Editorial

The Grenfell Tower tragedy showed a need to make major changes and improvements to the building safety system. In June 2019, the Ministry of Housing, Communities and Local Government (MHCLG) in the UK published a consultation document concerning proposals to improve safety and minimise the risk of fire in certain buildings. They want views on the proposals and the document gives detailed descriptions and a series of questions under various headings.

There are many areas within the consultation that are important for structural engineers, not just in the UK, and, when enshrined in legislation, will affect their responsibilities and working practices. The proposals concentrate on higher risk residential buildings but may be expected in future to be expanded to other buildings where a large number of people sleep, or indeed where they congregate.

For years there has been evidence of an eroding system in which standards were allowed to slip, concerns from those in the industry, and from residents, were not heeded, and some took advantage of the situation to cut corners. Many of the problems now being highlighted have been seen in CROSS reports over the years.

This is the opportunity to rebalance and improve the system by backing the proposals. There will be adjustments to be made and the emphasis on different recommendations will change depending upon the number and tenor of the responses. Engineers at every stage of their careers should read the full document and respond to the consultation, answering as many of the questions as they can, and as fully

DIRECTOR:
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as they can, even though this is task of some magnitude. The more responses there are, and the higher their quality in terms of evidence, the more attention will be paid by Government when framing the subsequent legislation.

Included in the consultation proposals are recommendations for all those who work on buildings to:

• Expand and strengthen the existing CROSS scheme to collect more voluntary reports on structural safety issues and to have a scheme for collecting reports on fire safety issues.
• Implement a new mandatory occurrence reporting system to the building safety regulator for key dutyholders to facilitate reporting of fire and structural safety issues.

To support these proposals, please read the guidance from Structural-Safety on responding to three consultation questions in particular, with instructions on how to make a submission. The closing date for responses is 31 July 2019.

HOW TO REPORT
For more information, please visit the How to Report page.

If you have experienced a safety issue that you can share with CROSS, please Submit a CROSS Report.

If you want to submit a report by post, please send an email to cross@structural-safety.org asking for instructions.

KEY
R CROSS Report
C CROSS Panel Comments
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VISIT: EMAIL:
Industry not reacting to failures

REPORT
The tragic events at the Grenfell Tower fire should have been a wake-up call for the construction industry. The Hackitt report and the harrowing evidence at the Public Inquiry has revealed serious issues across the board which we should all be striving not to repeat, says a reporter.

They are concerned that those in the construction industry have not reacted at all to this tragedy and are carrying on as if nothing has changed. Whilst the current regulatory framework has not yet changed (although the government has just released a consultation on this), Dame Judith Hackitt has said that the industry should not wait for legislative change and should act now to ensure the safety of buildings.

Following the Grenfell Tower fire, the reporter has personally experienced clients and contractors putting money before safety, and consultants giving poor advice on fire related issues. Examples include fire engineers attempting to justify poor designs rather than ensuring good design from the start, and structural engineers poorly advising on fire related aspects of the structural design. The reporter speculates that some of this may be down to a fear of telling the client that they can’t do something, combined with a lack of knowledge and experience in the realm of fire design.

The reporter has also uncovered products being put into buildings without the certification or justification which demonstrates their adequate performance, and in one case with certification to a relevant fire related British Standard which shows it does not meet the required standard in the guidance in the Approved Documents. While this could be deemed satisfactory if the performance of the materials is properly assessed as a whole, the reporter is referring to products being selected purely based on cost without regard to fire performance.

If attention is not paid to the products and their likely performance in the building, then surely it is only a matter of time before some unsafe combination of material and circumstance come together.

Prior to the government ban on combustible materials on high-rise homes, the reporter had experienced contractors and consultants proposing to install combustible insulation in cladding products for tall buildings, without thought or justification as to the performance of the system in fire, and the likely consequence. They will have known that this was reported to be a major contributor to the rapid fire spread at Grenfell.

Whilst the facts are not fully known until the Public Inquiry completes its work, the publicity alone should have been enough to make people review what they were doing, and in this case to realise that what they were doing didn’t comply with current guidance, let alone any lessons that needed to be learnt from the Grenfell tragedy. The reporter continues to see combustible products proposed in high rise residential buildings, despite the ban.

Following the Grenfell Tower fire, the reporter has personally experienced clients and contractors putting money before safety, and consultants giving poor advice on fire related issues

In the view of the reporter, this is simply not good enough, and it is time for all parties to take responsibility. Buildings are complex and bespoke, and the reporter acknowledges that the overall responsibility is not straight forward. However, the reporter believes that if each developer, architect, consultant, contractor, tradesperson and product supplier were to consider safety as their first priority, then many of the issues that they see would not occur.

Professionals are bound by their Institution’s Code of Conduct, but the reporter wonders whether all professionals are really taking this seriously.
COMMENTS

This demonstrates the challenges faced as the industry goes through a period of change following the tragic fire at Grenfell Tower in 2017. It is also a timely report following the publication of the consultation on building reforms by the UK Government on 6 June 2019.

This consultation, which is open until 31 July 2019, seeks views on the government’s proposals for a radically new building and fire safety system which puts resident’s safety at its heart. CROSS encourages readers to respond to the consultation. The results from the consultation will be used to frame legislation which in turn will have as an aim the changing of culture. There will be major changes aimed at safeguarding the public.

Everyone in the construction industry needs to take responsibility for the changes to happen. Clients must take the lead to ensure that their team, as a whole, produces a safe design. It is about more than following rules laid out in a regulatory system.

Behavioural changes are required so that safety comes first, and legislation is not needed for this to begin. The reporter is concerned that saving money is still given priority over safety which, as Dame Judith Hackitt says, is symbolic of the ‘race to the bottom’.

However, some progress is being made. The question of competency with its ramifications throughout construction is being addressed by the CIC Competence Steering Group. LABC have developed a test for its most experienced surveyors to demonstrate their competence in fire safety in higher risk and complex buildings.

Clients such as Network Rail have been running safety initiatives including Safe by Design, the principles of which are to actively eliminate or reduce risk during design development for construction and maintenance activities. Structural-Safety is working on several fronts to develop new systems to aid structural and fire safety.

Whilst sometimes overlooked, ethics play an important part and the Royal Academy of Engineering’s Statement of Ethical Principles sets out the values and principles that guide engineering practice

The most significant points are that:

- All involved in the design, construction and operation of buildings must behave responsibly.
- Lowest cost must not be the main criteria for selecting products, processes, or people.
- Harm must be avoided throughout the construction and operation of buildings.
- Responsibilities must be recognised and not devolved.
- Lessons learned must be shared.

Feedback on this report, and the comments, will be particularly welcome.

NEWS

CROSS United States (CROSS-US) launch

In association with Structural-Safety, Glenn Bell, President-elect of SEI and IStructE Board member, has launched CROSS-US, with ASCE/SEI as the principal sponsor.

View ASCE article on CROSS-US launch>
Visit www.cross-us.org>

CROSS-AUS Newsletter 2

CROSS-Australasia published their second Newsletter in July 2019.

View CROSS-AUS Newsletter 2>
Sign-up to the CROSS-AUS mailing list>

Grenfell Tower Fire - The Consequences for Safety

ASCE have published an article summarising the special session at the Structures Congress 2019 in Orlando on the Grenfell Tower Fire - The Consequences for Safety.

View article on Grenfell Tower fire>

Iconic Global Structures: what can we learn?

The first joint international conference organised by the IStructE and SEI of ASCE will be held in Dubai, UAE from 29-30 September 2019.

Visit conference website>
Defects in tapered thread reinforcement bars for coupling

A reporter says that B500 reinforcing bars of 12mm, 25mm and 32mm diameter were observed after delivery to site to have visually different tapered threads cut into the bars, with the length of threaded section and depth and pitch of the threads varying between bars of the same diameter.

These bars were quality controlled during their production, including the threading of the bars, continues the reporter. The reinforcement manufacturer cuts the threads into the bars using equipment supplied by the coupler manufacturer. The manufacturer's quality control process requires that 1 in 10 bars are checked using thread gauges.

When these bars were delivered to site, most of the threaded bars were already fitted into the reinforcement couplers by the manufacturer. This is common, as the bars with couplers fitted are first cast into elements, with threaded bars later being installed into the couplers for construction of follow-on elements. This means that it may not be possible to visually assess threaded bars before use.

All threaded bars were returned to the manufacturer, fitted couplers were removed and 100% of the threaded bars were tested using thread gauges, which was witnessed by representatives from both the purchaser and reinforcement manufacturer. Over 25% of the couplers tested were found to have non-compliances with the coupler manufacturer specified thread requirements. Four distinct defects were identified; thread cut too short, thread cut too long, incorrect thread pitch and non-contiguous threads cut into bars leaving considerable surface area of bar unthreaded.

All defective bars were replaced. The manufacturer's quality control process was amended to 100% testing of all manufactured bars using thread gauges before fitting of couplers and supply to site. To avoid recurrence, consideration should be given to specifying 100% thread gauge testing of bars. Removal of couplers and visual inspection of threads for randomly sampled bars is recommended by the reporter, at least for initial deliveries to site.

Certification schemes rarely involve 100% sampling, and therefore rely on quality management systems and quality control procedures, where defects such as the one described in this report should be reported to the supplier/fabricator and, where the response is considered inadequate, to the certification body.

This is a valuable report highlighting what might be a very important safety issue. If the defective bars had been cast in, and not discovered, then safety would have been compromised. Alternatively, if the defects were discovered during or after construction, remedial costs and delays could have been huge. It is fortunate that vigilance on site detected the problem and that responsible action was taken to resolve the situation.

The construction industry relies on products meeting defined standards. The onus is on the supplier to operate quality systems to ensure such standards are met. However, as product quality often depends on workmanship, it is essential to have adequate supervision and inspection of work on site.

It is not known whether the reinforcement and mechanical couplers used in the project were specified as CARES approved in accordance with the UK National Structural Concrete Specification. Certification schemes rarely involve 100% sampling, and therefore rely on quality management systems and quality control procedures, where defects such as the one described in this report should be reported to the supplier/fabricator and, where the response is considered inadequate, to the certification body.

Certified suppliers should be operating continuous improvement processes which reports such as this would feed into to reduce future risk. Overall the benefits of independent third-party certification by an accredited body, of safety critical components, has been long acknowledged. Indeed, the use of such schemes is a recommendation of the Hackitt report Building a safer future - Independent Review of Building Regulations and Fire Safety for safety critical products.

In 2018, construction of a major railway project in Hong Kong was severely delayed due to allegations of steel reinforcing bars being improperly cut to imitate proper installation into couplers on parts of the project. The Interim Report of the Commission of Inquiry was published in February 2019 and shows the extent of problems that can be attributed to issues with couplers.

Figure 1: Defects in tapered thread reinforcement bars for coupling

Representatives of both the reinforcement and coupler manufacturers inspected the bars on site and confirmed that they were defective and were unlikely to provide the required tensile capacity when connected. A technician from the coupler manufacturer visited the reinforcement manufacturer and inspected the machinery used for cutting threads, and it was confirmed that the machine was working properly. The cause of the defects was determined to be machine operator error.
784: Swapping insulation behind cladding without adjusting details

**REPORT**

A reporter is concerned that after the Grenfell Tower fire, the industry has knee-jerked into swapping polyisocyanurate (PIR) insulation to mineral wool insulation behind cladding, without fully considering the consequences.

The reporter states that:

- Mineral wool insulation is approximately 70% heavier than PIR insulation for a given thickness.
- The U-value of mineral wool is approximately twice that of PIR insulation, which will tend towards using thicker insulation for mineral wool (the lower the U-value, the better insulated the building element).
- For roof panels:
  a. Composite walk-on-ceilings are a particular risk due to the flat surface of the steel which connects to the mineral wool - see CROSS report 54 Walkable ceilings can deteriorate.
  b. Mineral wool will not adhere to the cladding in the same way as PIR. Therefore, fixing details will need to be amended.
  c. The compression capacity of mineral wool is much lower than PIR. Therefore, the detailing where plant is situated above needs to be carefully considered.
- For wall insulation:
  a. Mineral wool is water and water vapour permeable, which can be an advantage if detailed well. However, if not detailed well, it will allow water to collect around cladding fixings which can lead to corrosion where the protection is inadequate or broken.
  b. Where cold formed studs are used to support the cladding, a standard detail is to fix the insulation directly to the studs. For mineral wool insulation, this can lead to corrosion of the studs, particularly at the top and bottom cut ends as well as the lip edge. A break, oriented strand board (OSB) or plywood with a breather membrane should be applied in this situation, in the view of the reporter.
  c. Sometimes cladding fixings to studwork are fixed through PIR insulation, allowing for the compressive rigidity of this insulation. Mineral wool insulation does not provide the same resistance. Therefore, cladding fixings should be fixed directly to the studs with structural breaks.
  d. As mineral wool insulation tends to be thicker and heavier than PIR insulation, it results in higher forces and moments in the fixings. Also, with its lower compressive strength, it generally requires more fixings to provide the required restraint.

The reporter feels that if these differences are not considered, the industry could in time start to get structural cladding failures.

**COMMENTS**

Another serious issue and there have been some reported failures due to substitutions of this kind. The problem is that those making such changes may not have the experience or knowledge to appreciate the factors given by the reporter. It is an issue for the cladding industry to address and another case where competency of companies offering the service, and their operatives, is vital.

All changes need to be treated with caution and significant changes must be approved by the designer. Cladding must be seen as a system, with interactions between all the components that make it up. Changing any one of the components must lead to an evaluation of the performance of the whole system with the incorporation of the new component.

When replacing insulation behind cladding, measures during construction must also be considered. For example, weather protection of mineral wool is needed in the temporary situation, making it a more demanding product in terms of temporary works.

CROSS is aware of cladding failures in tower blocks due to moisture trapped in mineral wool during construction.

Despite manufacturer’s guidance on the need for structural justification of fixings and certification bodies highlighting the need for fixings calculations, cladding, whether new or as a replacement, may not be regarded by clients or contractors as having structural significance, so there may not be a structural engineer involved and the importance of the substitution could go unnoticed.

When there has been a major failure, there is often a “knee-jerk” reaction and careful evaluation is needed to avoid unintended consequences. The first defence against this is having the experience to identify when a component change warrants a system review. Techniques for keeping water out of buildings, and insulating them, have been developed over years and present complex issues.

The British Board of Agrément (BBA) have recently published a technical case study on avoiding external insulation failures.

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**INFORMATION**

Report 786 Incorrect load testing of steel lifting frames

CROSS would like to thank the readers who provided feedback highlighting an issue in the CROSS Panel’s comments on report 786 Incorrect load testing of steel lifting frames, published in Newsletter 54. The comments have now been updated.

View report 786 Incorrect load testing of steel lifting frames
R  REPORT
A reporter writes in response to CROSS report 298 Props to large excavations, as they have witnessed a failure on site as a result of the design issues discussed in this report.

The photo below shows a detail where the design required a cantilever beam to resist the vertical reaction from a raking prop where it connected to the waling beam. The cantilever beam was welded to the sheet pile behind and the design required that a large fillet weld be applied around the entire beam.

However, the contractor installed the cantilever beam after the waling beam had been fixed and was therefore unable to fully weld around the bottom flange.

The partial weld to the bottom flange failed, allowing the beam to rotate upwards. The weld to the web of the beam seemed to remain intact, with the rotation causing local deformation of the sheet pile at the web.

The reporter adds that additional brackets were welded on as an emergency remedial measure.

C  COMMENTS
One feature that this failure highlights is that ‘design’ is not just a matter of calculation. If it was impractical for the contractor to install the cantilever beams prior to the waling beam, then the temporary works designer could have realised that with the waling beam in place first, it would be difficult or impossible to weld or otherwise fix the bottom flange of the cantilever beam.

Equally, if the design cannot be built, there should be an onus on the contractor to go back the Temporary Works Coordinator to flag the issue and get a revised solution from the temporary works designer. A discussion on construction sequencing between the temporary works designer and the contractor should have resolved this issue.

From the description, the cantilever beam failed upwards, implying tension on the bottom flange, which is the exact location where the weld was omitted. Self-evidently, the resistance of the profile weld must have been significantly less than the design intent.

This incident shows a repeated theme from numerous CROSS reports that what was actually built did not match the design intent. As with report 844 Defects in tapered thread reinforcement bars for coupling, site inspections are highly desirable.

INFORMATION
Report 788 Concrete grade confusion in software

The feedback received on report 788 Concrete grade confusion in software, published in Newsletter 54, highlighted some differences in understanding across different sectors of the industry.

Concrete specified to BS8500 has a dual designation, for example C45/55. From a testing point of view, the first number is the characteristic strength found from testing cylinders with a height to diameter ratio of 2. The second number is the characteristic strength of the same concrete found through testing cubes where the height to width ratio is 1. From a design point of view, the first number reflects a value close to the uniaxial strength of the concrete. The uniaxial strength is the true strength of the concrete, independent of any confinement such as that caused at the ends of specimen by friction with the surface of the testing machine.

Historically, UK design practice was to use the concrete compressive cube strength, appropriately reduced, for design and to specify just the cube strength to the supplier. Since the introduction of the Eurocodes, structural concrete design has been based on the characteristic cylinder strength as this better reflects the structural strength of the concrete. Cube samples still usually form the basis of UK conformity testing.

Therefore, there is a risk, as highlighted in the original report, that a designer using the characteristic concrete strength of 45MPa in the design, and then specifying a concrete strength of 45MPa, would end up with a weaker concrete than assumed in the design due to a 45MPa characteristic concrete cube strength being supplied.

This highlights the need for clear and consistent concrete specification, preferably in accordance with BS8500. Where the specification is not clear, the supplier should seek clarification. Where prebagged materials are used, similar caution should be exercised as product names may relate to either the expected cube or cylinder strength and reference to the technical data sheet is required to clarify.
794: Contractor uses incorrect fixing bolts for masonry support angles

REPORT

Whilst carrying out a routine inspection of a three-storey apartment building under construction, a correspondent noticed that the proprietary masonry support angles which had been specified to support the outer leaf of masonry over a large corner window opening had been incorrectly connected to the steel beam using carriage bolts.

They were alerted to this by the cupped head of the bolt, and on further investigation, noticed that the square section of the bolt shank located under the cupped head was clearly preventing the bolt from seating properly onto the serrated washer. They also noted that the bolt grade was 4.6, as would be normal for the bolting of timber, but not appropriate for the steel to steel connection in this instance.

Of particular concern to the correspondent was that the proprietary masonry support angle was detailed in such a way that there is a high degree of setting out tolerance in the vertical plane via long slotted sections on the supporting bracket which are locked in place by serrated sections. Clearly, the bolt which had been used on site was not capable of being tightened up owing to the cupped head.

They believe that the contractor had mistakenly ordered the masonry support angle for a concrete framed building which came without any bolts. The correspondent states that the contractor rectified the issue on site with the correct kit for a steel connection being provided by the supplier.

COMMENTS

This is yet another report which demonstrates the value of site inspections to ensure that design intent is realised on site. As well as improving quality and safety, site inspections are also a valuable learning tool for designers, which is something that is often overlooked. By attending site and speaking to the contractors building their design, designers at the start of their careers might realise weaknesses in their ideas which were difficult to envisage from their office. This could help them to develop an improved way to conduct their design next time around. At the very least, site visits will help all designers to develop a relationship with the contractors which should result in better collaboration to resolve any related issues that arise during construction.

There are similarities in this report with CROSS report 534 Contractor installs incorrect steel grade, as it is not always possible to distinguish different grades of steel simply by looking at them, although bolts are typically marked on the head to show their grade.

Nonetheless, the comments on report 844 Defects in tapered thread reinforcement bars for coupling in this Newsletter about the importance of QA/QC systems are particularly pertinent.

Regrettably UK procurement practice of masonry supports can lead to errors on site because:

- Structural engineers typically provide generic concept details for incorporation by the architect into their drawings so that waterproofing and joints are shown on a single architect’s drawing. However, projects do not always have a final coordinated drawing.
- Installation drawings may not exist for the particular manufacturer used and their system may not incorporate the tolerance needed.
- If bricklayers are installing the masonry supports, they may modify the installation to suit the brickwork programme, without consideration for the effect this change might have. The importance of bricklayers understanding what they are being asked to do was highlighted in the Edinburgh Schools Inquiry.

NEWS

An overview of the specifying and detailing of masonry construction

The IStructE report responds to the Independent Inquiry into the Construction of Edinburgh Schools, highlighting key aspects of masonry construction and the main responsibilities.

Fire safety design: we need to talk about timber

Dr Angus Law, who holds the Building Research Establishment Lectureship in Fire Safety Engineering at the University of Edinburgh, delivered a lecture on fire safety design: we need to talk about timber as part of the IStructE Technical Lecture Series 2019.

The proprietary masonry support angle was detailed in such a way that there is a high degree of setting out tolerance in the vertical plane via long slotted sections on the supporting bracket which are locked in place by serrated sections. Clearly, the bolt which had been used on site was not capable of being tightened up owing to the cupped head.
800: Retaining wall excavation collapse

REPORT
On a domestic project in a major UK city, a deep excavation collapsed due to insufficient propping, says a correspondent.

The existing property formed part of a 1980s terrace and was constructed on reinforced concrete ground beams and piles. The project was to build a residential basement under the existing property. The basement size was approximately 12m long by 6m wide by 6m deep and the soil investigation showed made ground with decent gravel at around 5m deep.

The design for the basement was a separate reinforced concrete box, isolated from the piled structure to prevent differential movement of the terrace. The basement walls were to be cast using the hit and miss underpinning methodology, with 1.2m wide pins as this fitted well with cutting steel mesh sheets in half. The pins were designed to be stable when propped at the base by the basement slab. In the temporary case, the design of the pins required cross propping.

The designer had suggested that the pins were to be cast in two drives. The first drive to a depth of 3m forming a box around the site, with the pins cross propped. The second drive would then be to the full depth, with the pins again cross propped and the basement slab then cast. The designer had provided a temporary works design for this construction methodology.

From the beginning of construction, the contractor increased the width of the pins from 1.2m to up to 3m, according to the reporter. The designer told the contractor not to do this. The client then altered the brief during construction and asked for the basement length to be extended to the edge of the site. For this extension, the contractor did not excavate in 1.2m wide pins, but instead excavated across the whole 6m width of the site.

The client then altered the brief during construction and asked for the basement length to be extended to the edge of the site. For this extension, the contractor did not excavate in 1.2m wide pins, but instead excavated across the whole 6m width of the site.

The reporter believes that it was most fortunate that no site staff were killed.

The unpropped face which collapsed (with 2m long staff at the base)

COMMENTS
CDM 2015 makes clear the importance of ensuring that construction work is properly planned, managed and monitored. This applies to both temporary works as well as permanent works. When changes occur, which often happens, co-operation and communication between the various parties is equally important.

BS 5975:2019 gives recommendations for temporary structures on building sites, with practical guidelines on design, specification, construction and the use and dismantling of falsework. Whilst compliance with BS5975:2019 is not a legal requirement, it does provide an authoritative industry guide to the management of temporary works.

The Temporary Works Forum (TWf) recently published Information Sheet 6: The safe management of temporary works: The basics for small and medium-sized enterprises (SMEs). This advice provides a summary of the key components of BS5975:2019 for those managing temporary works in SMEs.

Pedestrian bridge collapse in Miami - investigation report
Following the collapse of a pedestrian bridge under construction in Miami on 15 March 2018, OSHA (Occupational Safety and Health Administration) published an investigation report on the collapse in June 2019.

View investigation report
467: Large stone panel falls from building facade

**REPORT**
A reporter was working in Asia on a building with a lobby that was open to the outside between the ground and second floors. One day the reporter was coming down an escalator in this area and witnessed a stone facade tile panel about 1m x 0.5m x 50mm thick detach from the face of the second floor concrete beam and fall to the ground. A group of school children were standing not far from where the panel fell.

The reporter believes that the fixings holding the panel in place had either corroded or failed with temperature variation cycles in fatigue (or a combination of both). They note that the stone panels were slightly eccentric to the face of the concrete beam, which may have caused an increased stress and corrosion rate on the fixings.

The reporter was relieved that no one was hurt. They reported the incident to their manager who they hoped would inform the building owner.

**COMMENTS**
This report adds to the body of evidence which CROSS has on failures of fixings and items falling off buildings, some of which are summarised in the 2010 SCOSS Alert on The Selection and Installation of Construction Fixings>.

The reporter correctly observes that the failure of a fixing in this situation has the potential to cause fatalities or severe injuries. The report also emphasises the value of paying design attention to what might at first seem a minor structural system. In reality, façades are important structural systems whose failure have caused fatalities in other instances, and the attention given to their design should reflect their safety critical nature.

The specification of any inspection and maintenance requirements for façade fixings should also be considered, which may require a combination of regular visual inspections with full inspections at appropriate intervals.

The reporter’s comments about eccentricity should alert designers to be realistic about judging the loads on fixings and to ensure that their designs are not sensitive to small changes. Due to tolerance, misalignment and so on, panel loads will most certainly not be shared equally amongst multiple fixings. Slight changes in projection can have dramatic consequences in terms of applied bending.

One of the largest categories for CROSS reports is failed fixings (or anchors) and the advice is always to treat these components very seriously from the perspectives of design, procurement, inspection, testing and installation. As well as manufacturers instruction, the Construction Fixings Association (CFA) website> and CIRIA publication C778 Management of safety-critical fixings> are useful references.

One of the largest categories for CROSS reports is failed fixings (or anchors) and the advice is always to treat these components very seriously from the perspectives of design, procurement, inspection, testing and installation. As well as manufacturers instruction, the Construction Fixings Association (CFA) website> and CIRIA publication C778 Management of safety-critical fixings> are useful references.

**CPD PRESENTATIONS**
Structural-Safety are giving lunchtime presentations to organisations who are interested in learning more about the work that Structural-Safety (CROSS and SCOSS) do, including sharing examples of safety issues to learn from.

For more information contact events@structural-safety.org>.

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