

# CROSS

## Confidential Reporting on Structural Safety

### Newsletter No 4, November 2006

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## INTRODUCTION

CROSS, on behalf of SCOSS (Standing Committee on Structural Safety), have continued to receive reports on the concerns of engineers and the lessons to be learned. In this issue are several very practical reports; the protection of scaffolds from impact, liquid metal assisted cracking (LMAC), and issues about cold formed steelwork framing and fixings to steelwork. In addition there are two follow up reports on adapted masonry support props. Further material on previous reports is welcome and enables trends to be detected. Indeed a guiding principle of SCOSS is that evidence gathered from reports will be used to issue alerts or to influence change. The reports on scaffolding and on temporary props have been brought to the attention of HSE who are considering them in wider contexts, and the subject of LMAC has previously been the subject of a SCOSS report. Recommendations on these and other topics will be made early in 2007 in the next biennial SCOSS publication. If readers have a concern, either related to published reports, or on new topics, or wish to pass on a lesson that they have learned then make a report to CROSS.

## CONSTRUCTION

### Scaffolds and traffic protection

A reporter who is a Local Authority Structural Engineer is often consulted about, and sometimes has to arrange for, scaffolds to be erected on the Public Highway, or at least within close proximity of vehicular traffic. What amazes him is the lack of consideration shown both in British Standards and industry guidance regarding the risk of impact of vehicles with scaffolds and thereby putting at risk those working on a scaffold and those in the vicinity should a collapse or partial collapse occur.

For many years the reporter has only been able to justify the need to consider and provide protection by producing a designer's (site-specific) risk assessment. He has never been able to find or cite the recommendations of a good practice guide, or British Standard requirement. When arguing a case for protection being provided (some contractors/clients are so blinkered to thinking through hazards that unless they can be shown a reference they believe it is not something that needs considering). Neither the old BS5973 scaffold standard, nor its new EN replacement, mentions the need to consider accidental impact. Chapter 8 for Highways is only concerned with signing/traffic management. Even the HSE guidance notes fail to highlight this, in particular their guidance on Construction Site Safety fails to mention in "safe consideration for site roads" the need to consider proximity to scaffolds.

The reporter's Authority has always insisted that for scaffolds they organise themselves (usually for a structural inspection of a building/bridge), they have some form of physical barrier such as temporary pre-cast concrete units, or water filled units or even timber sleepers strapped together; all spaced at least 500mm away from the scaffold to allow deflection/impact absorption to occur without contacting the scaffold. This would be say for a 30mph city centre location. Higher speed roads or heavier/larger vehicle access may need higher specifications, resident car parks to the rear of blocks of flats may need less.

*Comment This is an important subject given the possibility for multiple fatalities and HSE have suggested that it could be addressed and that a current research project on the use and selection of temporary Motorway barriers may assist with this. However, they point out that risk assessments will still be required and the guidance or advice should not be mechanistically prescriptive. In April 06 a 14 storey scaffold collapsed in Milton Keynes resulting in a fatality and two injured workmen. The cause is not yet known but it prompted HSE to issue an alert about scaffolding and possible vehicle impact was mentioned. The Highways Act requires a licence in writing for scaffolds and similar structures on highways and adjacent footways and the Highway Authority has the duty to impose such conditions as it considers necessary.*

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## NEWS ITEMS

### Wall collapse in north London

NCE in its edition of 24/31 August carried a report about a brickwork wall of a property that had collapsed during conversion works. Four workmen were injured. This is the type of failure reported in CROSS Newsletter No 3 and emphasizes the need for engineering advice when altering loadbearing walls. It would be interesting to know what the cause was and whether a temporary propping system was used.

### Boston tunnel panels

In July a large concrete ceiling panel in the Big Dig tunnel in Boston fell on a car causing a fatality. Investigations are said to be focusing on the failure of epoxy resin bonded bolts anchoring the panel to the tunnel roof. Tunnel operator MTA is installing additional connections to provide redundancy, and an investigation into the design and construction of the panels is under way.

Newsletter No 1 included a report about a heavy ceiling in an entertainment building that fell, fortunately when nobody was there. The ceiling was connected to an overlying concrete slab by proprietary fixings which may not have been suitable for that application. Other reports to CROSS have been about fixings and a warning had previously been issued by SCOSS on the subject. It is essential that the design and installation of fixings is given proper care and attention.

*Specific reference to impact protection is to be found in the following documents:-*

**Scaffolding** TG20:05 (NASC) states, "Scaffolds are vulnerable to damage from impact, overloading, wind loads and unauthorised modification" (page 27).

**Facade Retention** CIRIA Report, C579, on Retention of masonry facades has some observations on "Impact Loads" (Page 155 and 156, Clause 8.5).

**Falsework** BS5975: 1996 (as amended) states:

*"The effects of dynamic and impact forces on falsework should be evaluated and allowed for in the design ... Where possible, such impact forces should be minimised or avoided ... It is always preferable to prevent accidental impacts from occurring rather than to strengthen the falsework to resist them..." (Clause 6.3.1.4).*

*In addition CIRIA Report 579 has some observations and proposals for protection, with reference to temporary facade retention systems in general, and with some specific reference to scaffolding.*

*Other views on the protection of scaffolds and similar structures will be welcome, particularly on the need for additional guidance. The IStructE Advice on Temporary Structures which will be published soon is expected to warn against vehicle impacts and draw the attention of designers and constructors to planning against such eventualities. Whereas it is the case that those who design and work with scaffold are obliged to consider relevant hazards, it would be useful to reinforce the message in industry guidance, British Standards and the like. This would assist those cases in particular where standard temporary works are used with no recognisable design input and SCOSS will be looking at this. (Report DI 053)*

### Adapted masonry support props (2)

In Newsletter No 3 *Report DI 032* it was asked if other engineers have had any contact with a modified dead shore popular with builders.

A reporter has come across these in use and in his view they must only be used in the case of limited openings where the masonry can arch over leaving only a small area of masonry below the arching that can potentially break away. These shores, in his opinion, are usually adequate and indeed useful to support this small triangular area of masonry to limit the making good that would otherwise be necessary if all the masonry were removed.

However, there are safety issues, especially where they are used unsupervised or by inexperienced builders. There must obviously be sufficient of them to support the weight of the masonry referred to but this may be underestimated in large openings or other cases where arching may not take place. Another issue is that the eccentricity implies a horizontal force at the foot of the shore (it should not be installed out of plumb to compensate – another bad idea). The horizontal load may be resisted by friction and the impression gained that all is well but an accidental knock in the right direction could collapse the prop as the bottom skids out. Where there is doubt the reporter would advise fixing down the foot to whatever base (presumably substantial) that exists or placing a horizontal brace to the foot (which might form a trip hazard and need to be protected).

All in all these are for light use only and never for heavy shoring. The reporter thinks that the manufacturers, and possibly the hire companies, would be negligent if they did not provide some guidance on the use of such props.

### Adapted masonry support props (3)

Another reporter responding to the item has frequently seen builders using props with cantilevering head-plates which cause the supporting props to bend. Some years ago he photographed a set of such props which had very noticeable curvatures. The wall above had dropped in consequence causing damage to the building and resulting in a substantial claim against the builder. The reporter generally advises builders not to use such head-plates.

*Comment* Correct propping is essential and temporary works failures are a recurrent theme in collapses on site. It appears that this type of prop should only be used in specific low risk circumstances which have been examined by a competent person. Temporary supports must be used in accordance with the manufacturer's guidelines (where these exist), should be checked and signed off on installation, and should not be adapted without formal agreement of the appropriate responsible person on site.

*HSE has plans for a refurbishment safety initiative in view of the many safety problems encountered in this type of work, e.g. ensuring general interim stability of the building structure, and SCOSS will be apprised of progress. (Reports DI 057 and 058)*

### 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

## LIQUID METAL ASSISTED CRACKING

### Liquid Metal Assisted Cracking (1)

A reporter writes in connection with a problem on Hot Dip Galvanising (HDG) which he says is routinely specified in favour of paint systems and thermally sprayed metals for corrosion protection. This is a well established and effective technique provided that recommended procedures are adopted. According to the reporter possible problems (if the recommendations in BCSA/Galvanizers Association publication 40/05 are not followed) may include; strain age embrittlement, hydrogen cracking, restraint cracking, distortion, and recently, Liquid Metal Assisted Cracking (LMAC).

He gives the example of a girder which was fabricated in normal welded steelwork using beam and angle sections where possible and plate fabrication for the remainder. The design and specification were given to the main contractor, who in turn passed it to their own sub-contractor. Minor changes were made to the design and after fabrication the structure was galvanised as a complete unit. It was then found to have suffered severe distortion and there were numerous visible cracks. Some were in materials 20mm thick whilst others were in 6mm thick sections. The level of distortion was considerable and affected both primary and secondary members. All cracks seen were brittle in appearance with no indication of ductile tearing.

The reporter says that repair is not simple as it is possible that cracks in the steel may be obscured by the galvanising. It is not known if the guidance given in the BCSA/GA publication (40/05) was followed.



*Illustrations of Liquid Metal Assisted Cracking*

### Liquid metal assisted cracking (2)

Another reporter had to advise on a large timber grillage system that had been connected at the nodes with steel connectors formed of a central bar (about 100mm diameter) fitted with radial gussets welded on to it. The whole assembly was then galvanised. The trusses were erected on site, but during erection it was noted that there were large cracks down the sides of the gusset welds into the parent body of the bar. Fortunately this was spotted before it was too late, nevertheless, the whole truss system had to be dismantled for safety reasons.

The reporter's firm took expert advice to establish the cause of cracking and the consensus was that it had occurred in the galvanising bath and that it was Liquid Metal Assisted Cracking. It looked likely that the cracks had been masked by zinc so were not visibly detected until the structure had been erected and tension applied across the crack surface. The nodes were remade with tougher steel and the cracking did not re-occur.

*Comment BCSA document 40/05 emphasises that LMAC is a rare phenomenon. However it can occur if due attention is not paid to the design, fabrication, galvanising and inspection processes of susceptible assemblies. It is apparent that not all designers are yet familiar with the guidance. (Report Nos DI 045 and 049)*

## SCOTCROSS



In the 12 months from August 2005 a total of 547 reports were received on masonry and other materials falling, or in danger of falling, from buildings. The programme has been extended for a further year supported by the Scottish Building Standards Agency and assisted by the Scottish Association of Building Standards Managers. Analysis of the findings will be published in due course.

## HOW TO REPORT

Please visit the web site [www.scoss.co.uk/cross](http://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  
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Comments either on the scheme, or non-confidential reports, can be sent to [dir.cross@btinternet.com](mailto:dir.cross@btinternet.com)

### Possible galvanising concern

A third reporter has a question about using galvanised steel poles for the members of dome structures. The intention is that steel poles will be pressed to form the end connection serrations in the form of a 'fir tree'. In this cold forming process, there will be some residual stress at the serrations and the flattened part of the pole. Before the hot dip galvanising, the pole material needs to be cleaned by pickling, which is an acid bath. Thus the two components for stress corrosion cracking are present - stress from cold forming and then the acid giving the corrosive environment. Even though the pickled pole members will be cleaned or flushed and purged with hot air, the acid can remain in the small crevices that are present on the surface of the pole. When dipping into the hot zinc bath, all the crevices will be covered by the molten zinc and after the dipping, it is not possible to detect the small crevices by NDT. This is the inherent problem of any galvanised steel component if there is any cold forming beforehand. If the serrations are scratched in the installation process, the exposed steel part under high stress in the fir tree root may again be susceptible to stress corrosion.

The reporter wonders if this concern is justified and if so whether it would be related to stress corrosion or liquid metal assisted cracking.

*Comment* In the light of the two previous reports the concern may well be justified. This case emphasises the need to utilize the expertise within the supply chain at the design stage, particularly from fabricators and galvanisers, in order to identify possible problems and find suitable solutions. (Report No DI 048)

## STEELWORK

### Design of Head Track in cold formed steel framing

The reporter carried out a check calculation of a steel frame building to BS 5950 Part 5, Code of Practice for the design of cold formed thin gauge sections. Floors made from ribbed metal deck covered with concrete were supported on steel stud wall panels below. The head track of the wall panels supported the floor loads and the loads arising from the upper floors. The reporter noticed that the in-house structural engineer for the steel frame company had not taken account of all the loads in the design of the head track. This was a serious error and some wall panels had already been fabricated and had to be modified.

*Comment* Have any other engineers come across this problem and is it a one-off or is it symptomatic of a trend? (Report DI 039)

### Fixings to steelwork

The use of proprietary self tapping screws to fix to materials thicker than 10-12mm is questioned by a reporter. For example fixing ties to structural steelwork. The manufacturer's instructions normally give the maximum thickness of material on which these should be used. He believes that this recommendation is often ignored and is concerned that inappropriate use could lead to screws being weakened or sheared in torsion.

*Comment* A continuing theme is that manufacturer's instructions must be followed for all proprietary components and it is known that fixings can and do fail where this is not followed. There are two issues: firstly designers may be specifying inappropriate systems or got giving sufficient information, and secondly installers may not be following the requisite instructions. Both are serious and have the potential to lead to structural failures. (Report DI 044)

### On line reporting

Up to now reporters have been asked to download a form from the web site ([www.scoss.org.uk/cross](http://www.scoss.org.uk/cross)) and send it to a PO Box to avoid leaving a possible electronic trail and ensure confidentiality. However some reporters are not concerned with this aspect and would prefer to report on line; so now there is a new form on the web site. It can be completed on line and emailed directly to CROSS.