CROSS UK
COLLABORATIVE REPORTING FOR SAFER STRUCTURES

The Institution of Structural Engineers

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The Institution of Fire Engineers

CROSS Newsletter

CROSS-UK Newsletter 64 | **March 2022**

Fire safety risks with lithium-ion batteries

Fire protection of stair structure

Cladding and decking certification

Delay by party wall surveyor adds to risk

Share knowledge to help create a safer built environment

Editorial

Dame Judith Hackitt's review "Building a Safer Future" identified that the current system of building regulations and fire safety is not fit for purpose and that a culture change is required to ensure that buildings are safe, both now and in the future. She also noted that a new regulatory framework is required to drive culture change. This framework, in the form of The Building Safety Bill, is currently passing through parliament and will impact all those who have responsibility for the design, construction, and management of buildings.

The industry is accustomed to legislation-led culture change. The introduction of the Health and Safety at Work Act in 1974, and other legislation, drove significant culture change in the construction industry. Its success measured through the reduction in deaths and injuries on construction sites. Health and Safety is now at the forefront of all competent contractors' actions.

Similarly, the introduction of the Construction (Design and Management) regulations first introduced in 1994 drove culture change for clients, designers, and contractors. The need to ensure that work is planned so that risks are managed from start to finish, including the need for future maintenance, is now understood by all competent persons involved in the development of the built environment.

But how will one measure the success of the needed culture change described by Dame Judith Hackitt? In the long-term, its success will be measured by safer buildings and a reduction in the number of incidents related to structural and fire safety. Measuring progress towards this goal however is more challenging.

We are currently working with government bodies and industry leadership groups to explore how culture change, related to building safety, can be measured. The Building Safety Bill includes recognition that a voluntary occurrence reporting process is required and therefore the further growth of CROSS is one indicator of culture change.

The awareness across the industry of CROSS can be measured via the number of users who visit our website and read our reports. Interaction with us is measured through the number of people who register on our website, subscribe to our newsletter, or our social media feeds. Our goal is to receive, process and publish structural and fire safety reports and alerts to enable lessons learned to be shared across the industry.

By reading this newsletter you are already aware and interacting with us and we ask for your assistance in building on our current success and to be a part of the culture change. Please encourage your colleagues to read and subscribe to our newsletter and ultimately to submit your safety reports. It is the ability to confidentially share your experiences of incidents, that are not normally reported, that will assist in driving culture change and ultimately assist in having safer structures. That is the aim of CROSS.

This issue of our newsletter contains fire and structural safety reports which demonstrate the importance of sharing our lessons learned and I thank the reporters for their submissions.

Paul Livesey,
Scheme Manager, CROSS

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Reporting to CROSS

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

Find out more >

Fire safety risks with lithium-ion batteries

CROSS Safety Report Report ID: 1058

A reporter has raised concerns regarding the increase in the use of lithium-ion batteries, along with their related hazards which currently remain unregulated.

Key Learning Outcomes

For designers:

- Ensure that a competent fire safety engineer is consulted in projects that involve battery systems

For fire engineers:

- Stay up to date with the latest research developments in the field of battery systems
- Inform other members of the design team and clients about the potential risks arising when employing novel, unregulated technologies

For Authorities Having Jurisdiction:

- Carefully review proposals that employ novel, unregulated technologies, so that any potential risks are acknowledged and addressed with the appropriate justification

R Full Report

Of the currently available technologies, lithium-ion batteries have the highest energy density and are the first to employ an organic solvent in the electrolyte. Their failure probability is calculated to be extremely low when stored and operated within the recommended limits, but their normal operation can be disrupted if there is electrical (e.g. short-circuit, overcharging) or mechanical abuse (e.g. mechanical crash, self-heating, external heating source). If the heat losses (usually convective) cannot offset the amount of heat increase within the battery system (either by internal exothermic reactions or external heat fluxes), then a phenomenon called 'thermal runaway' occurs. During thermal runaway, the temperature increase leads to an exponential increase in the reaction rate within the battery, leading to a cascading effect that can evolve into a very serious fire or explosion.

The 'thermal runaway' phenomenon

The reporter explains some of the mechanisms involved, namely that once thermal runaway occurs then "hydrogen (c.a. 30%), carbon monoxide, carbon dioxide, hydrogen fluoride, hydrogen chloride, hydrogen cyanide, small organic molecules such as methane and ethane as well as nitrogen oxides are produced. When the gaseous mixture vents outside the battery, it takes with it fine droplets of the organic solvent, rendering it a dense white vapour". Depending on the environmental conditions around

News

1. Request a talk from CROSS-UK >

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

2. Balcony Safety Alert published >

CROSS has published a new safety alert 'Safety issues associated with balconies' which draws on confidential reporting experience from the UK, from Australia, New Zealand and from the USA. The alert is aimed at but not limited to, owners of residential and other buildings with balconies, Local Authorities, Building Control bodies, developers, building surveyors, architects, structural engineers, facilities managers and maintenance organisations.

3. CROSS fire consultants among recipients of IStructE's Honorary Fellowship Awards >

The Institution of Structural Engineers is delighted to award Honorary Fellowship Awards to Neil Gibbins and Peter Wilkinson, who are CROSS Designated People for fire.

Honorary Fellowship is awarded to senior non-structural engineering figures who share similar values to those of the Institution and whose activities and interests bring added value to the Institution and its work.

Visit:
www.cross-safety.org/uk

Email:
team.uk@cross-safety.org

the battery, there are two hazardous outcomes:

1. The vapour ignites immediately, and long flare-like flames are produced, as shown in Figure 1.
2. The vapour does not immediately ignite and forms a cloud instead. An example of such a case is shown in Figure 2.

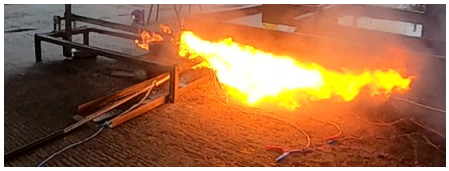

Figure 1. Flare-like flame, approximately 3m long, resulting from nail penetration of a lithium-ion battery electric vehicle module (8 cells each ca. 54Ah, 1.7 KWh).

Figure 2(a). An identical module to that in Figure 1, at 40 seconds after nail penetration.

Figure 2(b). An identical module to that in Figure 1, at 86 seconds after nail penetration.

For the second case, if or once the cloud is adequately mixed, it can potentially ignite, developing into a deflagration (subsonic speed of the flame front propagation, also known as a flash-fire). Increases in pressure can occur, depending on the surrounding confinement or any turbulence inducing obstructions. When the overpressure generated is enough to damage the surrounding elements and structures, the incident is considered to be a vapour-cloud explosion. Any of these scenarios can be extremely dangerous and it should also be noted that the vapour cloud is highly toxic.

Increasing domestic use of lithium-ion batteries

In the UK, there are some current drivers behind the increased use of domestic lithium-ion battery storage systems (DLiBESS). One of them is the "behind the meter" storage (storing charge when supply is cheap and using this stored energy when supply is expensive i.e. for optimising the time of use (TOU) billing), and storing renewable energy from photovoltaic (PV) arrays for domestic or commercial use (Virtual Power Plants to support the National Grid). However, the reporter considers that when it comes to the use of lithium-ion technology on DLiBESS's, the risks and hazards remain unregulated. Some indicative numbers for commercial systems are their range from 2 kWh to 130 kWh or more (the modules in the Figures provided are 1.7 kWh).

The reporter goes on to explain how lithium-ion batteries start to go unstable at temperatures as low as 60 – 70°C, although thermal runaway occurs at temperatures > 120°C. This could be attributed to possible abuse, e.g. by cycling at temperatures < 5 °C or > 60 °C, or by charging at high currents. The latter case causes the deposition of lithium metal on one of the electrodes and this, in turn, facilitates thermal runaway at much lower temperatures; even ambient.

The worry is exacerbated by the rise in the second-hand market of these batteries, which are routinely sold on the internet for the conduction of Do-It-Yourself projects by members of the public. In such cases, there is no guaranteed record of previous operational conditions. There have also been many recalls in recent years and "over thirty five fires and explosions involving industrial LiBESS across the world in the last 3 years, at least four of which involved vapour cloud explosions. The most recent was in April 2021 in a Beijing shopping mall which killed two people and badly injured a third. The testing of a DLiBESS in Australia by the Commonwealth Scientific and Industrial Research Organisation

Fire safety reporting

As we approach the first anniversary of the expansion of CROSS to include fire safety reporting, CROSS "Designated People" Dr Peter Wilkinson and Neil Gibbins provide a brief update on how the sector has responded.

Launching a new initiative that relies on developing understanding and trust is challenging at any time, but the challenges multiply during a pandemic. Whilst we would have been travelling around the country attending the many and varied fire sector gatherings, conferences, and the like, we have been doing our utmost to get the message out using other routes. Many organisations have adopted remote meeting technology to communicate with members or co-workers, the CROSS team have been invited to present online to describe what CROSS is and what it does. We are grateful for those opportunities; many have led to a good number of people visiting the website and subscribing. A few have taken the next step and submitted reports. Reports are the lifeblood of CROSS. Why would you look at us, if we don't have anything to tell you? –The reports received, published or in process, have immense value and will help make a difference. Please sign up and share.

CROSS is an essential element of a just and good culture. Many companies are encouraging their people to get involved, to share learning for wider benefit. Many individuals are signing up to receive newsletters, however, we are nowhere near touching all of the potential audience. CROSS is supported by our volunteer Expert Panels. They diligently absorb the information received in reports and provide additional commentary. They also look across "the system", having their fingers on the pulse of the fire safety world, providing comment on

(CSIRO) in 2019 resulted in a vapour cloud explosion and, in the same year, a vapour cloud explosion and fire destroyed a pleasure boat in Sneek harbour in the Netherlands. In February 2022, a DLiBESS fire badly damaged a home in Adelaide, Australia. Some other accidents have been presented in **a review by Wang et al>**. until 2019.

The reporter considers that these hazards will be present in any facility that has such a storage system installed.

C Expert Panel Comments

The expert panel agrees with the concerns raised by the reporter. This genuine worry is likely to become more prominent over time as batteries get increased use. The forthcoming Part S of the Building Regulations (on infrastructure for the charging of electric vehicles) is part of a trend that will increase the use of electric charging in car parks. This exponential rise in the use of LiB (and other alternative energy sources with their own respective risks) is being driven by the reduction of emissions and the agenda for achieving 'net-zero'. This drive has led to the use of LiB in all environments and scales, from small portable devices to scooters and electric vehicles (EVs), and to domestic, mid-scale (shipping containers) and grid-scale (Solar Farms) Battery Energy Storage Systems.

> **how these alternative fuels and systems interact with the built environment is of particular interest in this case**

How these alternative fuels and systems interact with the built environment is of particular interest in this case, because the hazards and risks identified in the report are real to not only the attending emergency services, but also to occupants and those in the vicinity of buildings, as well as to the environment. There is a certain level of uncertainty involved due to the potentially limited extent of research conducted so far, and that is a cause for concern. Specific issues that will be of concern in relation to buildings can vary drastically depending on the particular situation. For example, dealing with the fire risks of electric scooters on underground trains is very different from dealing with the fire risks of electric car charging in underground car parks, both of these could potentially be hazardous, but the methods for dealing with these fire scenarios would be very different.

One of the particular problems that could also be mentioned is the topic of suppressing such fires. It is often impractical or impossible for the fire brigade to extinguish such battery fires, so dealing with them can often simply involve waiting for them to burn out or just immersing them in a tank of water for a day or more. The panel is aware of examples and incidents of multiple vehicle fires in car parks in Merseyside, Cork, and Norway (amongst others) which highlight the risk of structural damage and subsequent collapse from such a large fire.

Regulatory or statutory guidance

Comments and insights are welcome from Building Control Bodies (BCBs) on the process involved in ensuring that the functional requirements of the Building Regulations have been met. Similarly, the approach followed by the Fire and Rescue Service (FRS) in order to enforce the provisions of the Fire Safety (Regulatory Reform) Order 2005 and provide advice on request can also take an interesting turn when LiBs are utilised in a project. This is not only an issue with new buildings, but it should be acknowledged that such systems may be installed retrospectively and be found present in any kind of structure.

The panel is aware that these issues are currently being assessed further, through ongoing work, but until now there is no statutory advice or other (British Standard etc.) guidance available. In the face of this uncertainty, and lack of technical developing trends and issues, or relaying insufficient progress in adopting learning that is critical if we are not to see a repeat of the Grenfell tragedy.

Reports highlighted in this newsletter are from several different parts of the fire "sector". They relate to some issues that are already high-profile, others will probably be new to many subscribers. All should provoke thought.

We say thank you to the reporters, our expert panellists and you, for reading this newsletter; taking the time to learn and care.

guidance, there is an argument to be made about the approach employed to support any proposal to install any such systems in buildings, and whether that should only be done through an evidence-based first principles approach by competent professionals. One suggestion could be to treat these systems like it is already done with other potential sources of hazards to health (and the environment), which could lead to additional safety provisions being placed alongside these systems.

Given the motivation and the increasing need to use batteries, along with their potential role in a more sustainable future, this is not only an isolated sector issue but one that society must address together in good time. Developers of such technologies, insurers, and government are key stakeholders in this, because if these concerns are left unaddressed then it is highly probable for battery fires to become the next 'legacy' fire issue, with a high cost to society and expensive remediation in the years to come.

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Submit Report

Submit Feedback

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. Asbestos-related cancer deaths >

The BBC has paid £1.64m in damages over the cancer deaths of staff consequent of them working in buildings riddled with asbestos. Reports claim that a large percentage of hospitals and schools still contain asbestos. Those involved in refurbishment should be aware of the threat.

2. February 2022: Storms Dudley, Eunice & Franklin cause damage >

During February, the UK was battered by a series of storms bringing high winds and flash flooding. Storm Eunice generated rare red warnings and record gust speeds. Significant infrastructure damage resulted including partial shredding of the Millennium Dome fabric roof.

Observation of wind damage incidents on domestic buildings shows that wind design knowledge is not always being properly applied. Several images are available of roofs sucked off and of brick panels being sucked out. Consequential impact damage to other structures was often seen.

3. Risks caused by flash flooding >

The February storms were accompanied by flash flooding generated by bursts of intense rainfall. In all safety considerations, rates of failure are a factor to consider. Fast failures are more to be feared as there is no time to minimise the risk to life or to effect emergency repairs. After Storm Franklin, the 'Independent' newspaper highlighted risks to basement dwellers of drowning in flash floods.

Concern over modelling of concrete frame building for construction stage

CROSS Safety Report Report ID: 1073

A reinforced concrete frame building was several storeys in height and supported by a critical transfer slab at first floor. It became apparent that the design had not appropriately considered the construction sequence of the frame.

Key Learning Outcomes

For clients:

- Clients should consider design validation as part of setting procurement and contractual strategies

For civil and structural design engineers:

- During design and checking consider the loads at each stage of construction
- It is good practice to carry out sense checks and validate all analysis and design outputs
- Ensure assumed construction methodology is communicated to contractors and is verified as constructible by contractor, with any changes agreed with the designer
- Consider the need for robustness at all stages of construction
- Independent checking is good practice

For constructors:

- Work with designers to see if there are requirements for providing additional strength or stability during construction
- Recognise the importance of heavy-duty transfer slabs and their role in the behaviour of a building

R Full Report

A reporter's firm had recently been involved in undertaking a peer review of another consulting engineer's design for a reinforced concrete flat slab frame. The frame was several storeys in height and supported by a critical transfer slab at first floor.

In undertaking the review, it became apparent that the original design had not appropriately considered the construction sequence of the frame.

The designer had undertaken their reinforcement design for the critical first floor transfer slab using a 'global' or 'whole building' 3-dimensional design model.

The design model assumed that the complete building structure was in-situ and fully cured. As such the analysis gave loads on the transfer slab much reduced compared to that of a conventional 'hand' load take down, or indeed what would be replicated by undertaking individual slab design models.

4. Tower block fire >

Fires in multistorey dwellings regularly feature in the press. This one on the 17th floor included wooden balconies ablaze (which can spread flames up building. façades). Reportedly there were no fire alarms. Another potential near miss.

5. Infrastructure degradation >

Every year the American Society of Civil Engineers issues a score card describing the decaying state of US Infrastructure. There was an example of infrastructure issues when the Fern Hollow Bridge in Pittsburgh collapsed just before President Biden was in the city to deliver a speech on such matters. The bridge was normally used by 14,500 vehicles a day.

The analysis showed loads in columns supported by the transfer slab were only about one third of those that would be obtained from a conventional load take down. It was clear that the global model had generated alternative load paths within the structure by 'hanging' of columns above the transfer structure; the columns being hung from frames above, proportionate to the frame stiffness, through a catenary or other action.

It is the opinion of the reporter's firm that generation of alleviating load paths was not possible at least when considering the self-weight of the structure. The structure above the transfer slab would either not have been constructed, or would not have sufficiently cured, to provide the stiffness required for such an effect to occur. This is clearly significant when considering a concrete framed structure, where about 80% of the load was as a result of self-weight.

The peer review indicated several areas of the critical transfer slab which were considerably under-reinforced. This could have led to structural failure of an element and a possible disproportionate collapse. Even in areas where reinforcement was within strength limits, there was concern that the designed structure lacked sufficient redundancy and was therefore not robust enough to withstand catastrophic disproportionate collapse. In such events, it is this 'redundancy' which will be relied upon to ensure the structure remains stable (even if only temporarily) to allow the safe evacuation of occupants.

> **could have led to structural failure of an element and a possible disproportionate collapse**

The reporter understands that the issues were acknowledged by the original designer and amendments to the design were made.

In the opinion of the reporter the issues stem from the inexperience of the designers in tackling such a structure, lack of competent internal checking and over-reliance on software. The lack of experience allowed the designers to proceed with the design not recognising the need to design the structure through all stages of its life, including those temporary conditions which would exist during construction. The reporter believes it is a case of 'rubbish in, rubbish out' as far as the modelling is concerned. Finally, checks should have been undertaken to ensure that software outputs mirror those which can be derived through conventional and empirical 'hand calculations'.

> **to ensure that software outputs mirror those derived through conventional and empirical 'hand calculations'**

As part of the review, enquiries were made with leading bodies who are authorities on concrete construction and there seemed to be a lack of technical guidance on this subject. The current design codes (EC2 etc.) did not appear to cover the temporary modelling aspect in any significant detail aside from general statements to consider all stages of construction.

Additionally, the reporter is concerned that the published guidance is now circa 15 years old and becoming increasingly outdated as more rigorous and detailed finite element type analysis is undertaken. The reporter was also surprised to find that the Institution of Structural Engineers (IStructE) latest technical guidance on this subject "Computational Engineering" does not even appear to consider the importance of this subject in modelling structures of this type.

In conclusion, the reporter considers that further technical guidance should be provided on the subject and perhaps even revisions to the aforementioned documents considered. Additionally, engineers should remain vigilant in undertaking simplified 'hand check' assessments and more should be done to reinforce this to more junior (and therefore inexperienced) engineers.

More CROSS reports

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

Unsafe working platform >

A reporter came across an access platform supported next to an excavated foundation with unstable sides while carrying out an inspection on site.

Unsafe instructions from a building inspector >

On the site for an extension to a domestic property, a building inspector instructed a contractor to excavate a deep trench. The trench was in front of the neighbour's adjacent boundary retaining wall and left a deep vertical face under the house being extended.

Another example of brick slips falling from height >

Another example of defective brick slips falling from the facade of a building.

Dangerous building work on domestic project >

Temporary propping fails during works to a semi-detached property putting the whole building at risk of collapse.

Specifying resin by colour causes confusion >

A mistake occurred on-site when resin for fixings was selected by colour of packaging rather than by colour of resin. The actual resin used did not reach sufficient strength and the installed fixing failed under a pull test.

C Expert Panel Comments

Unfortunately, it is not uncommon for lack of experience to lead to analysis models missing key construction stages, or those using the model failing to appreciate the presence of secondary load paths. In this case, the upper frames in the model were effectively acting as a vierendeel truss. As suggested in the report, it is unlikely this was the intention, and very unlikely that the elements above had been, or could be, designed for the additional vierendeel forces.

Other common mistakes include modelling one-way floor elements as a diaphragm such that the model assumes transverse bending in the floor; including torsional stiffness in elements but not checking the torsional resistance; column shortening reducing hogging moments when this may not be present during construction (although this depends upon the construction sequence).

Whilst updated guidance, as suggested by the reporter, would be helpful it can only ever give examples. It would not be a substitute for checking of the output by an experienced engineer who has an understanding of the expected behaviours. Here, the review engineer undertook a very simple load take down and discovered that the much more complicated analysis was indeed incorrect.

> **checking of the output by an experienced engineer who has an understanding of the expected behaviours**

It is essential that the temporary condition of the permanent works is considered at all times, as often the temporary condition of the permanent works can be more onerous than in the permanent condition. This must include giving full consideration by the designer of at least one buildable construction sequence. Early contractor involvement may be beneficial such that construction sequences can be modelled at the design stage. This will allow adequate consideration of temporary stages and their impact on the structure.

The **Temporary Works forum>** provide significant guidance upon **constructability reviews>**. Had such a review been undertaken during design of this project, the errors would likely not have been made. Furthermore, the engineers involved would have benefitted from a much broader appreciation of how design and construction are intertwined.

Structural robustness

The reporter is also right to highlight the robustness issues associated with transfer structures and particularly transfer slabs. The consequences of a failure in a transfer structure are potentially disproportionate and could lead to collapse. Guidance is provided in the IStructE document **'Practical guide to structural robustness and disproportionate collapse in buildings'>** with further guidance for high-risk buildings. It is important to note that for transfer elements, simply providing normal building ties may not be adequate.

Assumed construction methodology

Under the Construction Design and Management Regulations 2015 (CDM 2015) it is normally the case that the structural designer should confirm in the pre-construction information how they have assumed the structural frame is to be built. Clearly this information is essential in that the design is possibly only correct if the designer's assumed construction method and sequence are followed. Where the contractor chooses a different construction methodology, then all parties should be aware that the design may no longer be correct. Indeed, the intended change in construction methodology may lead to the structure being unsafe or overly conservative. Where a change is proposed, the design must be re-assessed using the criteria appropriate to the new construction methodology. Failure to ensure that the design and proposed construction methodology are compatible may lead to a structure which is unsafe to build or indeed unsafe in use. Designers may choose to state the assumed construction methodology as a condition of their design just as they would state the strength of steel and concrete.

The Health and Safety file should be updated after construction with whatever information is required to facilitate safe inspection, maintenance and eventual demolition of the structure.

> **Failure to ensure that the design and proposed construction methodology are compatible may lead to a structure which is unsafe to build or indeed unsafe in use**

Checking and validation

Computer aided analysis and design is an essential part of much structural design, but it must be remembered that the software is only an aid to the designer. The design organisation must fully understand and validate all outputs. In this case, the supervising senior design engineer should have identified all shortcomings. Safety demands that all computer outputs are subjected to a simplified sanity check which appears not to have happened. The design firm's checking and validation protocols should have been appropriate to the complexity of the work in hand and consider the experience of the engineers involved. Checking should be carried out at key stages in the design process before progressing to the next stage; consider checking 'basis of design', computer inputs/outputs, detailed calculations before checking drawings.

Checking should be carried out at key stages in the design process before progressing to the next stage

The importance of validating software is noted in the Institution of Civil Engineers Civil Engineering Journal August 2013 - **The importance of understanding computer analysis in civil engineering>**.

Previous CROSS reports of interest include **Unconservative design of flat slab due to software modelling issues>**.

It is to the credit of the checking engineer that the peer review considered the design more widely than simply assessing the information provided. This example highlights the value of independent third-party checks. The value of independent checks should not be underestimated since not only are errors found, but learning and development across teams are facilitated.

Opportunities for clients

Clients should be aware of the opportunities and risk in design processes. Where mistakes are made, this may well increase client risk. Where all parties to the design and construction process manage design risk well, the client is less exposed to risk. Clients should consider design validation as part of setting procurement and contractual frameworks. Independent checking and collaboration between designers and contractors at the right stages of the project will invariably reduce client risk. The elimination of design risk has benefits across industry.

Submit Report

Submit Feedback

Fire protection of stair structure

CROSS Safety Report Report ID: 1028

A reporter is concerned about the lack of structural fire protection in a fire escape stair, which is assumedly attributed to a lack of coordination between the architect and the structural engineer.

Key Learning Outcomes

For the design team:

- Establish a matrix of design responsibilities to avoid confusion
- Ensure communication between the teams so that all aspects of the design are fully addressed
- Building control approval does not absolve designers from their responsibilities

For potential buyers:

- Consider introducing an independent third-party review to check the suitability of the chosen solutions

R Full Report

The reporter was employed by a potential buyer to review and report on a hotel building which was being modernised. This process led to a new fire escape stair being constructed in the original central courtyard, as part of the building's new fire strategy.

This fire escape was forming a separate compartment through fire-rated walls. However, the reporter recognised a potential issue of structural performance in case of fire when they realised that the supporting steel structure of the stair was going through a plant room – which is considered an area of elevated risk – without any structural fire protection being present in this location. This raised the concern that a fire in the plant room could affect the loadbearing capacity of the escape stair and subsequently undermine the compartmentation achieved through any separating element that is being supported by this steel structure. As a worst-case scenario, the structural collapse of the stair was also considered a possibility.

> **a worst-case scenario, the structural collapse of the stair was also considered a possibility**

The reporter's worries were further exacerbated by the fact that the structural drawings "were silent on fire protection", and even though the architectural drawings covered issues of fire compartmentation they did not present any elements' fire rating. This led the reporter to include the concern in their review in order for the issue to be actioned by any future buyers.

Holistic approach in design process

The reporter is of the mind that there was a lack of coordination between the architect and the structural engineer, which caused both of them to not review this design aspect accordingly. This goes against the need for a holistic approach in the design process, which is essential in addressing design issues for the building as a whole and not as separate functional entities.

C Expert Panel Comments

Commonly, a stair structure does not need to have applied fire resistance where it is within a low-risk enclosure. In this case, it is not clear why the structural steel in the plant room doesn't have any fire protection given how that would normally be required, as the reporter suggests. If there is no fire protection to that structure, then that might be a breach of normal standards, unless there are other mitigating factors that are not mentioned in the report.

It can also be very common for drawings to omit structural fire resistance ratings, and to rely on a note. Of essence in this case is not only that there was a lack of overall thought and control, but also that when the issue was raised there was a lack of professional care on the part of the designers. They should have realised and acted accordingly.

In general, there is an excessive reliance on the existence of building control approval which is no guarantee that a building is safe. Building control approval does not absolve designers from their responsibilities.

lack of professional care on the part of the designers who should have realised the significance of the issue

Submit Report

Submit Feedback

Inadequate design submissions for alterations to an existing building

CROSS Safety Report Report ID: 1085

An upper storey extension was designed without considering the effect on the structure below. A further four attempts to prove the proposed new structure failed to demonstrate adequacy.

Key Learning Outcomes

For owners and clients:

- Ensure engineers are competent for the project in hand before appointing

For all built environment professionals:

- Work within the limits of your competence
- All professionals should understand the code of conduct of their qualifying institution(s), which they are obligated to uphold
- Codes of conduct will require professionals to apply appropriate skills, experience, and knowledge

For civil and structural design engineers:

- Supervision of design by experienced engineers can allow less experienced engineers to develop their competence
- Engineers should undertake full assessments of existing structures when considering alterations
- Independent checking is good practice

R Full Report

A report has been received from a consulting engineer who was appointed to check the design for an upper storey extension. The check was part of a landlord's consent process.

The checking engineer found that the structural design did not consider the effects on the existing structure below. When asked why they had not done checks on the existing structure, the design engineers did not appear to understand the need to assess the supporting structure. After accepting the need to assess the existing structure, calculations were re-submitted, but these proved to have very significant errors.

A second re-submission was made, and this also contained serious errors. A third, and then fourth re-submission were made; the last two versions had apparently been reviewed by a chartered engineer at the design practice. None of the submissions adequately justified the proposals.

The design firm responsible appeared to have little understanding of lateral stability considerations

The design firm responsible appeared to have, in the view of the reporter, little understanding of lateral stability considerations. The Landlord was told that the calculations were insufficient to prove that the building was capable of accepting the proposed upper storey extension. Subsequently, a second design practice was engaged to design the upper story extension.

Unsurprisingly, the reporter concluded that designs for additional storeys should only be undertaken by competent people.

C Expert Panel Comments

This is a worrying report. That several attempts were made without success to justify the structure suggests that the designers may have been working outside their knowledge and experience.

Engineers should always be mindful of their professional duties under law, their terms of appointment and the code of conduct of their qualifying institution. The code of conduct alone will require them to be competent to perform the duties offered, apply appropriate skills, experience and knowledge, to act with impartiality and have full regard for safety. It would be very unwise indeed for any engineer, or indeed other building professional, to act outside of their obligations. An engineer acting outside of their competence, as appears to be the case here, is a very serious issue that may well lead to unsafe structures.

> **An engineer acting outside of their competence is a very serious issue that may well lead to unsafe structures**

The value of independent checks

It is foreseeable that mistakes will occur however the supervising senior engineer should have identified all shortcomings when checking the design. It is fortunate in this case that an independent check was required as this led to the discovery of the inadequate design. The value of independent checks should not be underestimated since not only are errors found but learning and development across teams are facilitated.

Clients should assess competency before appointing

Clients should always be concerned to understand the competence of building professionals they propose to appoint. Capability in terms of the experience, training and qualifications should be assessed alongside the proposed resourcing. The firm's checking and validation protocols should be appropriate to the complexity of the work in hand.

Submit Report

Submit Feedback

Cladding and decking certification

CROSS Safety Report Report ID: 1095

A report has been received about a supplier of cladding and decking materials that refuses to provide their potential clients with their products' Reaction to Fire Class.

Key Learning Outcomes

For the design team:

- Consider requesting and keeping a record of all certificates for products that are used in each project
- Ensure that the people requesting such information have a clear understanding of the concepts involved

For manufacturers and suppliers:

- Ensure that products are certified under the appropriate test method
- Consider withdrawing or amending any marketing literature that does not provide clear or adequate information on the product being presented
- Providing insufficient, incorrect, and inaccurate 'clarifications' with an intention to mislead clients can lead to future ramifications

R Full Report

A report has been received about a supplier of cladding and decking materials that refuses to provide their clients with their products' Reaction to Fire Class.

The reporter contacted the company, which is assumed to be based in another country but operating in the UK, in order to be provided with the Reaction to Fire Class of certain cladding and decking products that they offered. However, the response was that this is not an issue that the clients had to worry about.

Some very troubling quotes from this response indicated a complete lack of understanding of the importance of the issue from the supplier's side. The response was:

"Thank you so much for your kind feedback. Our products have been treated with fire prevention, so you don't need to worry about this", supported by the statement that:

"Our products are fireproof, and have done the corresponding test".

The reporter is of the mind that the suppliers are unaware, or simply unconcerned of material testing and its use within specifications of technical guidance for design in the UK market.

It is also considered that people who specify products for a project should be aware of the Fire Resistance Rating and Reaction to Fire Class concepts, not buying into unsubstantiated replies, hence the need for such heedless behaviour on the suppliers' side to be called out. The reporter also thinks that such a stance should be scrutinised by a regulatory authority.

C Expert Panel Comments

The panel agrees that this is a genuine and significant concern. If any contractors are basing their purchasing decisions on such a wholly inadequate level of justification of fire performance, then those contractors are likely to end up with products that are inappropriate. This practice is considered unacceptable, and no one should be purchasing products on such justification alone.

It is unclear whether the product supplier understands the need for testing of fire properties, or they are trying to get around unfavourable results. A competent contractor would never purchase a product like this, would attempt to contact the technical department if possible, or would look for alternative suppliers.

> **A competent contractor would never purchase a product like this**

Responsibility of designer

With current regulatory standards, there would often be very few checks to prevent unsuspected contractors from specifying, ordering, and using such products. There is no guarantee that Building Control checks would go into enough detail to identify these problems, as Authorities Having Jurisdiction only have a certain level of resources available, they cannot – and should not be expected to – review the test documentation for every product that goes into a building. This is the responsibility of the designer.

With no product literature on fire performance and classification, and depending on what products are used and where, it will be almost impossible for the Responsible Person under the Regulatory Reform (Fire Safety) Order 2005 to assess these products' risk.

Similarly, **PAS 9980 – Fire risk appraisal of external wall construction and cladding of existing blocks of flats – Code of practice>**, was recently published, and the processes outlined in the document rely on identifying the product (in some way) to assess the fire risk (if that product is used in an external wall system). Therefore, any competent assessor, in the lack of such documentation, will almost certainly request the products to be tested to assess their performance, or be replaced.

Decking products also need scrutiny

The same comments apply as well for decking products, given how the UK Fire and Rescue Service have seen some significant fires involving composite decking, and issues with decking on common approach balconies of flats have already been published by CROSS in **Composite deck boards in common access balconies >**.

It is expected that the new changes to regulations and practice, through the Building Safety Bill and the Office for Product Safety and Standards, will increase the regulatory requirements for tall residential buildings, but strengthening the current regulatory framework is an ongoing issue.

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Delay by party wall surveyor adds to risk

CROSS Safety Report Report ID: 1010

A party wall surveyor causes delay which prevents a dangerous wall from being made safe in a timely manner.

Key Learning Outcomes

For surveying and engineering professionals:

- All building professionals should understand the code of conduct of their qualifying institution(s)
- Codes of conduct will require professionals to have full regard for safety
- The Party Wall Act provides a framework for decisions to be made and works to be put in place even where parties disagree information on the product being presented

R Full Report

A reporter says that the making safe of a dangerous 2m high masonry wall was frustrated by a person who did not place sufficient emphasis on the risk to safety posed by it.

A party wall surveyor acting for the owner on one side of the property, was told by a structural engineer that the wall was unsafe. A party wall surveyor acting for the second party agreed with this position. However, the first surveyor then stated that the wall did not fall under the scope of party wall legislation and therefore a third surveyor could not be appointed to make an award as would be the normal practice.

The second party challenged this position and reported the matter to the Health and Safety Executive (HSE) who referred the case to the Local Authority. The first surveyor then re-considered and decided that the wall did indeed come under party wall legislation.

It was clear to the reporter that prevarication and delays by the first surveyor obviously prevented the wall from being made safe in a timely manner. The reporter considers that safety should have been the overriding matter and taken precedence in decision making.

C Expert Panel Comments

Delays like this do need to be highlighted to raise awareness of the danger to public safety when the stability of a structure is in doubt.

Where the question is one of safety and there is a risk of death or injury if actions are delayed, a question that should be at the forefront of the professional's mind is, "Would I rather explain to a client why I agreed to spending money by acting, or explain to a Coroner, the Police, the HSE and the relatives of the deceased why I chose not to act?"

> **or explain to a Coroner, the Police, the HSE and the relatives of the deceased**

Professional duties

There may be an issue in this case of a party not wanting to pay for something which they start to understand could be their liability under the Act. However, surveyors and engineers should always be mindful of their professional duties under law, their terms of appointment and the code of conduct of their qualifying institution. The code of conduct alone will require them to be competent to perform the duties offered, including knowledge of applicable laws, act with impartiality and to have full regard for safety. It would be very unwise indeed for any surveyor or engineer to act outside of their obligations. Acting knowingly not to have full regard for safety, would be a very serious issue professionally, legally and morally.

The Party Wall Act etc 1996 lays down a framework of actions and timescales to assist parties to agree upon work that is desired or required. The Act is explained in the Government publication **Party walls and building work>**. Emergency work can be undertaken under the Act

with parties agreeing the scope, access and timescales for such work. When parties disagree, the Act still provides a framework for decisions to be made and works to be put in place; the Act allows for these circumstances. It should be noted that the Act is only relevant to England and Wales and not elsewhere in the UK (where it does not apply).

Dangerous structures

It may have been appropriate to have referred this case to the local authority as a dangerous structure. The local authority building control department has powers available to them under the Building Act 1984 to intervene where structures are unstable; they can act to make structures safe where owners do not act. The Health and Safety Executive may also choose to act where health and safety legislation is potentially breached. Of course, property rights and obligations exist for parties under common law and legal redress could be sought to clarify responsibilities. Nevertheless, the mitigation of safety concerns, as defined by the responsible surveyors and engineers, is the issue that all professionals would be obligated to resolve without delay.

Further reading

Further guidance upon the Party Wall Act etc 1996 is available:

UK Government: ***Your garden walls; better to be safe>***

UK Government: ***The Party Wall etc Act 1996: explanatory booklet>***

Submit Report

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Ineffective fire socks

CROSS Safety Report Report ID: 1115

A reporter shares their concern about how the quality of fire stopping in a residential project was found to be substandard and the potential reasons that led to this happening.

Key Learning Outcomes

For project managers:

- The Regulatory Reform (Fire Safety) Order 2005 defines the Responsible Person who has to ensure that they use a competent professional to do the work

For the construction team:

- Be aware that passive fire protection components should be installed in accordance with the manufacturer's specifications
- Consider introducing a quality assurance process that covers the correct use and installation of fire protection products and components

Architects and lead designers on projects:

- Establish a matrix of design responsibilities to avoid confusion

Site Engineers:

- Ensure communication between the teams so that all aspects of the design are fully addressed

Fire Engineers:

- When contracted to do so, attend site at key stages to inspect the works to ensure they are being built in accordance with the design

R Full Report

During the construction of a 'general needs' block of flats, some quality issues were identified – subsequently, concerns were raised. To address these a professional was hired to investigate and review the standards of fire stopping in the project. The works included the construction of cavity walls with a masonry leaf. The concerns were principally related to wall cavity socks, which at this stage of construction were partially enclosed.

Potential breach of compartmentation

The review concluded that the standard of installation was poor in a high percentage of the locations surveyed. This further enhanced the concern that most of the cavity barriers already fitted were not appropriate to the limitations and standards required by the manufacturer's technical specifications. It follows that the potential impact of this is the propagation of fire through the cavity, which can lead to a breach of compartmentation. This raised some serious concerns because the intention was to implement a 'stay put' evacuation strategy, whose utility and intended function would be obviously precluded if there is any potential for the structure to inadequately inhibit the spread of fire beyond the flat of origin.

Checking the installation of fire socks

The reporter attributes this to the principal contractors completely relying on the masonry sub-contractors to install the fire socks competently in an appropriate manner, without anyone overseeing the quality of installation or engaging with an appropriate third party to certify the works. The available experience suggests that this is an all too often approach to the installation of fire socks during the construction of cavity walls with a masonry leaf.

To uncover the motivation behind this practice, says the reporter, the issue was discussed with site and project managers that work on similar scale projects. From these conversations it was indicated that synchronising the cavity wall construction with third-party fire stopping inspection would introduce delays into the critical path, which is the sequence of dependent tasks that form the longest duration for project completion; any delay can incur additional costs, which is to be avoided.

The findings of this review forced the principal contractors to make good all deficient construction by hiring the services of a third-party fire stopping sub-contractor, which will of course be reviewed again to ensure its quality. This led to a considerable overspend in the overall project, likely to result in significant financial losses to the principal contractors.

> **The findings…led to a considerable overspend… likely to result in significant financial losses to the principal contractors**

C Expert Panel Comments

This is another useful report about the incorrect installation of passive fire protection components, as it adds to the weight of the existing reports around this issue and supports any previous CROSS response. Once again, the need to employ competent people to carry out the work, along with thorough inspections during construction and extensive record-keeping in all phases cannot be overstated.

The Principal Designer, under the Construction Design and Management Regulations 2015, is required to recognise the significance of these fire stops, and accordingly emphasise the importance of correct installation, ensuring the appropriate quality of the work through any means available. It is the panel's general impression that Principal Designers do not carry out site inspections to a degree that would ensure the elimination of issues such as the one raised in this report.

Finally, experience has shown repeatedly that spending the money to do it right the first time is always cheaper than spending the money to fix it.

> **experience has shown repeatedly that spending the money to do it right the first time is always cheaper than spending the money to fix it**

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Testing of smoke control systems

CROSS Safety Report Report ID: 1099

A reporter is concerned about the way that smoke control systems in residential buildings are commissioned, installed, tested, and maintained.

Key Learning Outcomes

For facilities managers, fire risk assessors, system designers, and installers:

- There is a need for competent people at all stages of the design, installation, configuration, commissioning, and handover
- For those ultimately responsible for compliance with the Building Regulations at the build stage to be able to demonstrate how this has been achieved

For Responsible Persons:

- Be familiar with the requirements of Regulatory Reform (Fire Safety) Order 2005
- Ensure any smoke control system within their premises is configured correctly and check that this was carried out by someone who is competent to do so
- Ensure any smoke control system within their premises is tested and maintained correctly, this should be carried out by someone who is competent to do so

R Full Report

Smoke control systems are technical solutions to ensure the protection of life in case of fire. Their main function is to operate in case of an emergency so that no smoke will be present in access corridors and evacuation stairwells. Should a system fail to operate as designed, the consequences could be severe, which is why it's important that systems are identified as inadequate through regular checking and maintenance, before a fire occurs.

The issue reported came to light out of research conducted into the functionality of smoke control systems in existing residential apartment buildings. The programme included approximately 50 field tests, for the conduction of which the reporter requested the attendance of a smoke control or fire alarm engineer to test the cause and effect of the systems.

The presence of these professionals was requested because maintenance records offered by block managers were considered unreliable for the quality level and thoroughness of the research conducted. Similarly, the reporter is of the mind that risk assessors do not necessarily request or witness testing. Recent experience from real fires in **Regents Quay in Leeds>** (where smoke vent shaft doors opened in additional floors and allowed the spread of smoke) and **New Providence Wharf in London>** (where the smoke detectors failed to operate the Automatic Opening Vent) motivated the reporter to fully interrogate the systems in place.

Current technical guidance dictates that automatic opening vents (AOVs) are configured in such a way that only the vent in the fire affected floor should operate, with the rest in the remaining storeys staying closed. For example, this is articulated in BS 9991:2015 (paragraph 14.2.2.4) where:

"Only the AOV leading from the protected corridor or protected lobby where the smoke has been detected should be configured to open. This should open either to external air or into a smoke shaft; all other protected lobby vents should be configured to remain closed. Fire and rescue service override controls should not permit multiple lobby vents to be open simultaneously".

Smoke control testing, like the one carried by the reporter, involves the exposure of automatic fire detection devices to artificial smoke or the activation of point detectors in 'fire mode', rather than an engineering override function. This way the system deals with the incident as with a real fire. A well configured system will 'lock out' once a detector is activated, so that if other point detectors in other floors are activated, the vents will remain closed. These additional vents should be able to be operated again after a system reset.

Even though the analysis is ongoing, the reporter's initial estimation is that 60% - 80% of buildings have failed cause and effect testing. The failures have been attributed to many different reasons, examples of which are that vents are opening in the wrong direction, design critical vents are not

opening at all, or that many systems are not 'locking out' allowing the operation of vent doors beyond the fire floor.

Another concern originated with one mechanical depressurisation system not clearing smoke effectively, leading to smoke pooling in corridors due to the lack of airflow in the corridor. However, the system had passed the air flow readings at the stair door and shaft vent. Re-testing of this system is pending.

A survey for further insight from groups of professionals who are involved in testing and maintenance of smoke control systems indicated that there is a lack of competency and awareness of the proper operations of these systems. Additionally, smoke control installations are not being inspected, tested, and maintained correctly, according to these groups.

The underlying causes for this issue, according to the reporter, are the lack of competent contractors in the industry, which contributes to improper installation and commissioning, and the eventual ineffectual testing and maintenance of these systems. Finally, the reporter considers that any cause and effect testing is not being completed as specified, either by block managers, contractors, risk assessors, or fire service inspecting officers.

Finally, the reporter worries that these issues may be present in other buildings beyond the area that they surveyed.

C Expert Panel Comments

This is a significant concern and a recent London Fire Brigade thematic report included research into smoke ventilation systems in existing buildings and came to similar conclusions. These issues are being identified more and more by FRSs and obviously, unfortunately, normally 'during/post fire' but some being found during audit activity.

The report does not give the reasons for the non-functioning systems but these are likely to be poor design, poor installation, poor maintenance or a combination of all three. In addition, there can be a gap in understanding between those designing such systems and those testing and maintaining them. System design can be complex.

The report highlights two approaches to testing and maintenance of systems. One is based on simple cause and effect testing of the design. The other mentions testing the effectiveness of the system (i.e. a mechanical depressurisation system), with reference to 'smoke pooling', which infers that smoke from a fire was simulated in some way. These are different approaches to the testing of systems, and cause and effect testing in 'cold' conditions is typically done, rather than any simulation of smoke movement for practical reasons.

The report confirms the importance of an appropriate method for testing and maintenance of these systems, as the nature of testing with smoke, to assess system effectiveness, can influence the outcome of the testing (e.g. if 'cold' smoke is used, this behaves differently to 'hot' smoke, and may not necessarily be appropriate). Therefore, careful consideration needs to be made for appropriate testing and maintenance of these systems.

The real issues are those of competence and understanding. A UKAS accredited 3rd party certification scheme for installers of smoke ventilation systems in residential buildings is in operation, but not all installers are members of that scheme and in addition the scheme has only been in existence in recent years so there are plenty of existing systems that would have been installed by companies that are outside the scheme.

There are no schemes available for checks on the competence of companies that carry out maintenance of smoke ventilation systems, so there is no way for facilities managers to ensure that their systems are being maintained by a competent engineer. Facilities managers and fire risk assessors must be encouraged to ensure that they do what they can to ensure that systems are fully functioning. This may require investment but as they are safety critical fire safety systems that is necessary.

It is of vital importance that any smoke control system performs as required and intended to support the fire strategy of the premises. Failure to ensure this is the case may not only lead to formal enforcement action by the relevant authority having jurisdiction but may also place persons at risk of death or serious injury in event of fire.

There are documents that can be cited in ADB (both volumes), BS 9991/9999 as well as various documents on the Smoke Control Associations website **Smoke Control Association>**, particularly SCA Guidance on Smoke Control to Common Escape Routes in Apartment Buildings.

Submit Report

Submit Feedback

Basement excavation under a semi-detached house causes collapse

CROSS Safety Report Report ID: 1063

During construction of a new basement, a semi-detached house suffered a significant collapse due to inadequate temporary works during excavation of the basement. The form of the underpinning may have also contributed to the collapse.

Key Learning Outcomes

For clients and architects:

- Ensure temporary works engineers as well as permanent works engineers are engaged
- Party wall surveyors and structural engineers may be required
- Basement construction is specialist work for experienced basement contractors only

For structural designers:

- Structural designers must consider the construction processes required to build their designs and as far as reasonably possible, eliminate foreseeable risk
- Information about significant residual risks (for example, the requirement for lateral restraint to basement walls as excavation proceeds) shall be made available to the contractor and other duty holders

For the construction team:

- Temporary works required for basement construction must be designed and constructed with the same degree of competence and quality as required for permanent works
- Basement construction is specialist work which should only be undertaken by experienced basement contractors
- A Temporary Works Coordinator should be appointed

R Full Report

A reporter says that during construction of a new basement, a semi-detached house suffered a significant collapse. The collapse was caused by inadequate temporary works during excavation of the basement. The flank wall, rear wall, internal floors and roof as well as part of the front wall all collapsed. The party wall to the adjacent property was also damaged. Fortunately, the house was not occupied at the time.

The existing walls had been underpinned with reinforced concrete walls to a similar thickness as the masonry walls over. The underpinning concrete did not however have any toe or other thickening at its base to spread load. The new basement had been excavated but critically no propping restraints had been put in place to any of the surrounding walls. The basement slab had not been started.

The collapse occurred following a period of heavy rainfall which may well have contributed to the failure. The removal of the overburden soil within the basement will have lessened the soil strength under the foundation, potentially allowing a slip circle to form within the clay below the underpinning. The soil failure caused the underpinned flank wall to drop and rotate significantly.

The reporter considered that the inadequate underpinning and lack of any horizontal restraint to the new basement walls prior to the new slab being constructed caused the collapse.

The party wall to the adjacent property was stabilised by the Local Authority.

C Expert Panel Comments

Basement construction is specialist work

The lateral pressure on partly constructed or completed basement walls is very significant. Ground water and/or adjacent surcharge loadings (for example from a highway) can add greatly to the forces exerted on basement walls. It seems many overlook the fact that in basements, the floor(s) have an additional role to provide the horizontal propping between the basement walls. With basements, there is the dilemma of the project being stable when finished, but potentially unstable at intermediate stages. This is why basement construction is specialist high-risk work that can go catastrophically wrong and should only be undertaken by suitably qualified and experienced teams.

> **basement construction is specialist high-risk work that can go catastrophically wrong**

Basement design

The permanent works designer for a basement must indicate a viable sequence for the works and detail the basement walls and slab to allow construction in stages. This design and sequencing will be considered by the contracting team.

Basements require considerable temporary works

Temporary propping to resist ground forces is essential during basement construction. *BS 5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework* gives recommendations for temporary structures, with practical guidelines on design, specification, construction, and the use and dismantling of falsework. Basement temporary works should be designed by a suitably qualified and experienced engineer - the Temporary Works Engineer (TWE). Furthermore, a named person must be appointed to coordinate temporary works on site - the Temporary Works Coordinator (TWC). This may be a dedicated person on larger sites or, the site manager or another manager on smaller sites. Both the TWE and TWC must be competent in basement construction. Regardless of project size, these roles need fulfilling. In planning for construction, there should be discussions between the designer of the permanent works, the TWE, the TWC, the Principal Contractor and any specialist contractors to ensure that appropriate designs and sequences are in place before work starts.

The CDM Regulations 2015

It is critically important to understand that temporary works designers have the same designers' duties as permanent works designers as confirmed within the ***Construction Design and Management Regulations 2015 (CDM Regulations 2015)>***. The regulations also require the Principal Designer to take reasonable steps to ensure cooperation between all designers, including to confirm that permanent and temporary works designs are compatible. The Principal Designer's role continues into the construction phase when design work is carried out. On a Design and Build (D&B) project it will be common for the D&B Contractor to be appointed as both Principal Designer and Principal Contractor.

Basement construction guidance

Significant guidance is available (some of which is aimed at domestic scale projects) to help all parties, including clients. The Association of Specialist Underpinning Contractors has an excellent guide ***'safe and efficient basement construction'>*** which provides a significant body of practical guidance for clients, designers, engineers and others.

The Institution of Structural Engineers has published concise guidance in its ***Temporary Works Toolkit Part 2>*** covering CDM 2015 and the responsibilities of permanent works designers with regard to temporary works. **Temporary Works forum>** have guidance including ***Information Sheet No 6 - The safe management of temporary works: The basics for small and medium-sized enterprises (SMEs)***.

All temporary works should strictly follow BS 5975. The Health and Safety Executive has produced a summary guide for ***Domestic basements construction projects>*** following the principles in BS 5975:

- Ensuring a suitably competent TWE is in place to confirm safe and secure construction processes taking account of all the forces acting.
- Ensure adequate information flow between permanent works designers, TWE and contractors.
- Ensure the permanent works and temporary works designs are checked and complement one another.
- Ensure verification of correct erection of the temporary works and a TWC overseeing and monitoring the whole process.

Projects affecting party walls

Where projects impact party walls, party wall surveyors and structural engineers should ensure the design (both permanent and temporary) and construction method statements are properly reviewed.

Get appropriate expertise

Whichever approach is followed, there should be clear evidence that appropriate temporary works expertise has been engaged and basement failures, such as reported, won't follow.

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Submit Feedback

Overloading of existing steelwork frame

CROSS Safety Report Report ID: 1033

A reporter said that damage occurred to a flat in a multi-storey block, due to inadequate structural investigations and inadequate design of alteration works.

Key Learning Outcomes

For owners and clients:

- Ensure engineers are competent for the project in hand before appointing
- Time and money spent on site investigations is well spent

For structural design engineers:

- Detailed desk top and physical surveys are essential such that the existing structure is understood
- The effect of any revised loading conditions (temporary or permanent) must be assessed
- Engineers should undertake full design assessments of existing structural elements when considering alterations
- The effect upon foundations must be assessed

R Full Report

A reporter said that vertical cracking, displacement and damage occurred to a flat in a multi-storey block due to inadequate structural investigations and inadequate design of alteration works.

Framing details of the original structure were not available. There was also minimal opening up to provide details of the existing steelwork sections.

Design calculations for the alteration works assumed a significant increase in the allowable stress for existing steel sections with no justification. In addition, there was no substantiation of column sections.

These inadequacies led to overstressing of the existing steelwork and damage to the fabric of the building.

The reporter highlighted the following:

1. When considering alterations to existing buildings, structural engineers should be in possession of all relevant facts concerning the building.
2. Foundation assessments are required.
3. Where existing structural steelwork is concerned, assessment to verify both the strength and chemical composition of the metal are required.
4. The local authority may well be aware of any local building acts and bylaws, that would have applied at the time of construction.

C Expert Panel Comments

This report amply demonstrates that modifications to existing metal frames (both steel and iron) is a very skilled task that requires the engineer to intimately understand the existing framework (layout, sizes, materials, grades, age, condition, deformations and loadings) and how the framework interacts with the materials around it. The engineer should also understand how the framework was intended to perform, how structural form may have changed over time and how the structure performs at present, before assessing how any changes will impact the whole structure. Research should be carried out to establish the relevant regulations that were in force at the time of construction along with other published guidance.

Engineers should normally assume, unless investigations show otherwise, that the load bearing capacity of existing structures is fully utilised. Alteration (adding load or changing the basic structure) can only be made if a clear demonstration of reserves is forthcoming. This is especially important when the consequences of introducing a weakness are potentially disproportionate as in the case of alterations to one flat in a block. Only by knowing the structural form and condition can an engineer begin to understand the effects of changes to that structure.

Engineers engaged on a project within a block of flats, should be particularly mindful that other works in the block may have already caused unexpected shedding of loads, or even overloading in their project area; local or

even disproportionate collapse could result from poor design of alterations.

Knowledge, skill base and competence

With decarbonisation of construction gathering momentum, reuse of structures is going to increase, and as with all design, the knowledge and skill base of the engineer must be appropriate to the job in hand. Engineers must have a good depth and breadth of experience to be competent for alteration projects of this type. This applies to all building forms including those buildings using loadbearing masonry, steel or concrete beams/frames and various forms of flooring.

This case illustrates that cutting corners on site investigations and design (through resourcing constraints or incompetent design) will invariably lead to one or more of safety, reputational or financial loss for designers and/or owners.

> **cutting corners on site investigations and design will invariably lead to one or more of safety, reputational or financial loss**

Clients and designers should be aware of their liabilities under the Construction Design and Management Regulations 2015 (CDM 2015). The skills, knowledge, experience and organisational capability of all appointed to construction work should be examined as explained in the **Health and Safety Executive CDM 2015 guidance>**.

There is significant guidance upon building reuse, refurbishment and alteration to help engineers and contractors.

Records are a key asset

Ensuring that all buildings have a record of their original structure (preferably as built) will reduce resources required for future repurposing. Where records are not available and investigations are carried out these should be included in the building's health and safety file and made available as required.

The Institution of Structural Engineers has published a paper **desk research of existing buildings>** which provides insights to uncovering information about buildings.

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