Avoiding crane collapses: planning is key

Alastair Soane stresses the need for diligent risk analysis, training and application of best practice when operating mobile or tower cranes.

The deadly collapse in September of a large mobile crane onto the Grand Mosque in Mecca, Saudi Arabia, killed over 100 people and injured several hundred (Figure 1). Reasons for the collapse have not yet been determined or made public, although a possible contributory factor is said to have been a storm at the time.

There is a history of mobile and tower crane failures, and indeed there are websites detailing many collapses. In 2012, one of the USA's largest mobiles collapsed at a refinery and there were four deaths. In 1999, also in the USA, the tallest mobile in the world, the 'Big Blue', collapsed during a lift at a stadium. Cranes have also collapsed elsewhere, including some in the UK, with fatalities, damage and disruption.

As with all major structural failures causing death, the human cost is high, the financial impact can be huge, and for the companies concerned the reputational damage can be severe.

Catastrophic events

The report, *Preventing catastrophic events in construction*, prepared by CIRIA and Loughborough University for the Health and Safety Executive (HSE) in 2011, covers many of the issues relating to 'low-probability but high-consequence' safety hazards by looking at:

- the types of catastrophic event which have occurred or which might occur during construction
- the reasons for occurrence when there have been (or could have been) catastrophic events during construction, including an examination of the underlying factors

Catastrophic events are events that are beyond the ordinary or routine and are characterised by being of low probability but high consequence. Examples included in the report are: collapse of permanent structures, collapse of temporary works, collapse of plant or equipment such as cranes, fire, and tunnel collapse.

Risk analysis

When an event can affect large numbers of the public, the risk analysis has to be particularly rigorous. Such cases might include a temporary structure collapsing onto a railway track with the possibility of causing a derailment (a report sent to CROSS), or temporary stages collapsing onto audiences (the subject of a SCOSS Alert). Another class of risk is where a crane collapse could damage safety-critical equipment during the construction of, say, a nuclear power plant. If a crane could collapse, for whatever reason, then the surroundings would be subject to high levels of damage and people in the vicinity could face fatal hazards.

A major element of the risk analysis for any temporary structure, including plant, is the question of what consequences might arise from failure. If these could be catastrophic then appropriate actions must be taken to minimise them. Considering what constitutes a catastrophic failure demands an imaginative mind-set and the experience to know how circumstances might unfold. Learning from previous experiences is a sound attribute and it is best to have several points of view from different people as input into the process. Risk analysis must not simply be a formality. If a risk of catastrophic failure is identified, then authoritative action is required with the aim of eliminating the risk. If this is not possible then, as with any risk mitigation process, steps must be taken to minimise the risk, including informing owners of adjacent facilities of the circumstances.

Such processes are used by major clients, such as railway undertakings and highways organisations, which are acutely aware of the consequences of a major failure. Their standards are imposed on supply chains and are subject to rigorous scrutiny. The temporary structures industry, which also deals with large and sometimes slender towers not unlike cranes, has in place systems for checking designs and installations to comply with best practice.

**Recommendations**

There is legislation in many countries about the safe use of cranes. In the UK, the HSE has a number of webpages and publications on the subject and its guidance states that:

"Tower and mobile cranes are used extensively on construction projects and..."
present two principal hazards:

* Collapse of the crane – such incidents present significant potential for multiple fatal injuries, both on and off-site;
* Falling of the load – these events also present a significant potential for death and major injury.”

The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)[3] emphasise that all lifting operations involving lifting equipment must be properly planned by a competent person, appropriately supervised, and carried out in a safe manner. All crane operators, and people involved in slinging loads and directing lifting operations, must be trained and competent.

The Occupational Safety & Health Administration (OSHA) of the US Department of Labor similarly identifies the major causes of all accidents involving cranes as: contact with power lines, overturning, falls, and mechanical failures. Its Compliance Directive for the Cranes and Derricks in Construction Standard[4] gives comprehensive checklists for lifting operations.

Elsewhere, there is a great deal of advice available from crane manufacturers, from contractors, and from trade bodies such as the Construction Plant Hire Association in the UK. The common themes, as set out by the HSE[4], are:

- planning lifting operations
- having safe systems of work
- supervision of lifting
- thorough examination of equipment

Conclusions

It is known throughout the industry that crane failures occur. It is known that some collapses have catastrophic consequences. Why then, despite legislation and advice, does this continue to happen? Cranes are large, unwieldy, temporary structures functioning under site conditions and are expected to function with reliability and safety. SCOSS uses the three Ps to categorise risk: People, Product and Process. With most crane operations the people are trained, the product is sound, the correct processes are followed, and there are no problems. When there is an issue the product and process probably remain the same, but there may be a human factor involved. Diligent risk analysis, training, and the application of best practice are the principal keys to protecting operatives and the public from low-probability, high-consequence catastrophic events.

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REFERENCES: