Study Report on Crane Incident Analysis

Prepared by: Mr Simon Lee
Chairman of Crane Incident Analysis Workgroup
Scope

• Background
• Analysis of Incidents
• Findings
• Recommendations
• Detail Action Plans
Background

The spate of tower and mobile crane incidents in 2008 initiated concerns from industry and drew attention from public.
Background

No. of Workplace Incident 2007 – 2008

<table>
<thead>
<tr>
<th></th>
<th>Fatalities Involving Crane</th>
<th>Permanent Disablements (Lifting Equipment)</th>
<th>Temporary Disablement (Lifting Equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2007</strong></td>
<td>4</td>
<td>16</td>
<td>359</td>
</tr>
<tr>
<td><strong>2008</strong></td>
<td>5</td>
<td>13</td>
<td>465</td>
</tr>
</tbody>
</table>
These near misses have the potential to escalate into incidents that will incurred massive damage to both human lives and physical properties.

Bird’s Triangle

Source: F E Bird and G L Germaine, 1989, p21

10800 Near Misses

5 Fatalities (Yr 08) + 13 Permanent Disablements
Background

• The Crane Incidents Analysis Workgroup was formed under the WSHC (Construction & Landscape) Committee to:
  – analyze data of crane related incidents
  – identify prevailing trends to determine the causes of incidents
  – propose recommendations to mitigate occurrences of these incidents
# Background

The industry led workgroup comprises of the following representation:

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Representations</th>
</tr>
</thead>
</table>
| Chairman         | Mr. Simon Lee         | • Member, WSHC (Construction & Landscape) Committee  
|                  |                       | • Executive Director, Singapore Contractors Association Limited (SCAL)       |
| Deputy Chairman  | Mr. Reggie Lim        | • Member, WSHC (Construction & Landscape) Committee  
|                  |                       | • Country EH&S Manager, Bovis Lend Lease Pte Ltd                               |
| Member           | Mr. Lim Poo Yam       | • Member, WSHC (Construction & Landscape) Committee  
|                  |                       | • Deputy Director, Safety Division, Land Transport Authority (LTA)            |
|                  | Mr. Tan Kai Hong      | • Member, WSHC (Construction & Landscape) Committee  
|                  |                       | • Member, Institute of Engineers Singapore (IES)                              |
|                  | Mr. Henry Lim         | • Member, Association of Consulting Engineer Singapore (ACES)                  |
|                  | Mr. Frankie Tan       | • Member, Singapore Crane Association (SCA)                                    |
|                  | Mr. Rezal Bin Ramil   | • Member, Singapore Contractors Association Limited (SCAL)                     |
|                  | Mr. Albert Leng       | • MOM, OSHD Specialist Dept                                                    |
Analysis of Incidents

• Workgroup studied accident cases from 2007 to 2008
• Using the “5 M” Accident Analysis

- **Mission**: central purpose or functions
- **Man**: human element
- **Machine**: hardware and software
- **Medium**: ambient and operational environment
- **Management**: procedures, policies, and regulations
Analysis of Incidents

The following guide was utilized to identify the causal factors of crane accidents:

- **Man**
  - Skill-based error
  - Decision error
  - Perceptual error
  - Violations of rules and regulation
  - Equipment provided not used
  - No/ Inadequate / Irrelevant training
  - No / Lack of experience
  - Inadequate knowledge
  - Physical/Mental State
  - Medical background

- **Machine**
  - Misuse
  - Component failure
  - Poor installation
  - Maintenance failure
  - Design problem
  - Manufacturing error

- **Medium**
  - Weather
  - Ground condition
  - Time of day

- **Management**
  - Human resources
  - Inadequate safe work procedure
  - Lack/Inadequate supervision
  - Lack of communication
  - No/ Lack / Poor training program
  - Culture
  - Policies
  - No / Inadequate risk assessment
  - No / Inadequate emergency response plan
  - Inadequate preparation (Preventive measure, safe work)
  - Inadequate planning (work schedule, personnel, contingencies)

- **Mission**
  - Incompatible work
  - Unauthorized work
  - Complexity of work
Analysis of Incidents

**MAN**

- Violations of rules and regulations
  - Bypassing of limits switches
  - Ignoring warning alarms
  - Failure to check allowable load charts
  - Non compliance with Safe Work Practices

- Inadequate knowledge
  - Lack of information for load being lifted
  - Inadequate training and briefing

- Human error
  - Involved over hoisting of boom
  - Poor state of mental and physical condition due to fatigue and tight schedule

**Lack of Supervision / Awareness**

**Lack of Competency**

**Lack of Competency / Awareness**
Analysis of Incidents

**Machine**

- Failure of machine components
  - Alarm
  - Brake
  - Wire rope
  - Limit switch
  - Structural

- Improper use of cranes

**Lack of Maintenance**

**Lack of Supervision / Competency**
Analysis of Incidents

Medium

- Poor assessment of ground conditions
  - Soft / weak ground
  - Excessively inclined ground

Lack of Competency
Analysis of Incidents

Management

- Inadequate site assessment
  - Poor site assessment, coupled with unsafe medium will increase the probability of collapse of cranes significantly.

- Inadequate supervision
  - Provide the opportunity for operators to violate rules and regulations

- Lack of Safe Work Procedures
  - Include lifting procedures
  - Inadequate planning prior to work
  - Inadequate risk assessment

Lack of Competency / Awareness

Lack of Supervision

Lack of Competency / Awareness
Summary of Analysis

Collapse of Cranes

- Violation
- Inadequate knowledge
- Human error

Man
- Lack of supervision
- Lack of training / briefing
- Tight schedule

Machine
- Failure of components
- Lack of maintenance
- No established SWP
- Lack of supervision

Medium
- Unsuitable ground conditions
- Inadequate ground assessment
- Inadequate safety measures

Management

- Lack of Competency
- Lack of Supervision
- Lack of Awareness
- Lack of Maintenance
Findings

Areas identified for improvement:

• Regulatory requirements governing the competency training and curriculum of lifting operations related trades:
  - Lifting engineer / supervisor
  - Rigger and signalman
  - Crane operator
  - Approved crane contractors

• Maintenance programme of cranes and lifting gears

• Engagement and outreach programme
Recommendations

1. **Enhance Competency**
   1.1 To evaluate and enhance current training curriculum of the identified trades in lifting operations particularly the lifting supervisor and crane operator
   1.2 To improve on the quality of delivery to lifting operations

2. **Enhance Maintenance Regime**
   2.1 To review relevant Code of Practices (CP) and Safety Standards (SS) to include a comprehensive maintenance regime requirements

3. **Enhance Awareness**
   3.1 To enhance outreach efforts in engaging the upstream crane manufacturers to downstream crane operators.
Detail Action Plans

1. To evaluate and enhance current training curriculum of the identified trades in lifting operations particularly the lifting supervisor and crane operator.

<table>
<thead>
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<tr>
<td><strong>a)</strong> Evaluate and enhance current training curriculum of the crane operators, leveraging on the WSQ framework</td>
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<tr>
<td><strong>b)</strong> Evaluate and enhance current training curriculum of the lifting supervisors</td>
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</table>
Detail Action Plans

2. To improve on the quality of delivery of training courses pertaining to lifting operations

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<tr>
<td>a) Develop a system to ensure quality delivery of training courses</td>
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3. To enhance outreach efforts in engaging the upstream crane manufacturers to downstream crane operators.

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<tr>
<td>a) Develop a Safe Lifting Operations Kit. It should include the followings:</td>
</tr>
<tr>
<td>- Management Guide to Lifting Operations</td>
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<tr>
<td>- Lifting Supervisor’s Guidebook</td>
</tr>
<tr>
<td>- Crane Operator’s Handbook</td>
</tr>
<tr>
<td>- Riggers and Signalman’s Handbook</td>
</tr>
<tr>
<td>- Technical Advisory for Lifting Operations</td>
</tr>
<tr>
<td>- Compliance Assistance Checklist for Safe Lifting Operations</td>
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**Detail Action Plans**

3. To enhance outreach efforts in engaging the upstream crane manufacturers to downstream crane operators.

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<td>a) Develop a Risk Register for lifting operations</td>
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<td>b) Incorporate crane safety messages and case study in newsletters of concerned stakeholders. E.g. WSHC Website, SCAL’s Website, SISO Newsletter and WSH Bulletin.</td>
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<tr>
<td>c) Create engagement platforms, e.g. ProBE, Crane seminars, to engage and update relevant stakeholders on the legislative requirements and its change of safe lifting operations</td>
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Detail Action Plans

4. To review relevant Code of Practices (CP) and Safety Standards (SS) to include a comprehensive maintenance regime requirements.

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<td>a) Review Code of Practices (CP) 62 (Safe Use of Tower Cranes)</td>
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<td>b) Fact Sheet on Maintenance Programme</td>
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THANK YOU