CROSS UK
COLLABORATIVE REPORTING FOR SAFER STRUCTURES

The Institution of Structural Engineers

ice

The Institution of Fire Engineers

CROSS Newsletter

CROSS-UK Newsletter 63 | **December 2021**

Concerns about punching shear in a flat slab

Misleading fire rating on hatches

Steel truss failure during lifting operation

Plus more structural and fire safety reports included

Share knowledge to help create a safer built environment

Editorial

The CROSS team is delighted to announce that Paul Livesey has now joined as CROSS Scheme Manager. Paul's vision and passion for high quality outcomes are an excellent fit for CROSS at a time of great change and opportunity. A short note on Paul's career and aspirations for CROSS are contained in this newsletter. He takes over from the excellent Paul Mc Nulty who is now engaged on building the nation's rail infrastructure.

CROSS broadened its remit into fire safety in March 2021; to date some 20 fire reports have been received with 6 reports published. A particularly important report, Misleading fire rating on hatches is highlighted in this Newsletter – this is essential reading not only for those involved in the installation of services but also for all building managers. Also highlighted is the report Concerns about punching shear in a flat slab. This report shines a light on some punching shear reinforcement being inappropriately designed and detailed – an issue of real concern to structural engineers.

UK subscribers will be keeping an eye on the Building Safety Bill progressing through Parliament. The Bill is anticipated to achieve Royal Assent in 2022 and for various provisions to come into force over a further 18 months. One of the reforms at the heart of the Bill, is the creation of the Building Safety Regulator (BSR), which will sit within the Health and Safety Executive (HSE). The Regulator already exists in shadow form, with Peter Baker appointed as the Chief Inspector of Buildings. The BSR will have 3 main functions:

- overseeing the safety and performance of buildings
- helping and encouraging the built environment industry and building control professionals to improve their competence
- leading implementation of the regulatory framework for high-rise buildings

It is clear that the approval processes for buildings in scope are going to change very significantly. Clarity of responsibility will become more focussed than at present. The emphasis, particularly upon clients is fundamental; client decisions determining so much about a project during construction and in use. CROSS is contributing to the ongoing discussion being led by the HSE in formulating how our industry responds to the challenge of achieving and maintaining safety.

CROSS continues to work alongside industry and government to understand more about reinforced autoclaved aerated concrete (RAAC) elements. Research and assessment as to the risk of collapse of RAAC constructed floors, roofs and walls continues with the expectation that further guidance for surveyors, structural engineers and building owners will soon be forthcoming. CROSS is keen to hear about all experiences of RAAC affected buildings.

Finally, please do help the CROSS network by submitting reports, both fire and structural safety, which help all to learn from the experience of others and build safer.

David Hastings,
Structural Safety Consultant, 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 >

Concerns about punching shear in a flat slab

CROSS Safety Report Report ID: 1050

This report concerns potential shear failures in flat slabs. This originates from inconsistent design and detailing of the shear reinforcement where a proprietary shear link system is assumed in the design but not followed in detailing.

Key Learning Outcomes

For structural design engineers:

- Shear failures in flat slabs are serious and can result in structural collapse
- Flat slab shear reinforcement should be detailed exactly as designed. Proprietary shear link systems (studs/rails) should not be replaced with arrangements of traditional links
- Shear links in flat slabs should be detailed in accordance with The Institution of Structural Engineers **Standard method of detailing structural concrete>**

For the construction team and site inspection team:

- The importance of shear links in flat slabs cannot be overstated and they must be fixed exactly as detailed
- Where there are difficulties in positioning reinforcement the designer must be consulted

R Full Report

A reporter is a chartered structural engineer undertaking civil and structural engineering design in the UK. Part of the workload of their practice is undertaking the review, on behalf of an Approved Inspector, of engineering designs submitted for compliance with Part A of the Building Regulations.

The reporter has seen several examples of designs and detailing of punching shear reinforcement in flat concrete slabs which have raised concern. A number of engineers have used specialist punching shear rail computer software, provided by manufacturers of proprietary systems, to design a radial punching shear solution (see Figure 1).

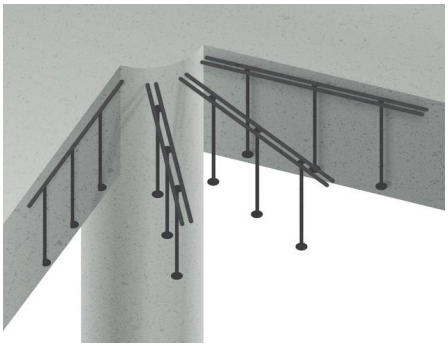

Figure 1: proprietary flat slab shear reinforcement (main slab reinforcement not shown)

News

1. Paul Livesey joins as Scheme Manager for CROSS >

I am delighted to have started my new role as the scheme manager for CROSS and hope that my 30 years' experience as a consulting structural engineer will bring further understanding to the challenges faced by all in the construction industry, including those in the fire sector, in their day-to-day roles.

I have been impressed by the depth and breadth of knowledge and skills held by our expert panels and their genuine passion to improve safety in the industry. I would also like to thank all involved in CROSS for their warm welcome and hope that we can continue to work collaboratively to achieve our goals.

There is much work to be done, following our successful expansion to include fire safety reports, to further strengthen our trusted position within the industry and to continue to promote the culture change recommended by Dame Judith Hackitt.

2. HSE publication on Safety Cases >

A recent publication from the HSE sets out the principles for the forthcoming role of the Building Safety Regulator in relation to Safety Cases.

Visit:
www.cross-safety.org/uk

Email:
team.uk@cross-safety.org

However, the engineers have then specified and drawn traditional shear links on construction drawings (see Figure 2). These links are detailed to a radial pattern (see Figure 3) similar to the proprietary system, even though the slab main reinforcement is orthogonal. The links do extend from the top layer 1 reinforcement to the bottom layer 1 reinforcement but do not explicitly wrap around any top or bottom reinforcement other than a lacer bar.

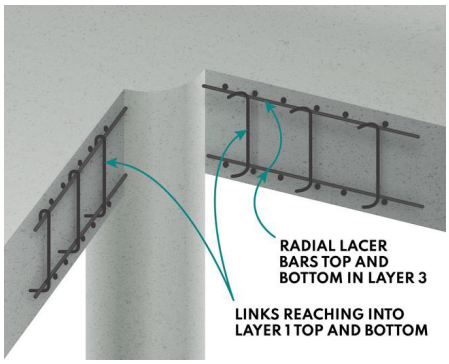

Figure 2: traditional shear links (shapes codes as per Standard method)

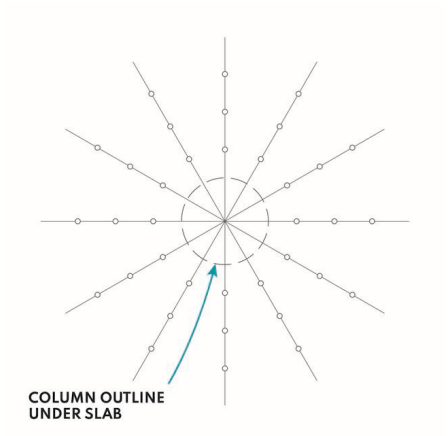

Figure 3: plan showing links in a radial layout (main slab reinforcement not shown)

The reporter has raised concerns about a number of aspects of this practice:

1. The traditional links are sometimes provided with short lengths of lacer bars so that they can be tied into the main reinforcement. However, the reporter is concerned that if the traditional links are not adequately anchored to the main reinforcement, they will not carry the tension loads developed from the applied shear force.
2. They are also very concerned about the practicality of installing traditional links on a radial pattern to the degree of accuracy that can be achieved with proprietary radial systems. The reporter is concerned that the alternative traditional reinforcement will not achieve the shear capacity of the proprietary designed system assumed in the design.
3. They are concerned that the level of supervision on site will be inadequate to ensure that the shear reinforcement will be placed in accordance with the engineers' drawings.
4. The reporter does not know if the Approved Inspector has any responsibility to check the structure during construction.
5. The reporter has raised the matter with a number of engineers, and a typical response is that, in their opinion, it is acceptable. Also, regarding workmanship onsite, they considered that it is the contractor's responsibility.
6. Given the nature of punching shear failure, the reporter felt that they should inform CROSS of their experience and concerns.

C Expert Panel Comments

Shear failures must not happen

Shear failures in flat slabs are very serious and can result in structural collapse not just of a section of the slab but of complete structures. It is concerning that software for proprietary 'headed' bars is being used to design traditional links. Headed bars may well have a more effective anchorage than traditional links and some software, for proprietary products, takes advantage of this either to increase the maximum shear that can be carried, or to allow a relaxation of the spacings required for traditional links. Unless it is clear that the software is fully compliant with Eurocode 2 for traditional links, it should not be used to justify the use of traditional links.

It may also be the case that shear capacity using a proprietary system is

News

3. Request a CPD Talk from CROSS-UK >

The CROSS Team are available to give CPD talks to firms and organisations. These give insight into the work of CROSS for structural and fire safety and 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.

4. CROSS-AUS Newsletter 6 >

CROSS-AUS have published their latest newsletter containing reports on structural safety issues with comment from the expert panel.

5. CROSS Safety Alert>

CROSS has published its latest safety alert 'The management of design related risks' aimed at structural, civil and fire engineers.

not based solely on calculation but on testing which draws in the benefit of the improved anchorage of such systems.

Detailing matters

The method of detailing has an effect on structural performance; indeed, the detailing will impact the actual capacity of the section. This is why documents like The Institution of Structural Engineers **Standard method of detailing structural concrete>** which sets out best practice, are essential reading for those responsible for the detailing of reinforced concrete. Moving away from such proven standard details, without a full understanding of the principles these details address, may well have an impact on the safety of the whole structure.

> **The Standard method of detailing structural concrete is essential reading.**

Traditional links should be fixed as per the Standard method of detailing structural concrete. Where fixing (lacer) bars are required, they should extend at least an anchorage length beyond the last link. It is not clear how this requirement has been relayed to the contractor, but the overall length of the fixing bar must be given and complied with on site. In addition, a design check is required to ensure that the fixing bar provides an adequate anchorage to the links as per Eurocode 2.

When designing flat slabs, it is also important to allow for the effect of holes immediately adjacent to the column for drainage and service risers; these holes will alter the shear capacity and require specific consideration. Detailing for holes, including links, is covered in the **Standard method of detailing structural concrete>**.

Ensuring reinforcement is fixed accurately on site

Attempts to set out traditional links on a radial grid will result in non-compliant spacings. Such links should be set out on an orthogonal grid as recommended in the standard method of detailing.

If the engineer has been checking on behalf of an Approved Inspector, then the Approved Inspector has a duty to review on site. It is however true, that the responsibility remains with the designer and contractor, and the Building Control body shouldn't be relied upon to do a contractor's QA check.

Previous reports

There have been previous reports about shear in flat slabs, including:

- **950 Inadequate punching shear reinforcement in flat slabs>**
- **906 Missing punching shear reinforcement in concrete slabs>**

Submit Report

Submit Feedback

More CROSS reports

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

Volumetric modular buildings and fire>

A report has been received concerning volumetric modular construction, in the form of permanent stacked modular buildings.

Structural failure of older timber connections >

A reporter shares three examples of the structural failure or inadequacies of connections in existing timber structures that they have encountered.

Incorrect steel lintel installation >

A reporter came across several issues, associated with the installation of steel beam lintels, while carrying out inspection works on a 1950's domestic property.

Risks associated with historic stone balconies >

A reporter highlights the structural issues of a stone balcony they encountered when working on a Grade II listed terrace house.

Column stability during erection >

A reporter highlights the importance of ensuring steel columns are temporarily supported until they are sufficiently tied and supported by the permanent structure.

Misleading fire rating on hatches

CROSS Safety Report Report ID: 1057

Retrospective fitting of various amenities including TV aerials, broadband, and satellite connections, may result in new access points being made in walls, ceilings, or through floors. These openings need to be made good using a method that provides the required fire safety properties for that specific situation, including integrity, insulation, and resistance to smoke spread. A reporter is worried that some hatches may not provide all three of these properties.

Key Learning Outcomes

For installers/specifiers/designers:

- The Regulatory Reform (Fire Safety) Order 2005 defines a Responsible Person who has to ensure that they use a competent professional to do the work
- When using a hatch to repair/make good an opening ensure that the hatch meets the criteria necessary for the situation in which it is being used. The criteria can be found by checking with the appropriate fire safety information; if that is not available, the relevant technical guidance or the Responsible Person could be advised.
- Hatches may be supplied that have been tested for a period of fire resistance in all or some of the terms of loadbearing capacity, integrity, and insulation. In some situations, the wall, ceiling, or floor that this hatch will form a part of may also require to have integrity, insulation, and resist the passage of smoke for a period, which may differ from the specifications of the hatch.

For manufacturers and suppliers:

- Ensure that, for products that offer fire resistance, it is made clear if they provide all the necessary performance characteristics, including integrity, insulation, along with resistance to the passage of smoke when needed
- If these products do not, they should be clearly marked as not suitable in certain situations

R Full Report

The reporter states that a broadband installer is using '2-hour fire rated' hatches to make good ceilings in blocks of flats. It has also been observed that the same '2-hour fire rated' hatches are being used in walls separating flats from the common areas, allowing access to services. The certification of these products indicates that they may only offer 2 hours of protection against 'E' integrity, but offer very little protection against 'I' insulation; in addition, they do not stop the passage of smoke. The case observed in the ceiling of the common area was in a timber-framed structure, where the ceiling was providing fire resistance to the timber structure, therefore this hatch should have the required EI values for the height of the building.

Similarly, the walls to the flats where the hatch had been fitted also required the correct EI values to ensure the correct fire resistance had been provided. The hatches are widely used, and they are being sold as 2-hour fire rated hatches in the marketing literature, which requires the person installing them to both understand fire testing and the requirements of the building that it is being installed. Such practise compromises the compartmentation of the ceiling and the walls, given how the reporter considers that heat and smoke can transfer between compartments as the correct insulation has failed to be installed. The consequence of this is that in the event of a fire, smoke may affect the available means of escape, or heat may transfer into another compartment, spreading fire around the premises and potentially compromising the means of escape.

Marketing literature

The cause of this, according to the reporter, is unclear marketing information/anomalous documentation from the hatch manufacturer, exacerbated by the incompetence of the installers. Even though the fire test reports for these products explicitly state that the hatch has not been tested/or offers very little protection towards insulation (I) and does not stop the passage of smoke, such information is less prominently presented or unequally highlighted with other performance points, to avoid navigating the complexity of fire testing and any limitations in performance claims. Those limitations are often in small print and often written in technical language so that non-specialists will not understand what it means. If a person relies only on the marketing information to choose a solution, then they do not get the full picture of the product's performance. This again raises the issue of the installer/specifier competence to know what the actual product information is and to select the correct product. The motivation behind this practice may be to improve the marketability of a product.

> **The experience of "ticking boxes" or a checklist in the office does not necessarily provide good quality work on-site**

It should be highlighted that whilst this hatch may be used safely in many circumstances, given the fact that most compartment lines are above the false ceilings in blocks of flats, if the hatch is fitted in an area required to offer E and I (such as in the case of the timber-framed building), then the reporter is of the opinion this poses a risk. Related to that, Table B3 of ADB vol 1 predicts that *'only if a suspended ceiling meets the appropriate provisions should it be relied on to add to the fire resistance of the floor'* and an inappropriate hatch can compromise that. This raises the question of whether the installer has the necessary information to derive where the compartment line is and what the performance required is so that the product installed matches the performance of the ceiling.

Finally, it is also highlighted that issues that are compromising the integrity of compartmentation, and thus the reliability of the fire strategy, are indicative of a trend, given the similarity in the recently published **Report ID: 1039 'Fire compartmentation detailing issues'>**.

Concept explanation, functional requirements, and guidance provisions

Appendix B in Approved Document B (ADB) provides a synopsis of the performance concepts employed. Paragraph B19 clarifies that *'Fire resistance is a measure of one or more of the following:*

1. *Resistance to collapse (loadbearing capacity), which applies to loadbearing elements only, denoted R in the European classification of the resistance to fire performance.*
2. *Resistance to fire penetration (integrity), denoted E in the European classification of the resistance to fire performance.*
3. *Resistance to the transfer of excessive heat (insulation), denoted I in the European classification of the resistance to fire performance.'*

Further clarifications can be found in Section 5 of BS EN 13501-2:2016 (Fire classification of construction products and building elements, Part 2: Classification using data from fire resistance tests, excluding ventilation services), a document which additionally defines the fire performance characteristic for smoke leakage (S), as *'the ability of the element to reduce or eliminate the passage of gases or smoke from one side of the element to the other'.*

This incident is of concern when taking into consideration that a building must satisfy the functional requirements as they are set out in the Building Regulations 1984. Related to this report, requirement B3 has two related clauses about limiting internal spread. Clause (3) states for fire spread that *'where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building, comprising either or both of the following –*

1. *sub-division of the building with fire-resisting construction;*
2. *installation of suitable automatic fire suppression systems'.*

Additionally, when it comes to smoke spread, Clause (4) in the same requirement outlines that '*the building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited'.*

From this last clause, it is indicated that smoke spread is of interest only in concealed spaces and within the structure's fabric. So it is up to the responsible person for making these changes to decide if the hatch is going through a concealed space or through building fabric that could act as a conduit for smoke spread and use the appropriate materials and products. If the cable services hatch is considered a penetration through fire resisting construction, whose elements have no internal voids to offer routes for smoke spread, then the integrity and insulation criteria are of interest, given how these hatches have no load bearing role to address the criterion of resistance.

ADB vol 1 paragraph 7.20.b clarifies that service cables should comply with Section 9 of the same document. Section 9 has ES (integrity and smoke) ratings only for ducts and flues, not cable service installations. The initial paragraph that refers to service cables in that section, 9.24.b, is under the theme of fire-stopping and part of it states:

'b. Openings through a fire resisting element for pipes, ducts, conduits or cable should be all of the following.

1. *As few as possible.*
2. *As small as practicable.*
3. *Fire-stopped (allowing thermal movement in the case of a pipe or duct).'*

A clarification follows that any 'materials used for fire-stopping should be reinforced with (or supported by) materials rated class A2-s3, d2 or better to prevent displacement' in some cases, which brings up the performance metric of the Reaction to Fire Class, which can be its own source of anomalous documentation in the market literature. Finally, it is mentioned in 9.26 that *'proprietary, tested fire-stopping and sealing systems are available and may be used. Different materials suit different situations and not all are suitable in every situation'*, with further guidance found in publications by the Association for Specialist Fire Protection (ASFP), in the section for additional reading at the end of this report. The same guidance is provided in ADB vol 2.

What is different in ADB vol 2, is that in Section 10 it is clearly outlined that *'The performance of a fire-separating element should not be impaired. Every joint, imperfect fit and opening for services should be sealed. Fire-stopping delays the spread of fire and, generally, the spread of smoke as well'.*

Product documentation

There are also three concepts around the issue of product documentation. In the ASFP Guide for Ensuring Best Practise for Passive Fire Protection in Buildings, these are clarified in Section 3. In order to demonstrate the performance of a product, fire test reports can be used that refer to the actual product and not any of its variations. To assess the variation of a tested product, an assessment, or expert judgement report can be used that expresses the opinion of a competent authority or a person on the likely performance of a product. Finally, a certificate of a third party can be used where a reliable third party validates the claimed performance of a product. Selective presentation of performance claims can be based on any kind of these documents.

C Expert Panel Comments

Selection of appropriate test criterion

This is recognised as a quite common situation. The initial cause of this, which is incomplete product information in the market literature, is also an issue with the performance characteristic of Reaction to Fire Class, or third-party accreditation. Product labels should be unambiguously clear in what performance characteristic (R,E, or I) a particular product offers resistance against. Responsible suppliers give clear warnings and disclaimers about the limitations of the use of their products. Simplified claims of a time performance according to a specific standardised test without any reference to the criterion tested sound technical but can be misleading. These claims go against the cultural change needed in the construction industry, as was mentioned in the Hackitt review.

It should additionally be considered that the choice of an appropriate product can be complicated further because when making alterations through a ceiling or other compartment boundary, any access panel needs to satisfy all the requirements of that compartment additional to fire, which are set out in other Approved Documents, usually for Acoustics and Structural needs.

It has also been noted by panel members that these issues of unsuitable products are regularly identified by the Fire and Rescue Service when auditing, considering this report as an extension of the common 'fire rated foam' problem. The core issue is that the breaching of fire compartmentation, caused by fixings through plasterboard walls or other construction, is a major issue that can undermine the fire strategy of buildings and appropriate care should be given.

Passage of smoke

Another possible source of confusion can be the requirement for the passage of smoke. While it is expected that openings made good will resist the passage of smoke, there is no metric defined in such cases. Such metrics can be found, however, for fire doorsets in Appendix C of ADB in the form of the Sa classification (according to BS EN 1634-3). Given how some of these hatches may be hinged, a possible pitfall could be that the requirements for fire doorsets are advised. This will depend on the intent of the component's function, but may sometimes be inaccurate. It should be noted here that the fire resistance of doorsets, in particular, does not have an insulation 'I' requirement. It is presumed that the reason for not needing 'insulation' is because doors tend to be in locations where there are no combustible materials close to the opposite face of the doors, so fire spread by heat conduction is less likely. Given how a ceiling hatch could have combustible materials above it, it is not certain that the same logic would apply to hatches. Additionally, doors are never really expected to form part of the fire protection to the structure, whereas in the case mentioned, the ceiling hatch is part of the protection to the timber structure above. Appropriate care should be given that the understanding of the component's function is clear and the desired performance characteristics are satisfied.

Appropriate care and understanding appear to be issues revolving around the competence of the people involved. On the top level, the Responsible Person under the RR(FS)O 2005, usually the building manager (or their representative), needs to be aware of how the building is designed and constructed. If there are certain parts of the building structure that are needed in order to achieve the necessary fire resistance (e.g. compartmentation or protection to structure) then they need to have restrictions in place to make sure people don't make any alterations without dealing with them appropriately. Following that, the person who is doing the work needs to follow the guidance of the building manager. If they are, for example, cutting a hole in a board that needs a specific fire resistance, then they need to ensure that the hole is sealed with an appropriate product and that the work is carried out to an appropriate standard; those will depend on the nature of the construction and the type of hole being created. Reciprocally, the building manager would need to be confident that the person has done the work appropriately, and there is a certain level of competence needed to do that. At present, these areas are not well controlled, yet it is expected that the Building Safety Bill will address these aspects.

This is one of the issues which was identified in the Hackitt review, with Chapter 7 of the final report being dedicated to

issues related to products. Further on this topic, the Inquiry into the Grenfell Tower fire has shone a light onto the way a number of products used in the building were tested, labelled, and marketed in effectively a dishonest manner. There is ongoing government work on the issue through the Independent Review of the Construction Products Testing Regime. There are also industry initiatives such as The Code for Construction Product Information by the Marketing Integrity Group of the Construction Products Association, so developments should be expected that will address such concerns. In the interim, what should be ensured is that manufacturers and suppliers have a consistent basis for their claims on fire performance and to ensure that specifiers are trained and competent in extracting and promoting the appropriate performance specifications.

Further reading

- **2014 – ASFP – Ensuring best practice for passive fire protection in buildings. 2nd edition>**
- **2016 – ASFP – Fire-stopping: Linear joint seals, penetration seals and cavity barriers 4th edition. Red book (Fire-stopping)>**
- **Code for Construction Product Information>**
- **Independent Review of the Construction Products Testing Regime>**

Submit Report

Submit Feedback

Steel truss failure during lifting operation

CROSS Safety Report Report ID: 1035

The lifting operation for a 40m long span steel truss had to be abandoned after the localised failure of a joint.

Key Learning Outcomes

For designers:

- Ensure all stages of construction including fabrication and lifting are considered
- Stress states during transportation and erection differ from those in the permanent condition

For the construction team:

- Discuss lifting and erection stages with the designer before starting operations
- Check stability and strength during lifting
- Keep track of fabrication and assess strength and stability at each stage

R Full Report

A correspondent discusses a project where they designed steel trusses with a span of around 40m. To facilitate the construction, the trusses were spliced and the connections checked. However, both the correspondent and the fabrication team failed to review the lifting operation fully and reassess the forces in the truss during lifting.

The truss was lifted in such a way that it was laid flat in its weak axis and the force in the weak axis of the splice connection was in excess of the weak axis capacity of the connection. This resulted in a localised failure of the joint and the lift had to be abandoned.

Following this failure, the lifting operation was then fully considered, and the joints were designed for the required forces with the works progressing successfully.

The correspondent believes that a cause of this safety issue was a lack of clarity over who was responsible for checking the truss during the large lifting operation. They go on to say that going forward, they will not design a spliced element or connection without fully agreeing the lift sequence step by step.

> **The correspondent believes that a cause of this safety issue was a lack of clarity over who was responsible for checking the truss during the large lifting operation.**

As a Chartered Structural Engineer with good experience in designing steelwork structures and connections, they acknowledge that they missed the process of lifting the truss from laid flat to vertical and did not account for this out of plane force. Whilst the consequence of this was minor in this instance, they say that it could have been significant.

They conclude by saying that this was a worthwhile learning experience for themselves and others.

C Expert Panel Comments

The reporter has been refreshingly candid and open and is to be commended on such a valuable report. It is a useful reminder of the importance of communication, clarity on responsibility, and consideration of temporary works: a classic case demonstrating the need for the temporary works and permanent works designers to liaise.

Communication and collaboration between temporary and permanent works

The designer of a long span structure needs to know transportation limits to enable an understanding of the structure in the temporary condition and the need for appropriate connections and temporary lifting points. It is interesting to note that the permanent works designer was asked to consider the construction sequence. Did the designer provide a detailed method statement so that the contractor was aware of the conditions at all stages?

Single controlling mind required for all stages

Designers, therefore, need to give thought to "how could this go wrong?" during either the construction or deconstruction process and engage in discussion with all parties to ensure all scenarios are addressed. There should be a single controlling mind to take this through from design, through fabrication, transport and erection to ensure that all is well.

The general cases for erection are:

1. any frame will not be in its (permanent) stable condition and loading cases during erection may be the critical ones,
2. any member will have stress states during its erection (e.g. during lifting) that differ from the stress states when that member is fully incorporated into a frame. The stress states depend on how the member is lifted and where the attachment loads are located.

Checks should be made to include stability of the compression boom under self-weight, which may be critical even if the truss is lifted vertically because, during lifting, the compression boom will not have any of the lateral bracing that might exist in the permanent condition. This is of especial concern when the lifting process is such that the normal 'tension boom' has to temporarily act as the compression boom (depends on the truss attachment points).

Lesson learned could be expanded to include the point that it could have been the section members in the truss itself, as well as the splices that might have failed during the lifting operation. For some trusses a support frame may be used to aid the lift.

Early contractor involvement

The report highlights the need for early contractor involvement and the need to refer to Relevant Good Practice for Temporary Works contained in **BS 5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework>**.

The only way to assure that such incidents are avoided is to track the process of assembly/erection in detail and assess strength and stability in each stage.

Submit Report

Submit Feedback

Fire protection of light gauge steel frames

CROSS Safety Report Report ID: 1030

A reporter is concerned that there is a lack of understanding regarding system testing and associated procedures, the purpose of fire assessments, and the role of materials that contribute to the structure's fire protection.

Key Learning Outcomes

For designers:

- Ensure that a fire safety engineer is consulted in the interpretation of test reports, and the conduction of any assessments
- Do not proceed with any alteration or substitution of products in a tested system without the appropriate documentation and justification

For suppliers and manufacturers:

- Make sure that the original test report is available and presents all the necessary data to the end users of the report

For site engineers and managers:

- Make sure that the installation of products on-site follows the design
- Substitution of construction elements and materials should not be made without design team verification

R Full Report

A reporter is concerned that there is a lack of understanding in regard to system testing and associated procedures, the purpose and utility of fire assessments, and the role of materials that contribute to the structure's fire protection; in this case, a Light Gauge Steel Framing structure.

Light Gauge Steel Framing (LGSF) is a form of construction in which the structural elements are comprised of thin, cold formed steel, usually C sections for loadbearing walls and sigma sections, lattice trusses, or composite solutions for floors. As with every construction method, they have their benefits when used in appropriate situations.

When it comes to structural fire protection and compartmentation, it is through system performance that the necessary fire resistance rating is achieved. This is usually done with layers of sheathing; traditionally gypsum-based, cement particle, or magnesium silicate boards. This boarding is part of the protection to the frame, which is the actual load bearing structure of the building. Certain walls may not need to be fire resisting for compartmentation reasons (e.g. a wall between two bedrooms within an apartment) but in an LGSF building they would need to be fire resisting in order to protect the structural framing within the walls. That level of complexity is often missed, meaning that certain walls are not designated as being fire resisting when in fact they should all be fire resisting for structural reasons.

> **certain walls are not designated as being fire resisting when in fact they should all be fire resisting for structural reasons**

A whole floor or wall assembly is tested in a furnace according to standards such as:

- BS EN 1364-1 Non-loadbearing elements – Walls,
- BS EN 1365-1 Loadbearing elements – Walls,
- BS EN 1365-2 Loadbearing elements – Floors.

This list is indicative and non-exhaustive. It follows that once a system is tested and achieves a certain fire resistance rating, it has to be constructed in the field according to the certified product assembly. Deviations in element dimensions, applied loads, and products used as part of the system (sheathing,

fixings, and finishes) are not allowed without an assessment. Guidance available from the Steel Construction Institute (P424) can assist designers in making assessments when it comes to transitioning to a thicker steel profile, or deviating in the whole element size by a certain bound, on the condition that a valid test report and corresponding data are available for that product.

'Like for like' assumptions causing concern

During a meeting regarding a Light Gauge Steel Framing (LGSF) for a residential scheme, plasterboard specifications were discussed. A reporter was alarmed when a question was raised about using branded boards different than the ones tested, followed by the suggestion that the various plasterboard products available are "much the same as each other". The reporter is of the mind that this is not necessarily the case, especially without sufficient test data to support such claims, and is worried that a change in the products of a tested system can affect its fire performance significantly.

Gypsum plasterboards are covered in BS EN 520:2004+A1:2009, and Annex B of that document provides some limits that can guide designers on the expected fire classification, depending on the plasterboard properties and dimensions. While this might be helpful in some cases when substituting products, it is also indicative of the possible impact that different plasterboard properties can have on the fire classification, and by extension to the performance of the system.

C Expert Panel Comments

This is another example of phenomena that were recognised in the Hackitt review. The substitution of materials with less expensive alternatives was recognised as a core component in the value engineering approach, which aims to lower the cost of the project. In the final report, it was explicitly suggested in Recommendation 7.1.b to provide clear statements on the use of systems products to '*ensure significantly reduced scope for substitution of any products used in a system without further full testing*'. Any change considered, that can invalidate a test result should be reviewed by a competent fire engineer, and ideally, the alternate specification is fire tested.

Practitioners should also bear in mind the definition of a **'designer' under The Construction (Design and Management) Regulations 2015>:**

''designer' means any person (including a client, contractor or other person referred to in these Regulations) who in the course or furtherance of a business—

1. *prepares or modifies a design; or*
2. *arranges for, or instructs, any person under their control to do so,*

relating to a structure, or to a product or mechanical or electrical system intended for a particular structure, and a person is deemed to prepare a design where a design is prepared by a person under their control'.

Anyone promoting or suggesting modifications is taking on the role of a designer along with the corresponding responsibilities.

Anyone promoting or suggesting modifications is taking on the role of a designer along with the corresponding responsibilities

This event also highlights the need for appropriate fire safety information to be available throughout the life of the building. If a structural wall component is not designated in the drawings as fire resistive, then later modifications or works that go contrary to the manufacturer's guidance could compromise the whole structural fire integrity inadvertently; for example, the improper installation of an electric socket.

While this incident was reported for LGSF construction, the possible implications are extended to any form of construction that involves the use of tested system products.

Frames such as these often have a structural function as part of the frame of a building. Fire considerations, therefore, have to be dealt with in association with a chartered structural engineer.

Further reading

- **2021 – SCI – P424 – Fire resistance of light steel framing>**

Submit Report

Submit Feedback

Sudden failure of storage silo

CROSS Safety Report Report ID: 1045

A 5,000 ton capacity storage silo containing ground granulated blast-furnace slag (ggbs) split apart suddenly and without warning onsite at a concrete production facility.

Key Learning Outcomes

For owners:

- Ensure designers and contractors are suitably experienced and competent
- Include a third party design check in the procurement process
- Arrange for regular inspections when in use

For the construction team:

Ensure that bolts and other safety-critical components are sourced from reliable suppliers and come with authenticated documentation

For structural engineers:

- Loads in silos can be uncertain
- Incorporate robustness into the structure to help resist unknown loads
- Thin-walled shell structures are complex and warrant an independent design check
- Regular inspections of such structures are recommended by HSE

R Full Report

The lower cone-shaped hopper section of a 5,000 ton capacity steel storage silo, some 30m tall, containing ground granulated blast-furnace slag (ggbs) for use as partial cement replacement in concrete, split apart suddenly and without warning onsite at a concrete production facility. The silo was almost full at the time and a large quantity of the fine powder spilt onto the surrounding area forming a dust cloud in the process.

The knock-on vacuum effect created from the rapidly falling material triggered buckling and rupture of the cylindrical shell as well as an inward collapse of the conical roof and some deformation of the steel support structure. The concrete batching plants were not in operation at the time of the incident and fortunately, nobody was injured. There were no harmful effects experienced from the dust emissions, the silo was dismantled and the fallen material safely removed.

Investigation highlights design issues with bolted joints

A detailed investigation on behalf of the owner was carried out which highlighted serious concerns over the strength of the bolted joints within the silo hopper section. With the silo in a near full condition, the bolts in the meridional joints near the top of the hopper would have likely been on the verge of an ultimate limit stress failure proceeding to a catastrophic failure of the silo.

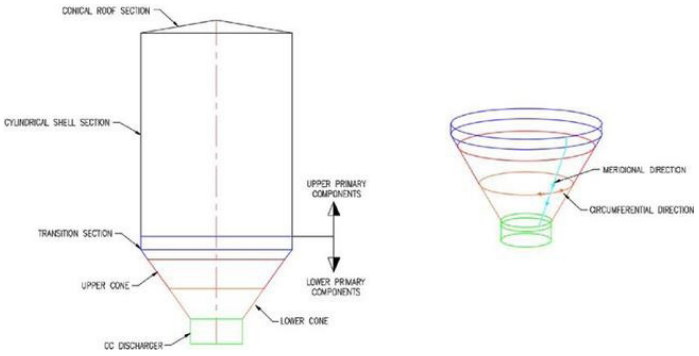

Figure 1: silo components and terminology

The investigation concluded that the silo failure happened by mechanical overload, likely of a meridional bolted joint in the hopper section. The primary cause of the overload was considered to be directly related to inadequate design, mainly in relation to the bolted joints in this area.

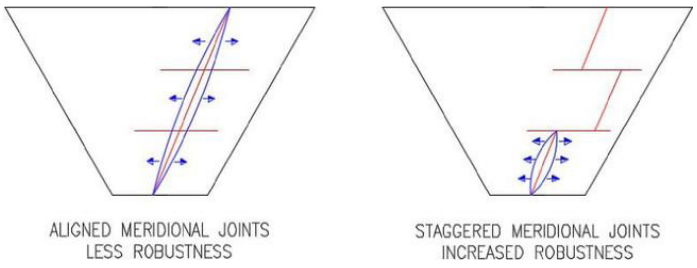

Figure 2: effect of staggering meridional joints

A number of contributing factors were also recognised including:

- underestimation of design loads/design error
- underestimation of the impacts of prying forces on the joints
- unknown impacts of cyclic straining due to thermal loads
- lack of robustness to deal with potential unknown loading, and
- lower than expected tensile strength in some of the bolts tested

Value of design review

Large silos of this size are special and uncommon structures. The reporter believes that an independent design review and Category 3 check should be considered for such structures. They say that silos of this magnitude should also have additional robustness built-in as loads are not well known. The meridional joints in the hopper section were aligned in this case and staggering the joints will provide increased robustness. They also suggest that independent testing of the structural bolts to verify the mechanical properties should be considered.

C Expert Panel Comments

CROSS welcomes the reporter's, and the owner's, public spirit in sharing information on this major failure so that others may learn.

This was a specialist structure containing a large volume of material that collapsed suddenly and was a near miss in terms of possible casualties. A general feature of all silo designs is that the loads are very uncertain being linked to the way materials move and settle during filling and discharge. There is a history of silo failures due to uncertainties in behaviour.

Checks by competent parties

Silos are, it is thought, most often purchased by private clients who may not be experienced in the practices of procurement and know the need for third-party checking of complex structures such as thin-walled shells. Checks not only during design and construction but during normal operations to determine if there are signs of deterioration could be desirable.

Analysis carried out after the event found several contributing factors including possible design shortcomings. The reporter does not give any information about the basis of design but several of the issues raised would be adequately covered by the Eurocodes (especially EN1993-4-1 for silos and EN1993-4-2 for tanks).

Importance of bolt sizing and strength

There is mention in the analysis of bolts in relation to prying forces, which is a design consideration, and lower than expected strength of some bolts. The requisite strength of bolts should be ensured by sourcing these from a reliable supplier. Although there is no suggestion of it here, CROSS is aware of instances where certification accompanying proprietary products has stated compliance with standards or specified requirements, but the products have been found not to be in accordance with the specification.

A degree of conservatism in bolt sizing, and design generally, may be warranted when the magnitude of applied forces is not readily determined. Robustness will improve.

It is known that some of these types of structures were often designed to working stress US codes where there is a lot of empiricism, which is fine as long as the designer does not depart from the standards in any way. Detailed assessments on tank type structures have found that some of the empirically based rules are very sensitive where stability is concerned.

In 2017 HSE published a safety alert: **Catastrophic failure of silo – bolted conical bottom section>** which highlighted the possibility of micro-cracks in silos where the conical bottom section has been cold formed and assembled using bolted joints. This gives useful information for silo owners and designers and recommends the need for regular inspections.

There are sources of design guidance on the web and users, if not familiar with the subject, should take care to ensure that the information they might use comes from a reliable source.

Submit Report

Submit Feedback

Front doors in blocks of flats - security versus safety?

CROSS Safety Report Report ID: 893

This report shares concerns regarding the provision of security doors to flats without due regard being paid to fire safety requirements.

Key Learning Outcomes

For managers, leaseholders, and tenant management organisations:

- Entrance doors to flats in multi-storey buildings are an essential part of a building fire safety strategy
- Containment of a fire to the flat of origin is a primary objective. The door leading from a flat is critical in a fire situation - it should close behind the occupants after they leave.
- The door construction, the self-closing device, the door furniture, any glazing, intumescent material between the door and the frame, along with cold smoke seals should all be to the standard required for the door in question
- The requirements may vary according to the height of the building, the configuration of the flats, means of escape, and other factors such as the existence of a sprinkler system

For residents of flats:

- Doors to flats can be vital for the safety of residents, should a fire occur
- Proposals to change doors for security, or other reasons, must take fire safety into account
- Replacement doors, their fittings, fixtures, and surround must be to the requisite standard for that particular situation
- Expert advice should be sought, and in most cases, approval must be obtained from the building owner and a Building Control Body

R Full Report

A reporter states that over the last two decades, security doors have been installed in numerous local authority blocks of flats. However, it is believed that these doors do not conform to fire safety requirements. Issues identified include:

- failure to fit self-closing devices,
- missing intumescent strips,
- no smoke seals,
- non fire-resisting double glazed vision panel,
- fanlight above door comprised of an obscure thin double-glazed unit that is not fire-resisting.
- Flat doors, including some that were not fire-resisting when originally installed, have been changed to security doors, without considering fire safety.

Historically, there are issues with fire doors not performing as expected, and there have been programmes undertaken by Local Authorities to address these following **findings that arose out of the Grenfell fire>**. This has led to the publication of **Government Advice>** on the issue.

The reporter states that they have raised these issues with the appropriate authorities but is concerned about the lack of urgency applied to resolve them. Feedback from one authority indicated that they were not concerned, their response being that "[…] the door in question is a ground floor property and as such, there is an alternative means of escape so fire doors are not mandatory". The reporter cites the lack of understanding of the requirements of the Building Act 1984 and the Regulatory Reform (Fire Safety) Order 2005 by building managers being a significant factor that has led to these failures becoming commonplace.

C Expert Panel Comments

Fire exit vs. Fire door

When it comes to doorsets, there can be some confusion as the general public sometimes confuses the meaning of 'fire exit' and 'fire door' (along with their associated requirements). The UK Fire and Rescue Service have dealt with numerous enquiries over the years where these concerns over security doors relate to the doors that access the common areas from outside - these do not generally need to be fire doors.

Notably, there is no need for any conflict between security (including Part Q of the Building Regulations) and fire safety, given how there are certified products available that will achieve both aims and requirements. There are also requirements for doorsets in other relevant Building Regulations guidance, which are included in Approved Documents E, L, and M.

It should be clarified that the fire safety legislation in England and Wales is **The Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O 2005)>**. The RR(FS)O 2005 applies to most premises other than those occupied as single/private domestic dwellings, it also covers the common areas of blocks of flats and apartments. Devolved administrations have their respective legislation. The **Fire Safety Act 2021>** (FSA 2021) which is set to commence has clarified the scope of the RR(FS)O 2005, where in relation to doors it states:

'Where a building contains two or more sets of domestic premises, the things to which this order applies include—

- *the building's structure and external walls and any common parts;*
- *all doors between the domestic premises and common parts (so far as not falling within sub-paragraph (a)).'*

Role of the Responsible Person

As such, it is the RR(FS)O 2005 that places the legal responsibility of ensuring there are adequate fire safety measures in place in the event of a fire on the Responsible Person (RP, as defined in the RR(FS)O 2005). To address this, the RP must ensure there is a suitable and sufficient fire risk assessment (FRA) for the premises, which will identify the fire safety measures needed and any resulting actions, including those doors as described above.

Where required in blocks of flats, the flat front fire door and associated parts i.e., the self-closing device, smoke seals, intumescent strips, glazing, and door furniture, is an integral part of the overall package of the above-mentioned fire safety measures.

Where any doubt exists concerning this, and any other fire safety measures, the RP for the premises should be contacted in the first instance. This is the 'person' who has control over the common parts and is generally, in blocks of flats, the premises management company or organisation.

In addition, as the enforcing authority for the RR(FS)O 2005 for most blocks of flats, advice can also be obtained from the local Fire and Rescue Service (FRS). Information on how to contact them should be available so that a fire safety concern can be raised.

Further reading:

- **ASFP Guide to inspecting passive fire protection for fire risk assessors>**
- **Secured by Design A guide for selecting flat entrance doorsets>**

Submit Report

Submit Feedback

Safety issues when adding PV panels to existing roofs

CROSS Safety Report Report ID: 1015

A reporter raises concerns over the lack of structural engineering knowledge and dangerous assumptions in assessments for the installation of photovoltaic (PV) panels for a number of public sector buildings and schools.

Key Learning Outcomes

For civil and structural design engineers:

- Structural design must comply with Approved Document A
- Load effects of snowdrift and wind uplift forces acting on the roof structure due to PV panels should be carefully considered
- BRE Digest 489 **Wind loads on roof-mounted photovoltaic and solar thermal systems>** provides very useful design guidance, based on EN1991-1-4 and the UK National Annex (NA) for calculating wind forces
- There have been a number of previous CROSS reports on PV panels and these risks were highlighted in a Standing Committee on Structural Safety (SCOSS) Alert in 2016: **Photovoltaic installations - structural aspects>**

For industry:

Note the CROSS recommendation that there should be guidance upon structural design and installation of PV panels for both new and existing buildings

For the building team:

- On existing roofs make sure that the structural aspects have been considered
- Be aware that PV panels can add load to existing roofs
- Be aware of the risks of working on existing roofs
- Inspection by a competent person should be carried out to ensure the works are installed in accordance with the design intent

R Full Report

A reporter's organisation have recently been involved in reviewing calculations for the installation of photovoltaic (PV) panels for a number of public sector buildings and schools. They were concerned about the lack of structural engineering knowledge and dangerous assumptions used in the assessments. They have seen/reviewed calculations from multiple organisations, mainly solo practitioners and small building surveying firms.

Insufficient design information and load assessment

A summary of the main issues encountered are:

- details of the existing structure and loading arrangement not included in the calculations
- details of the proposed PV and loading arrangement system not being provided
- calculations excluding the weight of ballast (weights to anchor down panels) and supporting frames when looking at the additional loading applied to the roof
- no back checking/assessment of existing structural members, liner trays or purlins, to check they are adequate for the proposed loads
- offsetting the roof access loads without consideration of snow loads
- in some instances, they have seen the full access load being offset, which raises the question of how someone is meant to install or maintain the PV panels
- no consideration of localised snow drift due to PV panels providing new obstructions on the roof
- uplift wind forces on the panels are often ignored completely
- mixing of design codes, for example using Eurocode loading with British Standard member design and vice versa

- no checks on serviceability criteria for the roof, for example to check that no ponding will occur
- eroding the partial factors for loading as a way of justification of new loading

They have come across calculations using assumed values with which to offset load. For example, a recent project had assumed that the roof had a ceiling and services allowance of 0.25kN/m2 (they thought this was an industry-standard value) which had then been used to offset loading. There were no existing load plans available to validate the ceiling and services allowance for this project.

They also report that wind uplift forces, which could be critical in non-ballasted installations on lightweight roofs, are often ignored and most engineer's reports only check for gravity load combinations.

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Another concern raised is the ballast arrangement on the roof frequently being ignored or not properly considered in design. Typically the PV suppliers will concentrate the ballast around the edges due to high uplift forces, while most structural reports ignore this and average the total ballast load over the whole PV installation.

Checks on fixings

They have recently seen several proposed installations where they are proposing to fix in to an existing timber roof with gang nail type trusses. While a global check is often performed on the roof structure, checks on the fixings between the roof structure and PV mounting frames are often omitted. In the reporter's experience they have often found this detail to be critical in terms of fixing layout and edge distances as highlighted in BRE Digest 489 **Wind loads on roof-mounted photovoltaic and solar thermal systems>**

Health and safety file

There have been issues where clients have not been advised on the risks that need to be included in the building's Health and Safety file, for example advising the client that roof access must be limited or that no additional services can be supported by the roof.

They have also noted that some reports contain statements/assumptions which they believe to be unsafe or dangerous, the following were contained in a recent report:

'…given the roof is only loaded with snow for short periods, we do not consider the loadings to be an issue'

'To summarise the structure has a comfortable factor of safety built into its design and a sufficient capacity for any minor overloading scenarios which may occur.

C Expert Panel Comments

It is good to see that this reporter's firm is checking calculations for such installations although worrying to observe the number and extent of the problems found. There have been a number of previous CROSS reports on PV panels and these can be found on the CROSS website along with a SCOSS Alert issued in 2016: **Photovoltaic installations - structural aspects>**.

Design guidance for determining wind loads

BRE Digest 489 **Wind loads on roof-mounted photovoltaic and solar thermal systems>** as referred to above, provides very useful design guidance, based on EN1991-1-4 and the UK NA. for calculating wind forces. Contractors may be familiar with electrical installation, and there are guides on this aspect e.g. **Guide to the Installation of Photovoltaic Systems>** from the Microgeneration Certification Scheme. This guide is not for the structural implications for the roof.

The Scottish Government published **Low carbon equipment and building regulations – a guide to safe and sustainable construction – Photovoltaics>** in 2012 which contains advice on installation.

Industry guidance needed

Given the growing practice of installing panels and the generic faults in design and construction, there should be a structural engineering guide, and possibly a Code of Practice, for the design and installation of such panels. This should cover both new buildings and retrofits on existing buildings. Post installation, there should be a certificate to confirm compliance with guidelines.

Safe working at heights

Note should also be taken of the risks with the manual handling and work at height issues associated with installing and maintaining the panels. There have been a number of incidents of workers falling through or from roofs during such work. Roofs must be left in a state where maintenance can safely be undertaken. HSE in Northern Ireland have a web page on **Installing solar panels safely>** which gives helpful information. The Working at Height Regulations and, by implication, compliance with BS5975 for temporary works are also relevant.

Generic faults in design and installation appear to be widespread, with structural safety and maintenance issues that may require great cost to resolve in future. With increased attention on the green agenda the use, and hence the associated potential problems, with these installations may be expected to increase.

Submit Report

Submit Feedback

Beam and block floors fire resistance

CROSS Safety Report Report ID: 1072

A report has been received about unsubstantiated claims of fire performance and the unavailability of test data for a specific form of construction.

Key Learning Outcomes

For designers and specifiers:

- When using a system as part of a design solution, make sure that it meets the criteria necessary for the situation in which it is being used
- Ensure that for every solution chosen, all product information related to performance claims is available

For manufacturers and suppliers:

- Ensure that, for products that offer fire resistance, it is made clear if they provide all the necessary performance characteristics, including integrity, insulation
- If these products do not provide the necessary characteristics, they should be clearly marked as not suitable in certain situations

For the construction team

Consider introducing a quality assurance process that covers the correct use and installation of fire protection products and components

R Full Report

A report has been received about unsubstantiated claims of fire performance and the unavailability of test data for a specific form of construction.

Since the Grenfell fire, an architectural practice has been undertaking 'due diligence' checks on all the products used in their designs. This includes locating all the test reports and data provided by manufacturers on products that have any fire performance requirement. It was a cause of shock to realise the lack of test data and the 'quiet disappearance' of fire resistance claims from product information in the market literature.

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This report is on a project employing a beam and block flooring system. Such systems are comprised of concrete or steel beams upon which blocks are supported to form a slab. The blocks can be made out of concrete based materials or expanded polystyrene blocks when a thermal insulation function is desired. An indicative cross-section of such a system is shown in Figure 1 below.

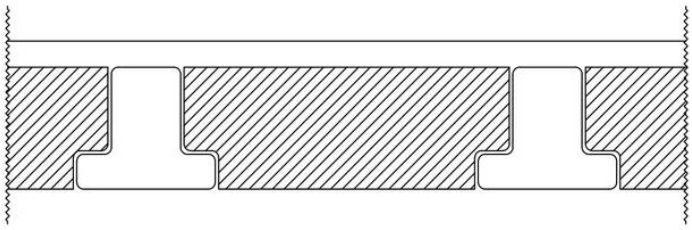

Figure 1: cross-section of a beam and block flooring system

Their usual field of application, according to the reporter, are as flooring on ground floor slabs in residential projects. However, the need arose for the same system to be used for the construction of upper floors due to site restrictions. This means that the floor will now be a compartment floor and has to satisfy the functional requirements regarding the limiting of fire spread and ensuring structural stability. The technical guidance in Approved Document in such cases recommends a fire resistance rating of 60 minutes in a furnace test.

The reporters claim that they enquired with manufacturers to substantiate some of their claims such as that "the concrete beams are 'fire rated' for either 30 or 60 minutes depending on depth" but were never provided with a test certificate that supported such claims, and when they insisted the general response was that "that's someone else's issue".

Third Party Schemes

A source of further confusion was that such structural systems are presented in third party schemes that assure conformance with the requirements for Acoustics, and Approved Document E. The reporters employ the guidance of this scheme as part of their detailing work to satisfy requirements that ensure no need for site testing for Acoustics. This, to them, is an indication that such systems are being detailed for and constructed in multi-storey buildings, in which case they ought to have some role in the fire design and a performance rating is needed. The reporters implicitly assumed that by the inclusion of these systems in such handbooks "they must have some fire resistance".

However, when the CROSS team investigated the aforementioned Approved Document, it was found that it did not deal with fire detailing issues, and instead directed the designers to the requirements of Part B of the Building Regulations. It follows that it explicitly deals with the requirements of Part E for Acoustics, and following this guidance is no guarantee that it satisfies Part B for Fire Safety.

C Expert Panel Comments

The reporters are correct in recognising and reporting the worrying trend of unavailable performance certificates, along with the inability of manufacturers to provide definitive answers.

A beam and block system may be supported by a number of structural forms such as, but not limited to, masonry walls, steel beams or frames, or other Reinforced Concrete or Precast Concrete beams and frames. It should have adequate fire resistance to meet the building regulations as part of a system – the latter includes any necessary additional fire protection such as ceiling boards or intumescent paints.

Past engineering standards, and now the Eurocodes, deal with fire requirements by prescribing the concrete cover to the reinforcement and minimum beam width, for simply supported beams, which can be an explanation of how some manufacturers' claims originated. Fire resistance is a metric for three performance components; loadbearing capacity, integrity, and insulation. The practice of standard cover tables can address the loadbearing capacity of the beams but ignores the presence of blocks and their influence on the system performance in terms of integrity and insulation. Performance issues have to also be addressed with the block selected and the gaps between beams and blocks, which may or may not be filled. Finally, the choice of the ceiling finish, along with any lighting sockets, and the presence or absence of a floor screed, is needed to properly understand how the floor performs and the most appropriate construction methodology to be employed.

Gaining substantiation for manufacturers' claims

When in doubt about using beam and block products for upper floors, confirmation should be sought from the manufacturer that their product has been tested as a system (beam and block). This is the most formalised way to substantiate their claims in the absence of any secondary means of providing fire resistance. Designers and specifiers are encouraged to request the fire performance information of floor systems from their manufacturers and suppliers. This information could also be provided by a third-party approvals body or a 'Notified Body', which should be able to provide a confirmation of fitness for purpose. In any case, it is crucial that appropriate quality control should be ensured on-site so that the system is constructed according to the manufacturer's specifications.

Design guidance for this form of construction is available and it provides three options for the calculation of fire performance:

- Evaluation of a product or system by testing,
- The use of calculation methods for resistance, integrity, and insulation,
- The employment of available tabulated data.

However, the interpretation of a testing certificate, the use of simplified or advanced calculation methods, and the choice of the appropriate tabulated case are the remit of a fire engineer. The structural system chosen might appear simple, but fire testing and performance are not; hence the need for specialist advice. The fire strategy of a building should be conducted by a competent fire engineer, who will be able to assist in the navigation of the issues that arose within this report.

Submit Report

Submit Feedback

Inadequate temporary works on domestic project

CROSS Safety Report Report ID: 1044

An example of inadequate temporary works on a project, and problems reporting the safety issue to the authorities.

Key Learning Outcomes

For builders and contractors:

- Propping work is important and has to be done safely by competent people
- Collapses can cause fatalities
- Be particularly careful when part of a floor or wall is cantilevering
- When temporary works are outside of your normal experience ask a chartered structural engineer for advice
- With the current trend for adding extensions to the rear of houses, this type of building work is likely to be relatively common

Reporting to regulators:

- HSE have a central team who review all calls about concerns and pass these on to local inspectors
- The lack of Building Inspectors and lack of resources to visit sites and raise standards is very worrying

R Full Report

An example of inadequate temporary works on a domestic construction project was spotted by a reporter on a very windy day in a major UK city. They say that the external wall and the entire corner of a house was propped by a brick on end at first floor level to one side of an opening that was being made in an external wall. A prop could be seen to be supporting the timber floor inside the house, but the bulk of the load would have been from the external wall and the arrangement looked extremely fragile and potentially dangerous. Had the brick crushed the corner of the house would have become a cantilever. No builders were in sight, and it had been like this for at least 24 hours, says the reporter.

The reporter was concerned that the external wall could collapse. They reported the issue to the local council, but since it was temporary works, the council said the matter should be referred to HSE under CDM 2015. However, the council did make their building inspector aware of the issue. The reporter then tried to contact the HSE, but their online reporting system malfunctioned.

In the reporter's view the industry needs dedicated access to the HSE for issues like this and wonders if more resources could be made available. They suggest that a Twitter account could be set up to directly message the HSE with concerns.

C Expert Panel Comments

This is a bad example of poor workmanship with apparently, no thought been given to the temporary works. It can be surmised that there are no qualified engineers involved, so the challenge is one of educating builders in the process of ' good building practice'. Anecdotally, the dearth of Building Inspectors and lack of resources to visit sites and raise standards is very worrying.

Regulation lacking on domestic projects

The matter of control for dangerous structures depends on whether it is dangerous building work and only dangerous to the contractors (HSE), or is dangerous to the public or occupants (Local Authority). If the latter, then Local Authorities need to consider whether there is imminent danger. If this was an unoccupied site, hoarded from the public and any potential collapse would remain within the site, they could not act. This type of situation is sadly not uncommon with renovation and remedial work on residential properties, as this sector is probably the least regulated.

Renovation trends causing issues

With the current trend for adding single-storey extensions to the rear of houses and the popularity of full-width bifold

doors to 'open up the house', this type of building works is likely to be relatively common. Useful advice is contained in **Part 10 of the IStructE / TWf Temporary Works Toolkit 'Propping and needling'>**, which is free to download.

The Temporary Works Forum> is a good source and should be consulted for advice on such matters.

Finally, the fact that the reporter was not able to find anyone to report this to is worrying. HSE say that calls are dealt with by a central team who review all notifications and pass on matters of evident concern, such as this, to the local inspectors who will investigate. Hopefully, this was therefore a transient situation when no contact could be made in this case.

All contractors should ensure that temporary conditions are properly engineered.

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