Call for support

by Alan McLean and Lizzie Brown

Over the past six months, we’ve seen many inspiring events, projects and learning opportunities focus on the important role engineering plays in humanitarian efforts. RedR Australia and Engineers Without Borders (EWB) Australia staff and volunteers have been out in force, actively sharing their stories and experiences around Australia. We now look forward to the technical workshop series and the major conference in early December in Melbourne.

The work of both RedR Australia and EWB Australia involves many interactions with engineers and engineering companies. Sometimes conversations between individuals lead to the comment: “The work of RedR and EWB is extraordinary. I would like to be directly involved, but I can’t because…” Our understanding response, in one form or another, contains the message: “Not everyone can go to the field. However, almost everyone can support the cause in some way.”

The work of EWB and RedR is both collaborative and complementary. RedR’s mandate of humanitarian relief after emergencies and disasters is clear, and has come into sharper focus due to global events of recent years and months. EWB’s mandate is equally clear. Its work is focused on the alleviation of poverty through creative and sustainable development projects based on local partnerships.

The connectedness of both mandates is very strong. Attention to preparation ahead of disasters, energy applied to try to reduce the impact of disasters and creation of resilience are all vital in the pursuit of the Millennium Development Goals.

A balanced analysis of how to provide contributions should lead individuals and companies to support both RedR Australia and EWB Australia.

Opportunities include:

• volunteering in Australia through EWB’s chapter network, knowledge hubs and local projects in both urban and remote locations
• applying to join the RedR Australia Standby Register of technical personnel
• contributing financially to EWB and RedR as shown on their websites
• creating opportunities for EWB and RedR Australia field returnees to share their experiences via forums, staff meetings and other specially created events

Natural disasters
Any discussion of structural failure in recent years must consider the role of natural disasters. Earthquakes in Haiti, Chile, Sumatra, Christchurch and Japan have devastated structures and resulted in significant loss of life, with the resulting tsunami in Japan earlier this year being particularly destructive. In the UK in 2009, flooding was an issue, with a number of bridges in Cumbria collapsing or being severely damaged. This year parts of Australia experienced significant flooding
On Saturday 14 August 2010, while concrete was being placed for the deck of a bridge over the Barton Highway in Canberra, a portion of the temporary works supporting the fresh concrete collapsed onto the road below, injuring 15 workers.

PHOTO: LANNON HARLEY, CANBERRA TIMES

and in 2009, the Black Saturday bushfires resulted in the loss of 173 lives and widespread structural damage in Victoria.

Natural disasters of this magnitude and scope have prompted discussions across the profession regarding the adequacy of design codes and the manner in which structural engineers approach risk analysis.

Buildings

Many building collapses throughout the world have tragically resulted in significant loss of life. For example, a 15 year old apartment in New Delhi collapsed in 2010, with at least 51 fatalities, and a mosque minaret collapsed the same year in Morocco, with 41 reported fatalities; in both cases, the engineering media has reported that heavy rainfall could have played a role in the failures. One of the more dramatic collapses was that of the Lotus Riverside apartment building in Shanghai, which killed one worker. The 13-storey building fell on its side, remaining almost intact, in June 2009. Although there is much speculation within the engineering community, the definitive cause of failure is currently unreported.

In New York City, a four-storey residential and commercial building collapsed in June 2009, injuring four, with New Civil Engineer magazine reporting cracks had been found throughout the building prior to the collapse. This was the second such collapse in New York, with little information available on causation in either case. In Cologne, Germany, a six-storey city archive building collapsed in March 2009, resulting in two fatalities. While the cause of the failure is unclear, the engineering media has reported speculation that the construction of a new subway line adjacent to the archive was related.

This year in the US, heavy snow falls resulted in a significant number of roof collapses, including a staggering 172 roof failures reported in Massachusetts between 1 and 9 February alone, 98 of which were commercial or industrial facilities. The failure of roof panels at the Hubert H Humphrey Metrodome in Minnesota was also due to snow load.

Cranes

A series of crane failures in 2008 in the US prompted concerned discussion in the engineering media. A summary of the failures is provided by Engineering News Record magazine. It includes four fatalities from a crane collapse in a refinery in Houston, Texas; two fatalities from a tower crane collapse in New York City as a tower crane snapped at its turntable; two fatalities from a tower crane collapse in Miami; and seven fatalities in New York City as a tower crane collapsed during a climbing manoeuvre (with the Occupational Safety and Health Administration pointing to unsafe rigging as the cause). Crane failures were not limited to the US – for example there were three fatalities in Singapore the same year and six fatalities in China in 2010.

Power plants and industry

While the earthquake and tsunami damage to Japan’s nuclear power stations this year is well known, a significant failure in the Sayano-Shushenskaya hydropower station in Russia caused widespread destruction to the facility and 75 fatalities. The New Civil Engineer magazine reported
that in August 2009, the holding down bolts of a turbine failed, causing the 1500t unit to break free and water to flow into the control rooms and turbine hall. The surging water and subsequent electrical explosions caused significant structural damage. The official investigation concluded that the holding-down bolts failed due to excessive vibration of the turbine.

In terms of environmental damage, the BP failure in the Gulf of Mexico dominated the news, but the failure of a 40m long segment of a tailings dam wall at the Ajka alumina refinery in Hungary in October 2010, resulted in seven fatalities and the pollution of approximately 1000 hectares of land with caustic red mud. Engineering News Record reported that preliminary investigations point to unsuitable dam foundations as a potential cause of failure.

Bridges

Bridge failures have been characterised by failures during construction, scour failures, and failures of bridge connections such as those at San Francisco’s Oakland Bay Bridge and Glasgow’s prestigious Clyde Arc Bridge.

In Ireland, the investigation into the sudden collapse of a portion of the Malahide Viaduct in August 2009 identified the cause of failure as scour action undermining the weir that surrounded and supported Pier 4, leading to the pier’s failure. Just as concerning was the investigation’s finding that information relating to historic scouring, maintenance, and the construction details of the viaduct had been lost due to corporate memory loss – a result of staff turnover. Scour has also been identified as the cause of failure of a railway bridge over the River Crane in West London in November 2009.

A number of failures have occurred during bridge construction, including the failure a portion of the temporary works of the Gungahlin Drive Extension Project Stage 2 Bridge over the Barton Highway in Canberra in August last year. The collapse occurred as concrete was being placed for the deck, with SMEC’s preliminary investigation report concluding that the main girders supporting the formwork were not braced to prevent their lateral movement when subjected to the loads imposed by the concreting works.

In December 2008, Engineering News Record reported on the collapse of a cable-stayed pedestrian bridge during construction in the Atlanta Botanical Gardens, resulting in one death. As with Gungahlin Drive, crews were pouring concrete for the 180m long, 12m high bridge, when a 120m section of the deck collapsed. Inadequate formwork design, fabrication, erection, support and bracing are reported as the cause of failure.

Similarly, in November 2009, while pouring a twin-deck, partially cable-stayed bridge in the Pyrenees principality of Andorra, a 20m long section of formwork collapsed, resulting in the deaths of five workers.

Perhaps the most high-profile bridge construction collapse was a footbridge in New Delhi, just 12 days ahead of the Commonwealth Games in 2010. The 100m long, bow-string arch bridge collapsed, with the deck breaking into three parts and injuring 23 people. Numerous Indian bridges have collapsed during construction in recent years, one of them, an unfinished 1100m long cable stayed bridge in Rajasthan, resulted in the deaths of more than 45 people.

Other structures

A number of chimney collapses in India have raised concerns regarding design and construction practices and in Australia a prominent failure was the Southern Star Ferris Wheel in Melbourne, which was closed due to structural deficiencies.

Understanding failures

While the vast majority of structural projects are engineering successes, the failures outlined here serve as a reminder that the risk of failure is an ever present reality for structural engineers and it is important to understand the failures. After all, as retired Professor Oswald Rendon-Herrero put it: “What sort of doctor would study only healthy persons?”

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