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COLLABORATIVE REPORTING FOR SAFER STRUCTURES

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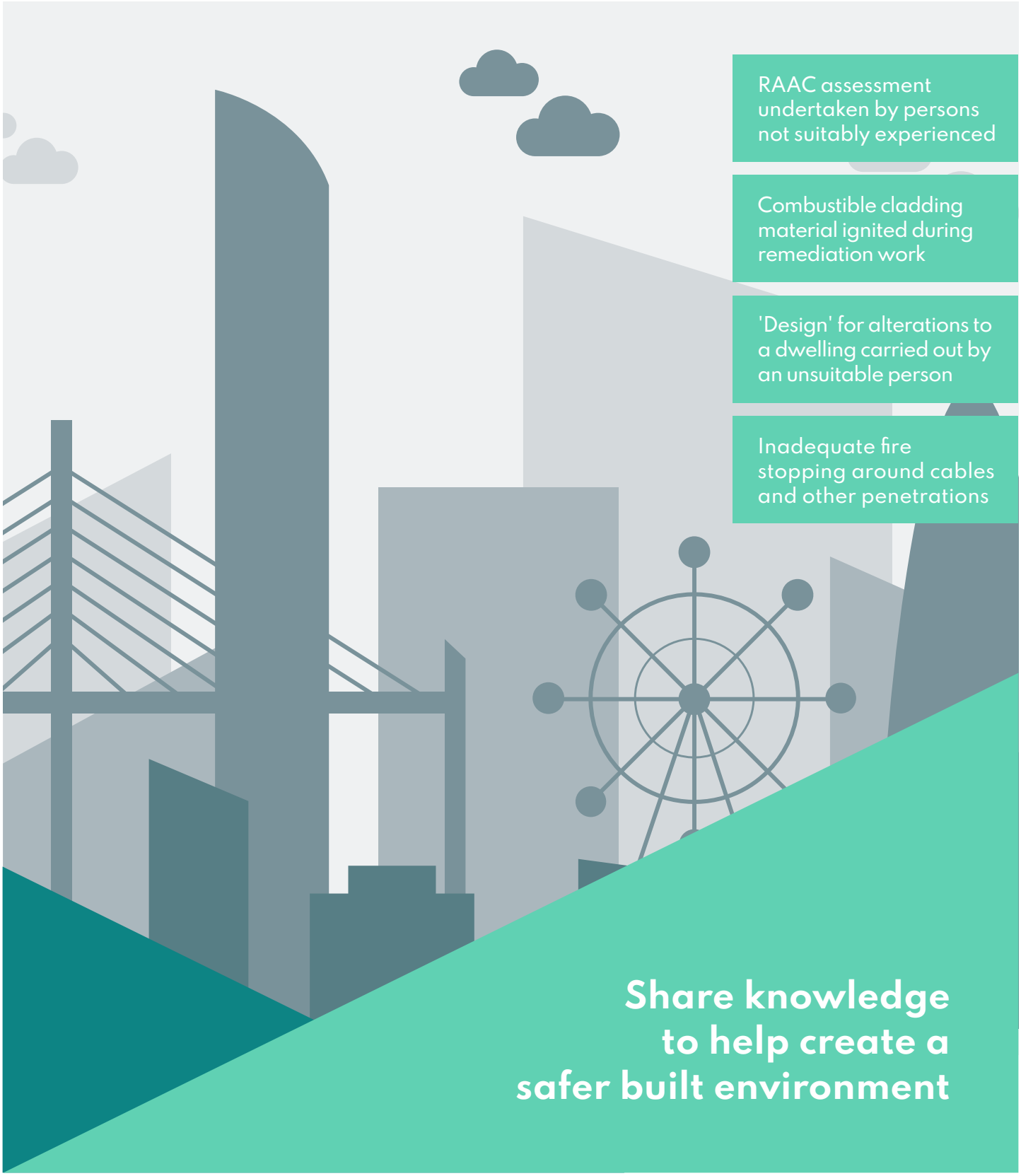
CROSS Newsletter

CROSS-UK Newsletter 70 | **September 2023**



RAAC assessment undertaken by persons not suitably experienced

Combustible cladding material ignited during remediation work

'Design' for alterations to a dwelling carried out by an unsuitable person

Inadequate fire stopping around cables and other penetrations

Share knowledge to help create a safer built environment

Editorial

Disasters always leave their mark and are subsequently known by the name of the building, structure, or ship concerned. Titanic, Piper Alpha, Ronan Point, Grenfell and, mostly recently, Champlain Towers South (CTS) which collapsed in Surfside Miami in June 2021 resulting in 98 deaths.

CTS is the worst structural tragedy of recent years and is the subject of the biggest ever forensic investigation to determine the causes. This is important because it was a 40 year old reinforced concrete frame of which there are very many in the US, the UK, and other parts of the world.

If one was so vulnerable that it collapsed, then what about others?

The multi-million-dollar investigation is being carried out by NIST **(National Institute of Standards and Technology)>** who recently made public some of their initial findings. The building had a suspended deck at ground level, the pool deck, which was connected at one end to the tower which rose to twelve storeys and was topped by a penthouse. The pool deck consisted of a flat slab (known as a flat plate in the US) supported on columns without shear heads and should have been designed and built in accordance with the national standards of the time.

A plan of the pool deck produced by NIST showed deficiencies in bending strength at many locations in the slab and deviancies in punching shear resistance at many column positions. Photographic and physical evidence from the debris showed that some rebar which should have been near the top of the slab was displaced downwards, and the relatively slim columns had high percentages of rebar. There was a limited amount of rebar passing through, or adjacent to, some columns. During the life of the building additional dead load had been added by way of finishes and there were substantial planters in areas which did not match with the positions shown on the original drawings.

At the time of failure there were very slim margins against punching shear at several column locations in the pool deck. Punching shear in flat slabs has been a known problem for many years and has been the subject of considerable research. Current codes in the UK and the US have specific requirements for the amount and arrangement of shear reinforcement around columns. It remains to be seen whether the NIST recommendations will comment upon these in due course.

Despite it often being thought of as a sudden mode of failure, there can be signs of incipient punching shear failure. A precursor may be cracking in the top surface of the slab around a column, but where there are finishes cracks might not be seen. An early example of progressive collapse was at the Pipers Row car park in the UK in 1997 when the shear failure at one slab to column connection led to the unzipping of adjacent connections.

Another line of thought will be what effect the current guidance to prevent progressive collapse, such as those that are given in the UK Building Regulations, would have had on the outcome at CTS. If initiation of the tower collapse took place at around ground level and involved the failure of a column, would designers using current codes recognise the possible risk and either make the columns sufficiently robust to be immune or make the structure above sufficiently robust to withstand the removal of one, or possibly more, columns?

At CROSS we have had reports about punching shear, reports about design and construction deficiencies including the misplacing of top rebar, reports about unauthorised changes (such as increases in loading), about the lack of maintenance, and about the need for regular inspections of older buildings. Lessons can

Contents

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be learned from all these so that precursors are noted and acted upon. However, and it is a big however, observing a precursor such as cracks around a column, and deciding to act is neither simple nor easy even for an informed engineer. In the case of doubt, the correct action is to discuss possible issues with experienced colleagues, call in specialists if there might be a significant problem, and keep the owner informed. It is far better to err on the side of safety, even if proved wrong, than to be involved in a collapse situation.

Alastair Soane, BSc PhD CEng FICE FIStructE Hon FIFireE
Principal Consultant, CROSS

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.

Reports make a positive difference and we depend upon people like you to submit them. The process is straight forward and by sharing information you will help to create a safer environment.

Find out more >

More from CROSS

Recorded Lecture: Champlain Towers South Collapse Investigation

In July, CROSS chaired a lecture presented by WJE (Wiss, Janney, Elstner Associates) at the Institution of Structural Engineers in London. WJE presented their theory of the collapse of Champlain Towers South in Surfside Florida based on evidence, material testing, and analysis.

A **recording of the lecture >** is available on IStructE's YouTube channel.

Request a CPD talk from CROSS-UK

The CROSS Team is available to give presentations to professionals and organisations on the work of CROSS as well as examples of structural and fire safety failures, and the lessons that can be learned from them.

To request a CPD talk please **complete the form >** and we will get in touch to make arrangements.

Follow CROSS on LinkedIn

If you are active on LinkedIn, you can follow CROSS's page to keep up to date with the latest safety news, connect with your network and discuss published Safety Reports with others.

Head to **CROSS's LinkedIn >** page and click 'follow' to join the CROSS community.

RAAC assessment undertaken by persons not suitably experienced

CROSS Safety Report Report ID: 1224

A reinforced aerated autoclaved concrete (RAAC) assessment was carried out by persons who did not appear to have appropriate experience, potentially putting building users at risk of harm.

Key Learning Outcomes

For building owners, managers, surveyors, and other persons responsible for the safety of buildings:

- Understand that building users could be at significant risk of harm if incompetent assessments of RAAC are relied upon
- If RAAC is suspected, an assessment should be made by a Chartered Structural or Chartered Civil Engineer familiar with the investigation and assessment of reinforced concrete structures
- If RAAC is confirmed, a risk assessment of the building and its use is advised
- Risk assessments should have input from an engineer with appropriate knowledge and experience of RAAC
- The Department for Education (DfE) publication, **Reinforced autoclaved aerated concrete: estates guidance>**, contains advice useful when appointing an engineer to assess RAAC

For civil and structural engineers:

- **Reinforced Autoclaved Aerated Concrete (RAAC) panels: Investigation and assessment>**, published by the Institution of Structural Engineers (IStructE) in 2022, provides identification and remediation solutions for RAAC elements
- **Reinforced Autoclaved Aerated Concrete (RAAC) Investigation and Assessment – Further Guidance>**, published in 2023, provides further advice on the critical risk factors associated with RAAC panel construction
- The IStructE also has a **Study Group>** to provide a place for information and guidance on RAAC

R Full Report

This report is about a reinforced aerated autoclaved concrete (RAAC) assessment carried out by persons who did not appear to have appropriate experience which, potentially, put building users at risk from RAAC plank failures. The reporter has been involved in undertaking RAAC surveys on buildings across England. Prior to each survey, the reporter's firm undertakes a desk study to gather available information about the building, including plans, previous surveys, condition reports, and any other relevant information that can be found.

In one such desk study, they came across a report that contained the structural calculations used to

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. What we know so far about school buildings closures >

The government ordered 104 English schools, nurseries, and colleges with reinforced autoclaved aerated concrete (RAAC) to close affected buildings immediately (31 August 2023) until safety measures, such as propping up roofs, are introduced.

This is because there are concerns that RAAC is prone to collapse. Education Secretary Gillian Keegan says the decision followed "new evidence" about the material, and that the government is taking a "cautious approach".

In a statement, quoted in the media, CROSS noted that: "Although called 'concrete', RAAC is very different from traditional concrete and, because of the way in which it was made, much weaker". All of this follows the **publication of the CROSS (SCOSS at the time) Alert>** in 2019. Since then CROSS has had a number of reports about RAAC including one in this Newsletter (Report ID: 1224).

In a separate news report on **Unsafe or ageing schools>**, safety being related to building age plus lack of maintenance was highlighted by the UK National Audit Office estimating there are 700,000 pupils in unsafe or ageing schools in England. The Office assessed the risk of injury or death from a school building collapse as "very likely and critical". Among the hazards identified were RAAC structures and asbestos.

establish the capacity of existing RAAC panels. The calculations, supposedly based on Eurocodes, used a proprietary software package and the parameters entered treated the RAAC as if it was normal structural concrete. This demonstrated a fundamental misunderstanding of the difference between RAAC and normal structural concrete, how RAAC would have been designed originally, and how it should be assessed.

> **Demonstrated a fundamental misunderstanding of the difference between RAAC and normal structural concrete**

The reporter believes the fact that the assessment author did not realise the calculations were not suitable suggests that they were not an engineer. The inclusion of calculations in an assessment report could suggest, to a layperson, including many building owners, a thorough approach to the RAAC assessment. However, a competent engineer would understand the calculations were inappropriate and made grossly optimistic assumptions about the properties of the RAAC.

> **The calculations were inappropriate and contained grossly optimistic assumptions about the properties of the RAAC**

The calculations used a compressive strength of 37 N/mm^2 whereas autoclaved aerated concrete (AAC) might more typically have a compressive strength of circa 3N/mm^2. Significant other differences between RAAC and normal concrete were also not taken into account. Furthermore, the reporter states the assessment did not consider other RAAC specific risks such as brittle failure arising from narrow bearings. Despite these failings, the assessment concluded the RAAC planks were fit for purpose. The reporter considers that if the owners of the building relied on the report, they potentially had an inaccurate picture of the building's safety and, consequently, a large number of people could have been put at risk of harm.

> **A large number of people could have been put at risk of harm**

Fundamentally, the reporter considers the issue to be that the survey and assessment report appear to have been undertaken by someone without appropriate engineering knowledge and RAAC assessment experience. The reporter's view is that the assessment of RAAC, in terms of risks and suitability for continued occupation, should only be carried out by a suitably experienced Chartered Structural Engineer.

The reporter concludes that any client procuring a RAAC assessment should follow the guidance provided by the IStructE and ensure they only appoint suitably qualified and experienced individuals or organisations.

C Expert Panel Comments

This worrying report refers to an assessment that may well have been assumed to be competent but as shown by the reporter this was not the case. Building users could be at significant risk of harm if incompetent assessments of RAAC are relied upon. All persons responsible for buildings where RAAC is present, must understand that the assessment of such elements should only be undertaken by engineers with appropriate knowledge and experience.

2. Balcony collapse >

The failure of balconies is quite common and CROSS highlighted the risks in a **Safety Alert>**. Another sudden balcony collapse has been reported from apartments in Florida. Following inspections, the whole concrete building was then deemed unsafe.

3. Sink hole above tunnel >

In May, a 6m dimeter hole suddenly appeared above a tunnel being driven for HS2. CROSS has previously highlighted potential dangers from sink holes and sudden loss of ground support in a 2017 **Safety Alert>**.

4. Newbuild block condemned >

A report from Camden condemns a newly built block as 'not fit for purpose'. There were cracks in the walls, and the timber frame was rotting. An independent report concluded: *"... demolition and rebuilding should be considered ... it is our opinion that there are no viable structural remedial works that would restore the stability and integrity of the building".*

5. Wall collapses during fire >

A major fire occurred in a multi storey building in Sydney. The need for structural integrity during a fire was illustrated by dramatic wall collapses occurring during the event.

6. Hospital collapse risk >

CROSS issued a Safety Alert on RAAC in 2019 and has a **Theme Page>** on the topic. Its presence has been subsequently found in many public buildings, including hospitals. The Government has decided that five hospitals are so badly affected that they will all need to be rebuilt.

Why are engineers with knowledge of RAAC required?

There is a risk of structural failure of RAAC planks. Failure can be gradual or sudden and, if sudden, there is no warning. Structural failure can be caused by several mechanisms and it is now recognised that RAAC is considerably less robust than structural concrete and ages much less well. Because RAAC planks were most commonly used in roofs, sudden failure can be dangerous and could potentially result in death or injury. It should however be noted that, at present, reported failures of RAAC are few and far between.

> **Failure could potentially result in death or injury**

As the reporter says, AAC is very different from normal dense concrete. It has no coarse aggregate and is made in factories using fine aggregate, chemicals to create gas bubbles, and heat to cure the compound. It is relatively weak with a low capacity for developing a bond with embedded reinforcement. The unit weight and compressive strength of AAC varies greatly depending upon constituents and manufacturing process but, typically, AAC might weigh about 20% to 30% of normal structural concrete and may have only about 10% to 20% of the compressive strength of everyday structural concrete.

> **May have only about 10% to 20% of the compressive strength of everyday structural concrete**

As RAAC is a very different material from structural concretes, engineers undertaking assessments of buildings containing RAAC must have appropriate knowledge and experience of how RAAC elements can behave. Without this understanding of the material, very serious potential structural failures which should have been averted, may be missed.

In the 1990s, there were instances of failure of RAAC roof planks installed during the mid-1960s and a proportion of such installations were subsequently demolished. In 2018, the Local Government Association and the Department for Education contacted all school building owners about the collapse of a plank in a school, and the SCOSS Safety Alert, **Failure of reinforced autoclaved aerated concrete (RAAC) planks>**, was issued in May 2019.

Appoint an engineer with appropriate knowledge and experience of RAAC

Many buildings are overseen or managed by construction professionals such as surveyors, architects and engineers. However, it is also the case that the management of buildings can be the responsibility of persons who do not have any significant experience of buildings or construction. Regardless, all persons responsible for the management and safety of buildings should be made aware of the significant concerns surrounding RAAC planks and panels.

> **All persons responsible for the management and safety of buildings should be made aware of the significant concerns surrounding RAAC planks and panels**

Where there is a concern that a building may contain RAAC elements, the responsible body or person should ensure an engineer with appropriate knowledge and experience of RAAC undertakes the required assessment.

7. Crane catches fire in Manhattan>

In Manhattan a fire broke out inside the cab of a tall crane servicing a 50 storey apartment block. The crane collapsed onto a nearby building. This incident illustrates the dangers of fire anywhere plus the potential consequences of collapse due to fire.

8. Bridge collapses a second time >

In June, a 3km long bridge in India collapsed while under construction. No reasons for the collapse were given, though a video shows the form of bridge permitted a progressive collapse along its length.

9. Freeway collapse >

Also in June, a span of the Philadelphia Interstate Freeway collapsed following a fire from an oil tanker in the underpass below. The effects of fires on structures, even bridges, can be devastating.

10. House collapse >

The entire back of a three storey house suddenly collapsed in Hackney (London). No cause has been given, but images suggest that lack of robustness must have been a factor.

11. Falling stone parapet blocks >

Several large stone parapet blocks fell off a bank building in Thurso landing on the pavement. Items falling off older buildings are a generic hazard and have caused deaths. In 2008, CROSS (then SCOSS) produced a **Topic Paper on the safety of buildings in Scotland>** following a recommendation by the Construction Industry Council for Scotland in their 2003 report, *Risks to Public Safety from Falling Masonry and Other Materials.*

The DfE publication, **Reinforced autoclaved aerated concrete: estates guidance>**, published in 2022, provides advice to responsible bodies in education settings on the process of assessing, investigating and developing a RAAC management and remediation strategy. This guidance may be very helpful to responsible bodies and persons across other sectors in both the public and private sector. The guidance includes matters to be considered when appointing an engineer who has the necessary knowledge and experience of RAAC.

The IStructE has published guidance, **Reinforced Autoclaved Aerated Concrete (RAAC) panels: Investigation and assessment>**, that provides identification and remediation solutions for RAAC planks. This guidance is recommended as essential reading when considering RAAC induced risk. The conclusions within the guidance state:

'Assessments of buildings with RAAC panels are recommended to include a balance of risks for the continued use of the building against the benefit of strengthening or replacement of the panels. The assessment should include a robust risk assessment and include consideration to the on-going monitoring and future management of the RAAC panels. The failure of the panels which resulted in the SCOSS Alert was a sudden failure and could be an indication that it was due to a brittle shear failure at or close to the bearing. Based on this a cautious approach to the assessment of RAAC panels is recommended and assessments should only be undertaken by a Chartered Structural Engineer with experience in the investigation and assessment of reinforced concrete structures.'

The IStructE also published **Reinforced Autoclaved Aerated Concrete (RAAC) Investigation and Assessment – Further Guidance>** in 2023, which provides further advice on the critical risk factors associated with RAAC panel construction. It includes a proposed approach to the classification of these risk factors and how these may impact the proposed remediation and management of RAAC.

The CROSS Theme Page, **Structural safety of reinforced autoclaved aerated concrete (RAAC) planks>**, provides a collation of all RAAC information published by CROSS.

Share your experience

For those with understanding of RAAC planks, CROSS encourages you to confidentially share your knowledge with us so that others can learn from your experience.

Visit **Reporting to CROSS>** for more information about submitting a report, and how they are anonymised and deidentified.

Submit Report

Submit Feedback

12. Huge fire burns in Las Vegas >

In June, a huge fire broke out in Las Vegas utterly destroying a block of flats. The flats were under construction at the time, so this is a reminder of the common dangers of fire on construction sites.

13. NIST issues new guidance for wildfire response >

This summer there has been a plague of wildfires across the northern hemisphere. Incidents have been especially bad in Canada, Hawaii, Greece and many Mediterranean Islands The death toll in Hawaii certainly exceeds 100. Large scale evacuations were required in the Mediterranean. The fire causes are thought to include climate change, so the hazard is going to persist. NIST have offered emergency response guidelines.

14. Harlow secondary school closes over structural concerns >

Second school built by Caledonian Modular told to close >

CROSS has collated several news reports alleging problems with modular buildings. These are about schools which are relatively new. The reasons have not been revealed but have required closure and demolition. Reports state that the projects were part of the Department for Education's £3bn modular framework, set up in 2020.

Combustible cladding material ignited during remediation work

CROSS Safety Report Report ID: 1222

Combustible insulation on the external walls of high rise residential premises is being remediated nationwide. In a recent site visit, the reporter identified a render faced wall with an expanded polystyrene (EPS) core attached to a building's structure. Damage was noticed in the insulation from apparent combustion within the EPS element.

Key Learning Outcomes

For project managers, contractors and building managers:

- Most buildings are occupied during cladding remediation works, so it is critical that safe working practices are adopted to ensure the safety of residents

For principal contractors:

- The principal contractor should ensure fire prevention measures are in place during remediation works. In particular, they should ensure that a competent person undertakes a suitable and sufficient fire risk assessment
- It is essential to ensure that any operations involving the generation of heat or sparks, such as hot works, cutting or grinding, are known about and suitably controlled

R Full Report

Combustible insulation on the external walls of high rise residential premises is being remediated nationwide. In a recent site visit, the reporter identified a render faced wall with an expanded polystyrene (EPS) core attached to the building's structure. Damage was noticed to the insulation from apparent combustion within the EPS element.

Extensive remediation works continue nationwide in the wake of the Grenfell Fire tragedy. There is a duty on the industry to ensure a safe and sustainable approach for owners, occupiers, and residents of the buildings involved. This applies during the remediation works being undertaken on site, as well as in the end condition.

As most buildings are occupied during the works, it is critical that safe working practices are adopted to ensure the safety of residents.

> **Unsafe working practices would appear to be the underlying cause**

With demolition/removal underway, friction from powered cutting tools has been indicated as the cause of localised ignition within the external wall. The combustion appears to have been extinguished after a short time in this instance but was not reported or identified as having occurred to

More CROSS reports

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

Checking structural calculations (Report ID 816) >

A reporter worked for a small consultancy, as a graduate structural engineer, where their calculations were never checked.

Potential overcrowding in education premises (Report ID 1202) >

A reporter expresses concern about the potential for greater occupancy numbers than planned for in education premises.

Poorly applied external insulation on buildings (Report ID 1203) >

This report concerns external insulation on buildings being inadequately applied and fixed, with poor control of the workmanship standards, leading to potential safety concerns and damage to the property.

the team on site. There does not appear to have been an extinguishing medium used, and therefore this has been identified as a near miss to the contractor, design team, and client. There is the potential that the fire could have entered the cladding and proceeded to burn extensively within the cavity between the cladding and the structure.

Unsafe working practices would appear to be the underlying cause. It is expected that any hot works should meet the requirement of **HSG 168 Fire Safety in Construction>**, and where applicable the **Joint Code of Practice for Fire Prevention on Construction Sites>**.

It is incumbent on the principal contractor to ensure fire prevention measures are in place during remediation works. A suitable and sufficient fire risk assessment should be undertaken by a competent person in respect of proposed works on site.

> **It is incumbent on the principal contractor to ensure fire prevention measures are in place during remediation works**

This assessment should consider the tools to be used, the materials in place, and the consequences of ignition upon relevant persons.

C Expert Panel Comments

This is a worrying report, which highlights how construction site operatives need training in the unintended consequences of what they are doing.

The cause of this safety concern appears to come down to the management of fire safety on a construction site which, as reported, appears to be poor.

According to the reporter there was a complete disregard for the requirement under the CDM Regulations to ensure that the proposed works do not compromise the safety construction operatives.

In addition, if works are taking place in an occupied building, the residents must be protected. There is a need for a pre-construction plan which ensures that what is undertaken does not compromise the safety of residents.

That includes the identification of any combustible materials that are present, such as combustible insulation, or introduced as part of the works (for example, timber scaffolding or weather sheeting) and any fire risk activities such as hot works, cutting, or grinding. It also includes any risk that the works might compromise the fire safety systems for the building (for example, any corridor smoke vents which might discharge into areas which are going to be scaffolded).

The fire risk assessment for the building also needs to be updated to reflect the situation during the construction or remediation phases.

A competent principal contractor should ensure that adequate supervision is in place, that subcontractors are competent for the tasks they are contracted to carry out and that appropriate controls for hot work, usually by a permit system, are in place.

> **There are too many instances where ignition from work practices have led to major fires**

This is an opportunity to highlight the need to alert the Fire and Rescue Service (FRS) in these circumstances, which should be part of the management and culture of fire safety on the site, as whilst those responsible may wish to 'cover up' the fire, the early summoning of the FRS is key. There are too many instances where ignition from work practices have led to major fires, and so we need this culture to change to make progress. This would be particularly tragic if there was another cladding fire in a residential building. The consequences for all involved would be severe.

Submit Report

Submit Feedback

'Design' for alterations to a dwelling carried out by an unsuitable person

CROSS Safety Report Report ID: 1236

A reporter was called upon to review a design for the removal of a loadbearing wall during the refurbishment of a residence. A builder was already on site but had stopped work since they considered the engineering design to be unsatisfactory and the structural designer was not responding to their queries. The reporter found that the structural design being followed was far from competent.

Key Learning Outcomes

For property owners and clients:

- Incompetent structural design may lead to a building collapse and loss of life
- Conversions and changes to domestic dwellings can be structurally complex
- You should be satisfied that structural designers are competent before appointing
- All structural design should be signed off by a suitably qualified and experienced person (SQEP) such as a professional civil or structural engineer

For civil and structural design engineers:

- Refrain from design work where there is insufficient opportunity to visit the site
- Inspect existing buildings before designing any changes to the structure

R Full Report

The reporter, an experienced Chartered Structural Engineer, was called upon to review the design for the removal of a loadbearing wall during the refurbishment of a residence. A builder was already on site and the client had engineering calculations and marked up architect's drawings showing the structural information. However, the builder had stopped work since they found the engineering design to be unsatisfactory and the structural designer was not responding to their queries. The reporter was therefore asked to review the structural design and recommend a way forward such that the works could be completed.

The design showed four steel beams, steel columns, some lintels, and new foundations. It did not show how applied loads had been calculated and did not allow for any wind loadings. No calculations had been provided to show how the beams should be framed with the columns to provide sway stability. The structural information showed new foundations, but trial pits dug by the builder revealed competent existing foundations which could be reused. The builder and building control body had agreed that two of the proposed new structural members could be omitted since there was no loading applied to them, and they were not required for reasons of stability.

> **(The design) did not show how applied loads had been calculated and did not allow for any wind loadings**

Following the reporter's review of the design and discussions with the building control body, it was agreed that the original design could not be modified, and a redesign was required. The reporter agreed to produce a new design, together with drawings and submit these to the building control body for approval.

During the reporter's review of the original design, it became apparent that:

- The original structural designer had not visited the site - they had based their design on the architect's drawings
- The original designer was not associated with either the Institution of Structural Engineers or the Institution of Civil Engineers
- Details of the designer's firm were not registered with Companies House

- The designer's website did not give the name of the business owner nor the names of any staff. It also did not give any contact telephone number

The reporter considered that, in failing to examine the existing structure, the original designer's input to the project fell short of expected standards, and that the 'designer', was most likely not competent or qualified to design building structures.

In the reporter's view, people who are not qualified or competent are setting themselves up as structural designers. When problems arise on a project, such unsuitable people may simply disappear. Furthermore, domestic clients can be taken in by such people - often on the basis of a well presented website. To the client, computer generated calculations may appear to be professional, however under examination, the calculations may be incorrect.

> **domestic clients can be taken in by such people - often on the basis of a well presented website**

In the reporter's view, such people present a risk to the public and action should be taken against them where appropriate. Finally, the reporter advises that clients should use the services of Chartered Structural Engineers such as those listed on the Institution of Structural Engineers **Find An Engineer>** website.

C Expert Panel Comments

The householder was fortunate in that they employed a competent builder who recognised the likely inadequacies of the 'design'. The builder, in pausing work and waiting for the design to be reviewed, potentially prevented a collapse. CROSS receives many reports about structural designs being undertaken by persons who appear not to be competent, particularly in respect of work undertaken in the domestic residential market. CROSS **Report 1183, Incompetent design of simple steel beams>**, published in 2023, is just one example. Incompetent persons who issue designs not only risk lives but are also likely not meeting their legal obligations.

> **The builder, in pausing work and waiting for the design to be reviewed, potentially prevented a collapse**

Conversion and changes to domestic dwellings can be complex and demanding. Identifying potential conceptual structural schemes and developing appropriately elegant, effective, buildable, and economic solutions, requires significant knowledge, skills, and experience. Any requirement to remove loadbearing walls must not be treated lightly, as both the temporary and the long-term stability of the dwelling could be put at risk. People too often think that the walls they wish to remove, are only there to take vertical loads, when, they may well be essential for the lateral stability of the whole building. Buildings may collapse if walls are removed without measures to safeguard the overall stability of the building. Clients should understand that structural engineering, domestic work included, is a complex discipline that should only be entrusted to a suitably qualified and experienced person (SQEP) such as a professional civil or structural engineer.

Clients must appoint competent designers

Clients should be aware that not every engineer, even if chartered, is competent to undertake all designs; their suitability will depend upon their experience and knowledge of the type of building being worked upon. As a minimum, a structural designer should be expected to be a member of a professional body that regulates structural designers, normally the Institution of Structural Engineers or the Institution of Civil Engineers. CROSS once again recommends that all structural designs, domestic scale work included, be signed off by a suitably qualified and experienced person (SQEP) such as a professional civil or structural engineer.

> **As a minimum, a structural designer should be expected to be a member of a professional body that regulates structural designers**

Domestic clients have an important role in making sure that the people they bring in to do work are capable of doing it in a way that avoids harm to anyone. This applies to both designers and contractors. The Health and Safety Executive provides **guidance for domestic clients>** including what they need to know about The Construction (Design and Management) Regulations 2015 (CDM 2015).

Designers should visit sites

It appears that the original designer did not visit the site. Competent designers will understand the value derived from inspecting an existing building before designing any changes to the structure. An inspection, amongst other things, enables the designer to understand the existing construction materials, the condition of those materials, previous changes to the building, existing load paths, and how the structure will respond to the proposed changes. Very little of this can be fully gleaned except by inspecting the structure. An inspection also allows the designer to consider what further 'opening up' of the structure is required to validate their design. Designers should refrain from undertaking work where there is insufficient opportunity to visit the site. Conversely, any person who proposes structural changes to an existing building, without inspecting it, could have their competence queried.

Designers should refrain from undertaking work where there is insufficient opportunity to visit the site

Designers should also consider what site inspections would be sensible during the works.

It can be that too much reliance is placed on the sign off of building control. Building control bodies do not create risks and therefore are not responsible for them. The draft code of conduct for registered building inspectors requires that they do not carry out design activities. This includes not advising contractors, designers, or clients on how to proceed. Only a competent designer can advise on matters of design.

CROSS **Report 1132 Inadequate design for basement works>**, published in 2022, also about works to a residential property, considered issues of designer competency and overall building stability.

Submit Report

Submit Feedback

Inadequate fire stopping around cables and other penetrations

CROSS Safety Report Report ID: 1201

A reporter observed inadequate fire stopping due to ineffective installation and/or damage caused by follow on trades.

Key Learning Outcomes

For passive fire protection installers:

- Persons employed to carry out work that involves safety critical, often hidden, passive fire protection measures must be competent for the task
- Companies employing installers should check the quality of work carried out

For risk assessors and fire engineers:

- Passive fire protection should be checked as part of a survey or risk assessment, to gain assurance that the fire strategy for compartmentation can be relied on

For building owners and managers:

- Assurance should be attained from competent persons that the fire precautions specified in a design fire strategy are in place and likely to be effective
- When follow on trades are contracted to work in areas where passive fire protection is installed, assurance should be obtained that the works have not compromised the protection
- The use of UKAS accredited third party passive fire protection certification schemes is encouraged

R Full Report

A reporter states that following numerous compartmentation surveys in residential flats, inadequate and incomplete fire stopping of cables and services have been regularly observed as they pass through compartment walls. These appear to be either as part of the initial build or following subsequent installations after premises occupation. These installations include fire alarm systems, communications wiring and general electrical works.

As well as creating new penetrations, existing fire stopping systems have also been damaged, thus rendering them ineffective. These compartmentation defects are very often in unseen locations, for example above false ceilings, and are therefore not obvious to building owners and managers.

The reporter estimates that 70 percent of residential flats they've seen in the last 12 months have some compartmentation issues.

A building may have had all service penetrations correctly fire stopped at the handover stage, but subsequent installations will have made the compartmentation defective, potentially without the building owners being aware. Due to the unseen locations of the penetrations, a fire could go unchecked from compartment to compartment. The areas affected include walls above flat lobbies and cross corridor doors meaning that regular checks of fire resisting door sets could miss these areas. If building owners are not aware until a later date that the compartmentation of a building has been affected then the costs, both financial and risk to life, could be significant.

The reporter asserts that the underlying cause appears to be a lack of communication between installers and building owners, as well as a lack of understanding of the importance of compartmentation/fire stopping systems. This may be due to a lack of training of installers rather than the company as a whole. Communication and agreement between both parties could prevent any misunderstandings.

Before any installation that will affect compartmentation in a building, there should be an agreement between building owners and installers that any penetrations will be effectively fire stopped. There should be a two way system of reporting if current fire stopping systems have been damaged and building owners should check the compartmentation post installation.

Fire risk assessors should carry out a sample of compartmentation as part of their assessments and building owners should be made aware of any issues, according to the reporter.

C Expert Panel Comments

Fire compartmentation issues appear to be a recurring regular reporting topic to CROSS. CROSS **Report 1039 Fire compartmentation detailing issues>** is a good example.

In this report, the reporter provides an additional concern relating to the importance of those responsible for the premises 'managing' the fire resisting compartmentation throughout its life cycle. This not only becomes a regulatory issue under The Regulatory Reform (Fire Safety) Order 2005 (FSO, with similar in devolved administrations) but is a good example of how an important fire safety measure will need to be managed by the golden thread of information when considering The Building Safety Act 2022, especially when accountable persons are preparing their respective safety cases.

> **It is important for fire risk assessors and building managers to check for new cables and penetrations when completing building inspections**

It is important for fire risk assessors and building managers to check for new cables and penetrations when completing building inspections. Owners and occupants of buildings should be reminded on a regular basis that any works requiring drilling or damage to their area or communal areas must be carried out with authorisation, and by competent persons. The use of a permit to work helps to ensure standards are maintained.

It is worth mentioning that the drive to install high speed broadband may exacerbate this issue further. Several national providers are installing their own systems in separate trunking in blocks of flats. This results in many more penetrations than would be necessary if they shared trunking or even cables. It is understood that the wayleave agreements these companies have, allows them to enter blocks of flats with minimal consultation or notice to landlords.

Submit Report

Submit Feedback

Overloading a portal frame with suspended services

CROSS Safety Report Report ID: 1195

A reporter designing a single storey portal frame used a standard roof service loading of 0.25kN/m². After the project was completed, a tenant for the unit took over fit out and added a considerable amount of sprinkler pipework into the roof. This created local overloading.

Key Learning Outcomes

For designers:

- The weight of suspended pipes full of liquid can be significant and may exceed nominal allowances for suspended roof services
- Clip type fixings on the flanges of purlins may become overloaded and cause damage
- Heavy point loads from secondary steelwork may compromise the integrity of main portal frame steelwork
- Make sure, whenever possible, that the client/owner is aware of load allowances and passes this information on to tenants

For contractors and sub contractors:

- Check with the designer of the primary frames that applied loads from heavy pipework are acceptable
- Be aware of what nominal allowances such as 0.25kN/m² means in practice

R Full Report

This report concerns the overloading of a roof due to a concentration of services that were not allowed for in the design. A reporter designed a single storey portal frame using an allowance for roof service loading of 0.25kN/m². After the project was completed, a tenant for the unit took over the fit out and added a considerable amount of sprinkler pipework into the roof supported from some newly added secondary steelwork. The reporter was consulted over the effect of the localised point loads applied to the main structure by the installed services and additional steelwork.

During their assessment, the reporter observed a considerable amount of other pipework in other areas of the roof that was supported directly from the cold rolled purlins, generally via a clip type fixing to the flange. In some locations, the total pipe loads were in excess of 100kg per metre run of pipe, with a significant number of pipes supported from a pair of cold rolled purlins. The reporter goes on to say that the loads, and their local effects, exceeded that generated from the 0.25kN/m² allowance and could have led to a serviceability failure of the supporting steelwork. This could have compromised the integrity of the roof, and at the very least led to leaks. However, more seriously, it could also have led to a partial collapse of the roofing system.

the loads, and their local effects, exceeded that generated from the 0.25kN/m² allowance and could have led to a serviceability failure of the supporting steelwork

The attachment of the mechanical services to the purlins, with very high point loadings due to the weight of the pipework being filled by water, was also not acceptable, even though the designer's risk assessment had raised it as a matter to be considered. The reporter goes on to say that clip fixings with large loads can lead to excessive local deformation of the purlin flange and cause the mechanical services to become detached. This would lead to a progressive collapse of the supported services. Fortunately, the sprinkler pipework had not been commissioned and was not full of water, and so no adverse effects were observed to have yet resulted. The reporter adds that a comprehensive programme of remedial works was specified. These included rerouting some services where portal frame stability was impacted.

In the opinion of the reporter, a number of factors contributed to the overloading problem:

- A lack of communication between the fit out contractor and the main contractor. The fit out contractor had been employed directly by the tenant. The main contractor was not aware that the fit out was being done and had not communicated any specific risks identified by the design team to the fit out contractor
- A lack of understanding by the fit-out contractor of the need to comply with mechanical services load allowances. It became clear through communication with the fit out contractor that they likely did not understand what a service load allowance of 0.25kN/m² meant in practical terms
- A lack of understanding of the capacity of the clip fixings. When challenged about the use of clip fixings to the purlins, the contractor said that they were adequate as the applied loads were less than the specified clip load capacity. The reporter advised that this may well have been true for the clip itself, but not so for the cold rolled purlin toe to which the clips were fixed

Following this experience, the reporter's firm reassessed what information they would provide as part of designer's risk assessments. They decided that they would in future, issue a document giving practical examples of mechanical services to a load of 0.25kN/m², supported off secondary steelwork.

> **the reporter notes that modern industrial buildings tend to have many more services than in the past**

As a wider discussion point, the reporter notes that modern industrial buildings tend to have many more services than in the past. In this case, the main culprit was sprinkler pipework but the reporter's firm has seen industrial premises with sprinklers, heating, cooling, data and electrical services, all of which are deemed to be within the 0.25kN/m² services allowance.

The reporter asks if there is an argument that this allowance is no longer fit for purpose. They wonder if the allowance should be circa 0.4kN/m² for buildings without photovoltaic (PV) panels, and 0.55kN/m² for buildings with PV panels. The reporter however notes that increasing service loads is likely to increase the amount of steelwork being used and therefore will have a negative impact on projects, both commercially and environmentally.

C Expert Panel Comments

This report underpins the role of designers who, before putting pen to paper and making calculations, need to open a dialogue with the client and/or architect about the function of a structure and what loads are applicable. As services are often an unknown at the early stages of a project, a prudent designer might suggest a working allowance, adding that it should be verified at a later stage.

It can be illuminating to ask students or indeed members of a construction team, what 0.25kN/m² looks like. Certainly, the fit out contractor did not appreciate what it meant in comparison with the loads that were going to be applied.

> **It is essential to have good communication with the original client about the future proofing of the structure**

It is always a risk that a carefully thought through engineering design is compromised by a late and ill-considered addition. There are many examples of where this has led to failure and collapse. The message from CROSS is that all changes must be approved by the designer; for example, in the case of this report, the designer of the main structure. It is essential to have good communication with the original client about the future proofing of the structure. For example, by suggesting that provision is made for additional roof mounted loads; externally for PV installations smoke vents and the like, and internally for sprinklers, ducts and other services.

The structural and services designers need to clearly describe the available capacity to the principal designer and provide clear visual information for inclusion in the Health & Safety file. Such information will be of value when changes are being proposed to the loads on a roof.

> **Such loads are substantial and would, in almost any circumstances, require special consideration**

The reporter makes the point that services may be heavier than they used to be. Interestingly, old Institution of Structural Engineers manuals, *Manual for the design of reinforced concrete (1985)* and *Manual for steelwork building structures (1989)*, as well as *SCI P359 Composite design of steel frame buildings* (2011) give design allowances of 0.32 to 0.45 kN/m². The current Institution of Structural Engineers *Manual for the design of steelwork building structures to EC3 (2010)* gives between 0.1 to 0.5 kN/m² for ceiling and service load, depending upon building type. The British Council for Offices recommends 0.24 to 0.49 kN/m². These put into perspective the very high point loads mentioned by the reporter. Such loads are substantial and would, in almost any circumstances, require special consideration. Sprinkler pipes full of water are heavy!

The reporter says that high local loads distorted the lip on the cold rolled section which is potentially a serious weakening of the section buckling capacity and could compromise safety.

a matter of individual designer judgement

There is a difference in approach between those who would increase allowances to protect safety and those who want to reduce structures to the bare minimum to protect the environment. It is a matter of individual designer judgement, though the client should always be made aware of the chosen position and be in agreement.

Submit Report

Submit Feedback

Fire resisting doors fixed open in hot weather

CROSS Safety Report Report ID: 1162

When visiting a client during a period of unusually hot weather, it was noted that most of the building's fire resisting door sets were wedged open to increase ventilation and reduce internal temperatures.

Key Learning Outcomes

For building managers and responsible persons:

- Permanent or temporary actions that involve changes to fire precautions should be assessed by a competent person

For fire risk assessors:

- Ensure even temporary changes to a building's fire precautions are fully considered in a fire risk assessment

R Full Report

When visiting a client during a period of unusually hot weather, it was noted that the vast majority of the building's fire resisting door sets were wedged open in an attempt to increase ventilation and reduce internal temperatures. This action resulted from a 'working in hot conditions' risk assessment, recently completed by the client.

The risk assessment had not considered the detrimental impact to the building's fire compartmentation strategy, which had been entirely compromised. In addition, no management interventions were arranged to close the doors when the building became unoccupied during the night.

Whilst duty holders and their H&S advisers must consider a wide range of safety issues and hazards in the workplace, change management protocols are a robust method of reducing the chance of unintended consequences.

C Expert Panel Comments

This incident is unfortunately all too common and something regulators across the UK deal with on an almost daily basis. The wedging of fire doors still persists as one of the simplest actions any person can take that adversely affects the fire strategy and precautions of a premises and which can place people at risk in the event of fire.

The fire risk assessment required under The Regulatory Reform (Fire Safety) Order 2005 (FSO in England and Wales with similar legislation in devolved administrations) is a live process and should reflect the premises as it is currently being used.

This live process will identify both fire safety measures, including fire doors and their importance, and what changes in use can be permitted within a premises that ultimately do not adversely affect the fire safety strategy. An example of this would be where an external 'fire exit' door may be safely held open to increase ventilation, as it is ultimately a final exit from the premises, but may not be safely held open if the exit is also a fire resisting door that protects a means of escape from above e.g. an external escape.

The practice of wedging internal fire doors becomes even more complex. Advice should always be sought from a competent person. Where a fire door is considered in needing to be held open, there are ways and means that this can be done safely e.g. appropriate automatic hold open devices that close on the activation of automatic fire detection.

> **A properly installed and maintained fire door can be one of the most important fire safety features in a premises**

A properly installed and maintained fire door can be one of the most important fire safety features in a premises, limiting the spread of fire and smoke and protecting the means of escape.

It is imperative that all persons within a premises are aware of the fire safety measures and their importance, and how their actions, or inactions, can adversely affect themselves and others.

Staff should receive training regarding fire appropriate to their responsibilities, and at least to a level where they are familiarised with the fire safety measures, including the identification of fire resisting doors that are required as part of the fire strategy. As well as adversely affecting the fire strategy for premises and placing persons at risk in the event of a fire, the wedging of a fire door may also be considered an offence under the FSO, which could be pursued formerly by the regulator and lead to a criminal conviction.

It is not recommended to create a situation where fire doors are held open to allow for air circulation. In addition to instances of hot weather, situations like the one described in this report have also been created by people reacting to the COVID-19 pandemic. The National Fire Chiefs' Council (NFCC) produced **advice for COVID-19>** which may be helpful in these situations.

Submit Report

Submit Feedback

Apparently simple home improvement work leads to dangerous situation

CROSS Safety Report Report ID: 1173

Apparently simple home improvement work, consisting of reroofing and a loft conversion, resulted in a 'near miss' with potentially dangerous conditions for neighbours.

Key Learning Outcomes

For clients and owners:

- Blocking a flue serving a neighbouring property may present a high risk to life
- The Health and Safety Executive provides **guidance>** for domestic clients
- Check that your proposed builder has experience with similar projects

For construction professionals:

- The government page **Party walls and building work>** provides advice on works to party structures and The Party Wall etc Act 1996
- Removal of chimney breasts requires the remaining masonry to be structurally supported

For builders:

- Work should not be undertaken on any part of a chimney without first checking that the flues are not in use

R Full Report

Apparently simple home improvement work, in this case, reroofing and a loft conversion resulted in potentially dangerous conditions for neighbours, says a reporter.

During works by a contractor, a fireplace breast and chimney stack were removed with debris heard falling down a flue by the occupiers of the neighbouring property. The party chimney stack was completely removed and tiled over.

The occupier of the neighbouring property had not been forewarned of the works. Had they not been in the property at the time to hear debris fall down the chimney any blocking of the flue may not have been obvious to them, says the reporter.

The concerned neighbour called in a Gas Safe registered engineer who found that the flue serving a gas fire appliance was blocked. The engineer deemed it necessary to isolate and remove the gas appliance. Water ingress damage to the property also occurred which caused electric circuits to fail.

The reporter is concerned that apparently simple home improvement work is far more complex than untrained personnel believe. Education within the building industry, and of the public, is needed to avoid life safety risks from such projects.

C Expert Panel Comments

The report suggests that a chimney stack serving both properties was removed without the neighbouring occupiers being aware that their property would be affected by the works. Furthermore, it does not appear that adequate consideration was given to the impact of the works on an existing flue. The report does not say how the situation evolved to reach this position, however, a lack of care on the part of those involved in undertaking the works would seem likely.

The builder and anyone else with a building background should have been aware that work should not be undertaken on any part of the chimney serving the neighbouring property without first checking that the flues are redundant and that the neighbour was agreeable to the work being done. Blocking a live flue serving a neighbouring property would show gross ignorance or incompetence and present a high risk to life.

> **work should not be undertaken on any part of the chimney without first checking that the flues are redundant**

From the report, it appears in respect to the chimney stack and flue, that the neighbouring property was damaged by the works. In common law, an owner has the right not to have their property damaged by someone else, and where a property is interfered with, they have the right for the damage to be remediated. Legal advice would normally be taken to fully understand what liabilities exist in situations as reported here.

Works to convert a loft require building regulation consent. If a building control process is followed to completion, with input from competent persons, situations such as those reported should be avoided, as well as the law complied with.

Removal or changes to chimney breasts and stacks requires significant thought to ensure the stability of the structure is not adversely affected. Where chimney breasts are removed, structural support of the remaining masonry is required and will need building regulation consent. Clearly, live flues would also need to be properly considered and allowed for in any work.

> **Where chimney breasts are removed, structural support of the remaining masonry is required**

It was likely that some of the works undertaken came under the scope of The Party Wall etc Act 1996. Under the Act, anyone intending to undertake in scope work, must give adjoining owners notice of their intentions. The Act lays down a framework of actions and timescales to assist parties to agree upon work that is desired or required. The Act is explained online at the government page **Party walls and building work>**. The seeking of an agreement under the Act would have almost certainly exposed that the works should not have proceeded in the form that they did. It should be noted that the Act is only relevant to England and Wales and does not apply elsewhere in the UK.

Home improvement work can be complex

The reporter is right to be concerned that apparently simple home improvement work can be far more complex than might first appear. Nevertheless, clients, designers and executers of works, however simple, are responsible and accountable for doing things properly. If there had been casualties or fatalities from carbon monoxide poisoning, then ignorance would not be an excuse.

Clients have a duty to ensure they engage competent people to design and execute their schemes. They also need to be satisfied that designers and contractors can complete the job safely without risks to health. This applies equally to domestic home owners employing small builders with minimum formalities,

CROSS **Report 1062, Dangerous building work on domestic project>**, published in 2022, suggested some of the issues clients should consider when appointing a contractor for domestic scale works. The Health and Safety Executive provides **guidance for domestic clients>** including their duties under the application of the Construction (Design and Management) Regulations 2015.

Submit Report

Submit Feedback

Fire involving fluorescent light fitting

CROSS Safety Report Report ID: 1157

This report concerns a fire involving a fluorescent light fitting that occurred in a corridor in a sheltered housing complex.

Key Learning Outcomes

For designers and specifiers:

- Consider the potential consequences of any electrical fittings incorporating thermoplastics and the combination of flaming droplets and surfaces

For fire risk assessors:

- The potential for flaming droplets should be considered in all circumstances where escape route floor coverings are likely to be ignited
- The potential smoke yield associated with thermoplastics should be considered in the circumstances of single-direction escape, especially where the premises include sleeping accommodation

For fire and rescue personnel, building control inspectors and property managers:

- If you are aware of instances of fluorescent light fittings on means of escape routes catching fire and creating a hazard for occupiers, please let CROSS know

R Full Report

A fire involving a fluorescent light fitting occurred in a corridor in a sheltered housing complex. Fluorescent lighting was situated throughout the common areas including the means of escape. These light fittings were fitted with thermoplastic diffusers made from polystyrene.

The reporter states that a fault within a fluorescent light fitting ignited the plastic diffuser, rapidly producing large amounts of thick black smoke. Flaming, molten plastic quickly enveloped the carpet within the corridor adding to the already dense smoke, making the means of escape impassable within a very short period of time.

As stated by the reporter, this resulted in eight residents having to be rescued by the Fire and Rescue Service.

It is noted by the reporter that the building had been visited by Fire Safety Officers from the Fire and Rescue Service and found to be broadly compliant with current fire regulations, i.e. The Regulatory Reform (Fire Safety) Order 2005. It was noted that the building had a high standard of fire protection; in particular, there was a comprehensive fire detection and fire alarm system providing early warning which was remotely monitored. Additionally, it was noted during their visit that fire-resisting doors were in good condition and had been fitted with intumescent strips and cold smoke seals.

Within certain limitations, the use of thermoplastic lighting diffusers in escape routes is currently permitted under approved guidance to the Building Regulations.

At the time of reporting, the reporter stated that the Fire and Rescue Service is currently carrying out further investigations and work on this matter and will be seeking to appropriately raise the issues arising with relevant persons, so that consideration can be given to the appropriateness of current guidance.

In addition to this work, CROSS would particularly welcome anyone who has experienced a similar fire to come forward so we can collate information and create a more complete picture and a better understanding of the issue can be made.

C Expert Panel Comments

Electrical systems

This report has raised important considerations for the design of buildings and in particular the specification of their electrical systems.

Designers and fire risk assessors are reminded that it is their job to always give suitable and sufficient consideration to all relevant factors. This report highlights the potential

consequences of specifying any electrical fittings that incorporate thermoplastics, as the combination of flaming droplets and surfaces need to be considered. This incident emphasises that all light fittings, including trunking and cable clips, located in common corridors, should be appropriately protected so that this cannot occur.

Fire risk assessment

This report highlights that those responsible for fire safety in existing premises need to consider such events as part of their fire risk assessment under The Regulatory Reform (Fire Safety) Order 2005. It is incidents like this that can inform those responsible, as well as regulators, of potential hazards.

Given that eight residents had to be rescued, it would appear the corridor rendered impassable was a critical part of the means of escape.

Whilst thermoplastic diffusers are permitted in escape routes, the guidance refers mainly to surface spread of flame rather than the smoke yield and potential for burning droplets. It could be suggested that, as part of the fire risk assessment, the potential for flaming droplets should be considered in all circumstances where escape route floor coverings are likely to be ignited, and the potential smoke yield associated with thermoplastics should be considered in the circumstances of single direction escape. This would especially apply to premises that include sleeping accommodation.

Submit Report

Submit Feedback

Cladding subcontractor change of connection strategy led to failure

CROSS Safety Report Report ID: 1189

As part of their final design submission, a cladding subcontractor changed the connection strategy for their cladding system. During their assessment of this design submission, the project structural engineer did not identify the design change. When the cladding was installed, the cladding loading resulted in excessive deflection and some twisting of the primary perimeter steel.

Key Learning Outcomes

For the client and design team:

- Be aware that one engineer acting as overall coordinator of the structure is best practice
- Ensure design responsibilities for packages of work are clear and coordinated between packages
- Ensure project change control processes are used by the whole project team

For all designers:

- **Principal designers>** and **designers>** have responsibilities under the Construction (Design and Management) Regulations 2015 to communicate, cooperate and coordinate
- Ensure all design changes are appropriately communicated across the design team

R Full Report

A cladding subcontractor changed the connection strategy for their cladding system within their final design submission but failed to inform the project structural engineer of the change. The project structural engineer did not identify the design change during their assessment of the design submission. The reporter explains that, when the cladding was being installed, the unexpected loading resulted in excessive deflection, and torsion induced twisting of the primary perimeter steel which required significant remedial works to resolve.

A value engineering exercise changed the concrete floor slab to a slimmer concrete system

The reporter states the structural design originally included cladding brackets that sat on top of a concrete floor slab on top of perimeter steelwork. However, a value engineering exercise changed the concrete floor slab to a slimmer concrete system. A further change made later was the omission of the floor screed for a timber deck option. This final configuration did not allow space for the originally conceived cladding brackets. The changes required the cladding brackets to be relocated to the bottom flange of the steel perimeter beams. These beams had, however, not been designed for this connection strategy and loading. During installation, the perimeter beams started to twist and deflect, manifesting itself as the closing up of cladding joints above and below the deflecting perimeter beams.

The reporter adds that the deflections were only discovered (and then deemed to be a fault) when the cladding joints had fully closed and investigations as to the cause were made. The discovery was made more difficult because the cladding masked the perimeter beams and the deflections were not readily visible from inside the building. The perimeter beam twisting was found to result from the altered load path with the cladding acting on an unrestrained lower flange.

It was concluded the changes in design to implement the value engineering savings had led to the problem. The value engineering savings had not been fully checked by the design team and, in particular, by the structural engineer so structural capacity checks had not been undertaken before the revised structure was built. The cladding had to be removed over multiple floors and the steelwork straightened and reinforced in situ. Some of the distorted steel could not be fully straightened so new steelwork was required at a significant cost.

> **The changes in design to implement the value engineering savings led to the problem**

The reporter argues the specialist subcontractors should have undertaken checks on the revised structural arrangements or at least clearly notified the project structural engineer of the changes they proposed. However, in this case, reliance was placed on the structural engineer identifying the design changes from drawings submitted to them (that they had previously reviewed) without any warning that changes to the design were being proposed. The reporter also highlights the structural engineer had a limited checking scope as the design and build contractor placed reliance on their subcontractors.

The reporter concludes that, under a design and build contract, when a specialist subcontractor proposes changes these should be approved by the project structural engineer.

C Expert Panel Comments

Design interfaces, in this case between steelwork designer and cladding designer, can promote fragmentation of design responsibilities. Where design is fragmented, risk can thrive. This report highlights the need for the responsibilities of each designer to be clearly defined. Care should be taken to ensure contractual arrangements, such as a design and build arrangement, do not prejudice coherent design interfaces. As so well illustrated by this report, gaps and inconsistencies between designers can lead to safety issues.

> **This report illustrates the importance of someone taking overall responsibility for all structural matters**

This report also illustrates the importance of someone taking overall responsibility for all structural matters, regardless of the contractual framework in place. The engineer responsible for the overall stability and robustness of the structure could ensure the compatibility of the design and details of parts and components, even where some or all the design and details of those parts and components are not made by this engineer. This engineer should verify the form of any connections adopted at the interfaces between other designers, and verify that the load paths are acceptable. The Institution of Structural Engineers (IStructE) **Manual for the design of steelwork building structures to Eurocode 3>** makes these points very clear as do other IStructE design manuals. The need for one engineer to take overall responsibility for all structural matters has featured in CROSS Safety Reports on a number of occasions, including CROSS-UK report 1172 – **Cladding failure in strong winds>**, published in 2023.

Designers have responsibilities under the Construction (Design and Management) Regulations 2015 to communicate, cooperate and coordinate

A designer's decisions can affect the health and safety of all those involved throughout the lifespan of a building, including its construction. **Designers>** have responsibilities under the Construction (Design and Management) Regulations 2015 to communicate, cooperate and coordinate with any other designers (including the principal designer) so that all designs are compatible and ensure health and safety, both during construction and beyond.

> **A lack of effective communication and coordination between designers appears to be at the heart of the reported failure**

Principal designers> have responsibilities that include ensuring that everyone involved in the pre-construction phase communicates and cooperates, coordinating their work wherever required. A lack of effective communication and coordination between designers appears to be at the heart of the reported failure. CROSS-UK report 1128 - **Unsafe design of retrofit cantilever balconies>**, published in 2022, considered designers and principal designers responsibilities under the Construction (Design and Management) Regulations 2015.

Managing design changes

The need for stronger change control processes was an issue highlighted in the **review led by Dame Judith Hackitt>** following the Grenfell Tower tragedy. Management of design changes can be a very significant problem for design teams. It is poor practice not to flag up changes to all other design team members since the implications of proposed changes, across contractual and design boundaries, may not be grasped by those making the change, as appears to be the case in this report.

It can be quite surprising how, under effective change management, a proposed change gets flagged as a potential problem by a discipline quite remote from the change. Value engineering processes will likely propose changes that must be managed. Project specific change control processes should detail how all proposed changes are communicated and validated across the design team. Problems caused by ineffective change control can apply across all territories as illustrated by the CROSS-AUS report 822 - **Managing changes to design>**, published in 2019.

This report illustrates the need to fully describe what revisions have been made when issuing revised designs

and drawings. In this case, simply noting what had changed on the drawings would have quite likely uncovered the unacceptable proposals before they were enacted. It is not at all helpful just to adjust the document revision reference.

Submit Report

Submit Feedback

Fire safety management during building works

CROSS Safety Report Report ID: 1193

A reporter shares multiple and various concerns about the maintenance of existing fire safety measures during a period of building work, as well as the approach taken to manage building evacuation for persons with reduced mobility (PRM).

Key Learning Outcomes

For building contractors:

- When commencing construction projects on partially occupied buildings, ensure the potential impact on fire safety is fully considered
- Use best practice guidance, such as the Fire Protection Association's Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation

For designers, consultants and building owners:

- Designing means of escape for persons with reduced mobility requires advice from competent persons
- Adequate project management is essential to prevent apparent reckless behaviour from contractors

R Full Report

The reporter is a fire, health and safety professional employed at a higher education institution. A substantial construction project had commenced by the time the reporter took up the post. The reporter identified various failings.

The reporter discovered that, as part of a major new build project, construction work was underway beneath student sleeping accommodation. On inspection, there was no apparent consideration of the provision of fire resisting construction to separate the construction site from the sleeping accommodation. Additionally, the construction project resulted in reduced widths and extended travel distances for escape routes from the occupied areas, with no emergency lighting provision, and inappropriate automatic fire detection. In the view of the reporter, this demonstrated a reckless attitude by the contractor.

The reporter identified ineffective project management with little substantial input from the client. There was no apparent cooperation between the relevant parties, nor use of easily available guidance such as the **Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation>**, published by the Fire Protection Association. A subsequent visit by Fire and Rescue Service inspecting officers resulted in a Notice of Deficiencies being issued.

Despite repeatedly urging the contractors to take more care, citing the Grenfell Tower fire and the failings identified in the Hackitt Review and the Public Inquiry, the reporter was met with apathy.

Whilst the reporter requested fire safety information in relation to the construction works and the new build, little information was forthcoming. A first draft fire strategy document referred to the necessity for evacuation lifts. However, the final draft fire strategy, as submitted for building control approval, made no mention of evacuation lifts but referred to '*identifying and training staff to physically assist wheelchair users*'. The reporter raised their concerns with senior management and it is understood, by the reporter, that the change in strategy was founded on false assumptions.

The reporter says that without regard for student safety the contractors started works with no apparent consideration of the impact on escape routes.

C Expert Panel Comments

Occupation of a building while construction works are underway requires very careful planning, and it seems that this was not done here. If there are doubts about fire safety precautions and management's willingness to address concerns, then the relevant enforcing authorities should be brought in without delay.

Previously published by CROSS, **Report 1169 Fire safety concerns for partially occupied Higher Risk Residential Buildings>** is relevant.

> **If there are doubts about fire safety precautions and management's willingness to address concerns, then the relevant enforcing authorities should be brought in without delay**

This report demonstrates the need for a holistic assessment of fire safety risk when building work is taking place, including the effects on any adjacent areas potentially impacted in terms of fire safety. This assessment should be undertaken by a competent fire engineer as part of a specific fire strategy to provide adequate safety and mitigation to suitably address risk.

Principal designers must recognise the importance of engaging with fire engineers to produce construction phase fire strategy documents which would identify the actions required to ensure the safety of those occupying the premises during construction works.

It could be concluded that the issues highlighted in this report demonstrate commonplace failings in the UK construction industry, which values project cost and timescale above all else. Competent input is neither sought, nor desired since it is likely to impact cost and/or timescale. The obvious failings identified by the reporter serve to highlight how much further the industry needs to improve even to meet a minimum level of safety.

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