Structural-Safety
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CROSS
Confidential Reporting on Structural Safety

Newsletter 60 | October 2020

Editorial

DIRECTOR:
Alastair Soane

The origins of the recent draft Building Safety Bill lie in the Building Safety Programme, details of which were published in July 2017 following the Grenfell fire, to make sure that residents of high-rise buildings are safe – and feel safe – now, and in the future. This was followed by Dame Judith Hackitt's report *Building a Safer Future* in 2018.

Her report proposed a fundamental shift in the approach to regulation, from prescription to one of the professions looking at buildings as a whole and demonstrating that they are safe. Although there had been much public focus on Grenfell and the role of cladding in that incident, the Hackitt review took a much broader view to tackle the basic challenge of making Higher Risk Residential Buildings (HRRBs) safe overall. The next step was Government consultation in 2019 on proposals for reform of the building safety regulatory system which was followed by the publication of the draft Bill. It will be 2021 before this passes through Parliament and perhaps 2022 before the secondary legislation flowing from it is implemented.

One of the principal features is the creation of a new Building Safety Regulator (BSR) as an addition to the existing roles for HSE. Their many duties will include taking over the building control regime for all buildings, although with an initial emphasis on HRRBs, and focusing on structural safety and fire safety, which means that engineers will be heavily involved throughout the process.

For some this will be business as usual, whilst for others it will mean learning additional skills and becoming conversant with new management and technical processes. Very importantly, the Bill makes provision for regulations for competence and this is not limited to work on higher risk buildings. The requirements relevant to structural engineers are being addressed at the highest level within IStructE so that members can be aware of any new requirements well in advance.

Included in the Bill there is a requirement for the Building Safety Regulator to establish and operate a system for the voluntary reporting of information about building safety. The proposal is for this function to be fulfilled through the expansion of CROSS, which will be extended to include fire safety. Work on this has been underway since the start of the year with MHCLG and a greatly expanded and enhanced CROSS will be launched in early 2021.

All the reports in this Newsletter are relevant to the requirements in the Bill with a common, and disturbing thread, that persons who are not competent are making unsafe decisions.

Reference: **Draft Building Safety Bill 2020>**

Alastair Soane

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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
- (N) News
- (I) Information
- (M) In Memoriam
- > Denotes a hyperlink

CROSS
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979: Outdoor video screens

REPORT

This report is to raise concerns about certain video screen systems being used out of doors. In one example the screen which is approximately 3m deep and 5m long is made up of a number of modules and is hung from a trussed beam supported at the ends by proprietary telescopic posts.

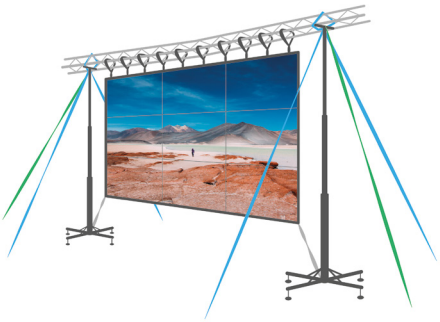

Figure 1
Sketch of typical outdoor screen arrangement

The reporter has a number of key concerns about safety as such screens are being used for public displays with large numbers of people in close proximity.

The vertical supports appear to be typical for proprietary products with an axial capacity of around 200kg. Manufacturers may provide no data for use outside and do not provide any ratings for lateral loads. One manufacturer of this type of product includes the warning: *Do not use the tower as a support for banners as with strong winds this can de-stabilise the tower and make it fail.*

The reporter has a number of key concerns about safety as such screens are being used for public displays with large numbers of people in close proximity.

Screen systems of around 5m by 3m probably weigh about 400kg so the self-weight of the screen and truss is at the maximum capacity of the vertical supports, even without forces from wind actions. From observation in one case the horizontal truss was visibly deflecting. Whilst that does not prove it is overloaded, the deflection will be inducing bending forces into the vertical supports by displacing them laterally and thus reducing the axial capacity.

Such screens are solid and not designed to allow wind 'blow-through'. The screen may be restrained against lateral swaying with tension members to the bases of the vertical supports. As the bases are not anchored to the ground, any tension forces could cause the bases to slide, leading to immediate collapse.

The provision of 'truck' straps as guys from the tops of the towers at right angles to the screen will result in increased axial loads in the vertical supports, almost certainly, in the view of the reporter, leading to overload/ failure in the event of significant wind forces. There are also no apparent measures to prevent guys or other equipment being tampered with by the public.

The screen system in use does not have 'tour frames' attached to the rear, which are designed to absorb bending forces between screen modules. With the modules restrained across the top and at the bottom corners, wind loads tend to cause the screen modules to deflect into a concave 'saucer' shape which over-stresses the module to module connections, an effect implicated in several screen failures to date. It is noted that this is a less likely failure mode here as the whole structure can be expected to overturn or collapse before a failure of the screen modules.

In conclusion the reporter believes such arrangements which would be worrying indoors are totally unacceptable outdoors. There clearly cannot have been any input from a structural engineer and so the fundamental concern is the failure of the regulatory system that allows this collection of equipment to be deployed regularly, and perhaps with increasing frequency due the Covid-19 restrictions on indoor gatherings.

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INFORMATION

What should be reported to CROSS?

Structural failures and collapses, or safety concerns about the design, construction or use of structures.

Near misses, or observations relating to failures or collapses (which have not been uncovered through formal investigation) are also welcomed. Reports do not have to be about current activities so long as they are relevant.

Small scale events are important - they can be the precursors to more major failures. No concern is too small to be reported and conversely nothing is too large.

Your report might relate to a specific experience or it could be based on a series of experiences indicating a trend.

Benefits of CROSS

- Share lessons learned to prevent future failures
- Spurs the development of safety improvements
- Unique source of information
- Improved quality of design and constructon
- Possible reduction in injuries and fatalities
- Lower costs to the industry

Supporters of CROSS

- Association for Consultancy and Engineering (ACE)
- Bridge Owners Forum
- British Parking Association (BPA)
- Building Research Establishment (BRE)
- Chartered Association of Building Engineers (CABE)
- Civil Engineering Contractors Association (CECA)
- Confidential Incident Reporting and Analysis Service (CIRAS)
- Constructing Excellence
- Construction Industry Council (CIC)
- Department of the Environment (DOE)
- DRD Roads Services in Northern Ireland
- Get It Right Initiative (GIRI)
- Health and Safety Executive (HSE)
- Highways England
- Institution of Civil Engineers (ICE)
- Institution of Structural Engineers (IStructE)
- Local Authority Building Control (LABC)
- Ministry of Housing, Communities and Local Government (MHCLG)
- Network Rail
- Royal Institute of British Architects (RIBA)
- Royal Institute of Chartered Surveyors (RICS)
- Temporary Works Forum (TWf)
- UK Bridges Board

C COMMENTS

Covid-19 restrictions mean that there are many pop-up temporary structures for outdoor events such as showing films. The entertainments industry has few defined qualifications and there is a propensity to rely on experience and "using a product" rather than designing a temporary structure. This is of concern as it can lead to operating outside of competence, either deliberately or in ignorance, and hence leading to public safety risks. This example looks as if a lighting rig has been used without consideration of stability, the suitability of the individual components acting as a whole, or the effects of high wind.

CROSS has many reports of temporary structures collapsing, often in wind. One cause is that such structures might be checked against low wind speeds, but any sudden gust above design assumptions can lead to disproportionate pressure increases. In 2006, a very large outdoors TV screen collapsed in Birmingham and this led to prosecutions. The owner/operator of a temporary facility is responsible for the safety of all concerned including staff and the public.

The IStructE AGOTS (Advisory Group on Temporary Structures) publication **Temporary demountable structures: Guidance on procurement, design and use (Fourth edition)>** includes guidance and recommendations on outdoor screens. It says there should be:

- an independent design check carried out by a Chartered Engineer having adequate skill and experience; and
- an independent erection check on the structure once it has been erected should be carried out by a competent person, who may be an employee of the supplier of the structure or a person nominated to carry out such checking by the Contractor.

Also, as they are wind sensitive structures, there should be a clear procedure for wind management to ensure safe operation.

In regulatory terms CDM 2015 may apply in some cases and it is likely that the Health and Safety at Work Act 1974 will apply and hence workers and public should not be put at risk. Whatever the regulations unqualified persons making safety-critical engineering decisions can result in catastrophic consequences. There have been collapses with multiple fatalities of temporary stages and SCOSS published an Alert in 2012 on **Temporary Stage Structures>**.

Further comprehensive advice is given by **HSE>** and by **Designer Buildings Wiki>**.

SUBMIT REPORT

SUBMIT FEEDBACK

N NEWS

RAAC planks update

In addition to the known problems with RAAC (reinforced autoclaved aerated concrete) planks from the 1960s-80s as stated in the May 2019 **SCOSS Alert on Failure of RAAC Planks>**, it has been reported that there have been problems with some that were installed in 1998. The earlier time period may therefore be too narrow so if any readers have further information could they please contact CROSS.

N NEWS

More supporters from CROSS-AUS

As CROSS-AUS celebrates its second anniversary they have announced that three more important bodies have agreed to become Supporters:

Engineers Australia (EA) - **https://www.engineersaustralia.org.au/**

Engineering New Zealand (ENZ) - **https://www.engineeringnz.org/**

Structural Engineering Society New Zealand (SESOC) - **https://www.sesoc.org.nz/**

845: Weld de-specification

R REPORT

A reporter's firm was engaged as sub-contract fabricators to complete 90 tonnes of steelwork for a main contractor. In the commercial negotiations at the onset of the project, the main contractor agreed that to hit their target prices the sub-contractors should de-specify all full and partial penetration butt welds from all steels and replace with 6-8mm fillet welds.

The sub-contractor had several conversations with the main contractor who refused to change the drawings to match the changed description of the welds. The main contractor assured the sub-contractor both in writing and in person that it was okay to proceed with de-specification of the welds, but they would not re-issue the drawings.

Eventually the sub-contractor declined to participate further due to this and other issues. The reporter's firm sought advice from the original designers and were told that for structural reasons the proposed changes to some of the welds should not be made. When the sub-contractor raised this with the main contractor as a health and safety issue they were told it was none of their business. The reporter is concerned that such practices exist.

C COMMENTS

Health and safety is everyone's business and there should be no criticism of those who raise these issues. There are numerous examples of concerns being ignored which have resulted in subsequent failures and lessons have to be learned. Designers are aware of the time, cost and difficulty of producing butt welds and will specify fillet welds wherever suitable. They also know that fillet welds will generally be cheaper than butt welds. Therefore, if butt welds have been specified it will have been for good reason and they should not be changed without formal approval from the design authority.

Proposals to change butt welds to fillet welds should always be treated with caution. They have very different characteristics, particularly in fatigue. Contractors may not be well versed in the longer term implications of the changes they make, or wish to make, when reducing cost or accelerating the build process, but their emphasis on this aspect of the product lifecycle can cloud a wider perspective and be dangerous.

Whilst not necessarily applicable here, it is not good for a main contractor to coerce a sub-contractor or have decisions made by persons who are not competent/qualified to make them. There are legal and ethical issues to be considered and if there had been a failure the consequences could have been severe for the firms and individuals concerned. Indeed, HSE could be interested in such behaviour.

Whilst not necessarily applicable here it is not good for a main contractor to coerce a sub-contractor or have decisions made by persons who are not competent/qualified to make them. There are legal and ethical issues to be considered and if there had been a failure the consequences could have been severe for the firms and individuals concerned.

To avoid such situations the following steps should be taken:

- Ensure that the frame designer always has opportunity to review and comment on connection designs and ensure that those detail designs meet with the specified requirements.
- Ensure that execution of works is in accordance with checked drawings only. If the drawings need to change, they should be changed through a design change process to ensure adequate re-design and re-checking.

SUBMIT REPORT

SUBMIT FEEDBACK

M IN MEMORIAM

Jonathan Wood

The death has been announced of Dr Jonathan Wood; an eminent and distinguished engineer who contributed enormously to structural knowledge over a career spanning many years. He wrote the definitive report on the collapse of the Pipers Row Car Park referred to in report 950, was UK member of the Forensic Engineering Group within IABSE, author of many papers, and keen supporter of Structural-Safety and CROSS. He will be sorely missed.

N NEWS

Box girder bridge collapses – 50 years on

Fifty years ago the bridge design world was thrown into turmoil by the sudden collapse during construction of the Milford Haven and West Gate steel box girder bridges. The lessons from those tragic events were far reaching and have influenced bridge design practice ever since, but are we guilty of ignoring them today? Ian Firth has written a piece on this 50-year anniversary for The Structural Engineer to remind us of those hard learnt lessons which may be in danger of being ignored or overlooked by modern procurement methods. He says: *"We would do so at our peril"*. **https://www.istructe.org/thestructuralengineer/** (published 16th October).

940: Fire in multi-storey car parks

(R) REPORT

Following the fire at the Echo Arena Multi Storey Car Park (MSCP) in Liverpool (See SCOSS Alert reference below) and articles in the technical press and on the national media, a reporter is concerned by the lack of awareness of such reports, and the reluctance of the industry to voluntarily take on board and proactively react to the lessons learnt. Being in a privileged position, the reporter often has the opportunity to undertake a peer review and to comment on designs that are in the concept stage or in construction.

Sadly, when the reporter challenges the suitability of designs that barely comply with minimum standards, they are confronted with a proliferation of economic reasons that they are told override potential safety issues. The Echo Arena MSCP in Liverpool demonstrated that a 15-minute fire-resistance rating may be totally inadequate for exposed steel framed MSCP structures occupied by modern vehicles. However, designers and clients are telling the reporter that, until the regulations change, the design has to be to current standards.

Sadly, when the reporter challenges the suitability of designs that barely comply with minimum standards, they are confronted with a proliferation of economic reasons that they are told override potential safety issues.

There is little doubt, says the reporter, that the Echo Arena car park may have collapsed if it had been constructed to current standards in unprotected structural steelwork. Whilst structural steelwork is absolutely fine and highly sustainable, it needs to have adequate fire resistance. The reporter's concerns also extend to the use of permanent metal formwork which is often specified and used structurally in MSCP decks. The reporter feels that the potential effects of fire beyond the 15-minute rule should be considered. They have an additional concern that these systems may have a reduced service life as a result of corrosion that takes place from salt laden water being trapped between the sheeting and the concrete.

The reporter often sees in existing car parks damaged fire doors which are incapable of protecting egress routes in the event of a fire, and cast iron drain pipes that have been replaced locally with plastic pipes which would burn through and allow burning fuel to cascade onto the decks below and propagate a fire.

Finally, the reporter fully supports the work currently being undertaken by the industry to raise standards, but in the meantime believe it needs a concerted effort across the board to take on the knowledge that we currently have in our possession and not rely solely on standards that are likely to be inadequate in some cases.

(C) COMMENTS

This list of short-comings and an apparent lack of thought and reflection is of concern and does not reflect well on some in the car park industry. A key benefit of CROSS is that the industry can learn from issues and not repeat the mistakes of the past. The risks from the Liverpool fire have been shown in the **SCOSS Alert Fire in Multi-Storey Car Parks>** and designers should take account of these. Building Regulations are minimum standards and responsible, informed owners, designers and contractors will acknowledge this.

One of the changes that will come from the Hackitt review is that buildings must be treated as holistic systems and consideration given to what might happen in extreme situations.

The recently published **Manual to the Building Regulations>**, clarifies some limitations of the approved documents (see, for example, page 22) and also the relationship between Building Regulation (the law) and the approved documents (statutory guidance). The new manual goes beyond the introduction to Approved Document B and provides helpful advice:

> *Anyone using the approved documents should have sufficient knowledge and skills to understand the guidance and correctly apply it to the building work. This is important because simply following the guidance does not guarantee that your building work will comply with the legal requirements of the Building Regulations.*

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Fire safety in car parks is an area that has caused alarm for some time. There have been a number of fires in recent years, some with significant consequences; Monica Wills House, Bristol, December 2006; Brent Cross, December 2007; Shaw Lodge, Manchester, April 2008; Smithfield Gates, Dublin, August 2008; Ancoats, Manchester, November 2008; Cork, August 2019.

CROSS has reported before on car park fires, for example **report 857 Fire resistance of multi-storey car parks published in October 2019>**

CROSS supports any move to improve safety in car parks and with all of the current attention on the draft Building Safety Regulator there is scope for raising further awareness of the potential problems.

SUBMIT REPORT

SUBMIT FEEDBACK

946: Swimming pool ceiling collapses

(R) REPORT

A reporter writes about the collapses of two swimming pool ceilings. The first was due to a gradual build-up of condensation causing corrosion of the pressed metal angle tie bars and fixings that supported the suspended ceiling above a swimming pool to the overhead concrete floor slabs. Eventually, after about 12 years, the weight of the ceiling exceeded the strength of at least one of the tie bars, which caused progressive failure of the remainder and then collapse of the ceiling. The swimming pool is located at basement level, beneath a multi-storey commercial premise.

The second case concerns the effects of a gradual build-up of condensation that caused the collapse of a rigid insulation board and suspended ceiling grid in another swimming pool. This was a commercially-operated venue, located in the basement of a sports centre. The pool's ventilation system was switched off each night (outside of trading hours), thereby creating the conditions needed to cause condensation.

For example, the guidance of the Canadian Building Digest is that the ventilation system is an essential part of a swimming pool's design and *"it must be properly operated if serious building problems are to be avoided"*.

Condensation was forming on the colder surface of the concrete roof, which was at ground level. This caused wetting of the insulation boards and corrosion of the support system for the suspended ceiling tile system. The condensation was generated by temperature differences between the 30 degree Celsius environment of the pool hall, and the outdoor temperature of the concrete slab, combined with the supply of moisture from the pool and a jacuzzi.

The ceiling tile system was provided for aesthetics and acoustics; it was not meant to be airtight or waterproof. The warm, moist air came into contact with the concrete roof where the silver-coloured foil on the insulation was missing or ineffective. This was occurring at the holes or gaps in the insulation; where joints between individual boards were not sealed with tape, where the tape was not properly installed along joints, or if the type of tape that was used was ineffective.

A condensation risk analysis, using the computer software of the Fraunhofer Institute for Building Physics, found that condensation and then water was always expected to occur with the type of construction that was used. Prior to the collapse of a part of the ceiling, there had been an issue with the appearance of brown-coloured stains on the ceiling tiles. This was managed on an ongoing basis by replacing the affected tiles. It is clear from images of the pool hall ceiling from one year prior to the incident that this was a widespread issue.

(C) COMMENTS

CROSS has received a large number of ceiling collapse reports and they usually follow the same pattern; there is failure of a single hanger which precipitates a cascade failure across the whole roof just as reported here. SCOSS produced an Alert about this in 2012 (**SCOSS Alert - Tension cable and rod connectors>**) and a fuller technical explanation can be found in Reference 1.

Ceilings can be very heavy, and their failures have the potential to cause injury and death. A ceiling collapse (precipitated by a hanger failure) over the Uster Swimming pool in Switzerland in 1985 killed 13.

All designers should know that swimming pool environments are highly deleterious to materials in the medium to long term. To search for ceiling failures on the CROSS database on **www.structural-safety.org>** and enter 'ceiling' into the Quick search box.

Designers need, universally, to ask themselves the question: 'How do I know it is safe?' Any tension member (e.g. a ceiling hanger) will tend to fail suddenly and catastrophically; this is in contrast to bending or compression design which tends to fail with forewarning. In the cases reported, how did the designers know that the hangers would remain intact? During the operational phase was there an inspection and replacement regime? Most importantly were competent persons engaged in these roles? The safety-critical aspects of fixings and anchors are too often ignored.

All designers should know that swimming pool environments are highly deleterious to materials in the medium to long term. To search for ceiling failures on the CROSS database on www.structural-safety.org and enter 'ceiling' into the Quick search box.

Owners and managers of swimming pools should be made aware of the sensitivity of fixings to corrosion. See **SCOSS Alert - Stainless Steel: A Reminder of the Risk of Failure due to Stress Corrosion Cracking in Swimming Pool Buildings>** from 2005.

Reference:

1. A P Mann: 'Safety of Hanging Systems: Lessons from CROSS Reports'
The Structural Engineer, Vol 97 (2002) Issue 9

SUBMIT REPORT

SUBMIT FEEDBACK

950: Inadequate punching shear reinforcement

(R) REPORT

This concerns the checking and inspection of punching shear reinforcement in a small number of medium rise residential buildings with flat slab floors. The building control function was being undertaken by a private building control company up to the point at which the reinforced concrete frames were complete.

At this stage, due to un-related difficulties with the private building control company, the developer decided to change the building control function to the local authority (LA). A reversion Building Regulations application was then submitted to the LA. They had therefore to assess firstly whether the design of the frames was in accordance with Part A of the Building Regulations and secondly to determine whether the frames had been built in accordance with the drawings.

The LA were satisfied with the design but requested inspection records from the private building control company to gain confidence that the frames had been built in accordance with the Building Regulations. Unfortunately, despite assurances of a comprehensive set of inspection records, very few inspections of the reinforcement to the flat slabs had been carried out and those were of a general nature and of non-critical areas.

The private building control company suggested that the responsibility for inspecting the reinforcement lay with the project's structural engineer. Unfortunately, again, insufficient inspections of reinforcement had been carried out by the structural engineer and they were unable to provide any verification or comfort that the structure had been built in accordance with their drawings. The main contractor then provided pre-pour sign off sheets of the reinforcement signed off by the frame contractor before the slabs were cast, hoping that this would satisfy the LA. These records however were not considered impartial by the LA.

One of the LA's greatest concerns was verification that the very significant quantity of punching shear reinforcement shown on the designers' drawings had been correctly installed. Punching shear reinforcement was required in the slabs to approximately 50% of all columns and in certain locations up to distances of 5 perimeters out from the face of the columns. When the frame contractors' pre-pour reports were forwarded to the LA, photos were also included of the slab reinforcement around a limited number of columns.

The photos showed that the as-installed punching shear reinforcement to these columns was inadequate. The quantity and setting out of the bars were not as per the design drawings or the relevant code of practice, and the inclination of bars was parallel to any potential shear failure plane, rendering the bars installed ineffective. This major defect was pointed out to the main contractor and designer who both accepted the deficiencies.

The choice was made by the main contractor and the designer and accepted by the LA, to strengthen all slabs where punching shear reinforcement had been required, as there was no easy way of verifying the punching shear provisions to any of the columns. This involved the installation of substantial stiffened shelf angles, being fixed to the columns hard up against the underside of the slabs with shear studs drilled through the slab at the required perimeters. Many lessons could be learned from this project, but perhaps the greatest would be for rigorous checking of critical structural elements; in this case punching shear reinforcement.

Many lessons could be learned from this project, but perhaps the greatest would be for rigorous checking of critical structural elements to the frames, in this case punching shear reinforcement.

(C) COMMENTS

Punching shear around columns in flat slabs has been causing concern for many years, both in design and execution, so well done to those who spotted this problem and their persistence which enabled the matter to be rectified before anything dire happened. It is clear that insufficient inspections were carried out by various parties to spot the poor workmanship that should not have been permitted in the first place.

A dramatic example of flat slab collapse was at the Pipers Row car park in 1997: **Pipers Row Car Park, Wolverhampton Quantitative Study of the Causes of the Partial Collapse on 20th March 1997>**.

Figure 1
Pipers Row car park (photo: Jonathan Wood)

It is of concern to think that other buildings may have deficient slab shear reinforcement at the column heads, especially as this type of failure is sudden and catastrophic. In any structural system, some modes of failure are more serious than others and flat slabs offer a prime example of this. Under overload, it is highly desirable that such slabs fail in bending before a support punching failure becomes critical, since the latter is brittle and gives little warning.

Regular readers of CROSS will identify the common theme of there being a mismatch between what designers thought was being built and what was actually built, and this report is yet another example of that. There is a generic concern that designers do too little site checking and records are too inadequate to verify construction quality. The Edinburgh school's failure (**SCOSS Alert - Inquiry into the construction of Edinburgh Schools>**) and others, exemplify the concerns such as:

- lack of quality control in the construction process;
- the need for proper supervision by competent staff and
- a lack of independent inspections.

Again, these are issues that should be addressed in actions flowing from the Draft Building Safety Bill and the introduction of the new Building Safety Regulator. It is believed by some of the CROSS Panel that a traditional Clerk of Works would have found the lack of rebar straight away and saved a great deal of money as well as ensuring safety. A body who address such issues is **GIRI (Get it Right Initiative)>** and their work is to be encouraged.

SUBMIT REPORT

SUBMIT FEEDBACK

968: Execution not matching design assumptions

(R) REPORT

A reporter has recently been involved in a large residential building project. The building was steel framed and at first floor level had large span transfer beams which took the load from major columns spanning over a wide opening at ground floor.

The transfer beams were arranged in pairs with the design load assumed to be spread evenly between them. Early during occupation, concrete soffit panels which were attached to the bottom flanges of the transfer beams were found to be cracked. Upon investigation, it was discovered that the bottom flanges of the pairs of beams had spread apart by up to 70mm.

An analysis was undertaken by the original designer, and independently by a third party. The conclusion they both reached was that the loading from the column was applied to the inner part of the inside flanges at the tops of the pairs of transfer beams, and not directly over the webs as the design had assumed. This was causing a rotation of the beams, and failure was only averted by secondary connections and fixings causing some additional restraint. Remedial measures were put in place.

The designs had been reviewed by building control and also by an independent third party checker before construction. The designs were in fact fine, but the connection of the column to the pairs of beams was not detailed at that point, and it was not highlighted that this was a critical part of the design.

(C) COMMENTS

Normal design implicitly assumes members are loaded in the vertical direction with members restrained against torsion. However that assumption can be invalid. It is especially important to consider possible twists during construction which can easily occur, say, during successive increments of vertical loading.

A more general issue is that almost invariably, loading and stability conditions will differ between construction stages and the completed stage. The onus is on the whole team to assure safe construction can take place and permanent works designers must ensure that any limitations on loading conditions are conveyed to contractors.

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A point made by the reporter is that the alignment of the column supported on the transfer beams was not 'directly over the webs'. For safety, realistic loading conditions must always be part of the model. In reality, no axial load can be presumed totally concentric because positional tolerances exist and are permitted. A column is thus always going to have some eccentricity to its support and a heavy axial load at a small tolerance is going to produce significant torsion. It might be recalled that one cause of the box girder bridge failures in the 1960/70s was that transverse girder webs did not align with the supports below and the webs buckled as a result.

In practical terms, where there are twin beams consideration should be given to how the pair will interact and provision made for eccentricities and load sharing. To ensure that this is the case, the detailed design drawings should be available to the contractor at the time of constructing the relevant elements. Having a process in place whereby the execution is not allowed to commence without the detailed design stage being completed and approved would help prevent similar issues.

Detail, alignment and tolerance all need attention, and at all stages of construction. Designers must challenge themselves: 'How do I know this will be safe and will remain so? What must be done right (or in some specific way) to ensure this safety?'.

SUBMIT REPORT

SUBMIT FEEDBACK

971: Workmanship in domestic buildings

(R) REPORT

A reporter on site discovered that a steel beam had the web cut away at the support to avoid having to divert some services. The cut-out meant that the whole of the loading on the beam would have been supported by just bending in the bottom flange once the temporary props had been removed.

Additionally, the site staff did not have all the structural drawings for the project, so had made up a beam to column connection as a flexible end plate whereas there needed to be a full moment end plate connection.

(C) COMMENTS

Domestic projects may not have the full range of professionals around and are, especially for one-off buildings, constructed by firms with limited resources. This does not exempt the builders, or anyone else involved, from acting responsibly and it is a real concern that sections of a major load-bearing component could simply be cut away for the convenience of a service installer.

That there was an incomplete set of structural drawings on site shows a lack of oversight particularly when the design called for a full moment end plate connection. The theme of 'failure by unauthorised change' is commonplace. As in other reports in the Newsletter, this exemplifies why a person who is not competent must not make design alterations that could have severe consequences.

Designers, whoever employs them; client, main contractor or sub-contractor, must ensure that the final drawings are distributed to all parties and that they approve the detailed designs and drawings. Contractors, if they are unsure about any structural matters, must consult the designers and not assume design responsibilities by devising their own details.

Some sectors of the industry are allowing incompetence to reign. Large and complex buildings are the focus of current interest with the draft Building Safety Bill but the proposed legislation needs to be in place for smaller buildings too to prevent such dangerous occurrences in future. Thankfully, this one was picked up, but how many are not?

Designers, whoever employs them; client, main contractor or sub-contractor, must ensure that the final drawings are distributed to all parties and that they approve the detailed designs and drawings. Contractors, if they are unsure about any structural matters, must consult the designers and not assume design responsibilities by devising their own details.

SUBMIT REPORT

SUBMIT FEEDBACK

PARTICIPATION

The success of the CROSS scheme depends on receiving reports, and individuals and firms are encouraged to participate by sending reports on safety issues in confidence to **CROSS>**.

FEEDBACK

If you have any comments or questions regarding this CROSS Newsletter, please **Submit Feedback>**.

CPD PRESENTATIONS

Structural-Safety are giving online 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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EMAIL UPDATES

Sign-up> to our mailing list for email updates from Structural-Safety, including the latest CROSS Newsletters and SCOSS Alerts.