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INTRODUCTION

It was announced by the Secretary of State for the Department of Communities and Local Government (DCLG) on 5 September that SCOSS have been asked for advice on matters relating to the safety of tall residential buildings. To help with this work additional reports are wanted on:

- Fire safety events or concerns
- Cladding failures (any type) and concerns
- Any tall building safety events or concerns

They should be sent to the report page on the web site, can relate from any time from 1968 to the present, and will be treated in confidence.

In its first review in 1977, SCOSS predicted, prophetically, that 'claddings form an area of structures which is likely to give trouble for several years to come'. It identified several problems, centring on awareness of building owners of the need for regular inspections, for guidance on methods and objectives for carrying out inspections, to take account of existing information on the design and erection of claddings, and the need to make provision for easy inspection and repair of fixings and other important features. In its 2000 review SCOSS added; 'These problems remain serious 23 years and many building failures later, despite reminders from SCOSS, and the publication of guidance from, amongst others, the IStructE.' Now, seventeen years on, and forty years since the first warnings, claddings are in the headlines for the worst of reasons.

Fire resilience is the main concern but there have been worrying reports of instances of fixing failures in external insulation panels that have emerged recently. In this Newsletter there is a report on thin stone claddings and inadequate fixings. More attention must be paid to claddings of all types and their fixings and it is clearly insufficient simply for CROSS and SCOSS to issue warnings. There needs to a regime with a tougher and more rigorous approach to the recognition of risk amongst all parties involved in the design and installation of large, heavy, and possibly inflammable, panels on the outsides of buildings. It may be that regulations need to be introduced to force those parts of the industry who are not complying to do so.

Other matters reported in this issue include fire safety risks and the dilemma of how to deal with these if a client refuses to act, inadequate design and construction issues, and the question is posed as to whether some current buildings have structures which are inherently vulnerable to future modifications.

Reports sent to CROSS are de-identified, categorised, and sometimes edited for clarification, before being reviewed by the CROSS panel of experts. The panel makes comments that are intended to assist those who may be faced with similar issues. In the Newsletters the reports are shown in black text and the comments are shown below these in green italics.

Reports and comments are also given on the website database.
What should be reported?

- concerns which may require industry or regulatory action
- lessons learned which will help others
- near misses and near hits
- trends in failure

Benefits

- unique source of information
- better quality of design and construction
- possible reductions in deaths and injuries
- lower costs to the industry
- improved reliability

Supporters

- Association for Consultancy and Engineering
- Bridge Owners Forum
- British Parking Association
- Chartered Association of Building Engineers
- Communities and Local Government
- Construction Industry Council
- Department of the Environment
- DRD Roads Services in Northern Ireland
- Healthy and Safety Executive
- Highways England
- Institution of Civil Engineers
- Institution of Structural Engineers
- Local Authority Building Control
- Network Rail
- Scottish Building Standards Agency
- Temporary Works Forum
- UK Bridges Board

The success of the CROSS programme depends on receiving reports, and individuals and firms are encouraged to participate by sending concerns in confidence to Structural-Safety.

689 Fire Safety Risks during Technical Due Diligence Survey

A reporter's firm was appointed by a client to carry out a technical due diligence survey as part of a building acquisition, meaning the client had not yet agreed the purchase deal for the building. During the survey, numerous and serious fire safety risks were observed:

- Fire exits deliberately barred with wooden or metal poles
- Fire exits chained shut
- Missing / damaged / poorly maintained fire extinguishers
- Blocked fire escape routes full of rubbish
- High volumes of flammable waste lying around (large quantities of cardboard containers, paper wrapping etc.)
- Sprinkler system capped off at the mains valves
- Fire alarm system in error mode

It was obvious that neither the current owner, nor the short-term tenant had carried out a fire risk assessment for the property. This was reported to the client the day after the survey. The reporter informed the client that they would notify the local fire authority that a fire safety visit was urgently required to enforce a fire risk assessment, if alternative action and instructions were not proposed by the client by the end of the day.

The client specifically stated that the authorities should not be notified as this could put the purchase deal in jeopardy. They seemed unconcerned about the obvious safety aspect. Reporting the matter to the authority would directly contradict the instruction of a client and result in breach of contract to said client. The client has also asked that the matter is not referred to in the due diligence report. Often technical due diligence surveys pull up serious health and safety issues such as asbestos, legionella, fire, stability and more. However, there is often no action taken by the client or current building owner, except to seek a lower price in any deal. How would this reflect on the reporting engineer if an incident were to occur in the future, had they not ensured that their client had taken appropriate action?

Comments

The defects discovered were dangerous and illegal. It would be unethical and irresponsible not to report them, but two questions arise:

1. Is the duty of care adequately satisfied by reporting only to the client?
2. Do the professional responsibilities of an Engineer take precedence over the instructions of the client?
If the issues are formally reported to the client then it must be made absolutely clear that it is then the client’s responsibility to alert the relevant bodies in a timely manner. In this case the client apparently did not want to know. However, if the dangers are real and imminent then the ultimate responsibility lies to the safety of those affected, and direct contact with the authorities by the Engineer may be the only way to achieve this. To help in dealing with such issues professional bodies have codes of conduct for their members and statements of ethical principles. Usually these are based on the principles set out by the Royal Academy of Engineering, updated in July 2017. The Institution of Structural Engineers Code of Conduct includes the statement: “Have regard to the public interest as well as the interests of all those affected by their professional Activities”. It also however says that members should not “Disclose the contents of a report to third parties, without the client’s express permission.”

These principles can appear to conflict with one another. Before deciding how to act it would be prudent for the Engineer to seek legal advice, but even if there is a contractual risk the Engineer might decide to apprise the Client that, for the greater good, the Engineer would be notifying potential dangers to life to those authorities who could act. It is to be hoped that in the event of a dispute the courts would protect the Reporter’s firm if they were to act in a manner to protect worker/public safety.

632 Risky new buildings?

A reporter says firstly may he congratulate CROSS on the work that is done for structural safety and allied subjects. Secondly, he is becoming increasingly concerned about some of the ‘exciting’ structures and buildings that are being produced. He is particularly concerned about the use of cantilevers in buildings! It is obvious where a cantilever exists in a stadium or similar conspicuous and simple structure and what is balancing what, is reasonably clear. But he sees them appearing in buildings, and is not sure how well the implications of the counterbalancing ties and struts are understood. For example, there is a newish building in a major UK city that has a very pronounced cantilever at the front. This must be tied down further back in the building by one or more tension members that could be of a relatively small cross-section. What is to stop someone just cutting through it in - say 30 years’ time - without realising its importance? His spur for this note was the photo on the front of a major engineering Journal which he is sure meets all necessary structural safety criteria, but looks risky, especially against lateral loads! The SCOSs invitation to engineers to use ‘reflective thinking’, which he does from time to time, makes him question some modern structures/buildings; particularly over their lifetime (50years plus?) and through numerous alterations. He asks if he is worrying unnecessarily.

Comments
The reporter is right to be concerned. CROSS has had reports of cantilevers where the cantilever designer has ceased ‘his design’ at the end of the cantilever and just assumed the supporting structure to be adequate. Cantilevers are often safety critical because of their lack of redundancy. On larger structures, it is to be hoped that designers have paid adequate attention to robustness and that proper records have been retained so that future engineers can adapt or demolish safely. For many buildings it will be obvious what is the primary structure and that unconsidered removal of this would be reckless. However, in certain building types this is not the case and it may be prudent to indicate in some way critical areas of the structure. Industry guidance in this regard would be welcome. A further area of risk is where the structure is distributed e.g. timber panel and metal stud type construction where it is less obvious what is working as structure and what is just a partition. This is equally true for buildings without cantilevers. In the same way that that PT tendons on the soffit of slabs are marked to stop people drilling into them perhaps there should be industry guidance on marking of principle load paths on these types of structures?

644 Inadequate end bearings for transfer beams

Whilst advising a steel fabricator on tendering for a transfer structure steel frame, a reporter’s firm noticed a serious design error. The structure comprises an irregular arrangement of large steel beams supported by steel columns and, at the building perimeter, bearing on to a reinforced concrete wall. The beams support a slab and several stories of stud-framed residential flats above. End reactions were shown on the drawings, with up to around 1,000 kN design load specified for the bearing on the RC wall. The bearing detail was clearly shown and comprised beams resting on a recess cast in the RC wall. The specified end bearing was 100mm. A simple calculation showed the bearing pressure to exceed twice the permitted maximum value. Experience has shown bearing design to be a common cause of major structural failure, with inadequate provision for tolerance often cited as an issue.
In this case were the works to be constructed as designed, tolerance issues could make an already bad situation much worse, with a reduction in bearing to 75mm being a distinct possibility even without unusually lax site control. Of particular concern is the fact that this defect was part of a structural design passed by a certification scheme; it thus illustrates the short-comings in that process. As the 13th Biennial Review of SCOSS pointed out, independent third party peer review is the gold standard in structural checking and the alternative of occasional sampling of in-house checking does not give the same degree of safety.

Comments
As ever, ‘Safety’ is often dependent on attention to detailing and this report illustrates how the safety of a large structure can be jeopardised by inadequate attention to supports. Five common themes emerge in such situations:

1. It is frequently connections that are the weak link in any structure
2. There are frequent problems at interfaces between different materials (here steel and concrete)
3. There are frequent problems when the designer of a connection has been tasked with developing an ‘impossible connection’ because the structure has not been adequately conceived/designed ignoring practicalities of fabrication/connection
4. The role of tolerances is often overlooked
5. An attribute of ‘safety’ is to assure that the design is not disproportionately vulnerable to minor error

As ever it is essential that there is adequate quality control in place to ensure all design criteria are met.

646 UNCONNECTED CONNECTION

A reporter came across a completely inadequate steel connection. While the endplate had been welded to the supported beam, and the flange plate has been welded to the endplate, the flange plate has only been tacked to the supporting beam. These tack welds could also be defective as the paint was not stripped prior to welding, so the welds may not have taken, or be porous. This astonishing error was only discovered by God’s good grace, says the reporter, when he was on site for something else and happening to walk underneath it. Originally the beams had been fabricated the wrong size, then installed upside down, then site modified to move the flange plates, then modified again because these had been put in the wrong place, then re-drilled on site because the bolts didn’t line up, and finally “welded” in place. These errors came about in part because (not for want of multiple warnings on the reporter’s part) the contractor used an inexperienced and non-CE marked steelwork contractor who was unused to structural steelwork, had no design capability, and had no welders with site welding certification. If contractors were aware of the law regarding structural steelwork, or even if Building Control enforced it, we would not have been in this position. Structural Engineers can only do so much especially if their advice is being ignored.

Comments
Once again, the diligence of a reporter has averted what could have been a major incident demonstrating again the importance of experienced personnel inspecting what is happening on site. Were this done more often the risks of collapse would be reduced. Assuming that the matter was raised and dealt with on site at the time, the remaining issue appears to be that the builder did not use CE marked steelwork. CE Marking of fabricated structural steelwork delivered to site became mandatory on 1 July 2014 under the Construction Products Regulations, which place legal obligations on members of the supply chain, including manufacturers, distributors and importers. BS EN 1090-1: “Execution of steel structures and aluminium structures” is the harmonised standard that covers fabricated structural steelwork. The client or main contractor that engages the steelwork contractor should carry out due diligence before appointing them and ensure that they engage a steelwork contractor with an Execution Class equal to that required for the project. The design engineer is responsible for specifying the Execution Class for the structure as a whole and for components and details they have designed in compliance with BS EN 1993-1-1 – “Design of steel structures – General rules and rules for buildings”.

Further information on this can be found in a very useful document “Steel construction CE Marking” published jointly by TATA and BCSA.

Trading Standards is the enforcement agency in the UK and given the undoubted seriousness of the example, should have been notified.
627 Cantilever signal base failure: holding down bolts in bending

A railway asset owner noticed that a 9m cantilever signal structure was sagging alarmingly and stopped trains on the line. It was observed that the baseplate of the signal was only in partial contact with the concrete base. The concrete foundation was intact showing no signs of movement, but it was noted that five of the twelve holding down bolts had failed. These bolts were embedded into the concrete foundation and, prior to failure, held the signal in the correct position using nuts below and above the baseplate. Of the remaining seven bolts, the lower nuts had been displaced downwards and threads stripped on six bolts. A single nut on one bolt was holding the entire structure from collapse. It was immediately apparent that the grout specified between the concrete plinth and the signal baseplate had not been installed.

This is an important part of the installation which is required to reduce the bending stresses on the bolts in service. It also provides a secondary effect of encapsulating the bolts and excluding water/debris from the bolts. The Denso tape also shown in the design for covering the bolts above the baseplate had also not been installed (another anti-corrosion measure). Three of the bolts appeared to have failed due to the surface corrosion whilst the other two were less corroded and probably failed when the signal sagged. It is suspected that the omission of the grout would have subjected the bolts to increased stresses, which over time led to fatigue cracks and failure.

Comments
As in Report 630 Multi-storey car park foundations, this highlights the importance of column base anchorage. Several of the key themes set out above in Reports 644 Inadequate end bearings for transfer beams, and 630 are also applicable. In terms of ‘Safety’ another highlighted attribute is ‘Consequence’. Whilst many failures might be classified a nuisance, with just commercial consequences, this failure had the potential to create severe consequences and so the design, site supervision, and site inspection, should have merited special attention. Unfortunately, there was inadequate quality control on site because the installer did not comply with the design drawings which showed grouting. As such it is probable that both the baseplate and the bolt sets were significantly overstressed compared with the design. This construction error was not picked up on site and might have led to a major incident. It is essential that works are executed in accordance with the design or if varied this is only done with permission of the designer. Any reasonable inspection of the works would have revealed non-compliance with design, which should have eliminated the obvious risks.

648 Thin stone cladding problems

A reporter was involved with two investigations which uncovered problems with thin stone cladding. In both cases the cladding had been installed by the same specialist sub-contractor, and it was found that the stone masons had deliberately cut the dowels to make it easier to install the cladding. In one instance the issue came to light after a stone fell due to storm winds (thankfully not injuring anyone), and in the other a stone was dislodged by the window cleaner (rope access) highlighting the defect. On the latter building, the stone cladding extended to 10 storeys and rectification required stripping and rebuilding.

Comments
A standard category of CROSS report relates to inadequate fixings and these amount to 20% of the total. This is one more example. The Edinburgh schools’ problem was also due to fixings not meeting design intent. As in Report 627, the consequences of failure were potentially severe. There are just too many reports of contractors altering designs to ‘make installation easier’ and thereby creating danger. There are too many reports about claddings and two issues are to be considered. Firstly the design of fixings that appear rational on a drawing, but prove to be difficult to install and align in practice. Furthermore such fixing systems lack the robustness and redundancy that are normal in structural engineering. Secondly the lack of training and on-site control of subcontractors. With the increased use of large cladding panels, of any material or combinations of material, on multi-storey building this type of failure is likely to become increasingly common, and given the height from which panels may fall the potential consequences are severe. For further comments see the editorial in this issue.
630 Multi-storey Car Park Foundations

There are concerns about the integrity of a completed car park structure according to a reporter. It would appear from the evidence he has that many normal quality control procedures were not being adhered to, and nor were adequate records being kept. The Quality Assurance Forms were not completed and, apparently, inspections were not made of all of the excavations. Furthermore, concrete cubes were not taken for all of the concrete that was delivered to site and cubes were collected at much longer intervals than the specified 7 days. All of this came to light as a result of holding down bolts in a large concrete base having to be broken out, reinforcement being removed and the bolts being reset in new holes.

Comments

As with earlier reports CROSS has accumulated a great deal of evidence to suggest that the quality of build in the UK is not of an appropriate standard. There are too many reports of this kind to suggest ‘one off’ occurrences. Mistakes do happen, but they then need properly engineered rectification solutions. In accordance with the usual CROSS procedures the reporter was advised to contact the owner to express his concerns.

Appointment of Dr Paul McNulty

Structural-Safety are pleased to announce that Dr Paul McNulty has been appointed as Senior Structural Engineer to help with the increasing work-load on CROSS and SCOSS. Paul is a Chartered Engineer with experience in research and both the offshore and onshore industries. He has a particular interest in safety and enjoys promoting the best practices from his experience of working in both industries.

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The following course is being run by Forensic Engineering colleagues in Holland and may be of interest to readers.