Lifting Operation Safety

Construction Industry Council Seminar

Safe Practice of Lifting Operation in the
Hong Kong Housing Authority’s New Works Contracts

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Presentation Outline

1. Introduction
2. Contractual Control on Lifting Operation
3. Enhancement of Safety Awareness
4. Way Forward
Introduction
Accidents

In Oct 2017, a worker was struck to death by a fallen steel H-pile during the extraction of H-pile by an excavator in a building site.

In Dec 2017, a worker was struck to death by a fallen triangular metal frame during the lifting of the metal frame by a tower crane in a building site.
Contractual Control on Lifting Operation
Contractual Control on Lifting Operation

Safe System of Work

- Establish a safe system of work for all lifting operations
- Observe legal requirement and related guidelines
  - FIU (Lifting Appliances and Lifting Gear) Regulations (LD)
  - CoP for Safe Use of Tower Cranes, CoP for Safe Use of Mobile Cranes (LD)
  - Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear (LD)
  - Guidelines on Safety of Tower Cranes (CIC)

- Key Elements in Safety Plan
  a. Planning

  Appoint a competent person, (together with safety officer, site agent and lifting coordinator) to plan all lifting operations before commencement and determine working locations, access, scale and duration of operation
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Safe System of Work

- Key Elements in Safety Plan (cont’d)
  
  b. Risk assessment

  The competent person shall conduct a **specific risk assessment** to identify **potential hazards** (look for hazards, decide parties who might be harmed, evaluate the risks, record the findings, review assessment)
Safe System of Work

• Key Elements in Safety Plan (cont’d)
  
c. Method statement

  1. The competent person shall formulate method statement and control measures based on risk assessment and crane manufacturer’s instructions for lifting operation
  2. Define extent of danger zone to be fenced off with barriers with warning signs to prevent unauthorized entry
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

1. Appoint trained and experienced person to operate the equipment
2. Communicate effectively the safe system of work to all parties concerned
3. Control subcontractors for carrying out lifting operation of tower crane
   - < 2 tiers of subcontractors are to be engaged
   - Subcontractors must be registered under respective trades of the Primary Register of the Subcontractor Registration Scheme of CIC where applicable
   - Erection, dismantling and height alteration of tower cranes to be executed by subcontractors selected from the register on the specialty of “erection, dismantling and climbing” of the tower crane trade of the Subcontractor Registration Scheme of CIC
Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel for operation of tower crane with qualification, experience and competence fulfilling the CoP for Safe Use of Tower Cranes, CoP for Safe Use of Mobile Cranes of LD and Guidelines on Safety of Tower Cranes of CIC
- submit particulars of all these personnel to CM for approval
- all these personnel to possess valid Green Card
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel (cont’d)
   - Competent Mechanical Engineer / Competent Examiner
     - registered professional engineer under Engineers Registration Ordinance
     within the discipline of Mechanical Engineering or Marine & Naval
     Architecture or a relevant discipline specified by Labour Department as
     defined under Construction Sites (Safety) Regulations, Factories and
     Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulation
     - check tower crane before delivery to site
     - thoroughly examine the anchorage or ballasting
     of tower crane before erection of tower crane, and
     conduct testing after erection, relocation,
     changes in anchorage or ballasting, exposure to
     inclement weather (Form 2)
     - test and thoroughly examine crane within 4 years
     before use, after substantial repair, re-erection,
     failure, overturning or collapse (Form 3)
     - thoroughly examine at least once a year (Form 5)
Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel (cont’d)

- **Supervising Engineer (Tower Crane)**
  - possess qualification, experience and competency specified in CoP and Guidelines
  - complete 27-hour safety training course for site management staff provided by CIC or OSHC or equivalent
  - conduct visual inspection on parts of tower crane before operations
  - supervise operations of tower crane
  - empowered to stop work if necessary

- **Competent Person**
  - possess adequate training, experience and competency specified in CoP and Guidelines
  - conduct weekly inspection (Form 1)
  - supervise erection, dismantling and height alteration of tower crane
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel full time on site during lifting of tower crane and mobile crane

- **Responsible Person**
  - possess relevant training, experience and competency in discharging duties as specified in CoP
  - proper implementation of safe system of work and the permit-to-work system
  - have overall control of all lifting operations at all time
  - oversee the completion of risk assessment, formulation of safety procedures and implementation of safety precautions before lifting operation
Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel full time on site during lifting of tower crane and mobile crane (cont’d)

- **Tower Crane Operator / Mobile Crane Operator**
  - possess qualification, experience and competency specified in CoP

- **Slinger (Construction Materials Rigger)**
  - possess qualification, experience and competency specified in CoP
  - satisfactorily completed silver card course A12 of CIC
Safe System of Work

d. Implementation

4. Engage following trained and experienced personnel full time on site during lifting of tower crane and mobile crane (cont’d)

- **Signaller**
  - possess qualification, experience and competency specified in CoP
  - satisfactorily completed silver card course A12 of CIC
  - can be taken up by slinger with relevant qualification and experience

- **Tower crane worker (erection, dismantling, telescoping & climbing)**
  - satisfactorily completed silver card course A11 of CIC
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

5. Safety precautions in lifting operations
   - work within safe working load and safe working range
   - tie materials safely and securely to avoid movement of the load
   - work within site boundary unless CM’s prior approval is granted
   - use a tagline for controlling the load
   - fully extend and securely hold outrigger of mobile crane at extended position, level and support the outrigger before commencing operation

6. follow instructions given in machine manufacturers’ manual

7. safety information, instruction and training to workers

8. supervise and monitor to ensure implementation of safety measures

9. maintain crane in good working condition

10. formulate emergency procedures to deal with crisis
Safe System of Work

d. Implementation

11. Inspection, thorough examination and testing

- cover tower cranes (including its anti-collision system), static and mobile cranes, lifting appliances and lifting gear

- display valid test and examination certificates Forms 1 to 7 for lifting appliances and gear

- develop a checklist for checking Forms 1 to 7, critical parts of cranes, anchorage of supporting structure
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

12. CCTV system with recording before commissioning of tower crane
   - install camera at not higher than 6/F of block within each lifting zone, capable of 360° rotation and tilting from 0 – 90°
   - install camera at tower crane trolley or end of tower jib for best view
   - provide a LCD monitor for view by crane operator inside crane cabin
   - provide a video recording system with power backup, and the video record is kept for 60 days, giving valuable information of the time, date and the lifting conditions for CM’s view and taking photographs
   - rectify malfunction immediately and require responsible person to closely monitor operation of tower crane before rectification
Safe System of Work
d. Implementation

13. Computerized system in site office for full time surveillance of tower crane
   - monitor and record tower crane operations for at least 1 week of operation
   - avoid collision of cranes through anti-collision system
   - to be compatible with computerized system of adjoining sites when there are overlapping zone of tower crane operation

14. Reflective vest for operatives and site supervisory staff involved in lifting, except tower crane operator

15. Training
   - induction training, tool box talks and lunchtime’s safety training with training material in form of audio-visual medium

16. Accident / incident reporting
   - report near miss / incidents of lifting operation on site within the date of incident to project team

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d. Implementation

17. Permit-to-work for special lifting operations of tower crane
   - apply to lifting in
     - overlapping area where anti-collision system is by-passed
     - restricted area in which lifting operations are not normally allowed
     - using multiple lifting appliances
   - appoint a block foreman as lifting coordinator
   - safety officer to conduct training in safety procedures of lifting coordinators, signallers, slingers and tower crane operators before special lifting operation
   - lifting coordinator to apply permit from responsible person after completing preparation work
   - responsible person to issue permit before work and permit is not more than 1 day and cannot be extended beyond lifting coordinator’s shift
Safe System of Work

d. Implementation

17. Permit-to-work for special lifting operations of tower crane (cont’d)
- lifting coordinator to keep the by-pass key for anti-collision system issued by the responsible person and return the key to responsible person when signing off the permit
- before lifting, structural quality control coordinator to confirm location of unloading area and lifting coordinator to check the location for suitability
Safe System of Work

d. Implementation

18. Log book for tower crane
- record special operations including
  - inspection, testing, thorough examinations
  - repairs and maintenance
  - adjustment and renewal of parts
  - emergency repairs
  - temporary by-pass of anti-collision system
- key record include implementation of safety precautionary measures and hours of service of tower crane
- safety precautionary measures to include -
  - during by-passing the anti-collision system, slinging of loads in the overlapping lifting zones and guiding of tower crane operators to be conducted by lifting coordinator instead of slinger or signaller
  - team leader to keep the by-pass key and the General Foreman / site agent to monitor the usage of by-pass key
  - team leader to ensure and site agent to endorse that all safety devices have been implemented upon commencement of special operations
Safe System of Work

d. Implementation

19. Log book for mobile crane

- keep key record on inspections, tests, repairs, maintenance and hours of service, and implementation of safety precautionary measures

- safety precautionary measures to include
  - inform all lifting team personnel of safety precautionary measures before work commencement
  - not allowing free suspension of loads on hook
  - if mobile crane is stopped for maintenance or repair, lock the main controls, place a warning plate over main switch and the key to the lock to be kept by the crane operator
Safe System of Work

d. Implementation

20. Inspection of mobile crane
   - competent person to conduct weekly inspection
   - competent person / crane operator to conduct pre-use check before operation of each shift
   - cease to use the crane and report to responsible person for any defect identified or damage to the crane
Safe System of Work

d. Implementation

21. Inspection and certification of overhaul of crane

- ensure the cranes are in safe and serviceable condition
- covering tower crane, derrick crane, mobile crane, crawler crane, truck-mounted crane
- overhaul maintenance includes inspection, examination, repair, renewal and maintenance on critical parts and main components of crane according to manufacturer’s specification and reinstatement of crane in serviceable condition
- carry out overhaul maintenance once reaching overhaul age
Safe System of Work

d. Implementation

21. Inspection and certification of overhaul of crane (cont’d)
   - submit schedule of inspection, examination, testing and maintenance to CM in accordance with manufacturer’s recommendation or to suit actual plant conditions, whichever is more frequent
   - keep record of inspection, examination, testing, maintenance and breakdown for inspection by CM
   - competent examiner to inspect and certify overhaul of cranes at the overhaul ages according to the Checklists of Critical Parts for Overhaul Maintenance stipulated in specification and confirm that the crane is in safe working condition
### Safe System of Work

#### d. Implementation

21. Inspection and certification of overhaul of crane (cont’d)

<table>
<thead>
<tr>
<th>Major construction plant</th>
<th>Overhaul ages (years)</th>
<th>Maximum ages of crane on site (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Overhaul</td>
<td>2nd Overhaul</td>
</tr>
<tr>
<td>1. Tower cranes (rented)</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>2. Tower cranes (self-owned)</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>3. Derrick cranes (used for installing and dismantling tower cranes)</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>4. Mobile cranes (excluding crawler cranes)</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>5. Truck-mounted cranes</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>6. Crawler cranes (rented)</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>7. Crawler cranes (self-owned)</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>
Safe System of Work

d. Implementation

21. Inspection and certification of overhaul of crane (cont’d)

- qualified persons to conduct non-destructive test in the Checklists of Critical Parts for Overhaul Maintenance

- overhaul ages are defined by the crane itself or the critical part of the crane

<table>
<thead>
<tr>
<th>Crane</th>
<th>Definition of overhaul age</th>
</tr>
</thead>
<tbody>
<tr>
<td>All kinds of cranes (rented and self-owned) except derrick crane</td>
<td>Age of crane itself</td>
</tr>
<tr>
<td>Derrick cranes (used for installing and dismantling tower cranes)</td>
<td>Age of winches of derrick crane</td>
</tr>
</tbody>
</table>

- prohibit operation of crane beyond overhaul age without Certificates of Overhaul. Plan ahead and provide alternative lifting appliances to perform offloading / uploading from and onto such trucks

- self-owned plant mean plant owned by the contractor, contractor’s parent, sister or subsidiary company or its subcontractor provided that the subcontractor is on the HA List of Piling Contractors
Contractual Control on Lifting Operation

**Safe System of Work**

d. Implementation

22. Lifting of precast façade to domestic block
   - delineate a storage yard with restricted access and warning signs
   - provide details of maximum allowable wind speed, safety margin for safe working capacity of crane, safety precautions to be adopted to secure the facade against swinging or spinning during lifting

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22. Lifting of precast façade to domestic block (cont’d)
- provide anemometer on tower crane and cease lifting when wind speed exceeds the maximum allowable wind speed for the crane
- provide safety catch for crane hook
- one signaller to give signal at a time
- provide walkie-talkie for communication between tower crane operator and signaller
- provide audio-visual warning device at lifting locations
Safe System of Work

d. Implementation

23. Lifting of large panel formwork and working platform

- submit details to CM for approval

  - layout of storage yard with restricted access and warning signs
  - measures to avoid overturning of formwork, e.g. vertical posts fixed on ground
  - minimum 2 supports for each panel formwork
  - access to formwork for slinger’s operation
Safe System of Work

d. Implementation

23. Lifting of large panel formwork and working platform (cont’d)

- submit details to CM for approval
  - device for secure storage of tie rods
  - boxes for storage of small parts, e.g. bolts and nuts
  - containers for storage of long bolt and shaft
Safe System of Work

d. Implementation

23. Lifting of large panel formwork and working platform (cont’d)

- periodic checking of formwork to remove loose concrete debris to avoid falling objects
- paint steel doors / gate in contrasting colour for clear identification
- add fall arrest device to prevent movable steel door from falling
- seal up gaps between working platform and precast façade by openable metal plate attached to working platform
- provide barrier of effective height 1100mm with mesh infill panel along building edges and gable end wall
Safe System of Work
d. Implementation

24. Lifting of materials from and to vehicles

- maintain a list of lorry-mounted crane / operators for handling loading and unloading operations
- operators shall be both slingers and signallers
- workers assisting in unloading material shall be trained in lifting operations
- appoint a lifting supervisor for monitoring whole process. The lifting supervisor shall be a slinger and signaller with minimum 4-year experience in lifting operation
Contractual Control on Lifting Operation

Safe System of Work

d. Implementation

24. Lifting of materials from and to vehicles (cont’d)

- park the vehicle on level ground,
  otherwise adjust the vehicle to be level
  with outriggers fully stretched to rest on
  pads
- if there is a risk of falling load from
  vehicle during unloading, use a device
  such as a crane to secure the load in
  position before unfastening the strap /
  chain
Contractual Control on Lifting Operation

Safe System of Work

e. Review

1. conduct review in case of significant change in the machine or work environment to see if adjustment is required
2. consider feedback from operators and workers for improvement of effectiveness of system

f. Auditing & performance monitoring

1. prepare auditing plan to ensure adequacy of safe system of work
   - lifting operation is a critical item in safety audit
   - failure [i.e. < 70%] in critical pass ‘lifting operation in 1 quarter’ -> CM’s alert, failures in 2 consecutive quarters -> CM’s warning
   - lifting accounts for 20% of the payment under critical items
   - full payment for lifting under pay for safety when audit score > 70%
Safe System of Work

f. Auditing & performance monitoring (cont’d)

2. Surprise safety inspection of lifting operation quarterly
   - failure [i.e. < 70%] in lifting operation -> CM’s alert,
   - failures in the total score in 1 quarter -> CM’s warning
   - lifting operation accounts for 20% of the payment under surprise inspection
   - no payment for lifting under pay for safety to be released when the score < 70%
   - 0.7 of full payment for lifting under pay for safety to be released when the score > 70% but < 80%
   - Full payment for lifting under pay for safety when score > 80%
Enhancement of Safety Awareness
HA’s publication of **Good Practice Promotion Kit Lifting Operation of Tower Crane** for promotion of site safety measures and awareness for lifting using tower crane

HA’s safety promotion events such as seminars, forums, safety handbooks and videos about safe lifting practice

Available from HA website:
http://www.housingauthority.gov.hk/sitesafety
Proposed Enhancements of Tower Crane Lifting

a. 2-hour duration for weekly inspection of tower crane
b. Master programme to allow process of erection, telescoping, climbing and dismantling
c. Duty roster to allow adequate rest for operator
d. Separate power supply to tower crane
e. CCTV in control cabin
f. Implement mentor and mentee scheme for training operators
g. Two-brake system of tower crane
h. Positioning adequate CCTV on trolley / jib / mast to cover works area
i. Lifting supervisor for volumetric precast concrete element
j. Trial lifting in presence of a responsible person
Prevention is better than Cure

Control the risk at Source effectively will improve work safety

Thank You!