

CROSS

Confidential Reporting on Structural Safety

Newsletter No 16, October 2009

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Please [click here](#) for link to CROSS website

CROSS Contacts

CROSS Director

Alastair Soane

Tel 07836 664 595

Email dir.cross@btinternet.com

SCOSS Secretary

John Carpenter

Tel 07813 853 405

Email jzcarpenter@aol.com

CROSS Web site

www.cross-structural-safety.org

OUR NEW WEBSITE

Our new website (www.cross-structural-safety.org) has now been launched. It is a major step forward in the wider dissemination of CROSS information. There are many new features, key amongst which are the ease of use and the database which contains reports published in our Newsletters, and reports and papers published by SCOSS. Registration is very simple – just a name and an email address, and there is a feedback facility for those who want to comment on anything to do with structural safety. Reporting both online and offline has been streamlined with advice on 'What to Report' and 'How to Report'.

Most importantly the database can be interrogated using a 'Quick search' button or a more sophisticated search by report origin or classification. The categories have been chosen to represent the main areas of interest related to structural safety and as further reports are received the breadth of content will increase and the more useful the database will become.

This Newsletter has extracts from an important investigation in the US on the collapse of a fabric covered steel frame structure, reports on the problem of resources in a recession, the substitution of cheaper but less adequate hollow sections, a shuttering collapse due to inadequate components and management failings, more about public art, Christmas decorations and the responsibilities of local authorities together with a query about a boundary retaining wall

Reports are needed all the time and it is hoped that the new website will encourage more reporters to send in descriptions of events, or of their concerns about unsafe structures, or of lessons that have been identified and learnt. Reporting is very simple, it is confidential, and it will benefit others. If you have had an experience that could be beneficial let us know. Nothing is too small as apparently minor issues can be the precursors of major failures. If there are ways in which we could help you to report then let us know.

The site has been designed to be attractive, efficient, and useful and thanks are due to [Rippleffect](#) who achieved these goals and the Building Regulations Division of the Department of Communities and Local Government who provided the funds. Thanks are also due of course to the reporters who provided the material that has been used in the database and to the panel of experts who review the reports.

RESOURCES IN A RECESSION

I am very concerned (says a reporter) with a company's decision to transfer an incomplete design of a large complicated project from one department to another due to budget overspend and lack of work to the latter department. The work is now being carried out by less competent/experienced persons with little or no knowledge of the project. I am also concerned about the competency of the main contractor, due to poor quality of workmanship as witnessed through photographs and ill thought out programmed dates. I consider that a serious incident may happen on site. Other former colleagues whose services are no longer required have expressed similar concerns. Please advise course of action as I feel these concerns conveyed to the company's management are (considered to be) secondary to financial reasons.

CROSS comments: *This type of switching can happen at any time, for a variety of reasons, and although the reporter may consider the new designers less competent, he does not say they are incompetent.*

NEWS ITEM**Draft report on the collapse of the Dallas Cowboys indoor practice facility May 2 2009**

NIST, the US National Institute of Science and Technology, has published its draft report into the collapse in May 2009 of a fabric covered steel frame structure during windy conditions which injured twelve people, one seriously. Extracts from the Principal Findings are given below and the full report can be downloaded from:

http://www.bfrl.nist.gov/investigations/pubs/NISTIR7636_Oct2009.pdf

The following factors were found to be primary contributors to the collapse of the structure:

1. Wind loads used for both the original 2003 design and for a 2008 upgrade differed from wind loads calculated based on the provisions of both the ASCE 7-98 and ASCE 7-05 Standards, producing significantly lower design demands.
2. Frame member capacities reported in the original 2003 design were considerably larger than the capacities calculated by NIST based on the AISC specifications.
3. Details of joints, particularly at the knees of the frames, produced large bending moments and shear forces in the chords of the frame that were not considered in the design.
4. Reinforcements added in 2008 had a minimal effect as they affected only the compressive capacity of selected members; the most critical members were not reinforced.

Based upon the observations made during the field reconnaissance and the results of the analysis in which the demand-capacity ratios were ranked in descending order to identify a sequence of member failures, NIST identified the likely collapse sequence for the structure. (*A failure sequence is given in the report*)

NIST has identified a recommendation for improved safety of fabric covered steel frame structures. NIST believes the recommendation is realistic, appropriate, and achievable within a reasonable period of time.

NIST recommends that fabric covered steel frame structures be evaluated to ensure the adequate performance of the structural framing system under design wind loads. Of particular concern are (1) the use of the fabric covering to provide lateral bracing for structural frames, (2) determination of the appropriate enclosure classification in the

However, the fact that the report was sent is a cause for concern and it is an ethical question rather than a technical question. Chartered Engineers are bound by the rules of their professional Institutions and generally have a 'duty of care' to their fellow engineers and to the public. CROSS is unable to become directly involved as such action is contrary to its method of operation and beyond its own resource capacity. However, it would suggest that those mentioned in the report, and who are concerned, express their views in writing through the line management of the company. Management needs to be aware of the legal consequences to their company and to themselves individually should a serious event occur as a result. More likely is the realisation of PI claims resulting from poorly executed design or controls.

The way in which a concern is raised is important and can have a major impact on the outcome. On flight decks there are three levels of increasing emphasis when one pilot is worried about the actions of another, particularly when the comments are being made from a junior to a senior.

1. *I am concerned about.....*
2. *I am uncomfortable with.....*
3. *I believe the situation is unsafe.....*

This method could be adopted when an Engineer is raising a concern with superiors. The ethical issue becomes more difficult if the advice is ignored and the individual with the concern has to consider where else to go. If there is a real danger of a failure that could endanger lives then a local authority or HSE could be approached. (Report 161)

SUBSTITUTION OF COLD ROLLED HOLLOW SECTIONS FOR HOT ROLLED HOLLOW SECTIONS

We, says another reporter, carry out the structural design work for a number of modular building manufacturers. Very recently we have been advised by two of them that their buyers have purchased cold formed hollow sections rather than the hot formed hollow section which we clearly identified in our calculations. (*They have done this because cold formed sections are cheaper although of a lower specification.*) We are concerned that buyers of structural materials sometimes seem to be cost driven and do not appreciate the importance of the steel grade. Whilst we have become aware of at least two instances where this has happened, and have been able to take steps to remedy it, there may be others where there are buildings with structurally inadequate members.

CROSS comments: *This is not the first time that SCOSS has become aware of unauthorised changes being made without the knowledge of the designers. The unauthorised use of non-structural steel box sections and changes to structural fixings are two more examples. It is difficult for the designer to prevent others from effecting changes other than by making it clear, on drawings, or in accompanying issue slips, that all changes are to be referred to the designer.*

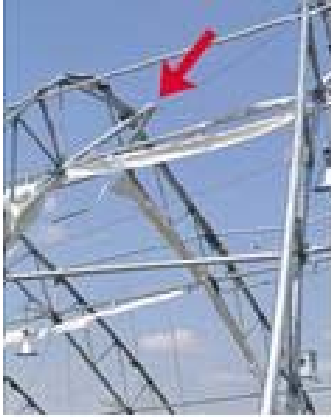
Those responsible for value engineering also need to ensure that their decisions do not affect the original design criteria. Concerns of this type need to be brought to the attention of buyers and quantity surveyors. Designers need to remain vigilant to ensure that the materials they specify are used on site. (Report 158)

COLLAPSE OF TANK SHUTTERING

The issue relates to the collapse of falsework erected to construct an insitu, reinforced concrete, circular water retaining structure. It was to be about 20m diameter by 15m high, with a cupola roof – a typical digester tank on a sewage treatment works. The company that employed the reporter was the design and build contractor for a

NEWS ITEM (continued)

calculation of internal pressures for design wind loads, and (3) the ability of the structural system, including the lateral bracing, to maintain overall structural integrity.



Buckling of the steel frame of the Dallas Cowboys practice facility is seen in the upper left of the photograph (marked by arrow).

Credit: NIST

Comment: The speed with which the results of the NIST investigation have been published, and the unequivocal nature of their recommendation, means that the owners of all fabric covered structures in the US must take steps to reassure themselves that their buildings are safe. The recommendation may also be applicable elsewhere and there are likely to be major consequences. Once the final report is published, NIST will brief and provide technical support on the recommendation to the American Society of Civil Engineers (ASCE) committee currently developing a building standard specifically for tensioned fabric structures. NIST also will brief the appropriate committee of the International Code Council (ICC) on the study's recommendation for use in improving provisions in ICC's model building code. The Advisory Group on Temporary Structures (AGOTS) at the Institution of Structural Engineers will be keeping a close watch on the situation.

number of tanks on the site. The formwork/falsework system was a proprietary system, not commonly available in the UK. It comprised an outer formwork skin designed to go into ring tension, and an inner formwork skin designed to go into ring compression. Because the latter would be subject to buckling action, it was supported by backing falsework, which consisted of a circular truss made up from adjustable sections.

Sections were fixed together by dowelling pins. There was thus a high shear force acting on the pins when the falsework was subjected to wet concrete pressures. The tank wall was on the second lift, so at about +6m above ground level. A working platform was fixed at top of shutter level, incorporating a concrete hopper travelling on rails to deposit wet concrete into the formwork – hence a further local vertical load. The falsework failed during concrete placement and a partial collapse of the system occurred. Fortunately, nobody was seriously injured. Collapse appeared to have occurred because of shear failure of the pins, which exhibited crystalline fracture surfaces indicating brittle failure. The reporter had several sent away to a testing lab, which reported yield strengths in the range of about 250 N/mm². In other words, mild steel.

As part of the investigation, the reporter reviewed the only available design calculations for the temporary works. These had been translated from the original documents by a non-technical person, and the following points were evident:

1. The calculations were for a different diameter tank and less onerous loads.
2. The limits for the calculations had been exceeded.
3. The pin in the model calculations was about 7mm diameter, with a UTS of about 700 N/mm². whereas the pin that failed was about 6mm diameter, with a yield strength of about 250 N/mm².

The technical reason for failure was under-strength pins which failed in shear, in a temporary structure with little or no redundancy. Beneath the obvious technical shortcomings, there were significant managerial and cultural issues in this case. It was these underlying problems that had ultimately permitted the gross technical errors to occur.

CROSS comments: There was obviously a lack of supervision and of the appreciation of the importance of temporary works. The *Final Report of the Advisory Committee on Falsework*, HMSO, June 1975, often referred to as the *Bragg Report* drew attention to the fundamental importance of the role and functions of the "Temporary Works co-ordinator". There is always a danger in using standard designs, particularly those which may have been translated from another language and which may have used different Codes. Information about the responsibilities associated with temporary works can be found in the *Institution of Civil Engineers Conditions of Contract* http://www.ice.org.uk/knowledge/contracts_conditions_of_contract.asp. BS 5975:2008 Code of practice for temporary works procedures and the permissible stress design of falsework requires a careful approach to falsework with design and review undertaken by competent persons and the appointment of a Temporary Works Co-ordinator to oversee the process. There are also CDM obligations. (Report 150)

MORE ABOUT PUBLIC ART

I felt (says a reporter) that I had to write concerning the issue of Public Art (CROSS Newsletter No 14 report 136), having had a lot of interaction with a Council when I was Head of Building Control. Operating under appropriate legislation worked well with responsible people in major organisations. The biggest problem was the Council itself and especially the community involved departments, who felt that their issues came above all else including structural safety. I took this to the Legal Department who in fact stated that all parts of the Council should comply with the legislation, but it would not be possible to take

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
- British Parking Association
- Communities and Local Government
- Construction Industry Council
- Department of the Environment
- Health & Safety Executive
- Highways Agency
- Institution of Civil Engineers
- Institution of Structural Engineers
- Local Authority Building Control
- Scottish Building Standards Agency
- UK Bridges Board

legal action against any part of the Council in default. Some departments complied, but a lot of others did not, because they said that they did not have the funding to comply with these requirements.

In general the control of these structures, whether temporary staging, gantries etc for an event or the public art type was very poor. On some occasions I actually dismantled structures, because they were too dangerous to leave standing. In the past, such matters would be the responsibility of the Borough Engineer, but in today's world of "outsourcing" this is an expense too far.

CROSS comments: *Although a public body cannot serve a legal notice on itself the duty for safety remains with the authority or public body. Others in a similar situation have advised that a carefully worded letter to the director responsible for commissioning the work with a reminder regarding the director's personal duty tends to have the desired effect. The Highway Authority and Building Control both have responsibilities and appropriate powers to deal with such issues and sometimes the licence for an event is the means of exercising control. Those who might be involved should read the reports on the 'Dreamspace' prosecution (Safety and Health Practitioner July 2009 and the correspondence September 2009 p19) and note their corporate and individual responsibilities. By allowing such situations to occur senior managers in particular are putting themselves at risk of prosecution. (Report 157)*

DECORATIVE LIGHTS AND BANNERS CAN DAMAGE STRUCTURES

There is increasing pressure from advertisers and others to make use of existing highway and building features to hang banners and decorative lights. So says an engineer who is closely involved with city centre schemes. Often, he goes on, it is desired to suspend quite large banners between lighting columns across the street. In general lighting columns [unless specials are requested] are not designed to support any loads other than their self weight and wind loading. They are tested and certified accordingly. It is also necessary to proportion the foundations correctly against the greater overturning forces. Often such banners are put up without any thought being given to the engineering considerations.

Decorative lights such as those commonly erected during the Christmas season (as well as other times of the year) require especial care when it is desired to fix to existing features. In city centres, where there is often a clutter of existing street furniture, it is preferable to fix to buildings rather than provide dedicated columns. The problem lies in determining an appropriate fixing point at the correct level along the sides of the street and then tensioning up the support wires. Usually the buildings are in private ownership and very rarely are there drawings of the structure. The cladding of the buildings will have fixings in indeterminate condition and will not have been designed for additional loading from the suspended lights. It is tempting on occasions to fix to the easy points such as parapets and balcony railings. Often these are the most exposed structural elements in the poorest condition. This is especially the case in masonry where the bed joint mortar may well have perished.

As computing power develops and large banner production techniques advance it is tempting for some designers to be ever more ambitious with their proposals. However this is often accompanied by the lack of experience in the practicalities of component fabrication and erection and maintenance. Also there is a general lack of thought as to how the public may react to the completed object. It is incumbent upon designers to try to foresee the unforeseeable in terms of loading and unusual uses or misuse. This may result in a good concept not being able to be transformed into serviceable reality.

REGISTRATION FOR CROSS NEWSLETTERS

To register for CROSS Newsletters go to the new website and on the right hand side of every page there is a 'Register' box. Enter your name and email address and click the 'Register' button. An email will be returned to your address confirming that you are on the list of subscribers.

REPORTING

Use either the 'How to report' button on the top of the website or the similarly labelled button on the right hand side to send on-line or off-line reports. It is simple, confidential, and could be important.

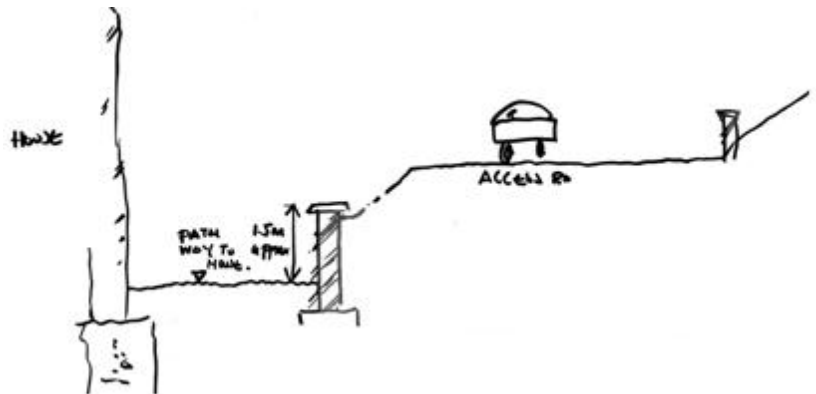
FEEDBACK

With the online 'Feedback' facility you can send comments on any aspect of CROSS or of the website or on anything to do with structural safety, and also read the input from others.

CROSS comments: We read press reports about 'the health and safety' brigade banning bunting at local events because of concern over insurance issues, and these may be over-reactions, but decorations do appear to be getting heavier and more elaborate. The Highway Authority and Building Control have responsibilities and appropriate powers to deal with such issues but the engineering ramifications of hanging heavy decorations from buildings may not be appreciated by the sponsors. Fixings should be designed for the required loads with appropriate factors of safety and "pull-out" tests conducted to ensure adequate standards. At another Local Authority Christmas decorations were taken down following damage to a building because the installer was unaware of the need for multiple fixings to distribute the loads. Temporary TV screens are of concern to SCOSS and are referred to in the 2007 biennial report. Some displays require independent temporary structures to be licensed, and this may be a way of controlling connections to inappropriate part of buildings. CROSS will endeavour to raise this matter with highways authorities to highlight that there have been failures and that concerns have been raised? (Report 159)

BOUNDARY WALL QUERY

A reporter is concerned about a brickwork retaining wall that he considers may be structurally unsuitable and separates a path alongside a domestic property from an access road. The history is unclear but it may be that the wall was built first and then, at a higher level, the access road. The retained height is about 1.5m and, according to the reporter, the local authority does not believe it is their responsibility to become involved as it is not part of the building. The reporter wants to know whose responsibility is it to take action in what could be a dangerous situation.



The property is on the left and the access road on the right of this sketch provided by the reporter.

CROSS comments: If this is an adopted public highway, it is a matter for the Highway Authority, which may not be the Local Authority. However if it can be shown, or suspected, that the wall is dangerous then a Local Authority has powers under the Building Act to take action in respect of a dangerous structure. Section 77 of the Building Act 1984 states that the authority may apply to a magistrate's court, and the court can then require the owner to remove the danger or in default the local authority can carry out the work required to make the structure safe. Section 78 of The Building Act allows the local authority to carry out work in an emergency if they consider that the structure is imminently dangerous. (Report 129)

DATES FOR THE PUBLICATION OF CROSS NEWSLETTERS

Issue No 17	January 2010
Issue No 18	April 2010
Issue No 19	July 2010

HOW TO REPORT

Please visit the web site
www.cross-structural-safety.org
 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