

CROSS

Confidential Reporting on Structural Safety

For an introduction to CROSS see www.structural-safety.org. Email: structures@structural-safety.org

NEWSLETTER No 37, JANUARY 2015

INTRODUCTION

REPORTS IN THIS ISSUE:

389 BUILDING CONTROL AND BUDGET LIMITATIONS	1
414 BLOCKWORK LATERAL RESTRAINT	2
420 CONTRACTOR VARIES STRUCTURAL DESIGN INTENTION.....	3
443 POST-FIXED RC ANCHORS - ERRONEOUS ASSUMPTIONS LEADING TO UNSAFE DESIGN....	3
461 METAL CLADDING PANELS BLOWING IN THE WIND.....	4
462 NON-STRUCTURAL ROOF SOFFIT LININGS — FAILURE	4
465 SECONDARY STEEL ITEMS ON ROOFS IN HIGH WINDS	5
437 MOBILE MESSAGE BOARD IN STRONG WIND	5
482 UNBRACED TEMPORARY PROPPING	6

Reports sent to CROSS are de-identified, categorised, and sometimes edited for clarification, before being reviewed by the CROSS panel of experts. The panel makes comments that are intended to assist those who may be faced with similar issues. In the Newsletters the reports are shown in black text and the comments are shown below these in green italics. Reports and comments are also given on the web site data base.

The number of reports received increases year on year and by no means are all of these confidential although each one is treated as such. The majority are from firms whose principals have decided to share lessons that can be learned. Most originate in the UK but a few have come in the last two years from Australia and Southern Africa, and the occasional report from elsewhere. In 2014 sixty one reports were made, of which thirty seven were published in Newsletters and added to the web site data base. Others have been added directly to the data base, a small number are awaiting further information to be supplied or cannot be published for legal reasons. The remainder will be published in due course. All reports help to improve structural safety and the contributions of the reporters are greatly appreciated. In this Newsletter are descriptions of several site situations, any of which could be precursors to more serious events.

The success of the CROSS programme depends on receiving reports, and individuals and firms are encouraged to participate by sending concerns in confidence to Structural-Safety.

389 BUILDING CONTROL AND BUDGET LIMITATIONS

A reporter is concerned that many local authorities do not seem to have the knowledge or impetus to address some technical issues even if the legislation is there for them as a course of action. The reporter quite often finds Building Control no longer have an internal structural engineer to review calculations or cast an eye over issues identified by Building Inspectors on site. The reporter's firm was recently contacted by one Building Control officer to ask if they checked their own calculations internally. It transpired that if there had been an internal check they would not review them. Otherwise they would have sent them out to an external party. The reporter understands that quite often external checking engineers are on a very limited budget. The other possible port of call would be the local Environmental Health Officer (EHO) who, says the reporter, quite often have limited knowledge of structural matters. The reporter suspects there won't actually be many structural engineers that are aware of the EHO's potential role in such an eventuality.

Comments

Building Control Bodies have a duty to satisfy themselves that Part A of the Building Regulations have been complied with. These checks have never been for every nut and bolt, as the ultimate responsibility rests with the client, the designer and the contractor. It is a legitimate question for a local authority to ask about the level of internal and third party checks as this may help to inform them about the depth of checking that the building control body undertakes. Other factors such as complexity and risk are also considered. It would be expected, however, that internal checking would not be a substitute for any review. The responsibility for the adequacy of submissions lies with the originating designer. ICE is currently preparing a guide to submissions under Part A and an IStructE Committee is looking at similar issues.

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So far as an EHO is concerned the following extract is from the HSE web site:

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
- Bridge Owners Forum
- British Parking Association
- Communities and Local Government
- Construction Industry Council
- Department of the Environment
- DRD Roads Services in Northern Ireland
- Health and Safety Executive
- Highways Agency
- Institution of Civil Engineers
- Institution of Structural Engineers
- Local Authority Building Control
- Scottish Building Standards Agency
- Temporary Works Forum
- UK Bridges Board

*To find reports in the data base go to the **Quick Search** box on any page of the [Structural-Safety](#) site and enter a subject e.g. "wall" and a list of summarised reports will follow. Searches can be refined using **Search data base** facility.*

"Enforcement of health and safety law is split between HSE and Local Authorities (LAs) depending upon the activity undertaken by the duty holder. Local authorities, as with HSE, provide advice and guidance on the management of risk and what the law requires, conduct inspections and investigations, and take enforcement action where appropriate."

An EHO will therefore carry out the same function as an HSE inspector in relation to a work activity for which they are the enforcing authority. Whilst the HSE are the enforcing authority for a majority of construction work, where construction work comes under LA enforcement, EHOs are able to call upon technical support from HSE if required. It is not uncommon for both HSE and building control to be jointly involved in cases where there are concerns over stability and the safety.

The issue of resources and experience is not confined to Local Authorities, the construction industry as a whole faces similar issues. Private sector Approved Inspectors face the same commercial pressures as Local Authority Building Control and it is often clients who drive down fees for building control without appreciating the benefits of having a thorough independent check. Indeed this report could be an incentive to designers to remind their clients that there is no second line of defence and to stress the importance of engaging competent firms and people.

414 BLOCKWORK LATERAL RESTRAINT

A recent building control inspection revealed issues with basement blockwork walls restrained by wind posts. Blockwork walls were being constructed to form basement plant rooms. The walls were approximately 140 thick, 5m high and 20m long. Intermediate lateral supports were provided at 6m centres in the form of wind posts. The masonry panels were designed as having support on all 4 sides. Vertical loading was from self-weight only, but horizontal loading was from differential internal pressures and a line load to account for pedestrians and trolleys moving around the basement. The wind posts were not built into the wall as normal, but were on the face, and ties were built in to the wall and welded to the posts. The reason was that M&E services in the corridor were also being supported by the posts. The blockwork contractor was concerned that movement in the wind post from the services dead load would crack the blockwork and inserted slip joints onto the ties so as to allow for some movement. This, of course, also removed any effective restraint and was not considered by the subcontractor, nor spotted by the main contractor. After being raised as a concern by the building control officer, the slip joints were removed.

Comments

There are at least three lessons that could be learned:

- a) all walls have lateral loads some of which might be poorly defined. Loads which are eccentric add to complexity so all walls need to be robust,*
- b) any masonry wall that does not have substantial vertical loading needs to be looked at carefully,*
- c) There is always a need to define a lateral load then have a clear (and stiff) load path back to ground.*

In this case, the subcontractor made amendments which altered the structural engineer's original design strategy without reference back. What was a small change could have led to failure, and it shows the importance of recognising design assumptions. Also by making the changes, the subcontractor may have attracted designer duties under CDM2007.

NEWS

Open letter from HSE

A letter was recently published to explain HSE's expectations in relation to the management of fire risks prior to and during the construction of timber frame structures. For any project, regardless of the construction method, duty holders have legal responsibilities to ensure the safety and health of workers and those who might be affected by their work activities, including those arising from fire risks. Serious incidents have arisen where fires involving timber frame structures under construction have affected neighbouring buildings.

Full text on the Structural-Safety web site [488 Fire risk in timber framed structures](#).

Many fires occur during construction – see for example: [Managing Health & Safety Risks \(No. 30\): Fires on construction sites](#), [The Structural Engineer Volume 92 \(2014\) Issue 8](#)

Worker hit by falling steel beam

Two construction firms have been sentenced after a 6m long structural steel beam fell from the sixth floor of a building, striking and injuring a worker on a third floor scaffold before crashing onto a busy street. The man, a self-employed sub-contractor, was in hospital for a week and unable to work for two months. The Health and Safety Executive prosecuted both companies for safety breaches and both were sentenced in the Crown Court. Several workers were dismantling the temporary structural framework on the sixth floor of the building when they lost control of the beam. The main contractor was fined £22,500 with £14,854 in costs and a second contractor would have been fined £50,000 had they not been in liquidation.

Correction to Elliot Mall Topic paper

In December 2014 a [Topic paper](#) was published on the subject of the Elliot Mall Inquiry. The email sent to subscribers mistakenly said that the collapse had taken place in Quebec whereas it occurred, in June 2012, in Ontario. Structural-Safety apologises for any confusion caused.

420 CONTRACTOR VARIES STRUCTURAL DESIGN INTENTION

This report concerns two steel beams to support first floor masonry and roof in a two storey house. The reporter says the fabricator provided splice and end plate details. The contractor installed temporary support and lifted two halves of one beam into position and inserted and tightened all bolts. He then lifted the two halves of the other beam into position and was only able to insert half the total number of bolts required because he could not reach into the inner web area masked by the other beam. The contractor did not seek the reporter's approval; the Building Inspector did not notice the lack of bolts; and the reporter only learnt of the situation from the building owner. This was near hit and in future the reporter's notes will include direction to contractors along the lines of...."the contractor shall plan and implement his temporary support and building methodology so as to ensure the permanent works are built as designed". The incident highlights, says the reporter, how modern procurement without professional site supervision is potentially dangerous.

Comments

This also raises the question as to what consideration the designer gave to construction difficulties arising from the design. As has often been noted before with CROSS reports, and elsewhere, the designer should know that what he thought was being built was actually constructed. This is however very difficult when the designer does not have a site role so contractors must be aware of the risks of making unauthorised changes. Here this was not so much a deliberate change as an omission made in order to construct the works. A designer should also ensure that his design can actually be built. Again, by making the changes the contractor may have attracted designer duties under CDM2007.

There have been many classic failures caused by unauthorised changes. For example the [Flixborough](#) disaster in 1974 when there was a major explosion due primarily to a plant modification made without a full assessment of the potential consequences. Another was the [Hyatt Regency Walkway](#) collapse in 1981 when the method of suspending the walkway was changed without consideration of the design principles. In both cases there were multiple fatalities.

443 POST-FIXED RC ANCHORS - ERRONEOUS ASSUMPTIONS LEADING TO UNSAFE DESIGN

Structural engineering consultants on a recent project have reported that a number of steel to RC moment resisting connections were required. The steel fabricator proposed forming these connections using post-fixed anchors and the design was undertaken by their engineer. The reporter's firm reviewed the connection calculations which gave reduction factors for the capacity of the anchors and, when queried, the fabricator's engineer confirmed that this factor accounted for both anchor spacing and concrete edge distance in accordance with the fixing manufacturer's design guidance. During construction the reporter became concerned about one of the fabricator's designs and undertook a check using the fixing manufacturer's proprietary design software. In doing this it was realised that several of the proposed fixings did not have the minimum concrete edge distance required, and when these fixings were disregarded the software calculated that the design had only a small fraction of the required capacity. The issue was raised with the fabricator's engineer who explained that they had specified an adhesive type of grout and that this adhesion between the steel and the concrete meant that concrete edge distances could be ignored when calculating anchor capacity. There was no reference or mention of this assumption in any of the connection design calculations or on drawings. The fixing manufacturer said that those anchors without the required edge distance would only have a small but unpredictable capacity and that there was no established design

method for accounting for adhesion between the steel and concrete. Several of these connections had already been installed on site but fortunately had only had a small proportion of the full design loading applied. Extensive strengthening works were required to achieve the required capacity in accordance with the manufacturer's guidance. Had these issues not been identified then there was very real danger that part of the structure would have collapsed and the reporter is concerned that engineers may be using post-fixed anchors without complying with the manufacturer's guidance or ensuring that their design assumptions are applicable. It was also very worrying to learn that such an important design assumption had not been communicated in calculations or on drawings.

Comments

Fixing problems make up 10% of all reports to CROSS and of these many have related to post-drilled fixings. The Alert [Tension systems and post-drilled fixings - March 2014](#) gives details of several cases of failure and advice on inspecting existing installations and installing new fixings. The importance of following manufacturer's instructions is stressed. A review of the design process for many proprietary fixing items will reveal the complexities of differing design processes. It is course very important not to assume that recommendations for one product will suit another. Many failure studies highlight that they result from errors in apparently small items or that what one party thought was being built was not actually so. A feature in some of the ceiling collapses previously reported (enter "ceiling" in Quick search box on web site) was failure of the anchorages. A lesson might be that where these are key components, part of the QA procedure should be site testing to ensure their strength capacity. [The selection and installation of top fixings for suspended ceilings](#) published by AIS gives advice on all aspects including testing for smaller fixings. The relevant British Standard is: [BS EN 13964:2014 Suspended ceilings. Requirements and test methods](#).

461 METAL CLADDING PANELS BLOWING IN THE WIND

A local authority was called to investigate a dangerous structure where metal cladding panels on the 10th floor of a student accommodation block were flapping in high winds. The building had been constructed two years previously and had been subject to a building control check on both calculations and site work. The cladding panels were of aluminium (3-4mm thick) which were folded at the edges and fixed into a supporting frame using 24mm long self-tapping screws fixed on site. There were a large number of fixings per panel, and subsequent investigation found the calculations to be adequate for standard design wind loading. The cause of failure however was identified as flexing of the panels under the fluctuating wind load which led to prying forces in the fixings for which they had not been designed. This demonstrates the need for fixings and systems to be checked for dynamic and quasi-dynamic forces, and that thin panel systems would be better stiffened in some way.

Comments

There have been previous similar incidences and a very early report to CROSS ([Cladding fixed to stainless steel](#)) cited a failure of cladding panels. The cause was that the self-tapping screws had simply vibrated out under fluctuating wind pressures. A low grade stainless steel had been used which would not accept self-tapping so the contractor pre-drilled pilot holes and the resulting slackness allowed the screws to unwind. Vibration due to wind effects is well known and dynamic effects should always be considered, particularly where fixings are concerned. Risks can be minimised by education, good procedures and checking of designs. Fixing selection is often carried out by specialist contractors but these should be critically reviewed by the principal designers. There is a strong argument for designs to be reviewed by an experienced engineer, with no connection with the design. This is not a compliance check but to spot conceptual errors, such as the importance of fixings and their interaction with associated components, and to bring to bear the benefits of experience.

462 NON-STRUCTURAL ROOF SOFFIT LININGS - FAILURE

The reporter has observed the occurrence of compressed fibre cement sheets becoming dislodged from the soffit of several buildings in Australia. This lining is typically considered to be non-structural but with linings on buildings of 15 or more storeys, the risk of these falling and causing damage to people and property is considerable. Failure typically appears to be in the form of the sheeting pulling over the head of fixing screws. The reporter believes these soffit linings are typically not being designed by a structural engineer but that installers are utilising the product design information to determine framing and screw spacing. It is apparent from reviewing the product design information available that design tables have been provided for residential structures and conditions. In Australia

these are typically categorised as being two storeys or less, so significantly different to conditions being experienced at 15 storeys or more. The lesson to learn here, says the reporter, is that product design information should be reviewed for applicability to the conditions and, if the conditions are outside the stipulated parameters, the product application should be engineered from first principles utilising product capacity information and support from the product manufacturer.

Comments

This is similar to report [461 Metal cladding panels blowing in the wind](#) where fixings failed due to wind vibration and it adds to the trend of problems with fixings. The soffit panels in this case are akin to ceiling panels where there are many examples of failure. These are amongst the “non glamorous” aspects of design which do not get the attention they need. Generally the applied loads are uncertain; the adequacy of the fixings is uncertain; the reliability of installation is uncertain and the consequences of failure potentially can be dire. A sheet falling from 15 storeys could be lethal. To guard against this designers, whether working for consultants or for contractors, must appreciate their responsibilities. Redundancy is required and in safety critical cases a robust retention solution should be considered. Furthermore it is always unwise to extrapolate design aids beyond the scope for which they were originally intended.

465 SECONDARY STEEL ITEMS ON ROOFS IN HIGH WINDS

This reporter lives in the highest wind speed region in Australia where the working wind speed of over 250km/hour (70m/s,155mph) and an ultimate speed of 316km/hour (90m/s,196 mph). His firm routinely ensures that flashing, cappings, solar hot water heaters, ridge vents, skylights, satellite dishes and other appurtenances are tested by the manufacturer for the wind loads and rated accordingly. They must then be fixed to the roof in accordance with the manufacturers' recommendations and the engineer must ensure that the members they are fixed to can take the uplift loads. Roller doors and shutters and windows (including glass, frames and fixings) on walls are also areas of concern.

Comments

This is the kind of engineering recommended in the comments on the previous two reports ([461 Metal cladding panels blowing in the wind](#), and [462 Non-structural roof soffit linings – failure](#)) where high, and uncertain, drag and uplift loads should be taken into account by the designer.

437 MOBILE MESSAGE BOARD IN STRONG WIND

A mobile variable message sign was set up on a hard standing away from the hard shoulder on a motorway and when the wind caught the sign it acted as a sail and moved onto the region of the hard shoulder and lane one. The manufacturer's instructions advised that the sign should not be erected when the wind is over 25mph (11 m/s). The reporter suggests that this is not a safe approach. It mirrors an approach taken in the entertainment industry with stage safety. (See comments below on this aspect)

Comments

This emphasises the need, and obligation, for a risk assessed approach. A moving sign on a motorway could have had catastrophic consequences and is in the category of a “high impact, low probability event”. The 2011 HSE publication [Preventing catastrophic events in construction](#) contains the following warning:

“The industry may not be sufficiently aware of the potential for it to be associated with more major events (those involving multiple deaths and/or significant damage to property and infrastructure). These major or catastrophic events may have wide implications such as extensive delay or project failure, significant business impact, loss of money and loss of reputation for all concerned.”

If the wind design speed is 11m/sec and it happens to gust to 13 (who can tell accurately at such low speed?) the force jumps to $(13/11)^2 = 1.4$ which might well eliminate any stability safety margin. The standard safety lesson is enshrined in the word “sensitivity”. How sensitive is safety to the basic design assumptions?

The Highways Agency says: ‘It appears that the incident occurred when the mobile sign was in use, and the supplier's instructions regarding safe deployment had not been followed. The highways authority keeps under review the use of all temporary and operational traffic management equipment and procedures, and where necessary will remind its Service Providers of their obligations, and the

need to use equipment safely and only as advised by the supplier’.

In the entertainment industry outdoor temporary stages are frequently designed in accordance with [Temporary demountable structures, Guidance on procurement, design and use, Third edition](#), published by the Institution of Structural Engineers, 2007 where guidance is given on the active management of such structures in the event of high winds. This, however, would not be practical for unattended items such as motorway signs.

482 UNBRACED TEMPORARY PROPPING

An alarming photograph has been sent by a contributor.

Comments

Many years ago BRE Good Building Guides contained an almost identical photograph as shown below. Clearly any disturbance of the props could result in collapse. If these props were erected by a householder, the individual was putting his own family’s lives at risk. If they were erected by a builder, the individual was at risk of a manslaughter charge and custodial sentence, should they have failed and caused death.



2014 photograph from a reporter



BRE Good building guide illustration

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HOW TO REPORT

Please visit the web site
www.structural-safety.org
for more information.

When reading this Newsletter online
[click here](#) to go straight to the reporting page.

Post reports to:
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Comments either on the scheme, or non-confidential reports, can be sent to structures@structural-safety.org

DATES FOR PUBLICATION OF CROSS NEWSLETTERS

Issue No 38 April 2015

Issue No 39 July 2015

Issue No 40 October 2015

Issue No 41 January 2016