This guidance states, *'One of the most important questions in temporary works is simply: 'When and where are temporary works needed and how long do they need to be in place?' Many failures occur because it is assumed that structures, excavations, stockpiles and other features on construction sites will stand up on their own, at each and every stage of construction, when in fact they won't. Engineering analysis is needed to back up such judgements.'* The guidance examines the fundamental issues that those persons (including those at head office) responsible for construction projects which include any form of temporary works, should understand and act upon.

All involved in projects, including but not only, principal designers, designers, temporary works coordinators, works co-ordinators and all contracting parties should be asking the question 'what temporary states may exist as part of the works to which I am contributing?' Ultimately, of course, contractors should have in place appropriate systems of work that ensure all temporary works, and importantly temporary states, are identified. BS 5975:2019 requires the use of temporary works registers to capture all temporary works and temporary states – control measures would then follow.

Seen or experienced a safety issue? Share with CROSS>

CROSS-UK welcomes reports about fire safety and structural safety issues related to buildings and other structures in the built environment. If you have seen a near miss or incident or have knowledge of a safety issue submit a report so we can distribute the lessons learned. Reporting is confidential and all reports are anonymised.

ensure all temporary works, and importantly temporary states, are identified

Where earthworks are identified as temporary works or a temporary state, then the specification of materials, working and management can be given due consideration. The following may be considered matters of importance:

- Excavations, stockpiles, slopes, embankments and similar should be risk assessed by a competent person.
- Stockpiles next to any excavation are likely to be higher risk.
- Encourage those preparing or checking risk assessments to adopt a 'what if' scenario and have contingency measures in place.
- Understand the impact of changing environmental conditions on temporary works/states, particularly where earthworks are concerned.
- Recognise the importance of continual monitoring and formalising the checking of temporary works or temporary states.
- Ensure that inspections are undertaken by staff with the appropriate level of experience and competency who have the requisite power to stop works, if they feel the situation so demands.

No method statement, no work

Clearly whilst this report concerns earthworks, the same need to identify temporary works and temporary states applies across all engineering and building activities. A good process for controlling all works may be via method statements – 'no method statement, no work'. Such a control can be taken right down to grass roots with all control measures passing through the appointed temporary works coordinator.

The TWf has published guidance upon excavations including **Information Sheet No 5>** which covers good practice for the management of stockpiles.

The Construction Plant-hire Association has published guidance (including input from the HSE) on the management of shoring in excavations. **Part 1 covers management processes>** including assessing the levels of excavation risk and design scrutiny. The appointment and competency of duty holders is also considered.

Submit Report

Submit Feedback

More CROSS reports

In addition to the reports included in this newsletter, the following CROSS reports have also been published since our last newsletter:

Critical welding of structural steelwork missed (Report ID 1126)>

The designer of a steelwork roof frame found a critical fabrication error when inspecting steelwork on site before it was erected.

Incorrect modelling of a cantilever (Report ID 1144)>

A steel framed building was incorrectly modelled and designed resulting in excessive deflection of part of the frame even before the frame was loaded with the self-weight of the building. The modelling error occurred due to an incorrect support condition being applied.

Concerns over execution class categorisation of steel pedestrian bridge (Report ID 1149)>

A reporter is concerned in respect of the steelwork execution class, and quality management arrangements, applied to the construction of a public access pedestrian bridge.

Fire spread through balconies

CROSS Safety Report Report ID: 1052

This report highlights that the extensive use of combustible materials in the construction of balconies can result in fire spread over the external wall to an extent which is inadequate for buildings, even those less than 18m.

Key Learning Outcomes

For designers:

- Consult with a competent fire safety professional to ensure that the building resists adequately the spread of fire

For fire and rescue service:

- Be aware that some balconies can pose an additional fire spread risk, and ensure that appropriate procedures are in place

For building managers:

- Ensure that occupants are informed about the excessive storage of materials, including gas cylinders, on their balconies that could pose a hazard in a fire event

R Full Report

A report has been received which touches upon the presence of combustible materials in balconies. The concern is two-fold; one is the extent in the use of combustible materials in the construction of the balconies, while the other is the inability of the balcony construction to sufficiently limit the spread of fire.

The reporter drew the conclusion from an event that the fire spread over the external wall was inadequately resisted. This is judged, by the reporter, as deficient performance, even for such a building which is below of 18m in height, because the compartment boundary was bypassed at an early stage, undermining the concept of compartmentation upon which a stay-put approach was in place.

Two phenomena are presented that indicated the breach of compartmentation, and two possible causes:

- One is the lateral spread of fire, horizontally over the elevation, between balconies of different flats, involving an external volume beyond the compartment of origin. The potential role of dividing screens in preventing or contributing to fire spread, and the continuity of balconies in enabling fire spread should both be explored. The presence of combustible materials in the construction of the balcony is referred to by the reporter as the cause of this type of spread; specifically, the presence of timber, and plastic netting below decking.
- The second phenomenon is the vertical spread of fire, through involvement of the balcony in the flat above the compartment of origin. This is attributed to the use of perforate decking in the soffit, which allowed the exposing to flames and subsequent involvement of combustible materials in the balcony above, leading to rapid vertical fire spread.

In both cases, potential solutions that involve any kind of treatments for the timber elements should be considered carefully, accounting for the effects of weathering and aging, along with their ability to resist large fire exposures at any point in their service life.

Additionally, the form and orientation of any timber used on the building should be considered as these are aspects that can affect its burning behaviour. Reaction to fire classifications should be checked to ensure that they are based on a relevant test, and are implemented while considering the form of the element and any surrounding materials.

Fire strategy considerations

The reporter considers that the extent of using combustible materials in balconies should take into account the possibility of fire spread and the potential undermining of a stay-put strategy. The building's fire strategy is provided to address the case of a fire in a single flat unit, which also usually forms a compartment. If there is external fire spread at a rate so rapid that can compromise the effectiveness of active fire safety systems, such as smoke control or suppression systems, even in buildings less than 18m in height, then it is the opinion of the reporter that

it could be questioned whether requirement B4 of the Building Regulations 2010 is still satisfied.

Issues related to this report are expected to be included in ongoing government issued research on "Fire Safety: Balconies, Spandrels, and Glazing" (CPD 004/0120/205). This is an indication that the state of knowledge in fire engineering is still evolving to cater for these new developments in construction practises.

C Expert Panel Comments

The panel agrees that this issue requires attention while appreciating the fact that government has commissioned research, as part of the review of Approved Document B, yet it is key that this research is ongoing. Issues regarding the fire safety of balconies has previously been the topic of a **Building Research Establishment (BRE) report>**.

As the reporter mentioned, it is generally assumed that the risk of fire spread is a combination of the combustibility of the materials that the balcony is made from and any combustible materials that are placed on them, and the panel is aware of cases where surveys recognised both issues.

> **competent designer to choose a solution they feel comfortable satisfies the functional requirements of the Building Regulations**

Different professionals and organisations have been following different approaches to this issue, in anticipation of the research findings, which is an indication of no definitive solutions. The form and orientation of timber panelling should be carefully considered on a case-by-case basis, with cognisance of how the reaction to fire classification has been obtained by fire testing, and whether that classification is considered appropriate for the end use. For existing buildings, PAS 9980 includes the assessment of risk of balconies, and eventually it is up to the competent designer to choose a solution that they feel comfortable satisfies the functional requirements of the Building Regulations.

CROSS has published a **Safety Alert>** regarding issues associated with balconies, fire safety included, and a **Safety Report>** about deck board in common access balconies, both of which touch upon and address some of the issues recognised in this report. CROSS has also drawn attention in the past to the dangers of storing gas cylinders on balconies.

It should be noted that, in England, from 1 December 2022, the guidance will be updated to apply to balconies on residential buildings with a floor above 11m. This change will cater for the nature of the balcony's construction.

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Connection fixity considerations for steel frame modelling

CROSS Safety Report Report ID: 1139

This report concerns the modelling of joints when using computer programs. In some cases, engineers are applying rotational releases to joints in models but subsequently designing the connections as rigid. This leaves a fundamental mismatch between analysis and design which may lead to unsafe structural connections argues a reporter.

Key Learning Outcomes

For civil and structural design engineers:

- Designers should understand the engineering principles and design rules that underpin specific modelling software before use
- Ensure the model correctly and appropriately represents the structure under analysis
- Ensure the structure that is being designed is compatible with that modelled
- The **SCI Green Books>** provide a basis for connection design that should be sufficient in most cases
- Designers should specify practical connection details that match their modelling assumptions and at least overview fabrication drawings to ensure their design intent is realised
- Ensure that there is a suitably qualified and experienced engineer with overall responsibility for design and checking

R Full Report

This report concerns the modelling of joints when using computer programs. In some cases, says a reporter, engineers are applying rotational releases to joints in models but subsequently designing the connections as rigid. This leaves a fundamental mismatch between analysis and design which may lead to unsafe structural connections.

The reporter cites three cases where they have regularly seen this being done:

- Instead of applying a 0/10/20% partial fixity to the bases of portal columns, with 0% fixity used at the ultimate limit state, the model is created with a single partial fixity definition which is applied globally, so acting at the ultimate limit state.
- For simply supported beams, a partial fixity is applied which helps reduce the mid-span sagging moment and mid-span deflection.
- In models where the end releases are leading to instability, a partial fixity is applied to provide some degree of continuity in the structure to allow the analysis to proceed.

In all cases, the model is applying a rotational spring to some or all joints in the model, with the analysis then being carried out on the basis of semi-rigid joints. The design for the connections is then completed through the design software which is written in line with the **SCI Green Books>**. However, because the design software detects an end moment in the beam or column, it will not permit the connection to be designed as a simple non-moment connection but applies a moment resisting connection as per the SCI Green Book P 398. The reporter goes on to say that the software user has therefore designed the structure with rigid joints whereas the analysis was undertaken on the basis of semi-rigid joints.

> **a semi-rigid connection requires the joint to have some ductility**

A semi-rigid connection requires the joint to have some ductility and so be able to rotate. This happens because of the flexibility of the end plate. This is not the case in a rigid connection where the end plate is taken to be thick and so does not yield. Therefore, from a rotational stiffness point of view, the end plate is not designed to allow the rotation that would be required to match the analysis model. The connection is significantly stiffer than that modelled. This means there is a significant danger that the connection will attract a much higher force than it is designed for. This could lead to yielding in components of the connection that were not designed to accommodate the higher forces, such as the bolts or flanges, but could also in some circumstances lead to premature failure of the joint.

The cause of the problem, continues the reporter, is two-fold.

1. A fundamental misunderstanding of connection design and the underlying component model used in the SCI Green Book for moment connections coupled with a lack of understanding of the implication of applying partial fixities/rotational springs in frame models.
2. A lack of understanding of the purpose of the common approach to partial fixities in portal frames of applying 0/10/20% fixities or not understanding how to do this in the software and instead applying global partial fixities without understanding the consequences.

> **a lack of understanding of how rigid and semi-rigid connections differ**

The basis of rigid connections is stated in the SCI Green Book P398. But some engineers may be designing connections using software without having read and understood the guidance. The reporter contends that there has been long-standing practice whereby the consulting engineer designs the elements, and the connections are designed by others. This has led to a situation where many consulting engineers have had little exposure to connection design and so lack a good understanding of how connections impact modelling. There is also a lack of understanding of how rigid and semi-rigid connections differ fundamentally in their behaviour. As semi-rigid connections are likely to become more common, in the opinion of the reporter, there is a need for more design guidance.

C Expert Panel Comments

This report highlights profound issues that have troubled researchers and code writers since the 1930s. The reality is that all steel connections are semi-rigid and it is not really possible to define their spring stiffness with any confidence even if the full details are known. Experiments show quite significant variations even between notionally identical connections. Moreover, the moment rotation characteristic is usually non-linear. It is not possible for a connection designer to offer a particular semi-rigid performance nor is it generally possible to provide a connection not exceeding the strength defined by the main designer (one of the reporter's concerns).

It was these observations that originally led to the concept of ultimate load design. A structure's stress distributions under lower loads might differ substantially from elastic predictions (not least because of connection variability) but provided the performance of the connections are compliant with ultimate load conditions, the structure should have adequate strength.

> **otherwise some deformations might be underestimated**

In terms of modelling, two conditions can be defined: modelling for strength and modelling for deformations. For the latter, connections will normally exhibit some rigidity, especially under low (service) load conditions and this can be accounted for in the modelling. Moreover, it should be accounted for otherwise some deformations might be underestimated (such as horizontal column bow if 'pinned ended' beam connections actually transmit moments to columns).

For an ultimate load model, it is best if connections are modelled 'pin ended' or 'fixed' since long practice has shown such assumptions generally result in safe designs. But no connection is actually a pure pin and no connection is ever fully rigid. What is essential in the detailing stage is that pin ended connections exhibit the requisite ductility commensurate with the rotations required of them at ultimate load. Green book compliance will normally assure this.

> **connections exhibit the requisite ductility**

The reporter has expressed some concern that modelling assumptions varying from reality may 'overstress connection components'. This may well happen at low loads with notionally pin ended connections but is not of concern since the imposed deformations (even with permanent yielding) are strain controlled and will not cause structural failure. A shear only (pin) connection has to be capable of deforming, elastically or inelastically 'out of plane' but still carry shear 'in plane' and that is why proper detailing to accommodate the movements is so essential.

Caution is required when unusual structures are being designed. Extra long length beams will normally have to carry appreciable end shears necessitating connections with many bolt rows. If these are designated 'pin ended' it may become problematic to assure they can be detailed to exhibit sufficient ductility. In end plate connections, ductility requires that bolt columns are widely spaced to allow the end plate to deform. Thus, there is an impact back on the main designer to assure the provision of members that are wide enough to accommodate such spacings. SCOSS (now CROSS) issued a **Safety Alert in 2018 concerning the Effects of scale>** – this included consideration of connections for long-span steel beams.

The reporter expresses concern about the interface between main designers and connection designers, whereby main designers have little experience of connection design. That concern is justified. A key obligation of main designers is to size and configure frames such that the connection design they require is feasible, and that cannot be done without experience.

It is interesting to question why pinned releases on the model are causing instability. The author does not state what that instability is or where it is coming from. One cause may be related to torsional instability in the beams due to torsional releases being applied along with major and minor axis releases. While green book connections do not normally have an explicit torsional capacity, they do offer torsional restraint and thus it is valid to not release the beams about this moment axis. This is conditional on the engineer then checking for any torsion that is reported in the analysis and designing for it appropriately (or designing it out).

requires diaphragm action from the floors to maintain stability

Another cause may be that the frame actually requires diaphragm action from the floors to maintain stability. Mimicking diaphragm action by applying minor-axis moment connections is dangerous as it analyses the structure in a way that is not aligned with how the structure is intended to behave. In addition, designing and detailing connections for non-existent minor axis moments is an unnecessary cost.

The reporter raises very well the point that engineers must understand the engineering principles and design rules which are written into and underpin the software they are using. Equally those checking designs must also appreciate the same.

using alternative methods may more readily highlight errors

There should be compatibility between analysis and design, otherwise, it is likely that some of the structure could be under-designed. It is essential that all design assumptions are verified. Designers using specialist software need to be properly trained, experienced and competent to be able to rely on the results. It is also essential that analysis and design are both checked. Checking using alternative methods may more readily highlight errors. The report also raises the point that there should be an engineer with overall design oversight/ coordination responsibility, as otherwise work packages (in this case member design and connection design) may not be compatible with one another.

A report **Modelling of structures published by CROSS-AUS>** in August 2022 considers the limitations and basis of modelling, and also examines the verification of modelling.

Submit Report

Submit Feedback

Do planning applications hinder safety improvements?

CROSS Safety Report Report ID: 1043

A potential issue about the reconstruction of a structurally inadequate external fire escape from a building has been raised with CROSS.

Key Learning Outcomes

For building owners, employers, persons responsible for compliance with fire safety legislation:

- Fire safety provisions must be maintained to be fit for purpose
- Replacement or repair of fire precautions, including external fire escapes, may require planning permission; this may take time to be achieved
- A fire risk assessment is a 'live' process, reflecting the premises as it is, and amended to account for temporary situations

R Full Report

A potential issue about the reconstruction of a structurally inadequate external fire escape from a building has been raised with CROSS. An application to a Local Planning Authority to make safe the external fire escape has been submitted, and the Authority insisted on a full and formal planning application.

The reporter is of the mind that this process is liable to take months, or even longer than the average time, and this time horizon is not appropriate for a case that is in need of immediate safety improvements.

The reporter is of the opinion that this is an “unthinking application of planning rules”, where safety is treated purely as a legal issue and not an engineering matter. They call for a better understanding between the engineering profession and the legal profession, in order to align their prioritisation of safety and better serve the public.

C Expert Panel Comments

It is the panel’s opinion, that ideally, a fire escape should never have got to the point of needing to be rebuilt, either because of degradation due to the lack of oversight and maintenance, or due to deficiencies in the original solution.

Planning laws are in place to prevent people from doing unacceptable things to buildings that could adversely affect the occupants and the neighbourhood; there is an obvious need for planning, and it needs to be respected. While fire safety is important, there may exist numerous other issues that cannot be overridden. It is part of the Local Authority’s duties to prioritise these issues. If planning requirements mean that there is a delay in doing the work, then the owner needs to put in place appropriate temporary measures, following procedures that are already in place.

> **a fire risk assessment is a 'live' process**

It is the responsibility of the Responsible Person (under the Regulatory Reform (Fire Safety) Order 2005 (FSO)) to ensure there is a suitable and sufficient fire risk assessment (FRA), and a record (where required) of the risks and the associated measures, including adequate means of escape. A fire risk assessment is a 'live' process, reflecting the premises as it is, with any issues being identified as soon as possible. If the means of escape stair is no longer available, then this must be recorded and accommodated in the FRA, with adequate measures instigated immediately.

If the reporter has concerns that have not been addressed, then they should contact the local Fire and Rescue Authority/ Service who are (in general) the enforcers of the FSO and are the appropriate body to check if a breach of the FSO, which places relevant persons at risk of death or serious injury in the event of fire, may have been committed.

Submit Report

Submit Feedback

Stunts on bridges cause concern

CROSS Safety Report Report ID: 1136

A thrill-seeker travelling up and over the arch of a bridge, risking serious injury to themselves and others, raises the concerns of a reporter.

Key Learning Outcomes

For bridge design engineers, architects and their clients:

- Designers, clients, operators and users should contribute to risk assessments that consider inappropriate access
- Address inappropriate access early in the design process
- Consider if disciplines outside of engineering could contribute to the consideration of mitigation measures
- Be aware that mitigation measures may need to be adapted over the service life of a structure
- Designers should stay alert to how designs can develop to best serve society

R Full Report

A reporter says that incidences of people inappropriately crossing newly constructed bridges show that in some cases more consideration could be given to discouraging climbing, scaling, or even riding on arches and other parts of bridge structures. The reporter is concerned that serious injury to persons inappropriately crossing bridges and others, could occur.

Bridges that feature arches that connect down to deck level may particularly encourage access, says the reporter. Further, where there is a lack of any substantial protection preventing access to the arch then there is little to prevent climbing, riding or other access.

The reporter considers that the operational safety challenges presented by all, but particularly innovative designs, must be considered and adequately resolved at the early design phase. Designers of bridges should consider not only established modes of inappropriate access but also emerging modes of personal transport methods and the potential safety concerns they generate.

C Expert Panel Comments

This is an extensive and difficult subject area that has considerable sensitivities. Stunts, as described, could be unplanned (for example dares and drunken incidents) or indeed planned (for example protesters). Extremely important questions arise as to how far infrastructure designers and clients should go to counter inappropriate behaviour, vandalism and malicious acts or indeed other behaviours such as when people are not of stable mind. These questions arise for many types of building and civil engineering structures.

The designer alone cannot deal with all the potential areas of misuse by members of the public. Designers, clients, operators and users should contribute to risk assessments and agree upon design solutions and any misuse mitigation measures that are appropriate. It may be appropriate to include parties such as police, local authorities or health boards in related discussions since the issues may be far wider than engineering problems. Solutions often benefit from the input of a far wider range of disciplines, especially those professionals who understand the minds of people with suicidal tendencies. The danger to children gaining access to structures and treating them like a playground is an ongoing problem which must be addressed. Malicious acts that could have disproportionate consequences should also be given consideration. The Government's **Centre for the Protection of National Infrastructure (CPNI)>** provide guidance on protecting critical infrastructure against malicious acts.

Mitigation measures

Mitigation measures should be reasonable and appropriate. It can often be difficult to find this balance, for example with listed structures. Requirements may change over the lifetime of the structure. Mitigation measures conceived at a design stage may need to be adapted over the service life of the structure as society and the environment local to

the structure changes. Installing mitigation measures can create a 'challenge' that some people may find irresistible. Non-engineering approaches such as maintaining good visibility may be helpful. Different sectors will have different approaches – the rail sector for instance, will consider 'threat and vulnerability assessments' as well as security measures in the design of infrastructure. Measures such as anti-climb, omission of flat surfaces or means to gain grip, CCTV and signage may be considered alongside active measures such as public address announcements, help lines, neighbourhood and emergency service initiatives. Trespass risk assessments to industry standards are also undertaken. Clearly, strategies to prevent inappropriate access to arch bridges will be considered by designers and clients. As put forward by the reporter, emerging personal transport modes (such as e-scooters) may require alternative mitigation measures to those previously adopted. As with all design, the earlier such matters are addressed in the design process the more likely better outcomes will be found.

In conclusion, designers must keep in mind good sense (if something is clearly an 'invitation to climb' it needs guarding), but designers must also be aware of emerging trends in society so that good sense is kept up to date. It is very doubtful that rules can be set down, or (even if they could) that they would remain static. Designers must therefore have time to engage such that they can stay alert to how designs can develop to take account of the society that engineering serves.

Submit Report

Submit Feedback

Fire extinguishers in common areas

CROSS Safety Report Report ID: 1041

A reporter raises a point about the provision of fire extinguishers in the common parts of flats. They go on to say that extinguishers should be provided in some cases, to cover identified risks, but that they are not specified due to cost savings pressures and assessor unawareness.

Key Learning Outcomes

For building owners, managers, leaseholders:

- Fire extinguishers can be effective in tackling small fires
- Guidance on the provision of extinguishers is contained in **"Fire safety in purpose built flats">**

R Full Report

A reporter raises a point about the provision of fire extinguishers in the common areas of flats.

This concern emerged because risk assessors and companies alike are regularly recommending the removal of fire extinguishers from common areas. The assessors' explanation for this is that if an untrained tenant was to use the extinguisher, they would put themselves at risk. The reporter's assumption on the motivation of this practice is that it is purely driven by the reduction of installation and service costs.

The recommendation is in line with current guidance available, namely **"Fire safety in purpose built flats">**, where in part 21 it is stated that:

"21.3 It is rare for there to be a need for fire-fighting equipment to be used by people present in the common parts of blocks of flats. It is, nevertheless, usually provided in plant rooms and other such rooms, for use by the staff and contractors.

21.4 The provision of fire extinguishers and other forms of fire-fighting equipment in common parts for use by residents is problematic. It is not expected that residents should need to tackle a fire in their flats to make their escape. Indeed, to obtain a fire extinguisher located in the common parts for this purpose would involve the person leaving their flat in the first place.

21.5 This does not preclude residents from providing their own fire extinguishers and fire blankets. Indeed, it may be appropriate for landlords, and others responsible for the common parts, to encourage this as part of the process of engaging with, and educating residents on, fire safety".

Mixed-use buildings

However, the reporter is of the opinion that in cases of mixed-use buildings (if for example there is a commercial part), or if there are people who are working in the building (such as reception staff, security personnel, cleaners, or concierges), then these areas "fall under the definition of their work place and thus are covered under the **Health and Safety at Work Act">**. In conjunction with the **Regulatory Reform (Fire Safety) Order 2005>** – which applies to the common parts of buildings and makes provision in article 13 for non-automatic fire-fighting equipment to be available when appropriate – the reporter proceeds in the interpretation that extinguishers should be present in these areas.

Differing quality of training

They also think that there are different levels in the quality of training provided between all the available courses for fire risk assessors. They consider that when a course is fragmented and run through many third-party companies then it becomes harder to ensure consistency in the quality of the courses delivered. This may have as an outcome that some assessors may not have the necessary background to judge when it is appropriate to place or remove fire extinguishers from the common parts of buildings.

The reporter has interacted with professionals who have been certified as assessors by some courses and are operating in the industry. Despite this, they are not feeling completely comfortable doing some assessments. Despite that uneasiness, they continue completing these assessments so that they remain in business and do not lose their income.

The reporter's suggestion is for the introduction of a third-party registration of risk assessment companies, who can then only participate and complete a risk assessor's course on the condition of a proven track record for a set period of time.

C Expert Panel Comments

This is not a new issue, and this discussion has been recurring in the fire safety domain for some time. The need for portable fire fighting equipment (PFFE) in any premises is covered by the Regulatory Reform (Fire Safety) Order 2005 (FSO) and is, as always, subject to a suitable and sufficient fire risk assessment (FRA) by a competent person.

If PFFE is incorrectly omitted, or unnecessarily present, it is considered it is due to a misunderstanding of the need to provide PFFE in the risk assessment or the overselling of PFFE by suppliers. As with every industry that provides technical solutions, the potential for commercial pressures should be acknowledged in this discussion, and the eventual choice be made on technical merits or demerits, and, the finding of the FRA.

The Construction Industry Council's **Setting the Bar Report>** compiles the findings of Working Group 4 on fire risk assessors, and outlines their next steps on the competence of fire risk assessors. Work on this topic is ongoing, and the Fire Sector Federation has published an **Approved Code of Practice>** for fire risk assessors.

It is also of note that clause 156 of the Building Safety Act 2022 (Amendment of the Regulatory Reform (Fire Safety) Order 2005), under article 156(4) will amend the FSO to ensure that "The responsible person must not appoint a person to assist them with making or reviewing an assessment under article 9 unless that person is competent."

Submit Report

Submit Feedback

Toughened glass failures

CROSS Safety Report Report ID: 1135

The number of failures of heat-soaked toughened glass leads to a finding that the glass produced by some processors has not been properly heat-soaked and is therefore much more likely to shatter in use.

Key Learning Outcomes

For specifiers and procurers of toughened glass:

- Be aware that toughened glass (heat-soaked or not) can fail for a number of reasons
- Where heat-soaked glass is used, it is important that heat-soaking records are validated for the glass delivered to site
- Designers should properly risk assess their use of toughened glass

R Full Report

A reporter believes from their experience that toughened glass that has been heat-soaked in compliance with BS EN 14179 is many times less likely to shatter spontaneously than toughened glass that has not been heat-soaked, and consequently many designers specify heat-soaked toughened glass to minimise the risk of broken toughened glass falling from buildings. Nevertheless, glass has fallen from buildings, there have been near misses and people have been alarmed by breakages.

According to the reporter, failures caused by nickel sulphide inclusions (the impurities that heat-soaking counteracts) are very rare indeed in heat-soaked toughened glass provided by the majority of processors. However, there do appear to be cases of failure to heat-soak the toughened glass properly by a few processors.

The reporter and colleagues have analysed the number of breakages caused by nickel sulphide on several buildings where the glass was sold and CE marked as being heat-soaked and compliant with BS EN 14179. They found that the number of breakages was much higher than expected. This was evidenced by the statistical improbability of properly heat-soaked glass failing at the rates observed on affected buildings. Where a high rate of failure was observed, factory records of the heat-soaking process tended to be absent, untraceable to the actual glass delivered, or visibly altered in a way that is not consistent with human error. The analysis led to the finding that the rates of failure on affected buildings were not credibly consistent with the claim that the glass was heat-soak tested.

> **the rates of failure on affected buildings were not credibly consistent with the claim that the glass was heat-soak tested**

The reporter goes on to say that it is not possible to examine, test or check toughened glass when it is delivered, to ensure that it has been heat-soaked as marked, so reliance is placed on documentation and marking by the producer. Those responsible for buildings had no indication that anything was amiss with the affected toughened glass, which they understood to be heat-soaked, until a number of panes shattered, the origins of failure identified, retrieved, and analysed and the rate of failure compared with the expected probability distribution. It could take several years for the pattern of failures to emerge and to be recognised, during which time people were exposed to risks much higher than intended.

The reporter has advised those responsible for the management of affected buildings to re-assess the safety of the glazing and in some cases take additional measures to mitigate the increased risk because they have to assume that the glass is not heat-soaked and that further breakages are foreseeable. Protective measures such as canopies, diversion of pedestrian routes, daily inspection for broken panes, application of temporary films and re-glazing have been implemented. Property values and confidence have been damaged. Designers rely on the declared reliability

> **property values and confidence have been damaged**

of heat-soaked toughened glass (less than 1 critical inclusion in 400 tonnes) when designing facades and other glass applications, such as barriers, says the reporter. If the material supplied is much less reliable than that specified, the risk to people in and around those buildings is significantly increased. Broken toughened glass falling from height has the potential to cause significant injury or death, and failure to deliver glass of the agreed reliability exposes people to this unseen hazard.

The reporter confirms a trend over recent years for some designers to avoid the use of toughened glass because of the poor overall record of failures even when heat-soaking was specified. This has resulted in the use of thicker glass to achieve strength and more use of laminated glass to achieve impact safety in situations where reliable heat-soaked toughened glass would have been adequate. The reporter argues these specification decisions often result in higher embodied carbon impact.

The reporter emphasises that these concerns apply only to glass supplied by a very few processors and that it is the reporter's experience, that failures caused by nickel sulphide inclusions in heat-soaked toughened glass are very rare indeed from the majority of processors.

The reporter concludes that heat-soaked toughened glass can be reliable and efficient if properly processed. However, the only way to verify that toughened glass has been properly heat-soaked is by true and accurate records of the process having been applied to the panes of glass in question. This requires traceability and responsible practice by the processor. Finally, continues the reporter, those specifying and procuring heat-soaked toughened glass should exercise particular care in reviewing production control measures and documentation and may choose to observe the process directly.

C Expert Panel Comments

The reporter raises very valid concerns. As there is no way to tell the difference between heat-soaked and non-heat-soaked toughened glass, it is hard to enforce compliance with standards at a practical level. One incident saw a number of panels fall from a tall building all with nickel sulphide inclusions. Subsequent investigations showed that records had been properly kept and the process was followed all the way back to the heat-soaking machine which was properly calibrated and checked. The only conclusions that could be drawn were that the records appeared anomalous and that the glass had never been heat-soaked. Incidents like this may have led some practitioners to take the approach of not allowing toughened glass when overhead or where it could fall and cause a danger to passers-by (unless the glass is part of a laminate).

The Manual to the Building Regulations (page 54, F31) states that '*If a material is at risk of spontaneous failure, such as toughened glass, and the consequences of failure are likely to present a safety risk, it is unlikely that the material will meet the requirements of the Building Regulations.*' Monolithic toughened glass can fail without warning for a number of reasons, including impact from a sharp object, any impact when previously damaged, poor detailing, differential solar exposure, nickel sulphide inclusions, etc. As nickel sulphide inclusions are just one cause of failure relating to monolithic toughened glass, it is arguable that designers should not rely on heat-soaking to make monolithic toughened glass safe, in conditions where its failure would present a life-safety risk.

> **designers should not rely on heat-soaking to make monolithic toughened glass safe, in conditions where its failure would present a life-safety risk**

Furthermore, the UK Government has banned the use of laminated glass in some parts of tall residential buildings (above 18m under regulation 7 and above 11m in the approved documents). This means that the use of laminated glass in balustrades may not comply with Building Regulations. Monolithic glass used in such circumstances must comply with Part K4 of Schedule 1 to the Building Regulations 2010, which states *'Glazing, with which people are likely to come into contact whilst moving in or about the building shall - (a) if broken on impact, break in a way which is unlikely to cause injury;…'*. Thus, any glass which if broken fails to provide reasonable containment or causes injury to those below as it falls is unlikely to comply with Part K4. It should not be forgotten, of course, that glass in buildings will likely need to satisfy a number of performance criteria including, for example, thermal and acoustic requirements.

Where heat-soaked glass is used, it is important that heat-soaking records are validated. The processes required to provide a suitable level of assurance could be extensive. The heat soaking process weeds out the critical nickel sulphide defects by forcing the failure in the quality control process, and so the panel containing the particle does not leave as a finished product.

Caution is required where the use of temporary films is proposed when considering the risk of tempered glass failure. If the film is not properly secured, the result can be a failed tempered panel falling in a single mass rather than a distributed cloud of particles.

> **the risk of failures still remains even after heat-soaking**

Designers should properly risk assess their use of glass, and because the risk of failures still remains even after heat-soaking, take account of the risk of using toughened glass where its failure would cause a hazard. CROSS

published a Safety Alert ***Structural safety of glass in balustrades>*** in 2019 which included consideration of glass types in balustrades.

The CIRIA publication ***Guidance on glazing at height (C632F)>*** includes information on glass manufacture and processing as well as risk and hazards as does the Institution of Structural Engineers publication ***Structural use of glass in buildings (Second edition).>***

Technical Note No 68 Overhead glazing, from the **Centre for Window and Cladding Technology>**, deals with the selection of glass to limit the risk of injury from falling glass. It is concerned with the risk of failure, failure mode and post-failure behaviour of the glazing.

Submit Report

Submit Feedback

COVID-19 and the impact on construction quality

CROSS Safety Report Report ID: 967

A reporter is concerned that during the Covid lockdowns, there may have been work done without adequate independent supervision.

Key Learning Outcomes

For contractors:

- Consider the environmental constraints holistically and carry out additional checks where appropriate

For designers:

- Where possible and contracted to do so, carry out thorough site inspections
- Adapt your activities as reasonably as possible to the novel natures of remote working

For Building Control Approval Bodies or Verifiers:

- Be aware that business as usual checks on-site may have not occurred

For clients, developers and owners:

- Supervision and proper checking are cheap insurance.
- Consider the impact of separating design teams from inspection activities

R Full Report

A reporter is concerned that during the coronavirus lockdowns, there may have been work done without adequate independent supervision. The Construction Leadership Council **issued guidelines>** on the safe operation of building sites, and the government said that construction sites should continue to operate, albeit with social distancing. This meant that construction work has carried on throughout the COVID-19 situation, to varying degrees.

However, the degree of compliance with guidelines on sites has been variable, and this has led Building Control Bodies, Verifiers, Warranty Inspectors, and clients' agents to limit their inspections of the works, due to safety fears for their staff.

The government did issue guidance to Building Control Bodies and Verifiers which ensured that they should not be signing off projects on the basis of remote inspections or photographs, however, the number of inspections during projects has fallen significantly during this period, which means that defects are less likely to have been picked up.

C Expert Panel Comments

The reporter touches upon a key issue of the past two years, and a **timeline of government lockdowns and restrictions>** provides more insight into the time periods this report is referring to.

Levels of inspection

The old adage is *"The measure of a man's real character is what he would do if he knew he would never be found out?"* (Thomas Babington Macaulay).

Similarly, *"There is also hardly anything in the world that some man cannot make a little worse and sell a little cheaper, and the people who consider price only are this man's lawful prey"* (John Ruskin).

It is true to say that the level of Building Control inspection was reduced and that some of that inspection was by remote means. There well may be "latent" defects that come to light in the future as a result, and a potential danger is construction during the past couple of years is going to get a very poor reputation; at some point there may be costs for someone.

There is a proven history in recent times of buildings having been built badly. The most recent experience with that is in relation to external wall construction, where the costs to society have been immense. That includes costs to whoever has to pay to rectify it in the end; this can vary from the insurers, the contractors, the people who end up owning those badly built buildings (often homeowners), and the government (who is assuming the costs in many cases). The same impact could be experienced for other forms and elements of deficient construction.

The difficulties encountered by the coronavirus restrictions do not mean that the contractors or developers had any less responsibility to get things right, of course. Contractors and developers need to have taken additional measures to carry out inspections before the work is finished and made inaccessible. Improvements to procedures need

to have been made across the full site team. A potential complication is that this work is in the past, so once again, reliance is going to be placed on the records claiming how the inspections have been made.

Regrettably, within a contractual chain, there may be stakeholders who, because of time and cost pressures, or even a culture of inadequate professionalism, will cut corners and attempt to cover them up, especially in hidden parts of structures. It is also expected, as part of human nature, that mistakes may be made in any well organised and well-intentioned process. The purpose of systems of work is to check and identify errors so that they can be corrected. The Building Control/Verifier check is a vital part of the process but is not necessarily the first line of defence.

Role and importance of Building Control and Verifiers

This case could also be considered as an exacerbated occurrence of inadequate levels of control (hence why it was reported), which may very well exist in a world without pandemic restrictions.

This should also be considered along with the reduction in Building Control charges, and therefore inspection levels, since the introduction of competition. If it is perceived by stakeholders that Building Control inspection is important, then this is a wider topic and should not be dealt with as a short-term issue.

It should also be borne in mind that the lockdowns enforced to address COVID may have changed perceptions of what is 'normal' and what is acceptable. The panel encourages a return to pre-lockdown levels of supervision of construction (albeit acknowledging that technology methods for inspection may have moved on). This is also part of the previous wider debate on what level of supervision is acceptable and what clients (and society) are willing to pay for.

A Scottish perspective

From a Scottish point of view, legislation is very clear that checking is the responsibility of the "Relevant Person" - typically the Client (owner or developer). It is common for a traditional client to have a Clerk of Work appointed on their behalf to undertake a checking role.

Local authorities are appointed by the Scottish Government as "Verifiers". Before construction starts, they verify the warrant drawings meet the building regulations and grant a building warrant. Before one can legally occupy a building, the "Relevant Person" must apply for a completion certification, which "The verifier will undertake reasonable inquiry" before granting. They are not required to monitor all construction work.

Clients and Designers

Clients that are not willing to assume the cost of site inspections will choose and use inspectors on the basis of cost when they can. This is all more worrying if one considers the findings of the **Hackitt Interim Report>**, where in paragraph 5.24 is stated that "Much of the feedback received indicates concerns that increased privatisation reduces the independence of the review process and leads to a decreasing capacity and expertise in local authorities. There are notable concerns also that third-party inspections are open to abuse given the potential conflict of interests, with growing levels of mutual dependence between developers and contracted inspectors".

Clients may argue that they are paying the contractor/developer to get it right, so there is no need for supervision or inspections. However, it is the public that is put at risk, and inspection is the cost-beneficial way to serve the interests of every party to the contract.

There has been a trend to separate design teams from site inspections, and this usually leads to what is being built failing to match the design intent. The proactiveness in avoiding such issues through good design can be compromised if one considers the impact of the sudden and imposed remote working on designers, which can introduce challenges in supervision and overseeing of design work, particularly when new team members join that have never really met their colleagues, undermining the benefits of 'team working'.

Potential for improvement

It is highly encouraged that those responsible for buildings constructed during this period should be aware of the issue and, as required, carry out their own verification of important details. The importance of good records cannot be overstated.

Another recommendation could be considered to "triage" defects, so assessment is done in a timely manner, and actions proportionate to the defect are appropriately taken.

In anticipation of future challenges, it may be wise to plan ahead and design assurance methods that are robust to the sorts of constraints that the COVID-19 pandemic brought. There is the potential that they can be designed to be just as reliable as conventional supervision (if not more so), while also being more cost-effective. An example of that, considering the use of assistive technology, is how many industries have already developed photography-based Artificial Intelligence enabled fault recognition.

Design teams could focus on what is really essential to get right and then identify Hold Points where direct inspection and thorough interrogation of the works take place. This should be done with a genuine appreciation of the Quality Assurance process, not treating it as pure rules on compliance. This will also serve the purposes of the client's insurance and assurance.

Submit Report

Submit Feedback

Inadequate design for basement works

CROSS Safety Report Report ID: 1132

An inadequate structural design for alterations to a basement led to structural distress within a substantial five-storey townhouse.

Key Learning Outcomes

For property owners and clients:

- Understand the competencies required of engineers for the project in hand
- All structural design should be signed off by an appropriately experienced chartered civil or structural engineer

For civil and structural design engineers:

- Engineers should undertake full assessments of existing structures when considering alterations
- **Designers>** have responsibilities under the Construction (Design and Management) Regulations 2015
- Consider basing the checking of designs upon drawings and specifications as well as the calculations
- Be aware that the adequacy of a structural design submitted to a building control body, lies with the originating designer - do not place reliance on the building control review

For building control bodies:

- Ensure that all structures are checked for compliance with Part A of the Building Regulations in England and Wales, and the equivalent in Scotland and Northern Ireland, by suitably qualified and experienced people

R Full Report

A structural engineer reported they were commissioned to investigate cracking within a substantial five-storey Victorian house that had recently been altered. The alteration centred around the removal of a load-bearing wall at the basement level. The property had previously been altered on a number of occasions.

The client for the basement works had employed an engineer to prepare structural calculations for the works. The engineer prepared a design for a beam (with padstones) to span over the proposed opening to be created in the basement. However, the engineer failed to check the supporting walls, piers, and foundations.

The client employed a second engineer to check the first engineer's design. The second engineer approved the design without flagging up the original engineer's failure to check the walls, piers, and foundations. The building control body signed off the project without deploying a checking engineer to assess the structural design.

Furthermore, the client for the basement works did not serve notices or arrange awards to other owners within the building as required under the Party Wall Etc Act 1996, even though the client was advised to do so.

Sometime after completion of the works, the reporter was called in to investigate cracks that appeared in walls supported by the newly installed beam. The reporter found that walls, piers and foundations needed to be opened up and assessed for the revised structural configuration and that the client would be responsible for the repairs to the flats above.

Failings and missed opportunities

The reporter concluded that failure by both the first and second engineers to recognise that structural assessment of the supporting masonry and foundations was necessary, led to the inadequate structural alterations. In addition, the building control body not identifying the structural inadequacy and the client not complying with the party wall regulations meant that other opportunities to spot the inadequate design prior to construction were missed.

The reporter confirmed the following learning outcomes:

1. Engineers should encourage clients to fulfil their legal obligations (including compliance with the Party Wall Etc Act 1996) and explain the risks of not doing so.
2. Engineers should ensure that they carry out a full design. If their clients ask them to carry out only a partial design, they should explain the risks and be prepared to walk away if their client insists on a partial design.
3. Checking engineers need to not only check the calculations they receive but also flag up any omissions in the design.

C Expert Panel Comments

This is a very worrying report indeed. There were many opportunities for this serious situation to have been avoided. For two engineers to perform so poorly in undertaking their duties, for the building control process to have no apparent impact on the design proposal and for the client to ignore important advice concerning party walls, displays clear failings which should not go unnoticed.

A question of competency

The competence and suitability of both the design and checking engineers for the project appear very doubtful. Ideally, they could have acted as an 'intelligent customer' and advised the client of the scope of structural investigations and design that was necessary. Whilst it is possibly not known how close the building was to a serious collapse, it appears that critical structural work was undertaken with little regard to the stability of structural elements below, around and above the wall that was removed. Furthermore, it appears no attempt was made to understand the impact on the overall stability of this building or indeed the adjacent buildings. Clearly, a thorough structural investigation and assessment of the building (and probably adjacent buildings) should have been undertaken. The required assessment is made more necessary and complex if the property was of multi-occupancy. This would add uncertainty and difficulty in reviewing what changes have been made in the past and changes to load paths. Nevertheless, the investigations and assessments should have at least uncovered and considered the following:

- The structural arrangement of this and adjacent buildings
- Materials and construction techniques
- The strength of the materials
- Existing distress, misalignment, or degradation of building fabric
- What alterations and repairs have been previously undertaken
- The existing load path(s) to earth
- The existing and new loadings (both during construction and on completion)
- The nature of the existing foundations and basement construction

It would appear that both the design and checking 'engineers' were working outside their knowledge and experience; both should have identified that a thorough investigation and assessment were required. CIRIA report **C740 Structural stability of buildings during refurbishment>** provides guidance for clients, designers, builders and others upon a range of refurbishment tasks, including removing walls. The advice also covers investigating and assessing existing structures.

> **the client was obligated to appoint competent persons**

The client was obligated to appoint competent persons. Nevertheless, it may be the case that the designer was asked by the client to do a beam design only. If this were the case, the designer should have insisted that a proper assessment be undertaken or refused to undertake the commission. The checking engineer does not appear to have been competent to undertake the check. Their work should have included a review of the structural concept and design (as described on drawings and specifications) such that they could make their own independent calculations and exercise independent judgement as to the adequacy of the proposals. This would have exposed the lack of appropriate investigation. Works of this type should always be signed off by a chartered structural or civil engineer.

Under the Construction (Design and Management) Regulations 2015 (CDM 2015), the designer should also have considered how the works were proposed to be implemented. The designer should have indicated as part of the design, what method of working and temporary works were assumed to be necessary to implement the design. Clearly, to do this they should have understood the building they were working upon. The HSE provides clear CDM 2015 guidance for **clients and designers>** for projects of this type.

> **the stability of several or indeed all buildings can be compromised**

In this case, cracking occurred, but significant structural collapse could have occurred if the removed wall were a key structural element providing stability to other elements in this building or indeed adjacent buildings. The removal of walls in terraced-type buildings can leave properties depending upon the neighbouring building for stability. Where walls are removed in terraced properties eventually the stability of several or indeed all buildings can be compromised, unless the removal of walls is engineered properly. CROSS report **Inadequate design submissions for alterations to an existing building>** dealt with a not dissimilar case including failure to consider the overall stability of a building. Similarly, the removal of walls within a basement can cause a loss of stability to adjacent retaining walls and the collapse of the building(s).

The checking of engineering designs submitted under building control processes can have many benefits including, not least, the prevention of unsafe structures being erected. Building control bodies have a responsibility to review all designs for compliance with Part A. It would be expected that the building control body dealing with this project should have identified that further assessment of the proposal was required.

> **the ethics of all involved appear open to question**

Finally, but most importantly, the ethics of all involved appear open to question. The client decided it was necessary to appoint a checking engineer which is to their credit. However, they decided not to investigate party wall matters which would have likely opened up the lack of proper assessment. The designer appears not to have sufficient competence in that they did not understand their legal duties and unethical in that they did not have full regard for safety. The checking engineer and building control body also appear to have fallen short of their duty to ensure safety. Construction professionals should always be mindful of their professional duties under law, their terms of appointment and the code of conduct of their qualifying institution. The code of conduct alone will require them to be competent to perform the duties offered, apply appropriate skills, experience and knowledge, to act with impartiality and have full regard for safety.

Submit Report

Submit Feedback

Concern over the quality of a fire safety design submission

CROSS Safety Report Report ID: 1029

A Building Control Officer is disquieted by the quality of a design submission and the approach of a fire engineer in assessing structural fire matters.

Key Learning Outcomes

For fire engineers:

- Designers ought to understand the limits of their knowledge and work within them
- Fire safety designs should take into account all aspects and objectives of fire safety, holistically
- The fire engineer should consider the evacuation capabilities of all occupants expected to use the building as part of a Fire Engineered solution

For Building Control Officers:

- Ensure that fire engineered solutions cover sufficiently all design objectives
- Consider requesting a third-party peer review by a competent professional

R Full Report

The reporter is a building control officer and they review fire safety designs. This report is about a submission for a project in which an existing building is being incorporated into a very large new building. The concern was raised from the fact that the justification of the solution provided was deemed by the reporter inadequate and lacking consideration of fundamental concepts.

The reporter was alarmed because the expected structural fire performance of the existing structure, or any fire resistance rating, were unknown and yet this issue was left unaddressed by the designer. In contrast, the requirement in technical guidance for the new development was a fire-resistance rating of 120 minutes, in terms of resistance (R), integrity (E), and insulation (I). Additionally, there was no separation provided between the old and the new structure. Finally, without any explicit consideration or rationale for the decision, suppression was not being extended to the existing part.

The analysis and justification provided by the fire engineer was only the conduction of an RSET analysis (Required Safe Egress Time) for occupants, which demonstrated evacuation of the building after 6 minutes.

> **fundamentally…does not understand the structural performance of a building in a fire**

The reporter considers that this not only fails to acknowledge the evacuation of persons with reduced mobility, but also fundamentally shows that the fire engineer does not understand that the structural performance of a building in a fire (usually addressed through fire resistance ratings) also contributes to other aspects than means of escape, such as compartmentation to address internal fire spread, the potential for external fire spread, and any concerns related to firefighter safety and persons around the building.

This occurrence demonstrated to the reporter that the designer attempted to address the design process inadequately, and that "it is happening frequently and makes me question the competence of fire engineers in assessing structural fire matters".

The reporter is disquieted because had such a submission been accepted, then a very large building could have been constructed with a lower resistance to structural failure when exposed to fire, increasing the probability of structural collapse in case of a fire event.

They think that fire engineers should acknowledge the limits of their knowledge and consult with other parties where and when necessary, highlighting for this specific case that fire safety is not just about the provision of means of escape but satisfying a breadth of fire safety objectives.

C Expert Panel Comments

The issue of design submissions and their quality has been touched upon in past CROSS reports, focusing on issues of structural safety, namely **report 14>** and **report 65>**.

Unfortunately, this has been noted as an all too common approach where 'fire engineering' (a term loosely used in this specific case) is employed to create an ASET/RSET analysis as a means to justify the consideration of life safety only of the occupants, and then as the reporter states, does not consider those that may need assistance or other design objectives. A fire engineered solution is not just an ASET/RSET analysis, and the fire engineer should consider the evacuation capabilities of all occupants expected to use the building as part of a fire engineered solution. This incident could potentially be perceived by some as intentional, an example of unethical practice, and an excellent example of the need for culture change.

> **failing in understanding the holistic nature of the functional requirements**

The report showcases a complete failure to understand the holistic nature of the functional requirements. The lack of competency exhibited by the fire engineer in not carrying out a holistic analysis of how the proposed development could worsen the fire safety condition with regard to all of the functional requirements of Part B of the Building Regulations, and proposing mitigating solutions to meet Building Regulations requirements, is worrying.

The panel is happy to hear that the building control body (BCB) refused the application while acknowledging the eventuality that this could in some other circumstances potentially be 'accepted'. This of course relies on the BCB having the time, support, resources, understanding, and skills to question and interrogate thoroughly the proposals. A proposal from a fire engineer should ideally never be accepted without question, especially when the proposal has not been subjected to a third-party peer review by a competent person.

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