

# CROSS

## Confidential Reporting on Structural Safety

Newsletter No 2, April 2006

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## INTRODUCTION

There was a good response to the first Newsletter with messages of support and encouragement from many engineers. Several thousand hits were made on the web site and further reports were made on concerns prompted by the publication and on new topics. Several reports were from overseas, and although the scheme is initially aimed at UK concerns, these are welcome. Some engineers used the confidential facility and posted reports to CROSS, whilst others were happy to send them by email. In every case the identity of the reporter is removed together with any identifying features relating to organisations, sites, or products and they may be condensed. They are then reviewed by experienced engineers from SCOSS, who are representative of the industry, and make the comments that are published.

The long term objective is for SCOSS to determine adverse trends and to then take action to improve matters, whilst recognizing that most projects are designed, constructed, and maintained in a safe and proper manner. Until there are sufficient reports to do this the 'comments' that are given in Newsletter should be read in that light. When SCOSS has detected trends then full responses will be made to the relevant organisations. However there will be common issues at every stage and one that has already appeared in several reports is the effectiveness of communication between designers and sites. It is hoped that after reading the Newsletters engineers will be reminded of other instances that caused them concern and will pass these on as reports.

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## BUILDING CONTROL ISSUES

### Local authority checking

A reporter comments on the reference made in Newsletter No 1 to local authority checking. His experience, having been employed by several small engineering companies, is that consulting engineers routinely rely on local authority building control departments to check their work in lieu of proper in-house quality control. Local building control departments may, says the reporter, be inadequately staffed with suitably qualified engineers who have the requisite skills and/or time to check designs in detail. It is fortunate in his view that more failures have not occurred and that those that do occur are minor with more economic impact than impact upon public safety. Of special concern to the reporter is the situation that often occurs when a submission is checked that contains a large proportion of computer generated design. He has experience of engineers who have given only cursory attention to this element of a project, perhaps assuming it is right because it comes from a computer. However they may lack the time or computational resources, or have under-priced the checking commission, to carry out proper checks.

*Comment Both local authority resources and computer aided design were raised in the last Newsletter and in order for SCOSS to determine the magnitude of these concerns more reports are requested. If possible they should be specific as to engineering facts but of course no identification will be given to the SCOSS reviewers. (report DI 041)*

## ENGINEERS ON SITE

### Structural Steel - Reinforced Concrete Interface

The Reporter describes circumstances on site where organisations had different priorities. A client demanding instant progress, a main contractor with an inexperienced site manager, a steelwork contractor responsible for fabrication only and a steelwork erection subcontractor. There was a reinforced concrete substructure with conventional holding down bolts for a steel frame. The substructure had been constructed out of position to the extent that the steel frame could not be erected to tolerance and could not be connected to the holding down bolts. The solution adopted was for the bolts to be burned off at foundation level and for the steel frame to be erected in true position without any bolts. The modification was completed by placing the burned off portions of the holding bolts complete with nuts in the base plate holes and disguising the assembly so that it looked to be normal. The holding down bolts were required in order to sustain considerable uplift forces. Had the deception not been discovered by someone with sufficient knowledge to understand the potential implications of the loss of the anchoring forces a structural failure would have been a serious possibility and thus this incident constitutes a near miss.

*Comment This is an extreme case but there is evidence that concrete/steel interface problems are not uncommon. Again specific examples are sought so that any trends can be determined and recommendations for improvements can then be made. (report DI 019)*

### Steel Portal Frame Erection

The project described by the reporter involved the construction of a large span steel framed portal frame building. Longitudinal stability was provided by triangulated vertical side bracings and triangulated bracings in the plane of the rafters. The erection method statement had been based upon the principle that the first bay to be erected would be the bay containing the side and rafter bracings. There would be temporary wire rope guys until the permanent bracings had been installed and fully bolted. A delay occurred in the delivery of the permanent bracings to the site but nevertheless it was decided to press ahead with construction and use the temporary wire rope guys to achieve longitudinal stability. After erection of several bays of the structure had been completed a large quantity of purlins were lifted onto the roof. The eccentric load was sufficient to overcome the resistance to longitudinal destabilising forces provided by inadequately anchored guy ropes. The structure collapsed. This happened slowly enough for those personnel involved in construction to move to safety. It was a near miss. This clearly illustrates the need to adhere rigidly to method statements and which should only be changed with the agreement of the originator or at least an accepted figure of authority who has sufficient technical knowledge to make decisions.

*Comment Another example of the importance of temporary stability. Stiffness not just strength is needed for stability and guy ropes, even if strong, might well be too flexible to do the job properly. It is also the case that a vertical load applied eccentrically will cause lateral sway. (report DI 020)*

### Differing reinforcement couplers

On a recent project, because of supply problems, the contractor decided to change from the specified rebar couplers (type 'A') to those of another manufacturer (type 'B'). This was done without informing the consulting engineer. Although they look similar unless closely inspected, the two types have different tapered threads and thread pitches. The threaded bars of type 'B' will not go into the couplers of type 'A' because they are slightly larger; however the threaded bars of type 'A' will go into the couplers of type 'B'. The problem is that because the threads and taper

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### Roofs

*There have been two recent examples of potentially serious incidents concerning roofs in high profile buildings. A 4m long timber strut came free at one end and swung down over MSPs in the chamber of the Scottish Parliament Building in Edinburgh. At Wembley Stadium a 30m long steel girder dropped 500mm at one end while preparations were being made to weld it permanently in place. When further details are available they will be reviewed by SCOSS and any lessons that could be learnt will be given in a future Newsletter.*

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### COMMENT ON NEAR MISSES

#### Potential overloads by crowds

*In the last issue there were two examples of potential overloads on buildings by crowds. Since then there has been a report about a crowd surge at a pop concert when a large number of fans swept forward with such force that a steel barrier across the width of the venue was severely damaged. This has echoes of the disastrous crushes that have taken place at football matches and other events. Very recently a wall collapsed injuring a number of young people who were gathering to see a pop group. The Institution of Structural Engineers has a working party AGOTS (Advisory Group on Temporary Structures) which will be producing recommendations at the end of the year giving guidance on all matters relating to temporary stands and similar structures. Overloading by crowds can occur on permanent and temporary structures and reports on any such concerns are important.*

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are different the threaded bars of type 'A' do not engage properly with the type 'B' couplers and render the coupler joint ineffective. The problem was discovered because the concrete cracked at the affected connection. The reporter concludes that it is important to ensure that couplers are not replaced with different makes on the same project.

*Comment Another confirmation of the need for alert site engineers. Also confirmation that any propriety product must be used exactly as given in the manufacturer's instructions. (report DI 028)*

#### Small bridge inspection

Whilst carrying out a survey on a small bridge for a final project/dissertation a student found levels of corrosion of members under the bridge deck that would, in his view, probably require remedial work. However he was unsure as to how he should proceed.

*Comment The reporter was contacted and given advice as to how to bring this to the attention of the responsible authorities. Small bridges may escape regular inspection and another example has recently been brought to the attention of CROSS. On a wider front all structures deteriorate with time and having a sensible durability strategy is sound engineering. If the corrosion was under the bridge deck, there was risk it would not be spotted so access and 'inspectability' are relevant design features. Designers should configure the parts so that the areas at risk are accessible and visible. In a separate incident there was a tragic failure some time ago where a fatigue crack developed on a structure in a position that was not visible without removing a covering so no one found it. (DI 023)*

## DEMOLITION

#### Pre-cast concrete

During the demolition of a tower block, a column arrangement collapsed. All were aware of the form of construction and temporary stability requirements. However there were deficiencies in the original construction because the columns were pre-cast and the joints had not been grouted. On removal of the load from above, the column became unstable. The reporter comments that there is a lesson for all to share here – when dealing with pre-cast concrete demolition (or any demolition) take a pessimistic view of the construction quality.

*Comment There is a recurrent theme of weakness in demolition because it is an inherently risky business. Risk assessments for demolition should highlight whether or not 'as-built' information, if it exists, is reliable. (report DI 027)*

#### Materials falling from old buildings - SCOTCROSS

The SCOTCROSS scheme started in the summer of 05 and in the first 6 months more than 250 reports were received from 17 Scottish Local Authorities about objects falling, or in danger of falling, from buildings. Most of the buildings were old and fortunately there were no injuries but the potential for tragedy is there as the objects included pieces of stonework, rainwater goods, render, and slates. There will be reports on the SCOTCROSS study from time to time.

*Comment Meantime reports on falling objects or near misses in other regions and countries will be helpful. Copies of reports on actual falls of material and near miss situations at sea have been received from the maritime division of CHIRP (Confidential Hazardous Incident Reporting Programme). CHIRP is the model on which CROSS is based and details are on [www.chirp.co.uk](http://www.chirp.co.uk).*

## DESIGN ISSUES

### Steelwork connection designs

#### What should be reported?

- concerns which may require industry or regulatory action
- lessons learned which will help others
- 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
- Office of the Deputy Prime Minister
- Office of Government Commerce
- The Scottish Executive

This reporter specialises in structural steel only and is a consulting engineer for fabricators. He was asked to design connections for a multi-storey building in a UK city. The structure consisted of steel columns supporting steel beams that supported concrete floors. Lateral stability of the frame was to be provided by concrete cores and walls around the lift shaft and stairs. The main consultant provided loads for the beam end to column connections which were all shear only loads. The reporter designed for these forces only using 'green book' end plates and fin plates to carry shear (with nominal tie forces). Some months later the reporter discovered that the steel frame had been erected but not the concrete cores due to a change in plan, concrete was being poured onto the floors, and the main contractor had draped tarpaulins over the sides of the building to shield workers from the wind. He said; 'It is a miracle that the structure did not collapse. I can only put it down to the fact that the wind was light at the time'. He advised his client, the steelwork fabricator, to add temporary steel bracing immediately but this process took the best part of a week during which the frame was vulnerable. It appeared to the reporter that the main consultant had a contract with the main contractor which stated that temporary stability was not the consultant's responsibility. Responsibility was passed by contract to the steel fabricator yet the fabricator did not appreciate the requirements for temporary stability and the possible consequences.

*Comment* Some years ago a building in Scotland collapsed under similar circumstances and there were fatalities. Had there been a collapse in this case there would have been civil, criminal and moral issues and it is probable that all parties concerned could have become involved. The main designer should have made clear what was required to give both horizontal and vertical stability to the structure. At tender stage there should have been a method statement taking account of stability and construction sequences. Sub-contractors and their designers should all have been engaged in thinking about temporary stability, and it may be a common feature on sites that there are breakdowns in communication which could lead to such situations. Clarity of thought, acknowledgement of responsibility for the consequences, and competence in execution are all essential. CROSS welcomes other examples of divided responsibilities to see if there is a trend here. (report DI 025)

### Timber

Following the reports in Newsletter No 1 on concerns about the design standards for timber structures a further report was received on the same subject. The reporter has spent much of the last twenty years working for specialist timber engineering companies and judging by what he has seen of the quality of the structural engineering design of roofs in many hundreds of projects is lamentably low. He describes problems with a truss roof over a small hall. He suggests that the reputation of the engineering profession would improve if companies followed ISO 9000 and only took on work that their staff were sufficiently trained and experienced to undertake. The reporter believes that Local Authority engineers do not always take the time to check what appear to be simple timber structures.

*Comment* Timber design and detailing is a specialised subject and the three reports so far received by CROSS indicate that there is an issue with competence to be considered further. The subject has previously been addressed by SCOSS in their Alert of January 2002 which is available on the web site [www.scoss.org.uk](http://www.scoss.org.uk) and so far as timber framed dwellings are concerned NHBC have a relevant Technical Standard - see [www.nhbc.co.uk](http://www.nhbc.co.uk). (report DI 021)

## COLLAPSES

### Girder collapse

The South African Institute of Steel Construction ([www.saisc.co.za](http://www.saisc.co.za)) has given permission for the following description to be published, and a full report can be obtained from them. The failure was of a two-storey high trussed girder with a 36 m span, designed to carry a composite steel and concrete floor at the lower level and a trussed roof at higher level. Members were formed by making box sections from 200 mm x 200 mm angles (L8x8). Collapse was initiated by the failure of a welded joint connecting the first diagonal member to the top chord of the truss, and as a result many persons were injured. The suggested reasons for failure included differences between designer's and contractors' drawings, workmanship issues, an agreement to use partial penetration welds although these could not be made in practice, and the decision to fabricate the truss on site so that overhead welds were necessary.

*Comment* This emphasises the need for co-ordination between designers and constructors and the need to consider the practicalities of on-site welding. (report DI 030)

### Mobile phone masts

The reporter in this case lives in a country which is experiencing explosive growth in the use of cellular phones. This is accompanied by a proliferation of steel towers, which are probably imported. The concern is that erection, foundation design and construction, and maintenance are not carried out adequately. It was reported that during a squall a woman was driving past a tower when it collapsed on her car and she was killed. The reporter observed the erection of one tower and does not believe that the riggers had adequate training or expertise; procedures they were adopting were hazardous and there was no evidence of professional supervision. He believes that the government in his country needs to take action perhaps to localize the design, manufacture, fabrication and erection and have legislation covering certification and monitoring.

*Comment* The concern is that whilst the towers themselves may be suitable there can be deficiencies with work on site and CROSS will be very interested in any similar examples. For example should the exporters of such towers have any responsibilities for erection and maintenance. This is a complex issue and there could be a duty in respect of off-the-shelf products either as to suitable foundations or a warning that professional advice should be sought for the design of such foundations. Maintenance is an issue with light members and designers do not always appreciate the needs of site inspection and the provision of safe means of access for this purpose. The protection of lightweight metal sections against the risks of corrosion must be borne in mind. (report DI 022)

### Presidents' letter

The President of the Institution of Civil Engineers and the President of the Institution of Structural Engineers will be writing jointly to the chairmen and technical directors of contractors, specialist construction firms and consultants to promote CROSS and to encourage its use.

## HOW TO REPORT

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[www.scoss.co.uk/cross](http://www.scoss.co.uk/cross) for  
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When reading this  
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