CROSS

Confidential Reporting on Structural Safety

Newsletter No 12, October 2008

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INTRODUCTION

CROSS aims to influence change and has provided evidence for the Alert on Fixings recently issued by SCOSS. Further warnings will be issued by the Construction Fixings Association to reach all sectors of the industry.

In this Newsletter there is, sadly, a report of the death of another child from a collapsing wall and, together with previous reports, this will be presented as evidence for a possible change within the Building Regulations. The foundations for a multi-storey building were found by a local authority inspector to have a lack of reinforcement which could have resulted in failure if it had not been spotted. Multi-storey car park problems are not new but despite publicity about collapses there are still older car parks in poor condition, and one of them is reported on here. Two 19th century mill buildings have collapsed suddenly in unrelated incidents to show the inherent weakness in this form of structure. These illustrate the hazards and potential consequences of progressive collapse. Finally there is an example of concrete spalling due to poor grouting of pre-stressing ducts which shows that there is the possibility of undetected weaknesses in some structures.

All of these demonstrate the need for CROSS and for your contributions.

DEATH FROM WALL COLLAPSE

A wall which collapsed recently and killed a child did not have planning permission. The three-year-old girl died when the 2m high and 50m long, free standing, blockwork boundary wall fell onto her as she walked past with her mother. It is reported that a contractor used the wall to retain spoil from the excavations associated with an extension and apparently it was lateral thrust from the spoil that caused the collapse. A local authority spokeswoman is reported to have said that any planning application would normally deal with the “visual appearance” rather than “structural integrity”. The HSE has appointed a lead inspector to work with detectives probing the collapse. Ultimately, charges could follow if they find evidence of possible breaches of the Health and Safety at Work Act 1974. As well as having a duty to protect workers, employers also have a legal obligation to ensure the safety of the public.

CROSS comments: *Yet another tragic collapse but this time of a new wall which was clearly not designed to retain soil. Under current Building Regulations there is no requirement to submit designs or drawings for free standing walls although this may be addressed in future. It is anticipated that a formal report will be published by the relevant authorities. Everyone in the building industry should be aware of the dangers of vulnerable walls such as: those that appear to be very slender, those that have different soil levels on each side, those that lean, and those where there are signs of damage or deterioration. The building regulations do however cover retaining walls which provide lateral support to the foundations of another building. Notwithstanding the applicability of the Building Regulations, duties under the Health and Safety at Work Act, and other associated legislation, always apply if the actions are associated with a work activity. In essence this means that those creating the risk by designing and/or loading the wall have a duty to safeguard anyone who may be affected by their actions. For retaining walls within ‘4 yards of a street’, section 167 of the Highways Act 1980 requires the retaining wall to have approval from the local authority.* (Report No 116)

References giving guidance on good practice include:

- *Design of free standing walls, J O A Korff, Brick Development Association, February 1984 (BDA Design Guide 12; updated by information notes, August 1995)*

FIXINGS ALERT

SCOSS has issued an Alert on 'The selection and installation of construction fixings (Sep 08)'. This may be found at www.scoss.org.uk/publications.asp . CROSS Newsletters have contained a number of reports about fixing failures including several on ceiling collapses in Newsletter No 10 (www.scoss.org.uk/CROSS/newsletters.asp).

- *A reinforced brickwork freestanding boundary wall, G D Johnson, Brick Development Association, January 1988 (BDA Engineers File Note 7)*
- *BRE Good Building Guide - Building simple plan brick or blockwork freestanding walls GBG 14, May 1994*
- *BRE Good Building Guide - Surveying brick or blockwork freestanding walls GBG 13, April 1992*
- *ODPM. Your Garden Walls, Better to be safe than sorry www.rbwm.gov.uk/public/050728_odpm_breg_garden_walls_274.pdf, 2004*

INADEQUATE FOUNDATION REINFORCEMENT

The photograph below is of ground beams for a multi-storey development where the subcontractors carrying out the ground works failed to provide sufficient continuity reinforcement. In an attempt to provide continuity the steelwork was repositioned with the result that all reinforcement from a corner of the building was removed as shown in the highlighted region of the photograph. The local authority building control officer twice advised the sub contractors that this was unsatisfactory but they claimed that the consulting engineer had considered the work acceptable. Regardless of this statement the work was not approved.

Missing reinforcement

The reporter advises that this is not an isolated case because on many sites there is little or no involvement of the design engineer to ensure that his details are being followed on site. Traditional checks on construction standards from Clerk of works and site resident engineers are now rare because Clerk of works are not generally employed and the site engineers knowledge usually relates to setting out only. A reputable design team and main contractor were carrying out this development but the lack of basic knowledge of the ground workers would have gone unchecked if it had not been for the local authority inspection. There is, considers the reporter, a concern about the lack of site involvement by design engineers in respect of critical areas of construction. Reliance is placed on sub contractors but their lack of knowledge creates risk of fundamental errors in the construction process.

CROSS comments: *Unless adequate supervision is provided on site, problems will eventually result. This separation of design from construction is a potentially dangerous trend. It is common practice in the UK for reinforcement to be detailed by the contractor. In such a situation the design engineer would check that the reinforcement placement drawings met the design intent. It would appear that no such placement drawings were approved or if they were the steel fixing details were not followed. Whilst the*

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
- Communities and Local Government
- Construction Industry Council
- Department of the Environment
- Health & Safety Executive
- Institution of Civil Engineers
- Institution of Structural Engineers
- Scottish Building Standards Agency

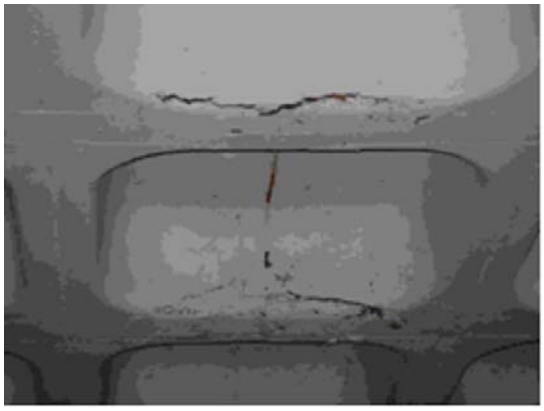
involvement of the original designer in site inspections provides the best check of design intent, there appears to have been failures in good practice prior to the start of works on site. Even for relatively trivial details checks should be in place. Design briefs often exclude any site involvement by designers whose activities are restricted to monitoring. However the key lesson here is that there must be competent structural engineers on site either from the design side or from the contractor to prevent failures. (Report 112)

MULTI STOREY CAR PARK DEFECTS

A reporter says it was interesting to see the note on the staircase collapse in a MSCP (multi storey car park) in CROSS Newsletter No 11 and it prompted him to write to express concerns which he has held for some time. He is regularly sent photographs on defects in MSCPs (below is a typical one of a soffit) and has been concerned for some time that there potentially could be another failure similar to Pipers Row in Wolverhampton – see SCOSS Report number 10 page 18.

Despite efforts by the Institution of Civil Engineers to encourage owners and operators to inspect and maintain their car parks as recommended in their publication "Inspection, Maintenance and Management of Parking Structures", there are still car parks in alarmingly poor structural condition. The reporter has raised his concerns on several occasions with relevant bodies but the take-up has been very poor and, in his view, the neglect continues. To make matters worse the reporter was concerned to find that the ICE publication (which was considered to be the Bible) is no longer in print and there are apparently no plans to update or republish it.

The reporter has also found that clients are paying lip service to undertaking Life-care plans and unless Government makes inspections and maintenance compulsory, similar to bridges, there will soon be another collapse. He wants CROSS/SCOSS to lobby on this matter.



Cracked soffit in multi-storey car park

CROSS comments: *It had been hoped that the publicity following the collapse of Pipers Row car park and the publication of the ICE report would ensure safe regimes in all car park structures. Such structures are subject to harsh environmental conditions, repetitive loading cycles and lack of maintenance. Structural engineers dealing with these buildings must be aware of the need for inspection, monitoring and repair. Owners and Local Authorities should follow the guidance given in the references below. CROSS would welcome further information on this subject in order that a comprehensive picture may be established, and will check with ICE as to whether their guidance will be re-printed.*

On 2nd October 2008 New Civil Engineer reported that a 1970s four storey hospital car park in Nottingham was closed following an inspection by structural engineers and the Health & Safety Executive). "The multi-storey car park has been weakened by deterioration in the concrete's strength," said an NHS trust spokesman. "After detailed specialist work over the past 48 hours we have agreed with the structural engineers and with the HSE that the car park should close with immediate effect."

The planning portal from the Department of Communities and Local Government has a report 'Enhancing the whole life structural performance of multi-storey car parks' (www.planningportal.gov.uk/uploads/odpm/4000000009277.pdf) which provides guidance and advice. (Report 119)

PROGRESSIVE COLLAPSE NUMBER 1

Nearby families were evacuated after part of a four-storey former mill building collapsed adjacent to their homes. Residents reported hearing a sound like a heavy goods train as the building fell. The mill was used for storage and was about to be converted into residential apartments. The reporter said that the construction was typical of 19th century mills with brickwork interior walls, cast iron columns and filler joist floors. It is thought that the sudden collapse was initiated by the failure of one of the columns.

CROSS comments: *This is a classic example of progressive collapse following the removal of a single element. It happened suddenly and apparently without warning and it was fortunate that nobody was inside and the debris did not hit the nearby houses. See below for more general comments on such buildings.* (Report 121)

PROGRESSIVE COLLAPSE NUMBER 2

The second report concerns the unexpected collapse following a fire of part of a twenty-five bay, five storey mill dating from around 1830. It had external masonry walls and internal cast iron columns with brick arch floors on cast iron beams. The original part had concrete floors whilst a later addition, abutting the original with straight vertical joints in the walls, had timber floors. The floor beams were tied with rods at the level of the arch soffit. There was a stone clad roof on timber truss roof supports. It is believed that the seat of the fire was at the base of a lift shaft which then travelled up the shaft and took hold of the roof structure. By the time the fire had been controlled the roof had collapsed and sections of the parapet had fallen on the front and rear elevations.

In making the structure safe a long reach grab was used to reduce the height of the top storey walls which posed a risk of collapse outwards. This included an attempt to reduce the height of the free standing gable wall shown in one of the photographs below. During this process some of the masonry from the gable fell inwards onto the section with timber floors and started a chain reaction of failure that led to the sudden collapse of the five

storey section. The straight joint in the masonry walls probably contributed to the sudden collapse. Onlookers, including the reporter, were surprised by the speed and extent of the collapse. Although no one was injured there was considerable damage to neighbouring houses.

Roof after fire damage

Unsupported gable

Collapsed section

Resulting debris

CROSS comments: *This is a case of progressive failure in which an impact on the top floor of a typical mill structure dating from the 19th century resulted in the cascading collapse of 5 storeys. Whilst the fire caused the initial problems there is no indication that it had weakened the part that fell. Whilst the collapse was initiated by the attempt to reduce the height of the unrestrained gable if this had not been done it could have failed in any event from wind, and the subsequent collapse could have had potentially fatal consequences.*

Buildings such as this were not designed with robustness in mind and there was no structural continuity and little in the way of bracing apart from façade walls. They were constructed, not always very well, for specific industrial purposes and are now used for a variety of functions including conversion into residences. Part A of the Building Regulations, and particularly the section on disproportionate collapse would apply in the case of change of use. The Institution of Structural Engineers is preparing a report on 'Robustness and progressive collapse', and SCOSS are concerned that the concepts are not well understood. Buildings that have performed adequately during their life may hide vulnerable details which make their behavior unpredictable when subjected to "Events". Those involved with damaged buildings and those undergoing alteration should consider this. Developers, designers and contractors, must be aware of the potential for catastrophic progressive collapse of some older multi-storey buildings. Useful references when examining or altering such structures include: Appraisal of Existing Iron and Steel Structures,1997 SCI 138, Historical Structural Steelwork Handbook, BCSA 1984, Structural Renovation of traditional buildings, CIRIA 111 1994, and Appraisal of existing structures, 1996, Institution of Structural Engineers. (Report 122)

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Comment on the scheme, or non-confidential reports, can be sent to
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PRE-STRESSING DUCTS

Pre-stressing in concrete has been used in bridges and heavy civil structures for many years and more recently in buildings. A reporter has come across a situation where during grouting of the ducts in a slab, patches of concrete as big as 0.5m x 1m and 30mm thick fell on to the ground creating a safety hazard. Investigation showed that the main reasons for falling patches of concrete were combinations of the following:

1) During grout the pressure was not monitored at the delivery end and entry end into the duct and higher pressures than normal were used.
2) The grout was expanding very quickly - more than that which was specified.
3) The ambient temperature was low during grouting.
4) Water found its way into the lowest points of the duct during rain and eventually froze resulting in partial ice expansion.

Soffit of slab showing pre-stressing duct

CROSS comments: *Grouting of pre-stressing ducts requires careful workmanship and supervision. Recent investigations have revealed the likelihood of a lack of properly grouted ducts in some buildings. One method of minimising the risks is to ensure that post tensioning installation is only carried out by properly trained teams, for example those certified for PT installation through the UK CARES certification Scheme. It should be noted that point 4 above (water ingress and freezing) can occur in completed structures where grouting has not been properly executed. An excellent guide on procedures and techniques is given in the CARES note distributed in June 2008 and now put on their web site: (www.ukcares.co.uk/PDF/CARES_Post-Tension%20Leaflet.pdf). Reference is made to the need for project specific reviews and advice is given for new structures.* (Report 089)

DATES FOR THE PUBLICATION OF CROSS NEWSLETTERS:

Issue No 13	**January 2009**
Issue No 14	**April 2009**
Issue No 15	**July 2009**
Issue No 16	**October 2006**

CROSS REPORT FORM

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For more information see www.scoss.org.uk/cross

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Date of report:	**Approximate date concern was noticed:**

1. Your personal details are required only to enable us to contact you for further details about any part of your report
2. You will receive an acknowledgement
3. This original report will be returned to you

NO RECORD OF YOUR NAME, ADDRESS, OR TELEPHONE NUMBER WILL BE KEPT

Affiliation		IStructE	ICE	RICS	other			
please tick the small grey boxes	✓	**grade**	none	graduate	technician	associate	member	fellow
Location	England		Wales		Scotland		N. Ireland		elsewhere	
Your job title:					**Age of structure (approximate)**			

Organisation –check		**Project stage** – check		**Structure type** – check		**Material** – check	
approved inspector		appointment		domestic building		brickwork	
builder/contractor		design process		building structure		pre-cast concrete	
client/developer		construction		bridge		pre-stressed concrete	
consulting firm		temporary works		highway		reinforced concrete	
government		In use		tunnel		steelwork	
LA building inspector		during maintenance		marine		stonework	
project manager		de-commissioning		water related		timber	
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utility company		other					
other							

Description of the reason for concern – use additional sheets if necessary

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