CROSS

Confidential Reporting on Structural Safety

Newsletter No 6, April 2007

Reports in this Issue

Please **click here** for link to CROSS website

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INTRODUCTION

SCOSS will soon publish its 2007 Biennial Report on trends in structural safety which will include an analysis of lessons that can be learned from reports sent to CROSS. Information from the reports is being used to influence changes in guidance to engineers and will be brought to the attention of relevant Institutions and government departments. Thanks to those who have submitted the reports that make this possible.

At a recent meeting with SCOSS the Presidents of the ICE and IStructE confirmed their support and have asked for 6 monthly updates on progress. Quentin Leiper, the ICE President, convened a meeting to encourage major contractors to participate and this is bearing fruit. In early April David Harvey the IStructE President visited the Indian Association of Structural Engineers in Delhi to extend relationships between the two bodies. It followed a presentation on CROSS to the Association which is considering whether a similar system should be implemented in India.

This issue has reports on Blind Bolts, Underpinning, Scaffold protection, and Low pitched metal sheet roofs. In addition there is a request for information on deterioration of precast concrete planks, and a comment on the need for clarity in the implementation of CE marking. The next issue, July 2007, will contain a number of reports on Building Regulation and Local Authority matters.

If you have a concern that could be shared to help others, and could improve structural safety, send a report to CROSS where it will be handled confidentially, published without any identifying features, and may help other engineers.

Details on how to report are given on the web site www.scoss.org.uk/CROSS. More reports are needed, especially on civil engineering topics such as bridges, although all will be welcome. Indeed a steady supply of reports is essential and the Institutions look to firms of consulting engineers and of contractors, to promote CROSS and encourage reporting.

CONSTRUCTION

Blind bolts

A reporter has experience of the partial collapse of a steel frame building due to the failure of some blind bolts during the construction period. Loads at the time were well below anticipated failure levels. Tests showed that the hardness of the blind bolts used on the site varied considerably. Many were extremely hard and had become hydrogen embrittled during the manufacturing process prior to delivery to site. The design of the bolts was such that in their embrittled state, these were extremely susceptible to failure on loading. It was reported that many bolts failed on installation or over a period time (up to several days) afterwards. It is clear that bolt failure ultimately led to the collapse of part of the building. The quality of the manufacture of the bolts in this case was variable, but the hardness of the embrittled bolts was far higher than it should have been, and the reporter says that this is easy to test in situ. From this experience the reporter's concern is whether others using such bolts have experienced any similar problems of brittle failure of the bolts on installation or afterwards, or have tested the hardness of the blind bolts being used to confirm they are in accordance with the manufacturer's specification.

Comment This is not the first time that concern has been expressed about blind bolts, or indeed about other bolts, and sometimes the sources of supply are thought to be doubtful. BCSA has a Model Specification for Structural Bolts and Holding Down Bolts which will be included in the supplement to the NSSS Commentary which is currently in preparation. This does not specifically deal with blind bolts. One of the issues with blind bolts is that they are not governed by any British Standard. SCOSS is considering how to best promote the necessary quality control of these products. It is of particular concern that bolts were failing after a few days and in the meantime, until further guidance is forthcoming, engineers should ensure that bolts comply with the necessary properties. (Report 071)

NEWS ITEMS

The following are extracts from news reports sent to CROSS about recent wall collapses.

Fears over crumbling Scotland

Fears have been raised over the future of some of urban Scotland's sandstone tenements after severe weather caused part of a wall to collapse in Glasgow.

The collapse of a rear wall in one of Glasgow's most prestigious tenement areas led to nine families being evacuated. Although the wall is said to have been suspect for some time the collapse followed high rainfall levels and raised fears that other properties could be at risk. One warning to other tenement-dwellers came from the Scottish Stone Liaison Group. Another came from a property expert who said: "There could be real problems ahead. The weather has been exceptional, with high winds accompanying unprecedented rain levels."

A CROSS report was also submitted on this incident.

Woman dies as wall collapses

A woman died after a wall collapsed due to high winds near Manchester. It appears to have fallen on the woman, aged in her 60s, as she was passing the wall.

Underpinning

This reporter (who was the 'Designer') attended site to meet a Party Wall Surveyor and the Structural Engineer, acting for the adjoining owner, for a building on one edge of the site. The groundworks contractor had proceeded with underpinning to that adjoining property in advance of the contract being signed but, more alarmingly, had completely ignored the specified 5-bay sequence and timing of the works shown on the reporter's drawings. Of the 5 bays in the sequence for the section of wall the contractor had started working on, 2 were concreted but not dry packed and a third had been excavated but not concreted, i.e. 60% of the wall was in an unsupported condition. The reason given by the site operative was that the cement for the dry pack had not been delivered to site so he had got on with the next task.

Obviously instructions were given there and then to make safe the situation and the Party Wall Surveyor stopped further excavation taking place. By proceeding in advance of any approvals, no-one who might have had cause to inspect the site was aware that work had started. The Contractor had appeared to be competent and experienced. The manager of the company had met with the reporter and the Client's Project Manager on site before any work took place and he clearly understood correct underpinning procedures. The Building Inspector has been calling into site regularly to inspect underpinning works being carried out in other areas and all these other works had been handled in an appropriate manner.

The issue seems to be that just one or two unsupervised persons on a site with little or no understanding of structures can unwittingly create a dangerous situation very quickly when they have safety critical works such as underpinning to do. Perhaps activities that have the potential to de-stabilise existing structures should come under similar legislation to demolition which requires the works to be supervised by a demonstrably competent foreman at all times.

Comment Underpinning as a construction activity is already covered by broadly the same strict requirements as demolition. The failure in this instance appears to be a lack of training given to the operatives and a lack of adequate supervision, both of which are covered in Regulations. There should be an agreed safe system of work statement from the contractor and this should be explained to the operatives on site. In this case the procedure was not followed or was ignored. Designers or Engineers involved with underpinning, and indeed all structural works, should satisfy themselves that the contractor, and the sub-contractor if there is one, fully understand the importance of the works. Key lessons here are to ensure the adequacy of communications, the importance of having safe systems, and the need for monitoring. Other reports of a similar nature will be welcomed. (Report 072)

Scaffold protection

With reference to the report in Newsletter No 4 on scaffold protection another reporter, who is involved with the refurbishment of a wrought iron bridge over a river, writes with comments. The bridge in question comprises of two main edge lattice through-girders with troughing between the bottom flanges. The temporary scaffold is suspended from the bottom flanges, on proprietary girder couplers, to provide a crash deck below to give full access to underside, together with a temporary roofed shelter surrounding the main girder above road level on one side at a time to allow single lane traffic, controlled by traffic lights, to run over. The above-road level roof structure will be relocated a further three times to cover both sides and ends of the bridge. To protect workers on both sides, a line of proprietary barriers is placed each side of traffic, positioned to give maximum working space available. These barriers are all slotted together with pedestrian guardrail on top and weighted barrels at each end. The barriers can be moved by machine quickly when the roof structure is moved from one main girder to the other, and are a lot lighter than the traditional heavy concrete vehicle barriers, especially on bridges where weight is a major consideration.

Comment For the protection of scaffolding, manufacturers have products and systems that can be used. Those in control must analyse site conditions, assess the risk of vehicle impact, and adopt a system that avoids as many hazards as possible. In short the barriers must be up to the job. It may be the case that temporary speed limits have to be imposed. Otherwise there may be no alternative but to close the bridge to traffic and establish diversion routes. (Report 073)

***NEWS ITEMS** continued*

Two-year-old boy has died after a wall collapsed

The boy was walking in north London, with his childminder when the 6.5m wall collapsed. Scotland Yard said a joint investigation has been launched between the police and the Health and Safety Executive. Police have said they cannot confirm that gale-force winds were to blame for the tragedy but that the weather "would not have helped".

Residents' cars were damaged by the falling wall

Fifty residents of an apartment block in Yorkshire had to spend the night in hotels after strong winds tore down part of the building. Nobody was injured when the gable end collapsed but two cars were crushed by falling masonry.

Scaffold collapse

There has been a further report on a scaffolding collapse. A scaffold which was several storeys high had been erected around a former industrial building where apartments and ancillary facilities were being constructed. However the phased dismantling of the scaffold resulted in structural failure when the scaffold pulled away from the building. Three scaffolders were taken to hospital along with a member of the public whose car was crushed by the collapse.

Comment Reports on scaffold collapses continue to cause concern. Temporary works need the same level of care as permanent works. The root cause of this failure is not known but it demonstrates the need for a suitable safe system supervised by competent persons. The type and fixing of scaffold ties are key issues during dismantling. (Report 079)

Wind damage

Following request for examples of wind damage this collapse was reported of the external brick skin of gable wall of a two storey timber frame terraced house.

Comment It appears that the ties have either failed or pulled away from the timber frame behind. During recent periods of strong winds there were many press reports of damage to domestic dwellings constructed in more traditional ways. See News Items. (Report 078)

CONCRETE

Precast concrete floor and roof planks - durability and potential safety concerns

A researcher is carrying out an investigation on certain types of precast units and needs information. Over recent years that there have been a small number of instances where sections of the soffits of precast concrete (pcc) floor units have become detached and fallen within buildings. It is understood that no injuries have been caused, but the potential for injury to building occupants exists. There is a need to collate information upon such instances so that an understanding of the frequency of such collapses can be established. In addition, it would desirable to establish the circumstances leading to such collapses and to seek to assess whether the risk of this form of failure increases with the age of the units and hence is likely to become more prevalent in the future.

The soffit detachment appears to arise from corrosion of the embedded steel reinforcement which, because of the hollow core form of the pcc floor planks and the location of the reinforcing bars within the cross-section, causes cracking at the bottom of the side walls of the pcc floor planks. This appears to cause delamination of areas of the soffit of the planks affected and this can pose a falling debris hazard to building occupants. There may be no readily observable visual indications of the development of the cracking or of delamination of areas of the soffit of the planks prior to the collapse. The planks may be of reinforced or prestressed construction.

It is understood that the pcc units which have experienced this problem have tended to have appreciable chloride levels, with the chloride being introduced at the time of casting. Whilst the presence of chlorides may lead to some pitting corrosion of the reinforcement or other embedded steel, the development of a significant degree of corrosion product would be expected to lead to cracking of the concrete as described above. The risk of cracking is expected to increase with age. In addition the corrosion of reinforcement may potentially lead to a reduction in its cross-sectional area, reducing its strength.

The reporter has knowledge of these problems occurring in a limited number of properties. The earliest are thought to date from the 1950's. Potentially this issue could extend to pcc units manufactured in the early 1970's when the use of calcium chloride as a set accelerator was stopped. The problems experienced to date appear to relate mainly to circumstances where the pcc planks have been used to form a flat roof. In a roof structure moisture to promote corrosion would usually be more readily available than in most internal floors, perhaps due to problems with the water proofing membrane or to condensation effects. In the longer term the presence of chlorides is expected to lead to an increasing risk of corrosion-induced cracking.

What should be reported?

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

Benefits

- unique reservoir of information
- better quality of design and construction
- possible reductions in deaths and injuries
- lower costs
- reduced concerns about liability

Founder supporters

- Association for Consultancy and Engineering
- Construction Industry Council
- Constructing Excellence
- Department of Trade and Industry
- Health & Safety Executive
- Institution of Civil Engineers
- Institution of Structural Engineers
- Department of Communities and Local Government
- Office of Government Commerce
- Scottish Building Standards Agency

The presence of moisture will further increase this risk. This may result in an increasing number of pcc units experiencing cracking and delamination.

The reporter would like to hear from those who have knowledge of such failures. Details to be provided should include:

- Location (in confidence if required)
- Indication of the amount of units that may be at risk in m2
- Brief description of incident
- Manufacturer of pcc units / other details about the construction of the pcc units involved
- Age of pcc units
- Environmental conditions (dry, wet, condensing, internal, etc)
- Chloride content by mass of cement
- Concrete carbonated / not carbonated (if known).

It is also known that problems of cracking and soffit delamination have occurred in some in-situ slabs within buildings. It would helpful to hear about these problems as well, but the form of construction should be clearly identified as being in-situ.

Comment Reports should be sent to CROSS where they will be de-identified, if sent in confidence, before being passed on to the researcher whose conclusions will be published in due course. (Report 077)

TIMBER

Low pitched metal sheet roofs

A reporter is concerned about low pitch metal sheet roofing attached to trussed rafters. He says that the weight of such cladding is about 20 % of that of concrete interlocking tiles so that there may be severe wind uplifts. The low pitch and building size result in large areas of higher wind pressures. BS 6399: Part 2 Table 10 gives Cpe as high as -2.6 compared with a typical uplift Cpe = -0.6. Roofing contractors are, according to the reporter, using self drilling and tapping screws with a minimum diameter of 5.5 mm into the top surface of the trussed rafters. The edge distance from BS 5268: Part 2 for this screw should be 27.5 mm, requiring at least 55 mm thick timber for the trussed rafters. Since trussed rafters are usually made from either 35 mm or 47 mm thick timber such screws are likely to split the timber even if placed accurately on the trussed rafter centreline. BS 5258: Part 2 also requires a check on loss of section of the timber for screws not less than 5 mm diameter.

In the reporter's experience the trussed rafter design software used does not include for zones of enhanced wind pressures. This, in his opinion, is of no importance for tiled or slated roofs of traditional pitches but gives grossly wrong fixing forces for light weight low pitch roofs. It would be very rare for a trussed rafter designer to be aware that designing to support metal sheet cladding requires professional structural engineering input. Taking into account these enhanced wind uplifts the reactions from the trussed rafters can be as high as 5 kN compared with the strength of a standard truss clip of about 2 kN. Standard strapping at industry standard spacings of 2 m is clearly appreciably less strong than the truss clips. Indeed safe anchorage may require substantial heights of wall to provide dead weight.

The high wind uplifts can result in stress reversal in the trussed rafters. This is seldom bad enough to require larger timbers or nail plates but it does require a check that the bracing is adequate. The reporter is usually involved because the trussed rafter designer realises that the external wall heads need lateral restraint but frequently has to fight hard to ensure that the trussed rafters are correctly braced and safely secured to the wall plates. The problems need sorting out during the design period, not as the brickwork approaches the wall plate level.

Comment This is an example of insufficient attention being paid to the overall stability of a system and the problem of co-ordination between designers, suppliers and builders. Codes require one person to have overall charge of structural stability and this should be someone who is competent to do so. No failures were mentioned but with the threat of increasing wind loading in the future such issues have to be taken seriously. Again the emphasis is on the importance of choosing the correct fixings at an early stage. The 'Guidance for Designers' at www.cskills.org/cdm which accompanies the revised CDM2007 Regulations, clearly indicates the responsibilities

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HOW TO REPORT

Please visit the web site **www.scoss.co.uk/cross** for more information.

When reading this Newsletter online **click here** to go straight to the reporting page.

Post reports to:
PO Box 174
Wirral
CH29 9AJ
UK

Comments either on the scheme, or non-confidential reports, can be sent to **dir.cross@btinternet.com**

of all those in the supply chain beginning with the scheme designer, and the need for adequate co-operation and co-ordination. When there is no designer in the conventional sense the builder or contractor takes on the design responsibilities. When purchasing such components, either the purchaser should stipulate the required capability for the truss manufacturer to match, or the trussed rafter manufacturer should stipulate limitations of use. Further advice can be obtained from the Trussed Rafter Association at www.tra.org.uk. (Report 066)

STEELWORK

CE marking scheme for structural steelwork

Concern has been expressed about the way in which the CE marking scheme for structural steelwork will be monitored, enforced and policed in the UK, since the use of CE marking is only voluntary here (but compulsory in mainland Europe). From this year the imposition of harmonized European Standards for structural steel hollow sections materials (mandated under the Construction Products Directive - CPD) will mean that CE marking can be applied to show that the sections are fully in compliance with the essential requirements of the Directive.

The CE marking process under the CPD is intended to benefit the consumer by providing products that can be used for construction purposes, safely and in complete confidence, whilst removing barriers to trade across Europe. If correctly implemented and consistently applied throughout the European Union, the CE marking system for structural steel products can undoubtedly offer benefits to both manufacturers and users. The reporter believes that there is considerable confusion in the UK over the precise legal framework of the CPD. Whilst the CPD is itself legally enforceable via the Construction Products Regulations (CPR) in the UK, CE marking of product is only voluntary. There are two Government Departments involved: the Department for Communities and Local Government, for implementing the CPR, and Trading Standards who are responsible for enforcement. According to the reporter this may lead to confusion.

As structural steel products are clearly safety critical items, and since the CE marking procedure states that CE marked materials must be accepted, it is essential, according to the reporter, that checks be put in place to confirm that the materials are of suitable and consistent quality. Such procedures should be designed to ensure that all structural steel being used in the UK is fully in compliance with the appropriate standards and that the manufacturer or supplier has obtained the necessary status and approvals. This would deter the use of cost cutting measures, which might involve the supply of poorer quality products, which might prove inadequate for the job. This cannot be done without a credible policy of "policing" and enforcement and without this, the UK and Europe will fail to gain the intended benefits from the CPD itself.

Comment There will be a number of issues such as this one with the introduction of Eurocodes. SCOSS has identified the topic before and is looking into it at present. It is probable that many engineers are not aware of the requirements or ramifications of CE marking and there will need to be more publicity and educational material available. SCOSS will continue to call for clarification on CE marking for all materials. (Report 070)

DATES FOR THE PUBLICATION OF CROSS NEWSLETTERS

Issue No 7	**July 2007**
Issue No 8	**November 2007**