CROSS UK
COLLABORATIVE REPORTING FOR SAFER STRUCTURES

The Institution of Structural Engineers

ice Institution of Civil Engineers

The Institution of Fire Engineers

CROSS Newsletter

CROSS-UK Newsletter 72 | **March 2024**

Dangerous alteration work results in two terraced houses being demolished

Lack of fire safety competence in care home setting

Unqualified engineer's unsafe computer aided design of a retaining wall

Share knowledge to help create a safer built environment

Editorial

Tanya de Hoog
CEng, FIStructE
2024 President of the Institution of Structural Engineers

In my inaugural address as 2024 IStructE President, I celebrated the vital role of engineers in upholding public safety, driving climate action, and positively impacting people. My address initiated a campaign, ***Engineering with purpose: aligning our values for global impact*** which centres on three key themes:

1. technical expertise

2. collaboration; and

3. aligned action.

These will, I'm sure, chime with the CROSS community.

First, the importance of technical expertise, and how essential it is for engineers to continuously learn and improve their skills and competencies.

I feel strongly about sharing knowledge for community wide benefits - a feeling I know is not just shared by everyone involved with CROSS, but indeed is the very purpose of the scheme. CROSS shares the experiences of reporters as widely as possible within the built environment, so everyone can learn from each other's experiences and knowledge.

Second, collaboration. It is vitally important that we work together with other professionals, both within the field of structural engineering and in other disciplines including fire safety, to achieve the best possible outcomes. By collaborating with others, we can pool our knowledge and expertise, and come up with innovative solutions to complex problems.

And finally, aligned action. I urge all those working in the development of the built environment to come together and take collective action to address the pressing issues facing our world, such as climate change and public safety. We can foster a culture of continuous improvement and collective responsibility, crucial for advancing the field and protecting the public and the environment.

I shared in my speech, and I share with you now, **three actions for the benefit of people and three actions for the benefit of planet>**, that you can commit to in 2024 to contribute to accelerated positive change.

Many of these actions can be aligned with reading and contributing to CROSS Safety Reports.

I ask you to **sign up to this call for action>** and commit to a specific personal or collaborative goal in 2024.

One action, for example, could be submitting your own report to CROSS about a near miss, concern, or incident you have seen. Submitting a report is simple and, crucially, completely

Contents

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confidential. Content is anonymised and deidentified so learnings and advice can be shared within a no-blame culture. As well as publishing individual Reports, CROSS analyses trends in the matters being reported, so there is no issue too small to share. Collectively, small individual actions can make a big difference.

Again, this sentiment aligns with the ethos of my inaugural address. I believe that engineers can shape a world focused on both humanity and the environment and accelerate our impact by taking small individual, intentional actions together.

We must align the technical rigour of engineering with our ethical and societal responsibilities. By focusing on safety, sustainability, and collaboration, engineers can create impactful solutions that go beyond mere construction, contributing to environmental conservation, human wellbeing, and global progress. This holistic approach ensures that the engineering profession remains relevant and respected, driving positive change, both within our own profession and in the wider world.

By working together, we can make a real difference.

Help to improve safety by submitting a report

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

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

Find out more >

More from CROSS

ICE updates advice on ethical conduct

The ICE has updated its **Advice on Ethical Guidance>**, which sets out considerations its members should make when faced with moral dilemmas. A section on the importance of reporting, with a paragraph about CROSS and our history is included. The guidance is important as civil engineers have a duty to behave ethically in their professional dealings. It was updated following a comprehensive review by the ICE Ethics Committee.

A Higher Bar – Third report of the Industry Response Steering Group published

The third and final report from the CLC's Competence Steering Group has been published. **A Higher Bar>** sets out the significant steps being made across the built environment and fire sector in improving skills, knowledge, and behaviours to drive culture change and improve the safety of buildings. A paragraph on CROSS is included with a link explaining our 2021 expansion into fire safety.

New appointments to CROSS-AUS

CROSS-AUS is pleased to strengthen its team with new appointments.

Iain Hespe, BEng MIStructE MIEAust, Senior Technical Director, Bridges & Civil Structures at Arcadis; Ed Bond, MEng, MIStructE, MIEAust, NER, RPEng, CEng, Principal, Robert Bird Group, Melbourne and Simon Lovell BSc, CEng, MIStructE NER RPEQ, Principal at Lovell Structural Engineering Consultancy have joined the CROSS-AUS Expert Panel.

David Donnan, BE (Hons) MIStructE FIEAust RPEQ NER APEC Engineers IntPE(Aus) of Donnan Consulting Engineers has been appointed to the CROSS-AUS Board.

Dangerous alteration work results in two terraced houses being demolished

CROSS Safety Report Report ID: 1274

Two mid terrace properties forming four flats had been underpinned and excavated to form a new basement whilst simultaneously removing internal and rear walls. This left the building in a dangerous condition and subject to a demolition order from the local council.

Key Learning Outcomes

For clients:

- Building owners should always ensure that professional advice is taken, ideally from a suitably qualified and experienced engineer
- The ability of a contractor to undertake the works should be confirmed prior to the award of contract

For contractors:

- The proper management of temporary works is essential in maintaining the stability of structures during extensive renovation

Full Report

A reporter's firm was called by a demolition contractor to review a structure prior to demolition following a dangerous structures notice and demolition order from the local council. It was found that there were two mid terrace properties forming four flats in a very poor state and at imminent risk of collapse due to works that had been undertaken.

The whole building had been underpinned and excavated to form a new basement. This had been done while simultaneously removing internal and rear walls. When reviewing the work on site (from a safe distance due to a prohibition order preventing entry), the reporter observed that inadequate temporary works had been put in place.

The reporter was informed that no engineer had been involved in the design and that the contractor had just built what they considered to be necessary. Architectural drawings had been submitted to the local authority, but the works on site did not match what had been proposed.

The structure was at high risk of collapse at any moment and the work was so poor that the building and its neighbour had to be demolished to make the area safe

The lack of engineering input meant that the job had progressed without anyone understanding how to stabilise the building during the works, and without anyone knowing how to progress the works safely for both those involved in the construction and the public. The

The impact of digital technologies on the occurrence of error in construction

The Get It Right Initiative (GIRI) has produced two reports exploring the impact of digital technologies on the occurrence of error in construction. The first report, ***The use of technology to reduce errors in design and construction>*** assesses the wealth of new tools being adopted by the UK construction industry, identifying those with the greatest potential to reduce the errors that are estimated to cost the sector up to £25 billion per year. However, the report warns that these new tools must go together with a wider cultural change to recognise the scale of the problem and embed error avoidance within construction programmes.

The **second of two reports>** The use of digital technology on site to reduce errors in construction explores technology is being used on site and whether it is having an impact on error. It identifies the technologies currently providing the most beneficial outcomes in terms of error reduction, enhanced project delivery, budget, and time savings. The research draws insights from an online questionnaire and discussions with professionals working on eleven live sites across the UK to understand how digital tools are viewed by those using them, explore barriers to adoption, the cost and timescales of implementation, and the opportunities for wider use of technology.

structure was at high risk of collapse at any moment and the work was so poor that the building and its neighbour had to be demolished to make the area safe.

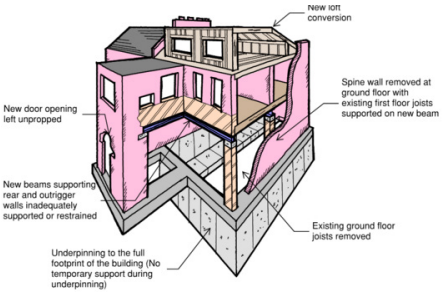

Figure 1: *A view from the rear*

Figure 1 shows the extent of works partially completed to the rear and internally when the reporter visited the properties.

After the local authority and the Health and Safety Executive (HSE) became involved, the contractor disappeared and has not been able to be traced.

This issue stems, says the reporter, from there being no suitably qualified persons to undertake the structural design of the permanent and temporary works, and the appointment of a contractor who was not competent.

The reporter concludes that this highlights the need for clients to ensure that there is a competent design team and competent site team who understand the risks associated with the complex task of adding a basement to an existing terrace property.

Along with an understanding of the temporary works that are required on site, the reporter feels that basement works such as this, should need full building control approval and planning permission prior to work being started. This would ensure that works are appropriately designed and will not cause undue risks.

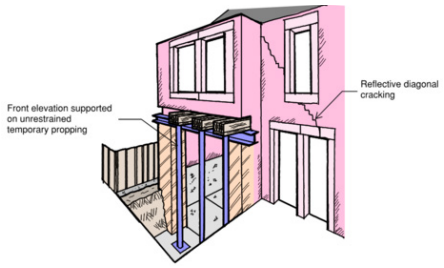

Figure 2: *A view from the front*

Figure 2 shows the extent of the works partially completed to the front of the property when the reporter visited the properties.

Expert Panel Comments

We have seen reports of similar instances before and sadly this is not an uncommon situation. CROSS Safety Reports **123>**, **423>**, **1044>** and **1062>** are all examples of similar issues.

The sentiments expressed in the reporter's last paragraph are correct.

Very often, a builder (who may or may not have suitable experience) will be engaged by the householder without reference to professional advice. The proper management of temporary works is essential in maintaining the stability of structures during such extensive renovation, yet many small and medium sized enterprises do not have sufficient knowledge, nor do they engage either temporary works designers, or structural engineers to design the permanent works.

As they do not understand the work they are undertaking, they are unable to control risks.

> **With the current financial difficulties to the forefront in clients' minds, it is likely that they will be tempted by inappropriate advice from unqualified enterprises**

Building owners should always ensure that professional advice is taken, that the ability of a contractor to undertake the works is confirmed prior to the award of contract, and that building control inspectors are provided with all necessary details and inspect the works at appropriate stages.

CROSS speaking at the annual UK Bridges conference & exhibition, 13-14 March, Coventry

Paul Livesey, Scheme Manager, CROSS will be **presenting at Bridges 2024>** at the CBS Arena on Wednesday 13th March. Paul's session will focus on CROSS, our history and examples of CROSS Safety Reports and CROSS Safety Alerts, including Reinforced Autoclaved Aerated Concrete (RAAC).

The **annual event>**, organised by Bridge Design & Engineering magazine, drives the debate at the heart of the UK's bridge community and features a series of high-quality presentations from top-level engineers, bridge owners and specialists in the industry; an exhibition showcasing technology and services specific to the bridge engineering and asset management sector.

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With the current financial difficulties to the forefront in clients' minds, it is likely that they will be tempted by inappropriate advice from unqualified enterprises in an effort to save money. Whilst it may be difficult, this temptation should be resisted.

Submit Report

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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. Nearly 10,000 people evicted due to fire or structural safety issues since Grenfell>

Data by the Building Safety Register shows 38 buildings with an estimated population of 9,600 people living in them have been evacuated (decanted) since Grenfell for fire or structural issues. Of these, 15 (nearly 40%) happened in 2023 alone.

2. Evacuation of Barton House forecast to cost £3.5m>

400 tenants were evacuated from Barton House, a 15 storey residential block in Bristol. Press reports say this was a large panel type structure and recent surveys concluded it might collapse in the manner of Ronan Point.

Since Barton House's evacuation in October 2023, there have been a number of high-profile failures, evacuations, and demolitions of residential buildings in the UK. These include another evacuation at **a block in Woking>**; demolitions of relatively new-build housing in **Margate>** and **Darwin Green near Cambridge>** due to structural safety concerns; and two balcony failures – **one in East London>** and another at **a block of flats in Hove>**. CROSS continue to collect information on such incidents or failures as they are reported in the press.

3. Latest on RAAC>

The government's survey of UK schools has found that 234 contain RAAC. Of these, more than 100 will have to be rebuilt or refurbished whilst about 100 more need RAAC removed.

Lack of fire safety competence in care home setting

CROSS Safety Report Report ID: 1255

A fire and rescue service is concerned about the lack of competence of maintenance personnel working in care homes. This is following two incidents where poor electrical and fire door maintenance put residents at risk.

Key Learning Outcomes

For responsible persons (RP):

- The UK's fire safety regulations[1] all require a structured and effective fire safety management regime to prevent relevant persons from being exposed to risks such as those described in this report
- Persons responsible for the fire safety arrangements of a premises must ensure that staff undertaking work that involves any of the fire safety systems or equipment are competent to do so
- Electrical maintenance or electrical installations should only be carried out by competent persons

[1]These are the Regulatory Reform (Fire Safety) Order 2005 (as amended) (FSO), The Fire Safety Regulations (Northern Ireland) 2010 and The Fire Safety (Scotland) Regulations 2006.

For fire and rescue services:

- Where modifications are recommended for an existing, nominal fire door, further guidance may need to be communicated to RPs about the competence of contractors undertaking these works

For care regulators:

- Care regulators should ensure fire safety competence is embedded into the whole range of persons with duties in a care home. This includes managers, care staff, fire risk assessors and maintenance staff
- Inspection regimes for care regulators and fire and rescue services should target the risk. Care homes are high risk occupancies, where staff competence is critical

Full Report

The reporter highlights that the lives of vulnerable residents rely heavily upon many critical fire safety elements:

- Competent management of systems, staff, and procedures
- Well trained care staff to carry out an evacuation in the event of a fire
- Well maintained fire safety premises infrastructure

The reporter is concerned that maintenance personnel working in care homes are carrying out works they are not qualified for, nor competent to do, and provides two example incidents:

4. Radiograph duplication and falsification>

The Health & Safety Executive's website reports on their investigation into non-destructive testing (NDT) record falsification. In the past, CROSS has reported on falsification of material quality certificates.

5. The Condition of School Buildings>

Schools in urgent need of repair have told the BBC they are struggling to keep children warm in buildings that are "not fit for purpose". Last year, a National Audit Office (NAO) report on school conditions said about 24,000 school buildings were "beyond [their] original design life" - that's more than a third of the entire school estate in England.

It also found about 700,000 children were having to learn in "a school that the responsible body or DfE believes needs major rebuilding or refurbishment".

6. Crane operator rescue at a site fire>

A crane worker had to be rescued when a fire developed in a high rise building below him. The man was rescued using a person riding basket. Site fires are relatively common and evacuation procedures should be part of the planning.

7. Hogwarts Express steam railway safety regulation>

An interesting safety problem occurred on the Hogwarts Express train which uses vintage rolling stock. Modern trains have central door locking systems, but because of its vintage, the Express does not. Retro fitting costs are so high they may force line closure. The safety question is one of: is the current design ALARP taking account of the implementation costs of retrofit?

Unsafe electrical installation

The first incidence was an electrical installation that was found to be faulty following an emergency call to a care home specialising in end of life and palliative care. The firefighters discovered that the electrical connections for a light fitting had been shorting, causing overheating and smoke.

The installation was later confirmed by a qualified electrician to have been clearly undertaken by an unqualified maintenance person. The reporter states that the responsible person for this and four other care homes were sent an official letter reminding them of their responsibilities under the Fire Safety Order, and to investigate who was responsible for the dangerous works, and urgently requesting they review the wiring in all their premises where this maintenance person worked. The letter also recommended that the RP suggest to the maintenance person that they do not attempt any further work for which they were not qualified or competent.

Faulty electrical installation that caused overheating and a fire alarm activation

Inadequate fire door remediation

The second incidence occurred following a fire safety inspection in a care home for residents over 65. One of the recommendations of the initial inspection was to upgrade the fire doors by fitting them with intumescent strips and cold smoke seals.

A follow up inspection of the remedial works found that the intumescent strips and cold smoke seals were incorrectly fitted to the door frame. The combined strip and seals were fitted to a channel, that was routed incorrectly, into the corner of the frame. The reporter suggests that in the event of a fire, the intumescent strip would swell and effectively lever the door open and allow passage of fire and smoke into the means of escape, compromising the evacuation. The door and frame were described as 'relatively old but substantial' and (if the combined strip and seal had been fitted correctly) would likely have given the level of protection required. Instead, they lost integrity and are now unfit for purpose.

Fire door rebate showing intumescent strip fitted incorrectly

The reporter is concerned that unqualified maintenance personnel are carrying out repairs to safety critical systems and installations with the potential for serious injury or loss of life.

Both safety cases appear to have arisen due to the lack of competence and knowledge of the maintenance personnel, and a similar lack of knowledge in the managers who permitted them to carry out the repairs. The reporter suggests the underlying cause is either *"well-meaning maintenance personnel and naïve managers allowing unqualified people to carry out repairs to essential fire safety infrastructure, or an attempt to save money"*.

The reporter has addressed these issues locally under the Regulatory

8. Eurostar trains cancelled after tunnel floods>

Eurostar services were cancelled after a pipe burst in a tunnel and flooded it. Thames Water said a "fire control system" was likely to have caused the flooding, rather than one of its own pipes. Tunnel flooding from external water or burst pipes is a design hazard to consider.

9. Data highlights increase in Electric car battery fires in UK>

The popularity of electric vehicles (EVs) has surged in recent years, leading to an increase in the number of fires caused by EV batteries. This trend has been highlighted in a recent study which sheds light on the regions most affected by these fires in the UK during 2022/23.

10. Sir Frederick Gibberd College in Harlow to be demolished>

A four-year-old school in Harlow is being demolished. Press reports state that 'a survey revealed issues with its modular mode of construction and fears were raised it would not survive extreme weather.

11. Wembley Flats Fire>

Families have demanded an investigation after fire tore through their north London block of flats. Brent North MP Barry Gardiner claimed the block's managers were "repeatedly warned" about safety risks and had known about "unsafe cladding" for more than three years but had failed to get it replaced.

12. Sydney Apartment block at risk of collapse>

Almost 1,000 recently completed apartments in Sydney's north are at risk of collapsing due to "serious damage" to concrete in the basements caused by defective workmanship.

Reform (Fire Safety) Order 2005 (as amended). However, they also wish to express grave concerns to the care sector that some of the most vulnerable people in society are living in premises where they are not as safe as they should be.

C Expert Panel Comments

A structured and effective fire safety management regime

A structured and effective fire safety management regime under the Regulatory Reform (Fire Safety) Order 2005 (as amended) is critical to the safety of vulnerable residents. This is similarly true for nations covered by the UK's other fire safety regulations.

The Panel expressed clear concern regarding the management and maintenance of care homes, and the lack of understanding of what is required to maintain fire safety. These two incidents exemplify the issue of managers employing a general maintenance person to undertake safety critical work.

Competence of maintenance staff

There was an apparent lack of competence by the maintenance personnel who undertook such installations. They failed to display sufficient competence to perform the tasks appropriately or, indeed, to identify that they should not even be attempting them.

Care home providers undoubtedly face challenges in maintaining compliance with every area of their responsibility. However, the financial issues facing care home providers should not mean they get such work done cheaply and compromise on competence.

There is a critical need for competent staff and personnel across the care sector, as it is sometimes these smaller issues that can align to create a far bigger, and potentially tragic incident.

Competence of fire risk assessors

A competent fire risk assessor critically challenging installation, testing and maintenance records should uncover these failings. The Panel points to some best practices by The Regulation and Quality Improvement Authority (RQIA), the care home regulator in Northern Ireland, including the **requirement for all fire risk assessments in care homes (including residential and nursing homes) to be undertaken by fire risk assessors holding third part accreditation>**. RQIA has also been proactive in issuing communications to responsible persons regarding inspections of roof voids.

Care home regulators and fire and rescue services (FRS) have a role

There is an ongoing duty of both the FRS and care home regulators to continue to explain the issues, the potential consequences (injuries, deaths, legal repercussions) and the expected standards.

Inspection regimes should target the risk. Care homes are high risk occupancies where staff competence is critical. This means that where there is high staff turnover, RPs may need to continually assess, train, and confirm staff understanding of their roles under the local fire safety regime e.g., FSO.

The care regulators should ensure that consideration of fire safety matters is included within an inspection regime. It is suggested a campaign by fire and rescue services and the respective UK care regulators could be developed to target RPs of care homes, to offer advice on their responsibilities and how to manage fire safety. This would need to be well structured to ensure it was easy to navigate and cover specific topics.

If the FRS take enforcement action this needs to be publicised to raise awareness and learning across the industry. The care regulator would likely be the best conduit for this communication.

Submit Report

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13. Bridgend fire: Arrest as building destroyed in industrial unit blaze>

A large industrial unit in Bridgend (Wales) collapsed in a fire and was destroyed. The cause is thought to be arson, which is an ever-present risk for fire initiation.

14. Bologna's leaning tower sealed off over fears it could collapse>

In Italy, one of Bologna's famous medieval tower blocks was sealed off after increasing tilt suggested it might collapse. Longevity is no guarantee of perpetual safety.

15. Valencia Fire>

A fire broke out a 14 storey block in the Campanar neighbourhood in Valencia, killing 10 people. Initial reports suggest the building's cladding may have contributed to the fire, with comparisions drawn to Grenfell.

Unqualified engineer's unsafe computer aided design of a retaining wall

CROSS Safety Report Report ID: 1210

A chartered engineer's check found retaining walls, designed by a person not qualified as a civil or structural engineer and who relied solely on a computer program, to be inadequate. It is likely the walls will need to be demolished and rebuilt.

Key Learning Outcomes

For responsible persons (RP):

- Only suitably qualified and experienced engineers should design boundary retaining walls
- Note that there have been numerous failures associated with freestanding and retaining masonry walls with serious consequences. The Safety Alert, **Preventing the collapse of freestanding masonry walls>**, was issued by CROSS (then SCOSS) in 2014

For civil and structural engineering designers:

- Design retaining walls in accordance with good practice and consult the references in this Safety Report if in doubt
- Computer programs should be used by those who have the knowledge and experience to check whether the results are sensible
- Where there are possibilities for change such as the height of retained materials wall designs should be conservative

Full Report

The reporter, a chartered engineer, was asked by a surveyor to check the design of retaining walls for their client's land. They checked the drawings and calculations provided to Eurocode 7 and concluded that the walls could overturn. The walls in question were only 1.2 metres high and, while they accept it could be argued they did not need to comply with Eurocode 7, the reporter believes the designer had a duty to their client and to the neighbours to ensure the walls were safe.

The reporter found the designer had failed to calculate the bending moment on the walls correctly. Although more than 40 pages of computer output had been produced, it was clear the designer did not understand how to design a retaining wall to Eurocode 7 - having failed to demonstrate that the wall was in equilibrium. The reporter considers the walls in question would need to be demolished and a much heavier structure provided.

On checking with the Institution of Structural Engineers and the Institution of Civil Engineers, the reporter found that neither the designer nor the checking designer was connected with either institution. The reporter believes the underlying cause of the problem is that unqualified or partially qualified designers are practicing as if they are chartered structural engineers, and there is no means of stopping them doing so.

More CROSS reports

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

Storm damage to pressed metal roof covering (Report ID 952)>

A modern dwelling with two separate V-shaped roofs sustained damage to the standing seam pressed metal roof covering during two separate weather events.

Failure of metal cladding panel on bridges (Report ID 944)>

This report discusses the findings of an investigation into the causes of the failure of metal cladding panels on a bridge parapet and provides recommendations concerning the use of pop rivets to fix such panels.

The reporter is concerned the public may be deceived by unqualified persons posing as designers, and that if designs such as this one go to Building Control errors may not be picked up as many Building Control bodies do not employ checking engineers.

The reporter hopes that when the Building Safety Act is implemented, the Health & Safety Executive (HSE) will have the power to prohibit such people from practicing.

C Expert Panel Comments

The Building Safety Act provides a statutory framework for competence from building control inspectors, but does not extend to other professions involved in the construction process. It is therefore difficult to envisage that the HSE would be able to prevent people trading. However, in the aftermath of an incident, a prosecution might be pursued against a designer.

There is a requirement for a designer of any structure to provide a safe design. The need for a design to be carried out by appropriately qualified persons, to determine the actual and not assumed ground conditions and site constraints, is vital if safety is to be maintained. Where retaining walls pose a significant risk to life due to their location or height, a suitably qualified and experienced engineer can produce a design to mitigate these circumstances.

There are empirical rules for the construction of garden retaining walls, such as those given in Building Research Establishment's **Good Building Guide 27>**, however such standard designs are only appropriate if they are used within their stated assumptions. They might not be appropriate for boundary walls, particularly those adjacent to a public footpath or between two gardens at different levels, where the consequences of failure are potentially higher.

Surface vegetation, root growth and increased height of retained materials can all contribute to the failure of a retaining wall and any designs should be such that they are not sensitive to these. In particular, the effect of increased height of retained material can drastically increase the forces a retaining wall must resist. For instance, an increase from 1.1 metres to 1.2 metres increases the stem bending moment by 30%. The 40 pages of calculations for a retaining wall in this report example suggests an over reliance on quantity of output over quality.

CROSS has previously issued a number of Safety Reports concerning retaining walls, their construction and design. Reports 129, 134, 189, 989 and 1119 all deal with similar issues to those raised in this Report. Report 989 also highlights the risk of using design programs with incorrect data entry, and Report 1119 gives a comprehensive list of further reading for the design of both freestanding and retaining walls.

- **Safety Report 129 - Responsibility for boundary retaining wall>**
- **Safety Report 134 - Deadly retaining wall>**
- **Safety Report 189 - Retaining wall concerns and the stance of a local authority>**
- **Safety Report 989 - Dangerous design of a retaining wall>**
- **Safety Report 1119 - Boundary retaining wall collapse>**

Submit Report

Submit Feedback

Non approved sealants are used with CPVC pipes and fittings

CROSS Safety Report Report ID: 1228

A reporter highlights a concern when non approved sealants are used with chlorinated polyvinyl chloride (CPVC) sprinkler system pipework and fittings. This can cause failures and/or leaks.

Key Learning Outcomes

For sprinkler system designers, specifiers, installers, and maintainers:

- Installers of critical fire safety installations such as sprinklers must be competent. It is critical that installers:
  - Study the pipe supplier literature carefully
  - Only use sealants approved by CPVC pipe suppliers
- Anyone who commissions, installs, or maintains a CPVC sprinkler system should check that the approved sealants have been used

R Full Report

A reporter is concerned that, if non approved sealants are used with CPVC sprinkler pipework and fittings, failures and/or leaks in those pipes can be caused due to environmental stress cracking or plasticization. This occurs when semi-volatile organic substances migrate from the sealant into the pipe or fitting. This can happen within a short time after installation or after several years. When leaks occur, this results in sprinkler circuits being turned off/drained down while failures are investigated, and repairs made. This can take several days or months, during which time there will be no protection from the sprinkler system.

In the opinion of the reporter, only sealants recommended by the specific sprinkler pipe manufacturers should be used. They report having seen failures in many premises because of this issue, where non approved sealants have been used. They suggest that the frequency of failures is increasing due to the increased use of residential sprinklers.

The reporter continues to describe other variables that affect the time to failure. These include environmental temperature (higher temperature favours failure) and lack of movement accommodation in the system. Hanger type and spacing also need to be in accordance with the pipe supplier's recommendations. The problem is further exacerbated when faced with overcrowded services at wall penetrations, e.g. through a 'letter box' type slot in the wall very close to the ceiling, with very little space to carry out removal and replacement of failed sections. This will inevitably lead to systems being shut off for longer to carry out remedial works.

> **only sealants recommended by the specific sprinkler pipe manufacturers should be used**

C Expert Panel Comments

Use of correct sealants

It is important to make sure that installers only use a type of sealant that is specified as being acceptable for that particular type of pipe. Different types of pipe have different lists of approved sealants, so care should be taken.

While this is a relatively simple issue, failure can have disastrous consequences such as failure of sprinklers during operation, flooding, and inoperative sprinklers leading to expensive and invasive remediation.

Competence

It is important to use contractors who can demonstrate their competence. Oversight of works should also pick up these relatively simple non-compliances.

Submit Report

Submit Feedback

Durability issues with engineered timber

CROSS Safety Report Report ID: 1275

A reporter has observed durability issues with engineered timber when there is water ingress or condensation issues. It appears to disintegrate more quickly than conventional timber, resulting in structural failure rather than distortion.

Key Learning Outcomes

For designers:

- Detailing to ensure watertight construction is particularly important with engineered timber components
- The introduction of high levels of insulation can lead to condensation build up and subsequent deterioration of engineered timber components

For designers, surveyors & building owners/occupiers:

- CROSS would be pleased to receive reports of similar instances

R Full Report

Following three recent surveys, the reporter has concerns about durability problems with engineered timber when there is water ingress or condensation. While this does not necessarily relate to an issue with the engineered timber product itself, there appears to be significantly more disintegration than with conventional timber components which results in failure rather than distortion.

Structural failure of primary support members has been observed by the reporter, with rapid deterioration of the timber product compared to traditional timber. Examples of the issues are illustrated in Figures 1-3.

Figure 1: *An example of OSB board deterioration*

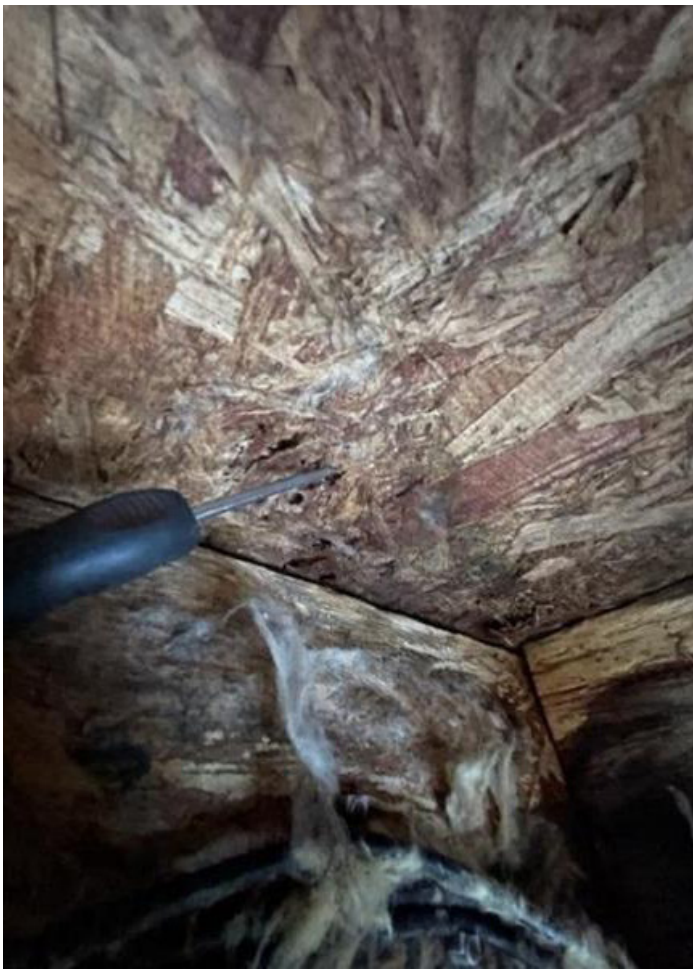

Figure 2: *Another example of OSB board deterioration*

Figure 3: *Engineered timber joist deterioration*

Figure 1 shows a top floor property within a development less than 15 years old. Water ingress and possibly condensation issues have resulted in significant deterioration of the engineered timber rafters and Oriented Strand Board (OSB) sheeting.

Figure 2 also shows a top floor property within a development again less than 15 years old. Water ingress and possibly condensation issues have resulted in significant deterioration of the OSB sheeting. The engineered rafters have been saturated but they are still sound in this case although they have areas of cracking after drying out.

Figure 3 shows a dwelling less than 13 years old. Again, this issue is likely a combination of water ingress and possible condensation issues because it has been designed as a passive house with high levels of insulation and cold bridging may have resulted locally. Engineered timber products were specified on the original plans, with glulam ring beams which the reporter notes have deteriorated significantly.

The reporter concludes that care is needed when specifying the circumstances in which engineered timber products will be used.

C Expert Panel Comments

In the UK, timber frame (TF) construction and the use of engineered timber products does not have the long history of traditional masonry and timber construction, however it is likely the issues highlighted by the reporter are related more to poor detailing or poor maintenance with regard to water ingress and condensation than the choice of timber based material. The problem is not so much that engineered wood products are less durable compared to solid timber but that, with increasing use of these products and systems, it is apparent that some parts of the industry need to better understand the DOs and DON'Ts of TF construction and the higher requirement for excluding water from such construction.

However it occurs, the presence of moisture in contact with wood based products can lead to difficulties and should be avoided. The most common causes of moisture build up are condensation and leaks.

CROSS is aware of considerable anecdotal feedback that 'durability' is not given the design attention it deserves, in particular the avoidance of water ingress through roof coverings, the avoidance of condensation and the limited ability to identify issues related to these before they may become so advanced as to require significant remedial measures.

CROSS Safety Report 852 – Rotting of cross-laminated timber (CLT) roof panels> - covered similar issues and a section is repeated below for the convenience of the reader:

What the reporter describes could be condensed water vapour dripping back into the building due to poor detailing or construction of the roof covering. BS 5250:2011 Code of practice for control of condensation in buildings gives guidance on the risks associated with excessive humidity in buildings, notably mould growth and condensation. Both can compromise the integrity of the building fabric. It describes the principal sources of water vapour, its transportation and deposition, and provides guidance on how to manage those risks during design, construction and operation.

Typically, the onset of decay starts when the moisture content of timber is over 20%. When there is a significant amount of trapped moisture or water collected during construction, the timber will begin to deteriorate. If moisture or water is continuously fed to the timber via roof leaks and/or condensation and it is not able to dry, then the rate of decay is accelerated.

If a material is only suitable for a dry environment, then it is essential that water ingress is prevented by sound detailing and correctly applied coverings. Maintenance is similarly essential and owners should be vigilant in taking action if there are observable leaks or excessive condensation.

Sometimes the use of the wrong sheathing board could also account for the sorts of defect noted within this report. The National House Building Council (NHBC) and other warranty providers have specified what sheathing material specification are acceptable on a residential site, for example NHBC Standards Clause 6.2.7.

There were press reports several years ago of issues with timber framed housing in New Zealand and Canada that in both cases led to extensive repairs and financial difficulties for home owners.

Submit Report

Submit Feedback

Fire protection of steelwork supporting a timber floor

CROSS Safety Report Report ID: 1234

A reporter shares concerns that developers and Building Control officials are assuming that, if a timber joist floor construction is suitable to provide 30 minutes fire resistance loadbearing capacity, then the structural steel supporting members within it will be similarly protected despite the absence of test data to support this approach.

Key Learning Outcomes

For fire protection product manufacturers:

- Supply literature and test data that accurately reflects the project application

For designers and engineers:

- Beware the term 'fire-rated', as it is often used without consideration of the individual aspects of loadbearing capacity (R), integrity (E) and insulation (I), which place very different requirements on products/constructions
- Even when products have been tested and given an appropriate REI rating, if the tested construction does not represent the project application reasonably well, the actual performance could be significantly worse than expected

R Full Report

In their submission, the reporter poses a scenario where a structural steel beam supports a timber joist floor in the same plane as the joists - a common detail in individual dwellings which prevents beam encasement. This scenario specifically considers intermediate floors within a dwelling, so the fire resistance (loadbearing) requirement is 30 minutes, but these principles will apply to other uses.

The reporter explains that, in their experience, developers and Building Control officials appear to be working on the assumption that, if the timber joist floor construction is suitable to provide 30 minutes fire resistance and maintain its loadbearing capacity, the supporting structural steelwork within it will be similarly protected. On a particular project the reporter is familiar with, they state the developer is seeking to avoid the cost associated with the application of intumescent coatings to the structural steelwork on this basis.

The reporter shares that they have struggled to find any test data that would support this developer's case. In the reporter's view, either ceilings or encasements are tested as an imperforate membrane, not accounting for penetrations for any recessed light fittings, extract fans, or whole floor build-ups are tested but not considering primary steelwork within them.

One test the reporter found is an example of the latter, prepared for a fire protection company to demonstrate that their products can maintain the 30 minute REI rating of a metal web joist floor. For the duration of the test (40 minutes), the floor did not collapse (criterion R), no flames came through the floor (criterion E), and the temperature rise on the upper surface was limited to below 140°c (criterion I).

However, this test was conducted on a complete floor assembly and demonstrates that after 30 minutes the temperature rise on the top surface of the floor was limited to between 43 and 48°c. Nevertheless, temperatures within the floor void, which are critical when considering the ceiling as a standalone element and the steels within the void, are in some cases as high as 430°c - highlighting the significant effect of the cavity depth and floorboards. Depending on their level of stress, steels supporting the joists could fail at temperatures as low as 350°c.

The reporter suggests this scenario demonstrates:

- a common misunderstanding of the concepts of integrity, insulation and loadbearing capacity
- an oversimplification of terms such as 'fire rated'
- a generalisation about fire protection methodology, and
- a failure to consider project specifics

The reporter concludes that, in this scenario, the steel beams may have been better protected by the application of intumescent paint.

C Expert Panel Comments

It is the view of the Panel that designers cannot rely entirely on a fire resistance test on a timber-framed floor, tested in isolation and without any internal structural steelwork, to demonstrate adequate fire resistance for the internal steelwork which is then inserted into the floor in a real building.

The fire resistance of the structural steelwork needs to be demonstrated, or suitably justified using calculation or expert judgement, for the R30 steel beam in its own right.

If designers can provide suitable justifications (with reliance on test data, calculations, or expert judgement) that the temperature of the steel beam will remain below its critical temperature (which will also depend on various factors, including its utilisation), then in principle this could be sufficient - but such justifications need to be explicitly provided.

Additionally, if, as the reporter recommends, intumescent paint is used to protect the steel, an adequate gap will be needed between the intumescent painted steel soffit and any plasterboard finish below which forms part of the fire compartmentation strategy. Such that, in a fire scenario, the integrity of the floor is not compromised by the expanding paint forcing off the plasterboard. This might be problematic as the soffit of the timber joists could be aligned with the top of the plasterboard, as you might expect in **this example detail>** from the NHBC Standards.

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Non compliant guard rails on high rise apartment buildings after modification

CROSS Safety Report Report ID: 1221

A reporter is seeing many high rise apartment buildings having balcony and walkway decks replaced and, in some instances, the increased height of the decks has resulted in the guard rails being less than 1100mm high meaning they are no longer compliant.

Key Learning Outcomes

For all professionals involved in balcony modifications:

- When making alterations to balconies the guardrail height should be maintained
- Increasing the guard rail height may result in the need to modify its fixings
- The balcony structure may need to be checked for increased vertical and horizontal forces as the result of the alterations

R Full Report

The reporter has been involved in a number of high rise residential schemes which have included making sure guard rails on balconies and walkways were designed and installed in accordance with Part K of the Approved Documents and BS6180. They report seeing that many of these buildings are having their decks replaced but the increased height of the decks results in the guard rails being significantly less than 1100mm high, meaning they are no longer compliant.

In addition to differences in the application height of lateral loads there may be, according to the reporter, unexpected consequences for the balustrade fixings and this may result in failures. The reporter also has concerns that companies involved in replacing old decks do not have previous experience in balustrades and upgrades so are not checking aspects such as guard rail and balustrade heights.

The reporter recommends that:

- All those involved in remediation need to be conscious of the structural consequences of their work
- Balcony decking companies should train and advise installers and clients on the impact that a change of deck heights can make to safety
- Building Control should ensure balustrade heights are checked on such building works

C Expert Panel Comments

This is an example of seemingly non structural alterations having potentially wide ranging structural implications. The reporter is certainly right to draw attention to dangers associated with lower guard rails but such modifications to balconies raise other concerns too, in particular the potential increased weight of the new construction has to be considered.

Readers are encouraged to consult the Safety Alert issued by CROSS in February 2022, **Safety issues associated with balconies>**, which covers the general construction of balconies and the widespread problems that have resulted in many countries.

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Fire protection considerations for roof structures in building design

CROSS Safety Report Report ID: 1249

The reporter highlights concerns that **Approved Document B>** (ADB) is being misapplied or misinterpreted when applying structural fire protections to a roof structure.

Additionally, the reporter highlights the need for design teams and clients to prioritise adequate fire protection measures for roofs, especially when they serve additional functions beyond merely supporting self-weight.

Key Learning Outcomes

For designers and engineers:

- A fire in a compartment below the roof should not result in the rapid collapse of the roof due to the addition of loads upon it. Fire resisting construction for a time relevant to the building's nature (i.e. ADB Appendix B table B3) would likely be regarded as adequate
- A fire on the roof should not threaten the means of escape of any roof occupants (for example, workers) or those in compartments below the roof. This might mean fire-resisting construction from the roof into the building is required or improved fire detection

For government and those writing building regulations guidance:

- Guidance should clarify when the removal of structural fire resistance is acceptable given the changing nature of roof space usage, particularly regarding photovoltaic (PV) and battery storage systems

For fire and rescue services:

- During firefighting, structural stability should form a critical part of any dynamic risk assessment with particular attention paid to: 1.) Any known fire resistance 2.) The effect of any imposed loads and 3.) The extent of fire involvement

R Full Report

The reporter highlights the increasing use of roof spaces, particularly for photovoltaic panels and air-handling equipment, and examples of schools and other large developments where the roof provides valuable space for such installations. The reporter suggests climate change drivers will continue to increase the use of these roof spaces for such equipment for new buildings, as well as additions to existing ones.

Fundamentally, this trend adds a combination of risk factors to what was previously often a sterile area, including:

- Fuel loads
- Ignition sources
- Imposed loads

The reporter is concerned that designers are using ADB inappropriately to avoid adding structural fire resistance to a roof that supports plant and equipment, often using guidance as follows:

Firstly using Approved Document B Volume 2 Appendix A Elements of structure definitions:units. If there is no water, or a delay in accessing or locating hydrants, it could be critical to a successful outcome.

Element of structure Any of the following.

- A member that forms part of the structural frame of a building, or any other beam or column.
- A loadbearing wall or loadbearing part of a wall.
- A floor.
- A gallery (but *not* a loading gallery, fly gallery, stage grid, lighting bridge, or any gallery provided for similar purposes or for maintenance and repair).
- An external wall.
- A compartment wall (including a wall that is common to two or more buildings).

NOTE: However, see the guidance to requirement B3, paragraph 6.2, for a list of structures that are *not* considered to be elements of structure.

Image 1, Extract from ADB Volume 2 Appendix A, Definition of elements of structure

Then using clause 7.3 of Approved Document B Volume 2 to omit the fire rating of the roof structure, arguing that the roof is not a floor and no structural fire protections are required.

Exclusions from the provisions for elements of structure

7.3 The following are excluded from the definition of 'element of structure'.

a. A structure that supports only a roof, unless either of the following applies.

i. The roof performs the function of a floor, such as for parking vehicles, or as a means of escape.

ii. The structure is essential for the stability of an external wall that needs to be fire resisting (e.g. to achieve compartmentation or for the purposes of preventing fire spread between buildings).

Image 2, Extract from ADB Volume 2 Clause 7.3a, Exclusions from the provisions for elements of structure.

The reporter suggests this is a misapplication of the guidance and if the roof is intended to support additional functions beyond merely supporting self-load and structural stability (ADB clause 7.2a), then it should be designed as a floor and have no less fire resistance than the other elements of structure (see ADB Table B4).

> **a fire could start unnoticed in or on a roof and lead to premature collapse, particularly if heavy plant equipment is involved, causing death or serious injury to people below**

The reporter states a fire could start unnoticed in or on a roof and lead to premature collapse, particularly if heavy plant equipment is involved, causing death or serious injury to people below. In addition, the reporter highlights the difficulties for firefighters carrying out firefighting operations under or on an unprotected roof.

The reporter, a fire engineer, advises design teams and clients that a roof structure is to be fire-protected when it clearly performs the function of a floor using the following examples:

- A roof terrace/ amenity space
- A roof that provides a means of escape route for day-to-day occupants
- A roof that supports plant equipment (unenclosed), of which the roof is providing stability (for example, air conditioning units, smoke ventilation systems, generators, heavy PV installations)
- A roof that supports plant equipment and installations which are part of the permanent construction (and therefore part of the day-to-day operation and running of the building)

The reporter considers that the intent of ADB is that fire protection to a roof can only be omitted where it supports only the roof itself and no other equipment, uses, or the stability of elements of structure and fire resistance.

C Expert Panel Comments

Intent of Building Regulations

The Building Regulations 2010> indicate that *"the building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period".*

The Panel acknowledge the concerns raised and agrees with the reporter that "the intent of ADB is that fire protection to a roof can only be omitted where it supports only the roof itself and no other equipment, uses or the stability of elements of structure and fire resistance."

> **Where the guidance is followed as intended, there should not be a problem. It is when the standards are not applied, understood, or misinterpreted that problems arise**

Furthermore, the Expert Panel indicates that there is a valid concern here if there is a misapplication of ADB, or if ADB doesn't cover 'common building situations' in terms of what roof spaces/structures are now often being used for (for example, PV arrays) and how this might impact the means of escape in a fire.

This goes back to interpretation and due diligence by the designer and installer. Where the guidance is followed as intended, there should not be a problem. It is when the standards are not applied, understood, or are misinterpreted that problems arise.

Design considerations for existing buildings

Little thought is given to the fire resistance of a roof after the initial construction has been completed and how the installation of new systems throughout the life of a building will have an impact on fire safety.

The addition of PV panels on top of a roof requires the supplier to complete a survey of the roof space and roof members to assess the suitability of their addition. The Panel suggests design objectives should consider the effect of adding additional imposed load, fuel load and ignition sources onto a roof and the effect this may have on means of escape for relevant persons on the roof and below if a fire occurs in the installation.

> **the compartmentation within the roof voids following the installation of new services should be adequately fire stopped by a competent person**

Many existing buildings are also found where the internal roof space has no fire protection at all (often exposed timbers), yet now supports an increasing array of electrical cables, junction boxes, batteries, plant, water tanks and other items. It is foreseeable that a fire starting in this area could break into common escape routes or apartments below and should be considered in a fire risk assessment.

In addition, the compartmentation within the roof voids following the installation of new services should be adequately fire stopped by a competent person.

Firefighting

The Expert Panel highlight there are substantial risks that firefighters face when fighting a fire at height or where there are risks to the structure from an incident. A good dynamic risk assessment is essential and defensive tactics should be considered.

Submit Report

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Design responsibility for steel to concrete connections

CROSS Safety Report Report ID: 1261

The reporter has provided an illustrative example to support their view that the design responsibility for steel to concrete connections should be shared between the responsible designers of both materials.

Key Learning Outcomes

For designers:

- A lead designer is required when there are numerous interfaces between designers, to ensure the designs are properly integrated and all assumptions closed out
- The need to form connections is often the whole driver behind a design solution
- In areas where there is congestion a 3D fabrication drawing may be required to coordinate reinforcement and fixing locations

R Full Report

The reporter believes design responsibility for steel to concrete connections should be shared between the responsible designers of both materials. In the event the steel fabricator is specifying connections, they add it should be the responsibility of the designer of the reinforced concrete frame to review and approve the fabricator's design and calculations to ensure the assumptions made about the concrete frame, and loads from the items to be supported, are consistent with the overall design. They also believe the designer should check the position of anchors do not clash with reinforcement.

To illustrate their point, the reporter describes the circumstances of a multi storey reinforced concrete frame building they were involved with as part of a new team. The building had a series of steel balcony structures which were fixed to the reinforced concrete (RC) frame at each level using post-installed resin anchors. The façade consisted of a masonry brick outer leaf and a lightweight structural framing system (SFS) inner leaf.

During construction the main contractor went out of business causing the project to temporarily shut down. At the time of the pause, the RC frame had been constructed along with the steel balconies connecting into the RC frame at each level. The construction of the masonry façade had not commenced.

The project re-started with a new main contractor but without the original engineering consultancy or the steelwork fabricator, who were no longer on the project. The reporter's consultancy was appointed to provide structural engineering services on the assumption that the design was complete. The reporter, however, reviewed the construction drawings including the connections between frame and balconies. They found that, for many of the connections, the anchors were set out to directly clash with the main top and bottom slab reinforcement.

> **for many of the connections, the anchors were set out to directly clash with the main top and bottom slab reinforcement**

Another issue was that holes in the steel end plates were oversized with respect to the anchor diameter and Table 6.1 in Eurocode 1992-4. The fabricator may have elected to oversize the holes, the reporter suggests, to allow for tolerance during installation. Such connections are predominately working in shear and by oversizing the clearance holes the designer cannot guarantee an equal distribution of the applied shear force to each of the anchors. A possible solution to this issue is to fill or seal the oversized anchor clearance hole by using special washers but this had not been done. It was found on site that there were connections where the end plate was not directly bearing on all the anchors.

A further unsatisfactory detail was that, for some of the connections, increased tolerance had been allowed for between the concrete face and the steel end plate. This is acceptable providing the designer checks the anchors for the increased lever arm to Eurocode 1992-4. However, the reporter found anchors which would have failed in shear (Cl 6.2.2.3 (3)) because of the length of the lever arm.

> **connections were found to be failing when checked to Eurocode 1992-4 and strengthening works were required**

A steel beam connected to the face of the first floor RC slab was intended to support three storeys of masonry above but the review found the connections had insufficient capacity. Fortunately, the masonry façade had not yet been constructed. To resolve this issue, additional proprietary masonry support brackets were installed at levels two and three to share the load. In addition, other connections were found to be failing when checked to Eurocode 1992-4 and strengthening works were required to ensure the connections had sufficient capacity. The reporter also noted a lack of redundancy with some connections.

The reporter, who was not involved in the original design, believes these connections were not actually designed and were only specified and detailed by the steel fabricator in a way that facilitated the easiest form of installation. They conclude their report with a reminder that all design should be carried out by competent professionals and should comply with the relevant codes and standards.

C Expert Panel Comments

This report demonstrates the need for a competent and capable lead designer who can integrate all aspects of the components forming the structural system, ensuring the designs are coordinated and with compatible assumptions. With increasingly fragmented design responsibility, in particular subcontracted design, the importance of an overview cannot be over emphasised. The involvement of the Principal Contractor in this process is also vital, in order to properly understand the constructability aspects and the need for appropriate detailing at the design stage.

The reporter also highlights the importance of the consideration of tolerances. The idealistic, perfectly detailed and coordinated CAD drawing rarely accounts for construction tolerances. Yet, lack of fit is one of the primary reasons for ad hoc alterations on site and subsequent latent defects.

The trend in recent years to minimise independent site inspection or supervision by designers has arguably led to an increase in the number of such problems not being recognised. However, with the introduction of the new Building Safety Regulator and their new powers, it is hoped that designers and contractors will become more focused on identifying safety critical matters and taking appropriate action.

> **the steel/concrete interface will be a key connection on which significant safety depends, this is no place to have unclear responsibility for design**

While this report draws attention to the design of fixings, it is also important to design the reinforcement in the concrete element so that a failure beyond the fixing cannot occur. **EC2-4>** gives guidance as to when such checks are necessary and that is the case for all but the smallest of loads.

The geometric fit-up of the fixings and the reinforcing bar in the concrete has to be coordinated. This is not helped by the way reinforcing drawings are made, individual bar locations are not detailed so in general reinforcement installers cannot be held to account for precise individual bar locations. However, in areas where there is congestion something akin to a steel fabrication drawing may be required.

Frequently, the steel/concrete interface will be a key connection (e.g. on a balcony) on which significant safety depends, so this is no place to have unclear responsibility for design.

The Construction Fixings Association> provides guidance in relation to EC2-4 and BS 8539:2012.

The Health and Safety Authority in Ireland has produced a **Code of Practice for the Design and Installation of Anchors>**. This contains a lot of useful information including a section on responsibilities for each of the key duty holders. While not a requirement in the UK, it does provide useful guidance.

Finally, the report illustrates the difficulties caused by 'handovers' and the need for those who take over to satisfy themselves in relation to the design and construction they are inheriting. All too often when contractors start to have financial difficulties corners are cut in an attempt to rescue the business. Designers need to be aware and particularly vigilant in these circumstances.

Submit Report

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Fire hazards in historical modular timber framed buildings

CROSS Safety Report Report ID: 1243

A reporter has raised fire safety concerns suggesting the potential existence of a systemic issue pertaining to the design and construction of modular timber frame systems.

Key Learning Outcomes

For responsible persons (RPs) and/or accountable persons (APs):

- Persons responsible for the fire safety arrangements and/or the safety case for a premises must have a comprehensive understanding of the risks the building presents

For fire risk assessors:

- It is essential to understand the construction type of the premises being assessed, in particular any common faults that may be found and the risks these present
- Fire Risk Assessors should have the appropriate level of competence to identify and understand the risk, bringing in expertise where needed

For fire and rescue services:

- Compartmentation and cavity barrier faults may allow unexpected fire spread. Firefighting tactics will need to consider this particularly if there is evidence of unusual fire or smoke spread
- Fire safety audits should question the RPs/APs understanding of their premises and the construction method

For designers:

- Many modern methods of construction cannot as yet be regarded as a Common Building situation and therefore guidance such as ADB or BS9991 may not be adequate

R Full Report

The reporter shares concerns they have about a modular system, that the reporter believes was used up to 2013. They explain they have inspected multiple premises using a modular timber frame system, including structures such as care homes and student accommodations, with heights ranging from 3 to 7 storeys.

During the inspections, several issues were identified by the reporter:

- **Timber composite decks** - some timber composite decks (I beams) were not underboarded
- **Expanded Polystyrene (EPS)** - unenclosed EPS of 50 mm thickness on timber walkways
- **Design details** - an absence of design details for framing and lining services penetrations from composite decks
- **Inadequate fire stopping** - an absence of test details to support fire stopping of walling systems and composite decks
- **Voids and unprotected cavities** - large voids and unprotected cavities within floors and external walls
- **Cavity barriers** - a lack of cavity barriers to seal external wall service penetrations

The reporter believes the underlying causes of these issues can be attributed to several critical factors:

- **Poor design** - inadequate design practices are considered to be a significant influence
- **Lack of testing of timber frame structures** - the absence of rigorous testing protocols for timber frame structures introducing uncertainty regarding their fire resistance capabilities
- **Onsite buildability and quality control shortcomings** - deficiencies in onsite construction practices, coupled with a lack of robust quality control measures, contributing to compromised fire safety elements
- **Lack of understanding and diligence from approved inspectors/Building Control** - approved inspectors and Building Control authorities, involved during the construction process, not identifying poor workmanship, installation or design

The reporter puts forth the following recommendations:

- A comprehensive assessment of all buildings constructed using modular timber frame systems during the specified period
- Steps to address the issues outlined above - the rectification of fire safety measures, proper insulation, installation of cavity barriers, and an overall improvement to construction quality

C Expert Panel Comments

Modular construction is seen as the future for rapid, cost-effective building projects and has been embraced by significant publicly funded projects, including the proposals for the Hospital Improvement Project and the model Hospital 2.0. However, modular buildings (timber framed or otherwise) have always had issues with the details around fire stopping, structural element protection, protection of connections and, in particular, cavity barriers to the voids created when modules are fitted together to form multi storey buildings.

The issues the reporter raises are concerning. The Panel highlights the importance of robust and tested detail for the fire protection elements for larger multi storey modular buildings, and offers the following advice:

- **RIBA Stage 2** - Designers must understand that many modern methods of construction cannot as yet be regarded as a Common Building situation and therefore guidance such as ADB or BS9991 may not be adequate. Understanding new methods of construction is critical to safe design and, in particular, the detailing of key fire protection features is critical to ensuring construction is completed competently
- **RIBA Stages 3-5** - Contractors, Building Control and approved inspectors should ensure critical features of the design are appropriately detailed and installed. Looking forward, it is important to ensure the measures introduced by the Building Safety Act 2022 are followed with robust monitoring
- **All stages** - RPs and/or APs must have a comprehensive understanding of the risks within, and construction type of, their buildings. Fire risk assessors can help identify issues but if doubts exist over the quality or competence of the construction or products used within, intrusive surveys may be required. This is particularly important where there exists a risk to the integrity of the compartmentation or there may be faulty/missing cavity barriers

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