INTERNATIONAL DEVELOPMENT OF CROSS

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ABSTRACT

CROSS (Confidential Reporting on Structural Safety) was established in 2005 by the Standing Committee on Structural Safety (SCOSS) to collect, analyse, and publish, personal reports about failures and the safety of structures. The objective is to learn from the experiences of engineers and help to prevent future failures. Names of authors are confidential and identifying features from event descriptions are removed. A panel of experts provides commentary on the lessons that can be learned, and the reports and comments are published on the website in quarterly Newsletters and added to the searchable data base (www.cross-structural-safety.org). When a trend is detected, action is taken to influence changes in culture and, when possible, in standards or legislation. A proposal is made for an Australian connection to the CROSS system to improve the national and international knowledge base for the benefit of engineers and the public.

UK operation

The Standing Committee on Structural Safety (SCOSS) was founded over 30 years ago to provide advice to the President of the Institution of Civil Engineers and the President of the Institution of Structural Engineers on the state of structural safety in the UK. It has a committee of distinguished engineers who meet regularly and a technical secretary who runs the normal business of the venture. Biennial reports are published along with alerts on topics of more immediate importance and these are highly regarded within the design and construction industry.

In 2005 SCOSS decided to expand its sources of material and established a scheme for Confidential Reporting on Structural Safety – CROSS - to collect and process personal reports about failures and the safety of structures. The objective is to learn from the experiences of engineers and help to prevent future failures using successful techniques developed by the aviation industry in the USA and the UK.

The Institution of Civil Engineers and the Institution of Structural Engineers have been major supporters, as have been several UK government departments, including the Health & Safety Executive, the Sustainable Buildings Division of the Communities and Local Government, the Highways Agency and the Scottish Building Standards Agency. Of particular importance is the interest of Local Authority Building Control which represents all building control departments in England. Funding from the Institutions and UK government departments has been used to establish the programme but additional resources will be needed as the International concept is developed.

Anyone involved in the building and civil engineering professions, but especially structural engineers and civil engineers can report to the scheme. Very importantly complete confidentiality is maintained and there are procedures to ensure that this is strictly complied with. Anonymous reports will not be accepted because the contents
cannot be verified. CROSS does not provide advice on urgent matters, and this is stated on the web site, but nevertheless some people reporting concern ask for help on current issues because they feel that they have nowhere else to go.

Reports can be made offline or online. For offline reporting there is a form which is posted to a secure address where it will be opened and seen only by the director. If the reporter is not concerned that an online form will leave an electronic trail there is an online version of the form. The material is processed in the same way as for offline reports. A report should give:

• a description of the event or concern,
• if there was a failure, then the cause of the failure if known,
• lessons that could be learned.

There is a process for classifying reports and adding them to a data base and if more information is wanted the reporter will be contacted and asked for further details.

An expert panel of engineers is sent de-identified versions of the reports, i.e. with no identifiable features and no names, and they comment upon them to offer solutions, without being adversarial or apportioning blame, so that readers of the report and the comments on it can benefit. The skill and dedication of the panel are crucial to the CROSS operation. The panel originated with several SCOSS members and has been extended to include engineers with skills in the types of problem being considered and there are others who may be called upon for specialised advice. Their comments are edited and combined to give a balanced view and reviewed again by the panel so that the members can be satisfied that the results are factual, sensible, and helpful.

Quarterly Newsletters are published containing a selection of reports, complete with comments, and emailed to a list of subscribers. This numbers around 6,000 people, ranging from students to managing directors. They come from consulting firms, contractors, local authorities, universities, and elsewhere. Anyone can join through the web site without charge. There are links in the Institutions’ eNewsletters and some organisations circulate the Newsletters to their members or employees.

Reported subjects have covered design, construction, use, demolition, and regulation issues associated with buildings, specialist structures and bridges. As the scheme has matured, the quality of report has increased and recent examples have included the failure of a winch on an offshore oil rig, the uncontrolled collapse during demolition of three multi-storey large pre-cast panel buildings, exploding concrete, concerns about public art, and collapses caused by high snow loads in the northern parts of the UK. The latter are being investigated with the Scottish Government with indications that the depth and weight of accumulated snow may have been greater than is recommended in current codes. Reports are usually made by fellows and members of the Institutions who work for firms of consulting engineers, but others are from contractors, building control officers, surveyors, and even some clients.

Figure 1 shows the overall percentages for reports and indicates that construction related concerns amount to nearly half, with design and normal in-use operations amounting to about a quarter each. This is an example of the type of information that is
held on the data base, others being: form of structure, materials involved, concerns about design, construction, operation, and demolition, and other parameters.

The reasons for most failures, individually or in combinations, are due to: ignorance, lack of judgement, carelessness, poor analysis, ignoring procedures, changed circumstances, bad value, or poor operation. Classification of reports is based on lists devised by the librarian of the Institution of Structural Engineers as it was found that there is no generally accepted way of categorising defects, or systemic failures. The list is simple but as most reports have little in the way of forensic data this is entirely suitable. As more reports are submitted the system will be refined.

Having received reports, classified them, obtained comments on the de-identified versions, and published them the most important aspect is still to come. How can the information be used to affect behaviour and benefit both engineers and the wider community? The Newsletters are a permanent record but may be forgotten soon after reading so the reports are stored in a data base on the web site, and the aspiration is that this will be a resource as engineers say: ‘What does CROSS have on ......?’ when thinking of a project with which they are involved. The cycle is shown in Figure 2.

To get to the final stage needs time and publicity and will be an ongoing business but another powerful way is to influence regulators and standards writers. Detailed evidence on failures, particularly if there is systemic failure or clusters of failures, is rare so a structured and moderated source of data can be of great interest when setting standards and making recommendations.

A recent example relates to reports that have been received on instances of secondary fixing failures, notably those that hold up heavy acoustic suspended ceilings, with a number of large scale collapses but fortunately no casualties, in cinemas and other publically accessible areas. As a result of action by SCOSS, British Standards Institution is reviewing the relevant code(s) and the UK Fixings Association is to bring out fresh guidance. An example of how the failure of a simple fixing system had
enormous consequences can be found in the story of the Boston Big Dig tunnel where the collapse of a panel held by bolts costing a few dollars ended with liabilities reportedly of many millions of dollars. Other reports, and the intervention of SCOSS, have resulted in manufacturers changing the advice given on their web sites.

Evidence of fixing failures, boundary and retaining wall collapses, and robustness generally have been presented to the Working Party that is reviewing the structural sections of the English Building Regulations. If and when these are incorporated then changes will have been influenced by CROSS. The SCOTCROSS scheme commissioned by the Scottish Government, received 1,200 reports from local authorities about objects falling, or in danger of falling, from buildings. As a result the Scottish Building Standards Agency is to issue further advice about the condition and maintenance of older buildings in the country.

CIRIA (Construction Industry Research and Information Association) is carrying out an investigation into Major Hazards in Construction and information is being shared with CROSS. There has been industry consultation and confidential analysis of case studies of actual ‘top events’; which are low probability but high consequence events.

The CROSS scheme is growing and is respected by those who know of it including senior figures within the industry. There is a high quality to many of the recent reports and events are being brought to the attention of the programme which would not otherwise be published. It is believed that the reputation of the Institutions is enhanced by their association with an independent and unique scheme that provides beneficial advice to their members and helps to protect the public.

**International development**

Since the publication of the first Newsletter there has been an interest from outside the UK in the programme and some reports have originated from other countries. The problems of structural safety and near miss (or near hit) incidents is of almost universal concern. All too frequently buildings collapse with fatalities and serious injuries somewhere in the world but conversely the organisations who are interested in CROSS are from countries with good safety records. Perhaps, however, this is to be expected.

Seventy four percent of web site hits are from the UK but, significantly, the next highest at 6% are from Australia. Next is the USA with 3% followed by Ireland, Netherlands, India, Singapore, New Zealand, UAE and Hong Kong. The Confederation of European Building Control has a work group examining ways of defects reporting with a view to reducing the considerable cost throughout the EU of remedial work, particularly on new buildings and discussions with this group are ongoing.

A good example of international cooperation is the International Confidential Aviation Safety Systems (ICASS) Group that promotes confidential reporting systems as an effective method of enhancing flight safety in commercial air transport and general aviation operations. The principal objectives of the ICASS Group are:

- to provide advice and assistance in the start up and operation of a confidential reporting system,
- to facilitate the exchange of safety related information,
• to identify solutions to common problems.

The group has grown over a period of 20 years from the original US system to include 13 countries, all with the common goal of increasing flight safety. It is likely that whenever anyone takes a flight their journey is more secure than it would have been without the work of the group although absolute safety is extremely difficult to measure. A similar arrangement could be established amongst counties whose engineers set up reporting systems on structural safety.

The Australian context

Structural engineering is an international discipline and to quote from IStructE’s definition of structural engineering - *structural engineers around the world are committed to sustainably developing a safer built environment*. Thus structural engineering in Australia is not very different from the practice in any other part of the world and wherever one goes, the same laws of physics apply and gravity works in much the same way – we would be in trouble if they didn’t. The significant differences are social, cultural and environmental. Our prime responsibility is to safeguard the public by ensuring the safety of the structures we design. However we are also human and mistakes can be made and thus we need to share knowledge with each other and learn from these mistakes. It is about managing and minimising risk.

In today’s environment we have a vast capacity to store knowledge, but the problem we wrestle with is how we pass that knowledge on from one generation to another; and equally importantly how we find and access that knowledge that will be relevant to the problem in hand – i.e. how do we capture and use the “Lessons Learned”? Knowledge management has become a huge industry in itself. As engineers we certainly have a thirst for this, particularly when the subject is structural failures and we only have to look back to ASEC2008 when the session “Lessons from Failures” was standing room only. Also many will have fond memories of “Miller’s Tales” in Engineers Australia magazine – for many of us it was the first article to be read in the magazine as it regularly brought to our attention some key issue affecting the engineering profession and often related to failures and safety.

More recently we find workplace health and safety legislation in Australia is following the trend in the UK with much greater emphasis on the role of the designer in ensuring the health and safety of all users of the structure from construction, through its use to ultimate disposal or demolition. With a new Model Workplace Health and Safety Act being drafted by the Federal Government and due to take effect in early 2012, Consult Australia (formerly ACEA) is calling for a National Code of Practice for Safe Design of Structures as an aid to promoting a safety in design culture across the building and construction industry. In developing this, the importance of information transfer between stakeholders has been stressed and it is clear that there is a need for more tools that could assist the designer in ensuring compliance with the legislation. CROSS could be one such tool.

There have been discussions with the Structural College of Engineers Australia for a year about either joining CROSS or establishing a parallel system. The principles and procedures can be used freely but there has been a considerable amount of time and
effort devoted to creating CROSS and this is not so easily transportable. Each country will have differences in the type of concerns that need to be addressed and there are different conditions and circumstances even though the principles are universal. As has been mentioned a panel of experts is essential to interpret reports and give balanced independent advice on what lessons can be learned.

There must also be an active process for obtaining data. Many hurdles have to be overcome to convince engineers to report. Limited perceived value, do not know how, not enough time, fear of being blamed, fear of being shamed, unfamiliar with the concept, fear of being disloyal, are all disincentives to participate. Overcoming these is not a simple process and needs publicity and presentations to groups who are likely to send in reports and who are also likely to benefit. Personal contact is probably the most effective way of starting a scheme and calls to senior personnel from a trusted source asking for information have been a good source for CROSS. A majority of the reports have come from fellows of the Institutions who are directors or principals of businesses and are confident that their report is important and there are benefits to be passed on. Interestingly, these people are not particularly concerned about confidentiality because they use the on-line method for reporting which is not as secure as the off-line method.

**Conclusion**
The establishment of an International group of confidential reporting schemes on structural safety would enable organisations in different countries to share information that could benefit them all. Major disasters in most countries are well reported and in due course the results of forensic investigations are published. There are however important precursors which can be reported to CROSS type systems and knowledge about these can help to prevent bigger failures when the information is passed on. Examples have already been given and if the data bases for each system were linked the lessons to be learned could become an international resource.

Funding is also an issue. It is difficult to show the cost benefits of successful safety schemes because, by definition, there are not usually any dramatic results to show. However the cost of structural collapses can be huge in terms of fatalities, money spent in investigations, remedial works and compensation, the careers and wellbeing of engineers who may be named, and the reputations of the firms involved. Weighed against these the cost of running a scheme on CROSS lines is insignificant. Nevertheless independent sources of funding have to be found and maintained. If there is an international community of schemes there will have to be a focal point to co-ordinate matters and that will need contributions from the member organisations.

**BIOGRAPHY OF PRESENTERS**

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