CRANE STATISTICS & CASE STUDIES

CHAN Yew Kwong
Deputy Director (Construction & Equipment Safety)
Occupational Safety and Health Division
Number of Registered Cranes

- Overhead Crane: 5,955
- Lorry Loader: 3,259
- Gantry Crane: 2,158
- Crawler Crane: 1,458
- Mobile Crane (Truck/Wheel Mounted): 1,246
- Tower Crane: 541
- Other Cranes: 3,120
Number of Registered Crane Operators

Total 5,962
- Mobile Crane Operator 2,734
- Tower Crane Operator 1,458
- Crawler Crane Operator 1,439
- Dockside Tower Crane Operator 331
Crane-related Workplace Incidents

No. of Workplace Incidents involving Cranes, 2007 and 2008

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace Fatalities</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>(involving cranes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Fatal Workplace Injuries</td>
<td>107</td>
<td>139</td>
</tr>
<tr>
<td>(involving cranes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dangerous Occurrence (DO)</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>involving Collapse, Failure or Over-turning of Cranes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Crane-related Workplace Fatalities, 2006 - 2008</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>8 fatalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by steel structures on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a lorry crane which had lost its stability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and toppled (CON)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker fell into the excavation when he</td>
<td></td>
</tr>
<tr>
<td></td>
<td>was guiding the hoisting process of a mobile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>crane (CON)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 3 workers were killed, with another 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>injured in a ringer crane collapse (SSR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker fell over the barricades of a roof</td>
<td></td>
</tr>
<tr>
<td></td>
<td>after being struck by a swaying concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bucket lifted by a tower crane (CON)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 2 workers were struck by steel plates while</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fell during the lifting operation of a mobile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>crane (LOG&amp;T)</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>4 fatalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was thrown out of the lorry crane-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>s bucket when the hydraulic pump of the crane</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ruptured and caused the boom to swing (LANDS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAPAE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by a falling formwork</td>
<td></td>
</tr>
<tr>
<td></td>
<td>component when it was hoisted by a mobile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>crane (CON)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by a crane boom which</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gave way and collapsed (SSR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by the pre-cast concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>section when it was loaded onto a prime mover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>by a gantry crane (MFG)</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>5 fatalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by a falling rebar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>when it was hoisted by an overhead travelling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>crane (MFG)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 worker was struck by a metal pipe which</td>
<td></td>
</tr>
<tr>
<td></td>
<td>swung towards him when it was hoisted by a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gantry crane (MFG)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 3 workers were killed in a tower crane</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collapse (CON)</td>
<td></td>
</tr>
</tbody>
</table>
CASE STUDY 1:
STEEL PLATES NO ENOUGH!
• A crane operator moved the crawler crane from one location to another within the worksite.

• Operator raised the crane boom to a near maximum boom angle of 80 degree to avoid the nearby building and site office as the site was small.

• Crawler Crane boom tipped over backwards while it was being swung towards the front and the back of crawler crane began to sink.
• Ground condition was soft due to the sunken hardcore.
• Steel plates were placed sparsely apart for crane’s travel route.
• Only 2 steel plates were found under the crane’s track.
• Lifting supervisor and crane operator did not make a proper assessment of ground condition to ensure safe movement of the crane.

• In fact, there was no movement plan!
Findings of investigation

- Lack of competent person to ascertain ground condition safe for travel
- No requirement to have a movement plan for crane
- Wrong method of laying steel plates on soft ground
Steel plates must be placed closely together.
CASE STUDY 2:
NOBODY KNOWS THE WEIGHT!
A main contractor was doing concreting for 2 columns.

A mobile crane (truck mounted variable boom) was used to lift the filled concrete bucket to the column and then discharge the concrete.

The concreting was done without any problem for the 1st column.

During the 3rd lift for the 2nd column, the crane toppled when the boom was reaching the column.
Scene of incident

Column being casted
Outriggers fully extended
• Outriggers on firm ground
• No ground failure
Findings of investigation

- The **Lifting Supervisor** mistakenly thought the load was 0.9 tons. He **did not verify the load’s weight**.

- **Crane Operator** also did not know the load’s weight, nor did he check the load chart before commencing the lifting operation.

- Crane Operator claimed that he did not hear the overload alarm sounded but only felt the crane toppled forward.

- Crane Operator obtained his licence only 4mths before the incident.
Crane toppled due to **overloading**: Load exceeded the crane’s SWL, based on load chart.
Lifting works involved moving sand from inside a storage tank to a sand pile for removal.

The crane used was a wheel-mounted mobile crane (without prime mover) with variable boom length.

After lunch, another crane operator took over to operate the crane.

He proceeded to lift the bucket full of sand from inside a storage tank to the sand pile when the crane toppled forward.
Scene of incident
Outriggers on Steel Plates & Firm Ground
Findings of investigation

• The lifting supervisor & both crane operators signed a lifting checklist, but the load’s weight & working radius were wrong.

• When taking over control, 2\textsuperscript{nd} crane operator did not check the load’s weight, crane capacity & verify the working radii of the crane.

• 2\textsuperscript{nd} crane operator heard the crane’s overload indicator sounded but by then the crane had already started to topple forward.

• 2\textsuperscript{nd} crane operator obtained his license only 3mths before the incident.
Crane toppled due to **overloading**: Load exceeded the crane’s SWL.
Systemic Problems of both Cases

• Crane operators do not follow basics of checking load’s weight and crane’s load chart before lifting.

• Lifting supervisors also did not verify the load’s weight and crane’s capacity for the required working radii, i.e. at pick-up and drop points.

• Over-reliance on safety devices like load radius indicator, overload alarm by lifting personnel to warn of unsafe conditions. They are not intended to take the place of load chart and lift planning.
DON’T BE THE NEXT ONE!

- 2001: crane operator ignored overload buzzer & continued to operate crane, resulting in crane’s collapse.
  - Fined $8,000 & registration was revoked.
- 2002: crane operator ignored overload buzzer & continued to operate crane, resulting in boom’s failure.
  - Fined $15,000 & registration was revoked.

Weight ??

Working radius ??

Mobile crane
Crane operators must:

- Know or can calculate the weight of each load
- Always use the crane manufacturer’s load chart & operation’s manual provided for each crane – language understood by operator
- Never use visual signs of tipping or overload alarm as an indicator of lift capacity.
- Follow strictly safe lifting practices, as well as manufacturer’s procedures for safe operation of crane
- Never overload a crane by ignoring or bypassing the overload alarm - Install a data logger to deter such unsafe behaviour!
CASE STUDY 3:
NO RA & SWP!
**Incident Brief**

- Piling operator & assistant pilling operator were instructed to lower the leader to check on a roller sheave located at the top of the leader.

- First they dismantled the right back stay cylinder from the chasis of the piling machine to placed it on the ground.

- Then they proceeded to dismantle the left back stay cylinder from the chasis to place it on the ground. Just as they were placing the left back stay cylinder on the ground, the piling machine toppled backwards.
Scene of incident
Findings of investigation

- Lack of Training - Workers are not formally trained on the method to lower the leader.

- No Supervision - Workers not supervised by a competent person during the process.

- No Method of Statement on the lowering of the leader

- Inadequate RA - Fail to identify and implement adequate control measures during the RA stage
CASE STUDY 4:
15 MAR 2008, NEW YORK CITY
7 FATALITIES

NEW YORK CRANE CATASTROPHE

Residents had long been worried about collapse and called the crane a menace.

NEW YORK

AT LEAST FOUR PEOPLE WERE KILLED AND A Dozen Others Injured in What Was Described as One of the Worst Accidents the City Has Ever Suffered.

The crane, reaching 90-feet high when it collapsed, fell during construction of a 42-story building on 31st Street, splitting into pieces shortly after 2pm.

The collapse occurred while the crane was being jacked up to reach the required height.

It exploded, releasing 700-foot-long and 70-foot high, splintering in half, said witness Goran Wallmark.

It pulverized a four-story townhouse and demolished parts of five other buildings.

Mr. Wallmark said she had been riding her bicycle nearby as the crane hit the buildings, and she saw the townhouse “falling like a house of cards.”

People at the scene said they heard a loud explosion, smelled a strong gas odor and saw a thick yellow dust cloud.

Crews were overthrown and crushed, and rubble was piled several stories high.

Remnants of the crane littered the ground after slicing through a residential building and a townhouse in Manhattan on Saturday.

At least four people were killed and a dozen others injured in what was described as one of the worst accidents the city has ever suffered.

The crane, reaching 90-feet high when it collapsed, fell during construction of a 42-story building on 31st Street, splitting into pieces shortly after 2pm.

The collapse occurred while the crane was being jacked up to reach the required height.

It exploded, releasing 700-foot-long and 70-foot high, splintering in half, said witness Goran Wallmark.

It pulverized a four-story townhouse and demolished parts of five other buildings.

Mr. Wallmark said she had been riding her bicycle nearby as the crane hit the buildings, and she saw the townhouse “falling like a house of cards.”

People at the scene said they heard a loud explosion, smelled a strong gas odor and saw a thick yellow dust cloud.

Crews were overthrown and crushed, and rubble was piled several stories high.

Remnants of the crane littered the ground after slicing through a residential building and a townhouse in Manhattan on Saturday.

The crane, reaching 90-feet high when it collapsed, fell during construction of a 42-story building on 31st Street, splitting into pieces shortly after 2pm.

The collapse occurred while the crane was being jacked up to reach the required height.

It exploded, releasing 700-foot-long and 70-foot high, splintering in half, said witness Goran Wallmark.

It pulverized a four-story townhouse and demolished parts of five other buildings.

Mr. Wallmark said she had been riding her bicycle nearby as the crane hit the buildings, and she saw the townhouse “falling like a house of cards.”

People at the scene said they heard a loud explosion, smelled a strong gas odor and saw a thick yellow dust cloud.

Crews were overthrown and crushed, and rubble was piled several stories high.

Remnants of the crane littered the ground after slicing through a residential building and a townhouse in Manhattan on Saturday.
How the Crane Fell

The collapse was initiated when the polyester web slings supporting a steel collar at the 18th floor level failed, allowing the collar to fall.

While workers were attaching a heavy steel support collar it broke free and slid down the tower . . .

. . . crashing into another collar and severing the support at the 9th floor. The entire crane became unstable and fell.

The two falling collars ended up stacked on top of the collar at the third floor.
Main Findings of Investigation*

• Improper usage of the polyester web slings resulted in the failure of the slings:

  > the no of supports provided by the slings did not meet the crane manufacturer’s requirements – only half of the required eight supports were used.

  > the positioning of the slings on the collar as installed was inconsistent with the crane manufacturer’s instructions.

  > the method of attaching the slings to the tower was not in accordance with accepted industry practice & standards.

  > one of the slings had been previously used rendering its condition such that its load capacity would have been reduced.

* Extracted from 51st Street Crane Investigation Report by Ove Arup & Partners
Management of Safe Lifting Operations

- Lifting Plan including Risk Assessment
- PTW
- Tower Crane 1
  - Lifting Supervisor
  - Crane Operator
  - Rigger(s)
  - Signalmen
Flow Chart of Lifting Operation

Lifting Plan including Risk Assessment
Flow Chart of Permit-To-Work system for Lifting Operation

**APPLY**
- The application, containing the written lifting plan, shall be given to the worksite’s appointed safety assessor for evaluation of the lifting operation.

**ASSESS & INSPECT**
- Assess whether all reasonably practicable measures have been taken.
- Inspect the site (including its surroundings) where the lifting operation is to be carried out together with the supervisor.

**APPROVE**
- Ensure that the measures are in place at all times during the validity period of the PTW.
- Continually review the progress of the lifting operation.

**MONITOR**
- Completing phases.

**REVOKE**
- Revoke the permit-to-work for lifting operation.

© All Rights Reserved
Management of Safe Lifting Operations

- **Lifting Plan including Risk Assessment**
  - Tower Crane 1
    - Lifting Supervisor
    - Crane Operator
    - Rigger(s)
    - Signalmen
  - PTW

- **Lifting Plan including Risk Assessment**
  - Tower Crane 2
    - Lifting Supervisor
    - Crane Operator
    - Rigger(s)
    - Signalmen
  - PTW

- **Lifting Plan including Risk Assessment**
  - Mobile Crane 1
    - Lifting Supervisor
    - Crane Operator
    - Rigger(s)
    - Signalmen
  - PTW

- **Maintenance Regime of lifting eqpt**
Management of Safe Lifting Operations

Lifting Safety Engineer

Lifting Plan including Risk Assessment
- PTW

Tower Crane 1
- Lifting Supervisor
- Crane Operator
- Rigger(s)
- Signalmen

Tower Crane 2
- Lifting Supervisor
- Crane Operator
- Rigger(s)
- Signalmen

Mobile Crane 1
- Lifting Supervisor
- Crane Operator
- Rigger(s)
- Signalmen

Maintenance Regime of lifting eqpt

Competencies of lifting personnel

Follow Safe Work Practices
We need to keep moving the bar up: that is what SAFETY is all about. You never get it cracked. We shouldn’t have any tower crane incidents. Some people might say that this is almost impossible. I understand that, but we need to keep moving the bar up.

John Spanswick
Chairman, Bovis Land Lease