

CROSS

Confidential Reporting on Structural Safety

Newsletter No 10, April 2008

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INTRODUCTION

The reports in this issue highlight a lack of competence or a lack of supervision of aspects of construction which may not be primary structures, but are serious in terms of safety. A brickwork gable wall collapsed without warning and narrowly missed a pedestrian; a substantial blockwork wall collapsed due to wind loads in the temporary condition after the workforce had left for the night; four heavy ceilings collapsed, again, by good fortune, when there were no people underneath. These all serve as reminders that the application of sound engineering and good practice, or simply the use of good building craft by competent people, are essential when dealing with fixings and apparently minor components. If any of these cases had resulted in deaths or serious injuries the effects on the individuals involved and their employers would have been devastating.

It is simple after the event to see what has gone wrong and why the failures occurred. It is difficult to make sufficiently strong recommendations so as to ensure that the people likely to be involved with these topics in the future are made aware of the risks and the importance of their role. CROSS has shown the relevance of confidential reporting in highlighting trends before there are tragedies, and this is enabling SCOSS to take action to give more publicity to safety critical concerns.

As ever CROSS seeks, and needs, more reports from individuals and from organisations. Reports from those who have the support of their employers will be very welcome when sending a description of a concern to be shared with others. There is a report form at the end of this Newsletter.

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

COLLAPSE OF A GABLE WALL

This report concerns the collapse of part of a gable wall to a fairly recently constructed block of flats. The collapsed masonry fell onto a parked car which suffered significant damage. The owner had left it only a minute or two beforehand, heard the crash as she walked around to the front of the building, and was therefore very shocked at how close she had come to severe injury or worse. The subsequent investigation found several reasons for concern. The lateral restraint ties were spaced excessively and had inadequate fixings. Wall ties had been bent up where an adjoining wall should have been tied in but were not connected because the coursing did not match. Similar defects were found on other gables and remedial action had to be taken.

CROSS comments: *Supervision on site is critical for good construction and was clearly lacking here. Are standards for supervision adequate and if not what should be done? Risk based inspections appear to some to be the way forward in Building Control, and this may be the basis for fewer random inspections so such deficiencies may not be picked up in this way. On the other hand if risks are thought to be significant it could lead to more inspections. The failures of inadequate wall ties and lack of lateral restraint emphasise that if mid-construction inspections are not undertaken then there is a risk. The fact that 'similar defects were found on other gables' suggests that the poor construction and supervision throughout the site. (Report No 092)*

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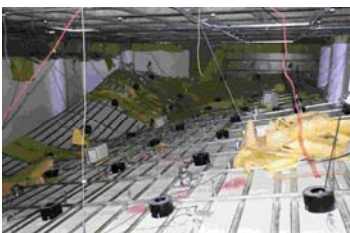
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COLLAPSE OF A WALL DURING CONSTRUCTION

An internal corridor wall collapsed in a school under construction. The wall, when checked, was not to be unstable in all stages of its construction even when built up to the head, until the external envelope was substantially complete. Programme constraints indicated that the walls would always be built before the envelope. A generic assessment of risk by the designer did identify propping masonry in the temporary condition, but, says the reporter, this was not clearly enough set out for the contractor to spot, though he should have questioned it. There were a number of panels which were subject to temporary situations which were more onerous than the permanent conditions, but the one that fell was off-grid and had no intermediate supports being 37m long by 3.8m high. It was indeed fortunate that the site had finished for the day and no-one was injured.

CROSS comments: *It is common for internal walls to be subject to temporary wind loads that exceed those in the final condition. For the significant scale of the walls here, it would have been essential for the temporary stability issues to have been identified prior to construction, in order to minimize the risk of collapse. Designers must eliminate hazards and reduce residual risks in a manner that contractors understand. They must highlight potential risks where temporary load cases are more onerous than the permanent case. They must also identify special cases where extra care is needed, and it might be thought that a wall of these dimensions was one of these on the basis of general building knowledge as well as of regulation. Contractors also should be more aware of temporary situations and assess each trade package as it develops. A review of temporary works should be carried out on any project to identify any short, or long term, supports that may be necessary, backed up by engineering advice as necessary. There is also the issue that programme changes may have been made without the knowledge of the designer who should always remain involved. Regulation 28 of 'Construction Design & Management Regulations 2007' covers stability of "temporary structures" and "temporary states of weakness or instability" and applies to such situations. (Report No 099)*



CEILING COLLAPSE IN AN EDUCATIONAL BUILDING

A suspended ceiling in a large teaching hall collapsed days before the official opening of a new educational building. The opening ceremony was going to take place in this location. The teaching hall was under an external circulation area of the building, and at a late stage there was concern over footfall sound impact affecting the space below. To overcome this problem an acoustic ceiling was designed and the contractor was instructed to install hangers for the suspension rods for the ceiling. On inspecting the failed structure, says the reporter, it was obvious what had happened.

The contractor had procured correctly rated brackets, but had procured compression brackets not tension brackets. All were overloaded but just working until one failed, which set off a chain reaction.

The reporter says that the reasons were:

- late instructions which caused a risk
- the specification for the acoustic ceiling was only partially complete
- there was ignorance about the importance of the brackets.

Comments are given at the end of this series of four similar failures (Report No 100)

CEILING COLLAPSE IN CINEMA No 1

A reporter writes about the failure of a mass barrier acoustic ceiling at a cinema complex in a major UK city some few years ago. The heavy ceiling was suspended by drop rods fixed to a U section channel system attached to the underside of a composite steel deck and insitu concrete slab. The design was for each rod to be connected to a nut with a washer over a pre-formed hole in bottom of the channel. In practice the washers were too small; one (or more) pulled through its hole, initiating a progressive collapse of the whole ceiling. At the time the cinema was operational but fortunately the auditorium was empty so no one killed or injured. It appeared to the reporter that there was an overall lax attitude to the installation of a heavy ceiling system, there was reliance on a suspect fixing arrangement and there was no evidence of inspection or supervision of the installation.

Comments are given at the end of this series of four similar failures (Report No 101)

CEILING COLLAPSE IN CINEMA No 2

A ceiling also collapsed much more recently at a multi-plex cinema in another major city says a reporter. This too had a mass barrier acoustic ceiling of two layers of nominally 12.5mm plasterboard fixed to a two-way light gauge steel channel system suspended from an insitu concrete roof slab composite with a steel deck. Ventilation ductwork was suspended below the mass barrier ceiling on threaded rods fixed to the roof slab soffit (ie through mass barrier ceiling) with single shot-fired fixings. There was a decorative lower ceiling suspended below the ductwork from the channel system with tie wires. The specification had however called for this ceiling to be suspended from the slab structure above.

One ductwork supporting rod (or its fixing) failed and it was found afterwards that a shot-fired fixing nail at this location was 16mm long and not 32mm as specified, and that the spacing of the threaded rods was excessive. The duct dropped onto the lower ceiling which in turn pulled down the end section of the mass barrier ceiling. It was further found this ceiling was not properly fixed to the support system at the perimeter of auditorium and that the supporting channels were inadequately spliced. There was a progressive collapse of major part of the whole two layer ceiling system. Again, by good fortune, the auditorium empty so there were no casualties.

The underlying causes, the reporter believes, were a lack of appreciation about the engineering risks inherent in the installation of a heavy ceiling system. There was reliance on a single shot-fired fixing (whereas the manufacturer recommended groups), coupled with an unworkable design resulting in unauthorised changes. There was no evidence of inspection or supervision of installation.

Comments are given at the end of this series of four similar failures (Report No 102)

CEILING COLLAPSE IN CINEMA No 3

A third cinema had several separate auditoria. Each had a ceiling consisting of a metal grillage supporting plaster board and on top of that was network of cables and ventilation ducts. The net loading was quite heavy at about 70 kg/m². The load transfer system between separate elements was complicated but the whole was held up on straps fixed to the underside of a concrete soffit by a mixture of shot fired nails and proprietary drilled in sockets. The strap top was bent over at 90° to allow the fixings to be made through the horizontal part and consequently the fixings were subject to direct load and bending.

Some of the fixings pulled out in one of the auditoria (both shot fired nails and drilled in fixings) setting up a cascade reaction such that the whole ceiling fell down. Inspections were carried out in the adjoining auditoria and it was found that the fixings there had partially failed. The collapse occurred at night so no one was injured

CROSS comments: *These are important reports that demonstrate a trend of progressive collapse mechanisms in public buildings where there is a high probability of casualties in the event of failure. In each case there has been a fault, or a combination of faults, in the design, selection or installation of fixings, and a lack of appreciation of the magnitude of the dead loads from acoustic ceilings. These would have been compounded because it is not usually possible to inspect the fixings after installation. The danger of falling ceilings is not new; there is old cinematographic legislation that was brought in because of failures with lath and plaster ceiling fixings. The Home Office document 'Recommendations on Safety in Cinemas 1955', and which is still relevant says: "Ceilings shall be in such a condition as not to cause a danger to persons visiting the premises".*

There are other examples where the failure of a single component must not compromise the whole; for example cable stayed bridges are designed so failure of one stay does not cause the bridge to come down. Similarly what is needed for heavy ceilings is a robust design with a sensible appreciation by designers of the importance of what might appear to be trivial structural detail. There must be a sound design tracing load paths back to a solid platform with a responsible person in charge. It may be that guidance there should be provided in Part A of the Building Regulations in a similar manner to the existing guidance on cladding systems.

SCOSS has been concerned about 'fixings' of various kinds for some time and these collapses illustrate very well the '3Ps' promulgated by SCOSS to illustrate the wide causes of failure:

People	<i>Those involved exhibiting a lack of structural engineering competence such that the safety critical implications of the work were not recognised.</i>
Process	<i>Lack of attention given to the procurement of the work and in particular to ensure that one competent party is responsible for the overall design. A failure to appreciate that these support systems are just as important as primary structural members. Lack of supervision and checking of installations.</i>
Product	<i>Specification (or choice) of the wrong product i.e. not fit for purpose.</i>

Fixing failures such as the 1981 Hyatt Hotel walkway collapse in which 114 people died demonstrate the magnitude of tragedies that can unfold. Because of the significance of these cases SCOSS will be writing to all cinema owning companies in the UK and citing this Newsletter.

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

Supporters

- Civil Engineering Contractors Association
- Health & Safety Executive
- Institution of Civil Engineers
- Institution of Structural Engineers
- Department of Communities and Local Government
- Scottish Building Standards Agency

DATES FOR THE PUBLICATION OF CROSS NEWSLETTERS

Issue No 11	July 2008
Issue No 12	October 2008
Issue No 13	December 2008
Issue No 14	April 2009

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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

CROSS REPORT FORM

Please complete the shaded boxes and the description below
For more information see www.scoss.org.uk/cross

Name:		<p>1. Your personal details are required only to enable us to contact you for further details about any part of your report</p> <p>2. You will receive an acknowledgement</p> <p>3. This original report will be returned to you</p> <p>NO RECORD OF YOUR NAME, ADDRESS, OR TELEPHONE NUMBER WILL BE KEPT</p>						
Address:								
Telephone:								
Date of report:		Approximate date concern was noticed:						
Affiliation		IStructE	ICE	RICS	other			
please tick the small grey boxes	<input checked="" type="checkbox"/>	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	<input type="checkbox"/>	appointment	<input type="checkbox"/>	domestic building	<input type="checkbox"/>	brickwork	<input type="checkbox"/>	
builder/contractor	<input type="checkbox"/>	design process	<input type="checkbox"/>	building structure	<input type="checkbox"/>	pre-cast concrete	<input type="checkbox"/>	
client/developer	<input type="checkbox"/>	construction	<input type="checkbox"/>	bridge	<input type="checkbox"/>	pre-stressed concrete	<input type="checkbox"/>	
consulting firm	<input type="checkbox"/>	temporary works	<input type="checkbox"/>	highway	<input type="checkbox"/>	reinforced concrete	<input type="checkbox"/>	
government	<input type="checkbox"/>	In use	<input type="checkbox"/>	tunnel	<input type="checkbox"/>	steelwork	<input type="checkbox"/>	
LA building inspector	<input type="checkbox"/>	during maintenance	<input type="checkbox"/>	marine	<input type="checkbox"/>	stonework	<input type="checkbox"/>	
project manager	<input type="checkbox"/>	de-commissioning	<input type="checkbox"/>	water related	<input type="checkbox"/>	timber	<input type="checkbox"/>	
research/academic	<input type="checkbox"/>	demolition	<input type="checkbox"/>	other	<input type="checkbox"/>	other	<input type="checkbox"/>	
supplier	<input type="checkbox"/>	vacant	<input type="checkbox"/>	where 'other' boxes are checked please describe in text				
utility company	<input type="checkbox"/>	other	<input type="checkbox"/>					
other	<input type="checkbox"/>							

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

Post your report to: **CROSS, PO Box 174, Wirral CH29 9AJ** Complete confidentiality will be maintained and the technical content, without identification, will be given to SCOSS for analysis. An EMAIL REPORT form is available on the web site www.scoss.org.uk/cross for use when security of electronic transmission is not of concern.