

A Review of Recent Tower Crane Accidents and the Lessons Learned

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Tower Crane Accidents

- **130 Accidents Worldwide 1989 – 2012**
- **Only Major Accidents Considered**
 - Significant structural damage
 - Collapse of the crane
- **Top Slew Tower Cranes**
- **Some Self-erecting Tower Cranes**
- **Not:-**
 - Mobile Cranes
 - Tracked Crawler Cranes
 - Dockyard Cranes – Gantry Cranes & Container Cranes

Tower Crane Accidents

■ Sources:-

• Internet

- Trade press websites such as International Cranes
- Private websites such as craneaccidents.com
- Local news websites

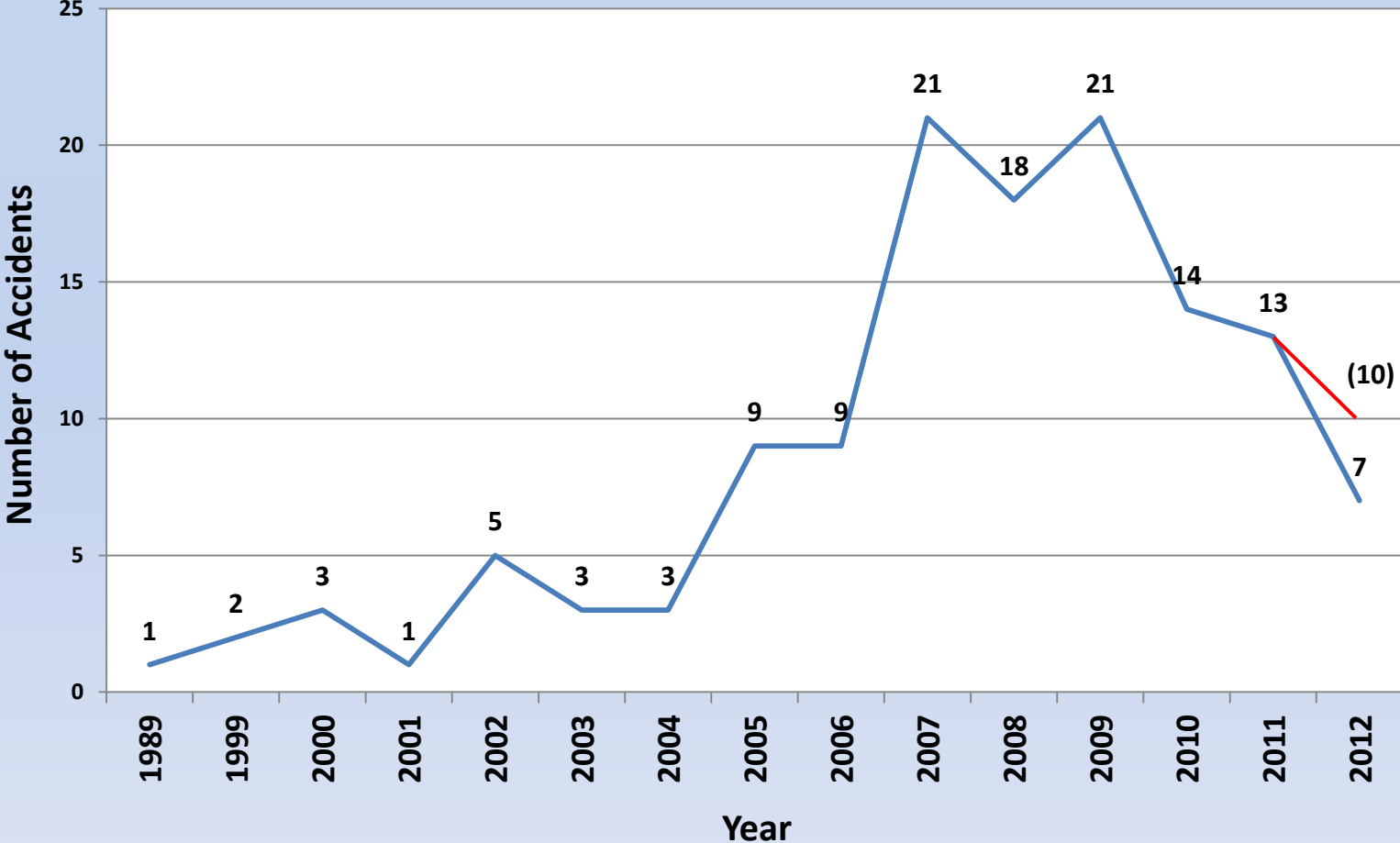
• HSE Report - *Tower Crane Incidents Worldwide*

• Personal knowledge

Limitations

- **No single source of accurate information**
- **Not all incidents reported on all sites**
- **Trade press websites good for initial reports and follow up where they can**
- **Private websites can be inconsistent with trade websites and often speculate on causes**
- **Not all the websites have knowledge of all the incidents. Some incidents are given on one website but not another.**
- **Local media usually reports in the immediate aftermath of the incident and details can be vague & inaccurate**
- **Geographic locations. Remote countries with less developed health & safety cultures tend not to be as well reported as in the U.S.A. & Europe**

Accidents by Year



Numbers of Accidents by Country

Country	No.	Deaths	Deaths/ Accident
China	23	55	2.4
USA	13	15	1.2
UK	10	8	0.8
Singapore	7	5	0.71
Malaysia	6	6	1
Russia	5	11	2.2
Germany	5	5	1
Netherlands	5	4	0.8
India	4	7	1.75

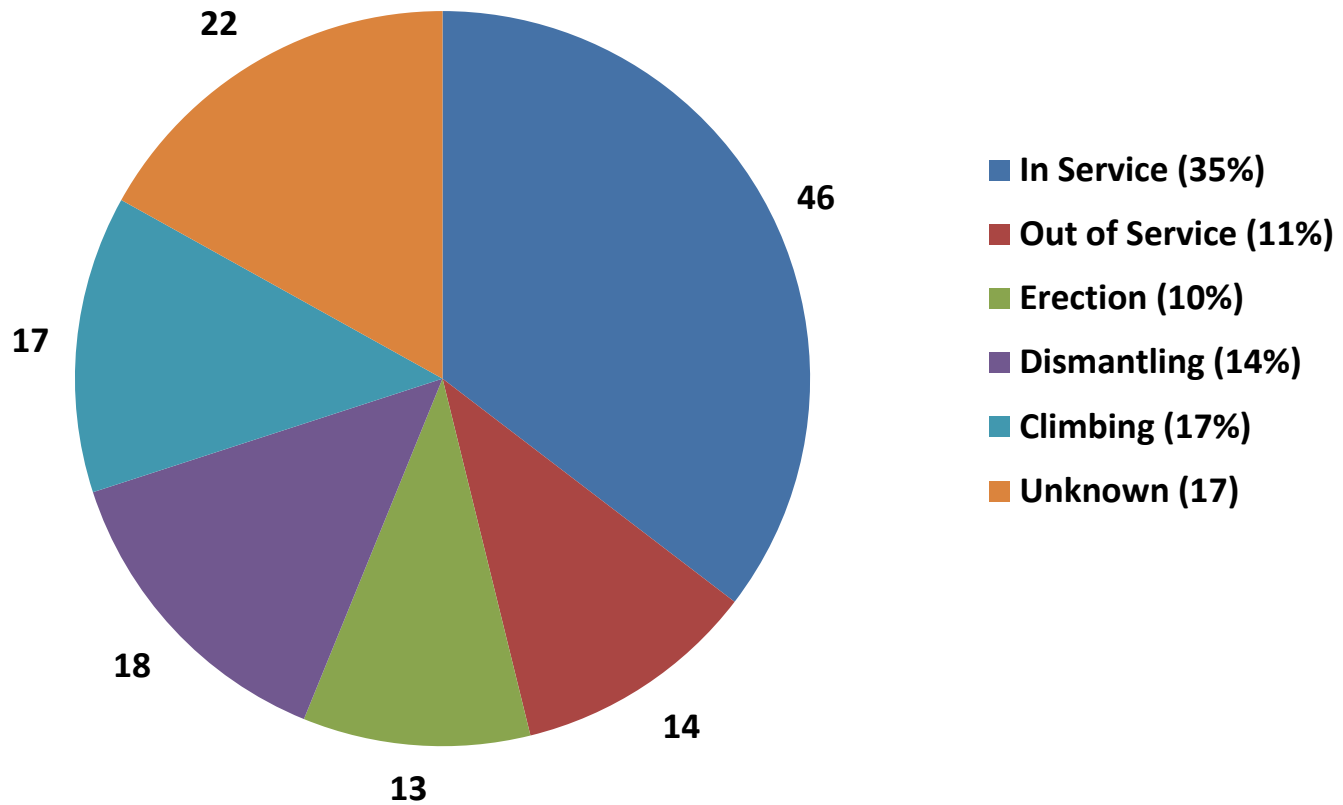
Country	No.	Deaths	Deaths/ Accident
Australia	4	0	0
UAE	3	6	2
Bahrain	3	4	1.3
Vietnam	3	4	1.3
Israel	3	3	1
South Africa	3	3	1
Canada	3	1	0.3
Malta	3	0	0
Switzerland	3	0	0

Numbers of Accidents by Country

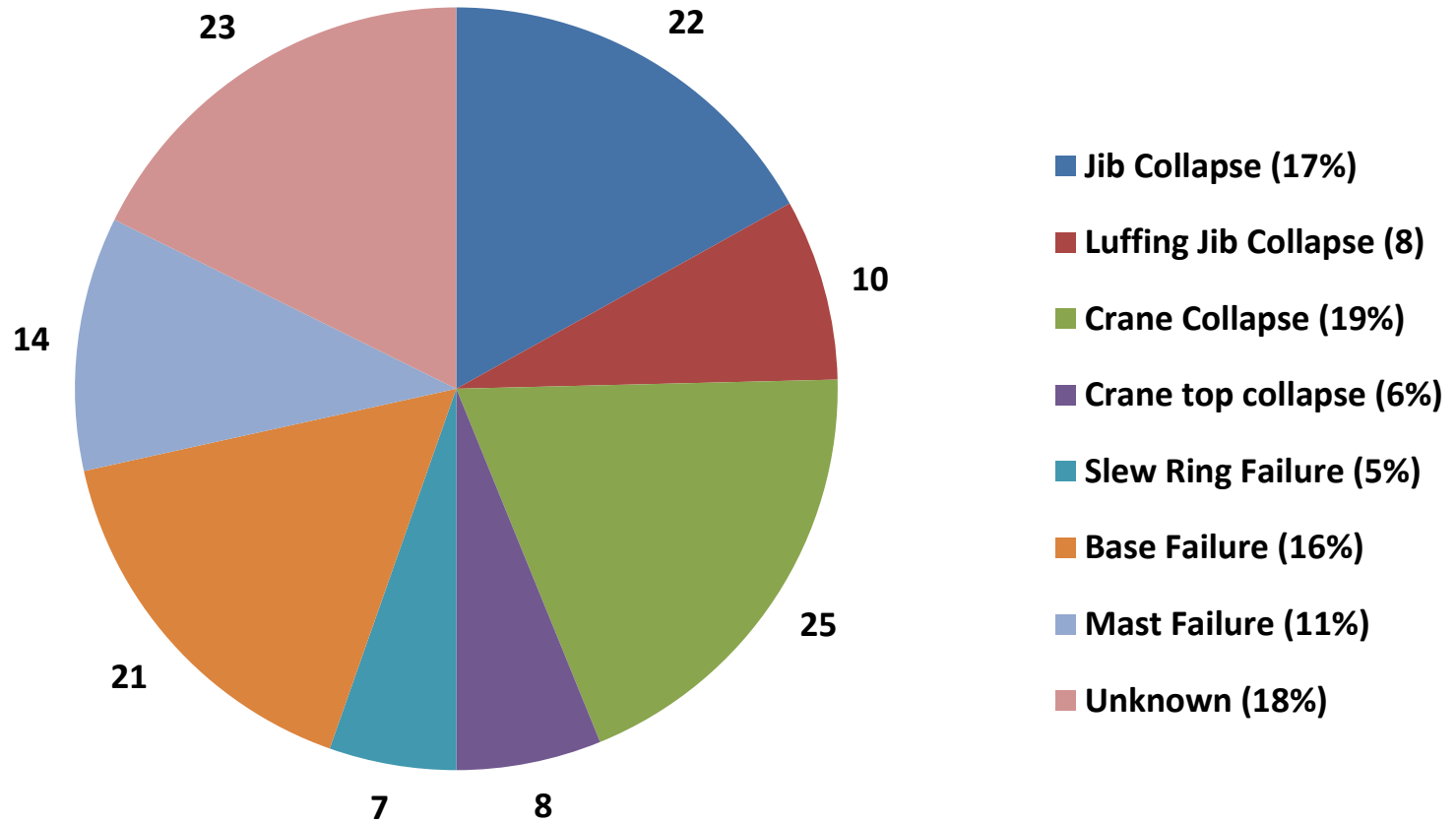
Country	No.	Deaths	Deaths/ Accident
Taiwan	2	7	3.5
Poland	2	1	0.5
Spain	2	1	0.5
Ireland	2	0	0
Philippines	2	0	0
Thailand	2	0	0
Romania	1	4	4
Syria	1	4	4
Norway	1	2	2

Country	No.	Deaths	Deaths/ Accident
Indonesia	1	1	1
Japan	1	1	1
South Korea	1	1	1
Argentina	1	0	0
Brazil	1	0	0
Czechoslovakia	1	0	0
Jordan	1	0	0
New Zealand	1	0	0
Saudi Arabia	1	0	0

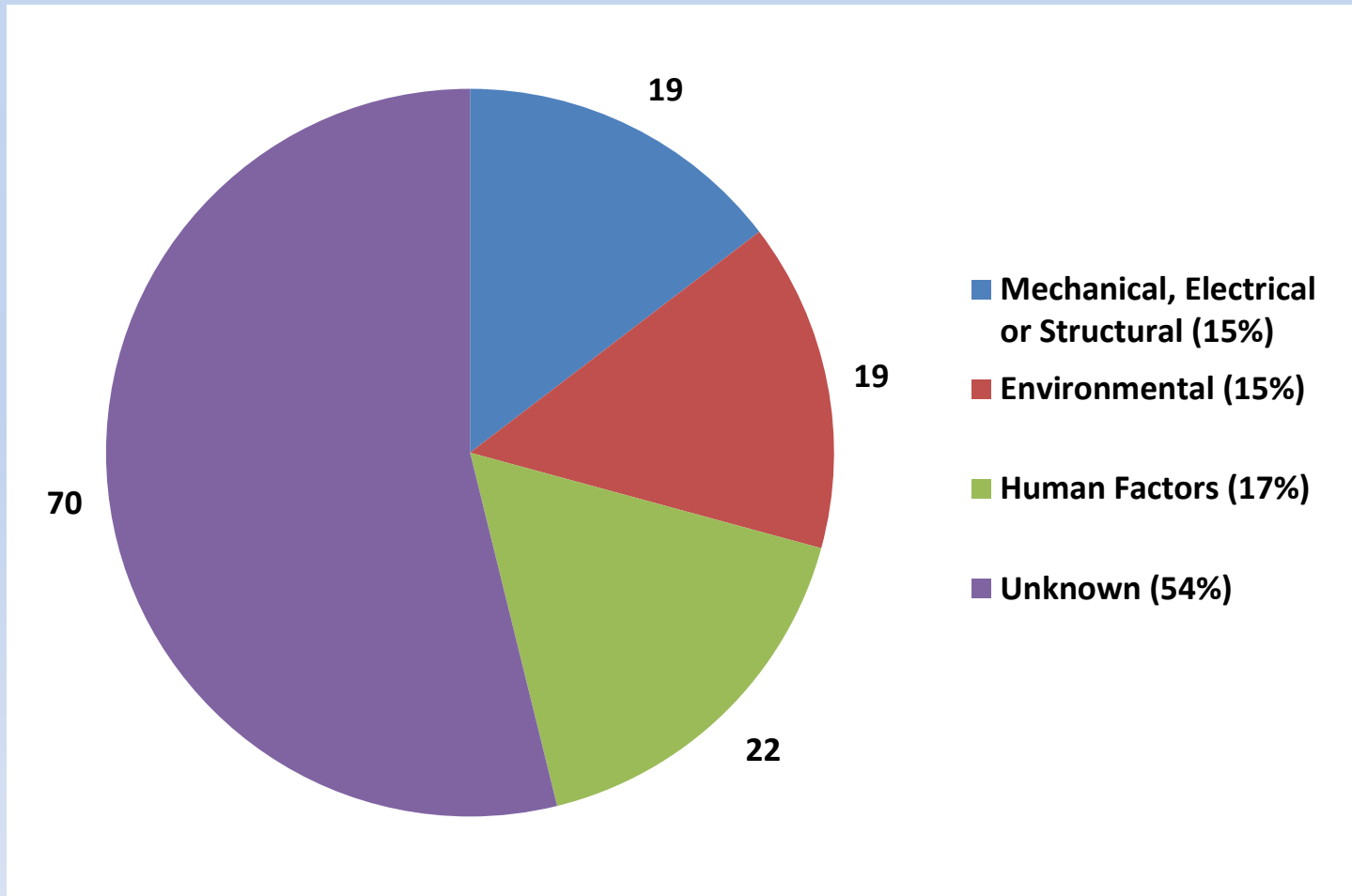
Service Condition



Failure Area



Identified Cause



Examples of Accidents

Environment

Liverpool - January 2007

- **Luffing tower crane**
 - 3 years old
 - CE marked
 - DOC to EN 14439
- **Crane was in use**
 - Light load
 - Close to minimum radius
 - Wind near maximum in-service limit
- **Jib fell backwards across the site during a lifting operation**
- **1 Construction worker killed**



Liverpool – Investigation Findings

- Jib at small angle to the vertical
- Wind from the front held the jib up and caused the luffing rope to go slack
- Luffing rope jammed in the sheaves
- Operator tried to lower off and paid out rope from the luffing winch, which looped down the back of the crane
- Luffing rope became free allowing the jib to drop until the slack rope arrested its fall
- Large dynamic load caused the jib to fail and the slewing section and counter jib became detached from the top of the tower at the slew ring
- One of the counterweights fell on a construction worker causing fatal injuries
- Issues:
 - Crane design standard

Liverpool Animation



Human Factors

Worthing – February 2005



- Two men killed
- One seriously injured



Worthing – February 2005

- De-rigging prior to dismantling
- The two erectors fatally injured working on the jib removing hoist and trolley ropes
- Third Erector had de-torqued tower bolts on one side of the mast
- Jib was slewed
- Slackened bolts failed and crane collapsed
- Crane owner prosecuted and fined £389,000 for not managing the dismantling process effectively
- Issues
 - Training
 - Planning



Mechanical Issues

Battersea – September 2006

- Saddle jib tower crane
- Twenty seven years old
- Crane had been in use for a number of weeks after erection
- Bolts in the joint below slew ring failed through fatigue
- Jib fell across site into an adjacent road
- Crane Driver + Member of public killed
- Slew ring bolts had been replaced in the air, shortly after erection
- Crane had been erected with too much counterweight
- Issues:-
 - Information and Planning
 - Maintenance
 - Thorough Examination



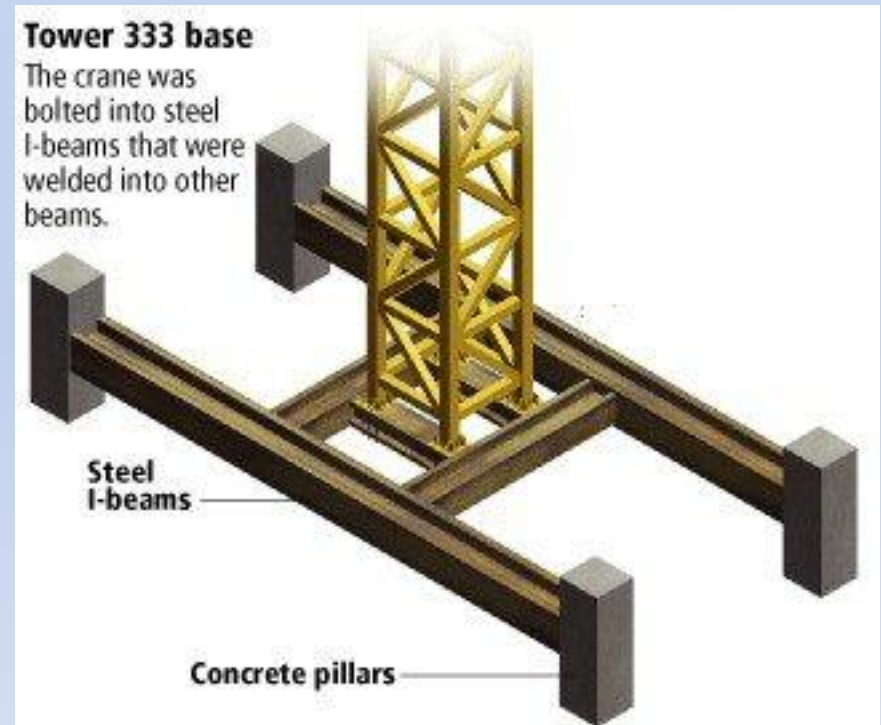
Human Factors and Structural Seattle – November 2006



Human Factors

Seattle – November 2006

- Official enquiry blamed inadequate design of foundation
- Fatigue failure
- Lack of maintenance and inspection
- Issues:
 - Planning
 - Base design
 - Maintenance
 - Thorough examination

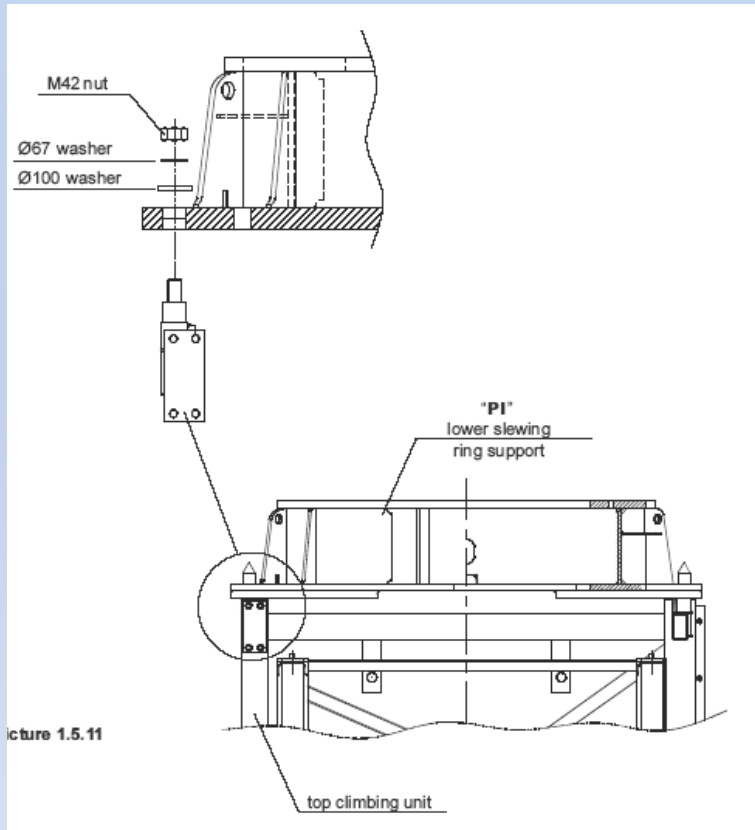


Human Factors

Croydon – June 2007



Croydon – June 2007



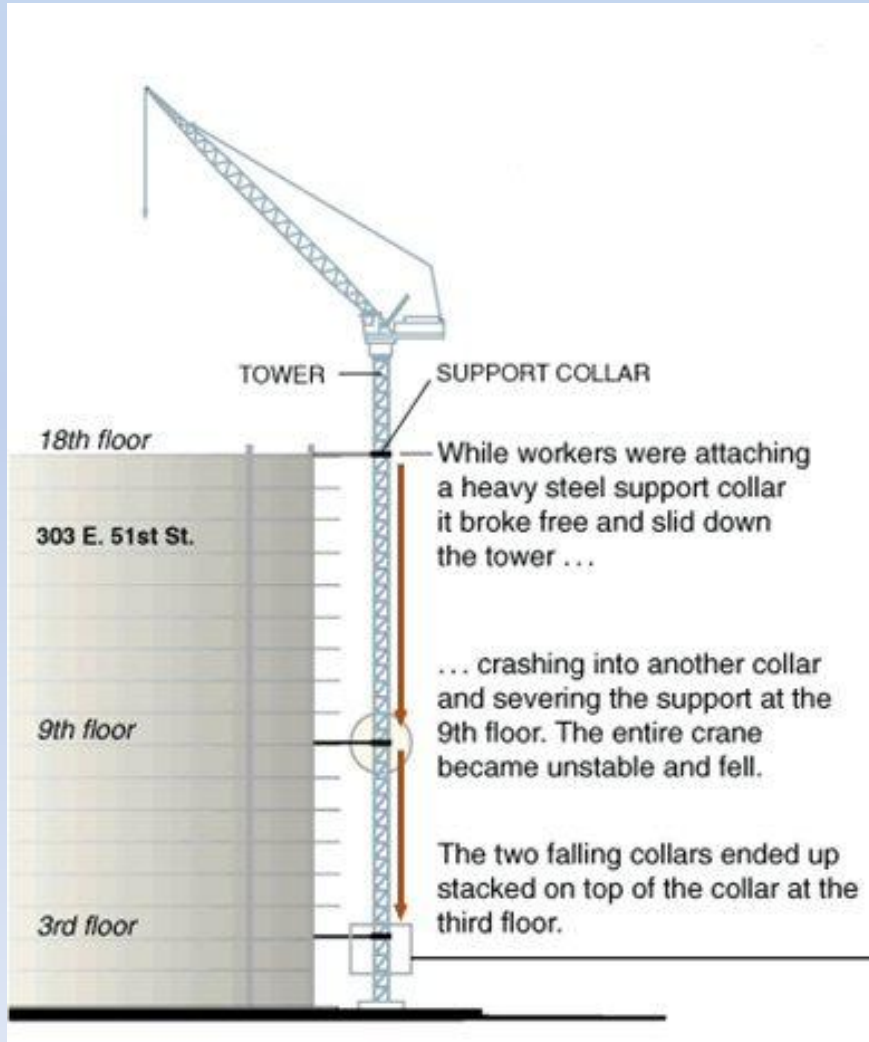
- Climbing team had not used the equipment before and had not had any specific training on its use
- Crane owner fined £100,000 + £33,196 costs
- Issues
 - Training
 - Planning
 - Not following manufacturer's instructions

Structural New York – March 2008



- Luffing Jib Tower Crane
- 7 Fatalities
- Tie collar being attached
- Fabric lifting sling failed, causing tie to fall
- Top of crane demolished building two blocks away
- Issues
 - Planning
 - Selection of equipment

New York – March 208



Human Factors

Miami – March 2008



- Libeherr luffing jib crane
- Climbing operation
- Tower section fell
- 2 Fatalities
- Issues:-
 - Planning
 - Selection of equipment

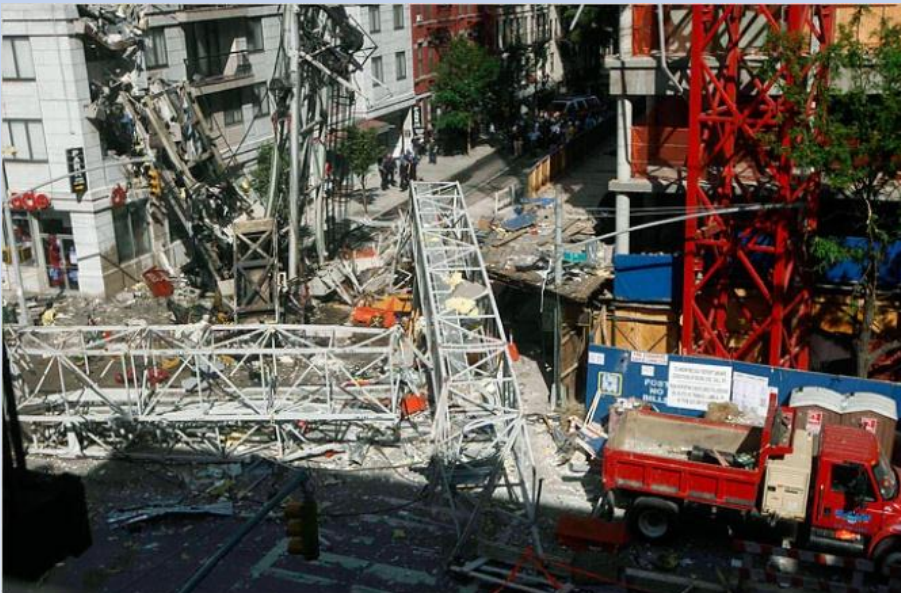
Miami – March 2008



Human Factors/Structural New York – May 2008



- 24 years old Kodiak luffing tower crane
- In-service but not lifting
- 2 Fatalities
- Slew ring support failed
- Had been repaired in China
- Issues:-
 - Maintenance
 - Thorough examination



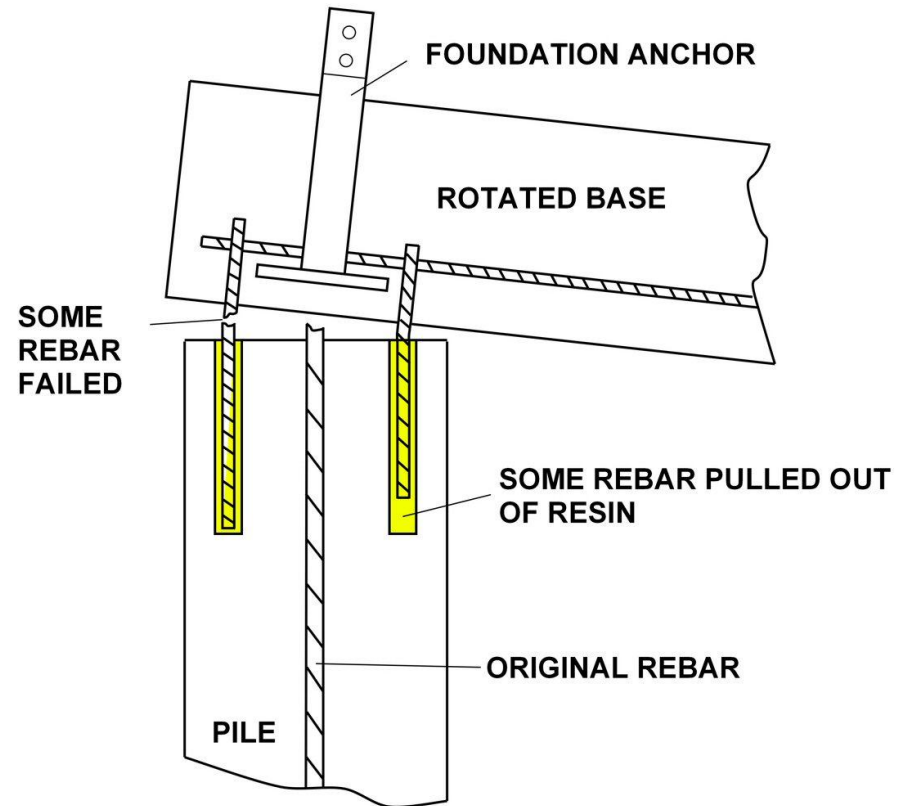
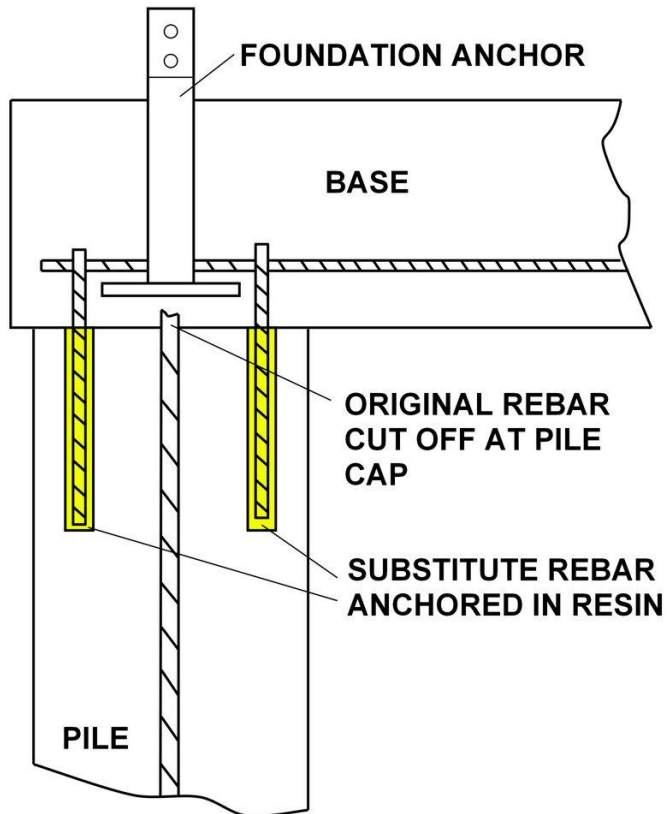
Human Factors/Structural Liverpool July 2009



- Luffing jib crane
- Lifting a light load at a small radius
- Witnesses reported hearing “two loud bangs”
- Tower crane collapsed onto an adjacent apartment building
- Counterweights fell through roof
- Operator fell out of cab and through hole in roof



Liverpool July 2009



Liverpool July 2009

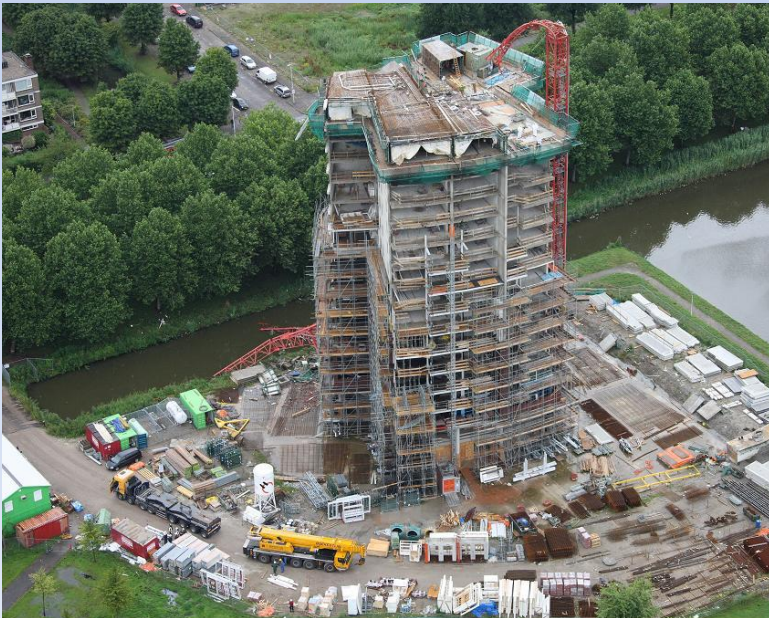


- Base Designer had no previous experience of designing this type of foundation
- Principal Contractor's employees had no previous experience of building this type of foundation
- Contractor fined £280,000 (\$450,000) (€350,000)
- Designer went into administration
- Issues:-
 - Poor design
 - Poor construction
 - Lack of experience



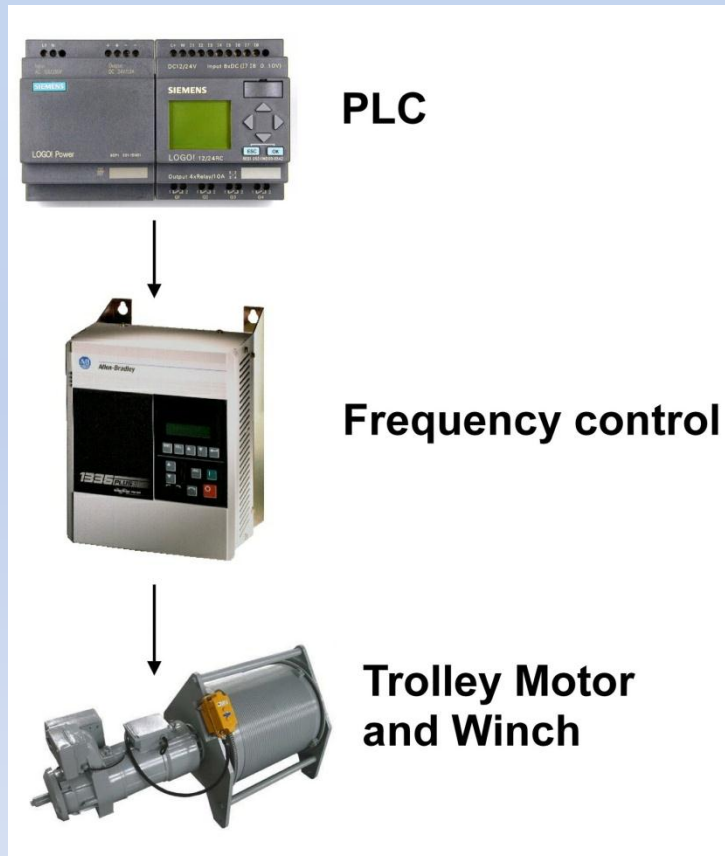
Human Factors/Electrical

Rotterdam – July 2008



- Lifting a heavy load (balcony slab) within its rated capacity close to the mast.
- Slewed and trolleyed to near maximum radius for the load
- Trolley stationary and held on mechanical brake
- The jib and mast had deflected under load
- Trolley control operated to bring trolley in before final positioning
- Instead of moving towards the mast the load ran away to the outer end of the jib
- Crane was overloaded and the mast failed just above the a transition section

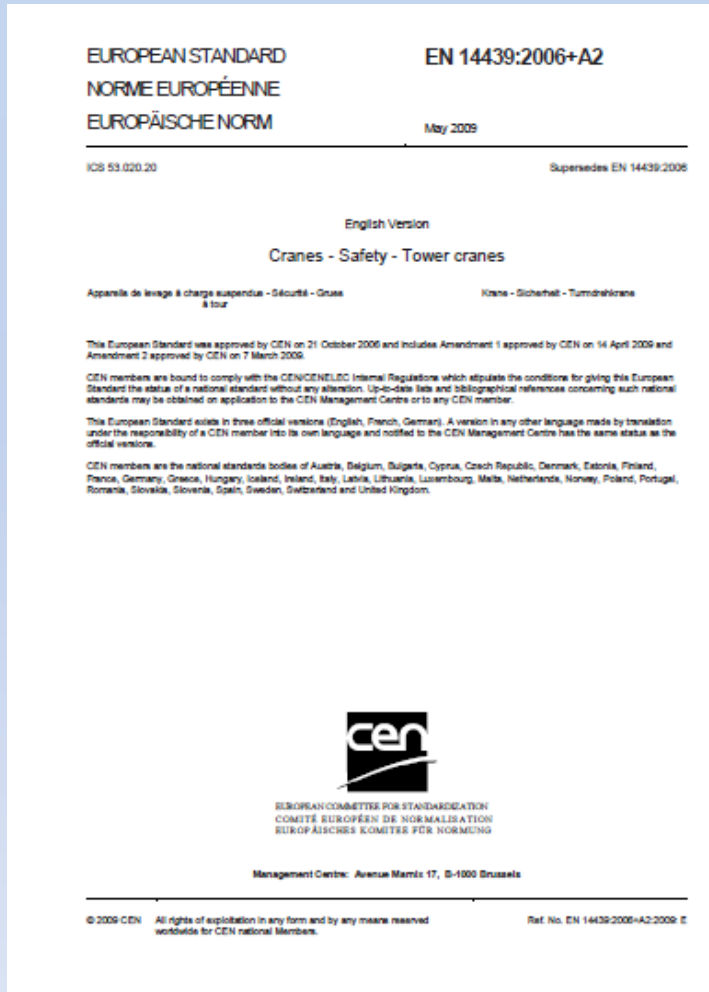
Rotterdam – July 2008



- Trolley winch travel motor control system was a PLC/Inverter electronic system
- The incident was attributed to settings of the control system
- When the trolley control was operated the trolley motor mechanical brake was released before the motor had built up sufficient torque to hold the load against the downward slope of the crane jib
- Issues:-
 - Poor design
 - Inadequate hazard analysis

Guidance on Dealing with the Issues

EN14439



■ CEN TC147/WG12 working on a revision:-

- Use of EN 13001
- Use of EN 13849
- Requirements for luffing jib cranes
- Interfaces for anti-collision systems
- Consideration of powered access to the operator's cab

Guidance

BS 7121-5:2006

BRITISH STANDARD

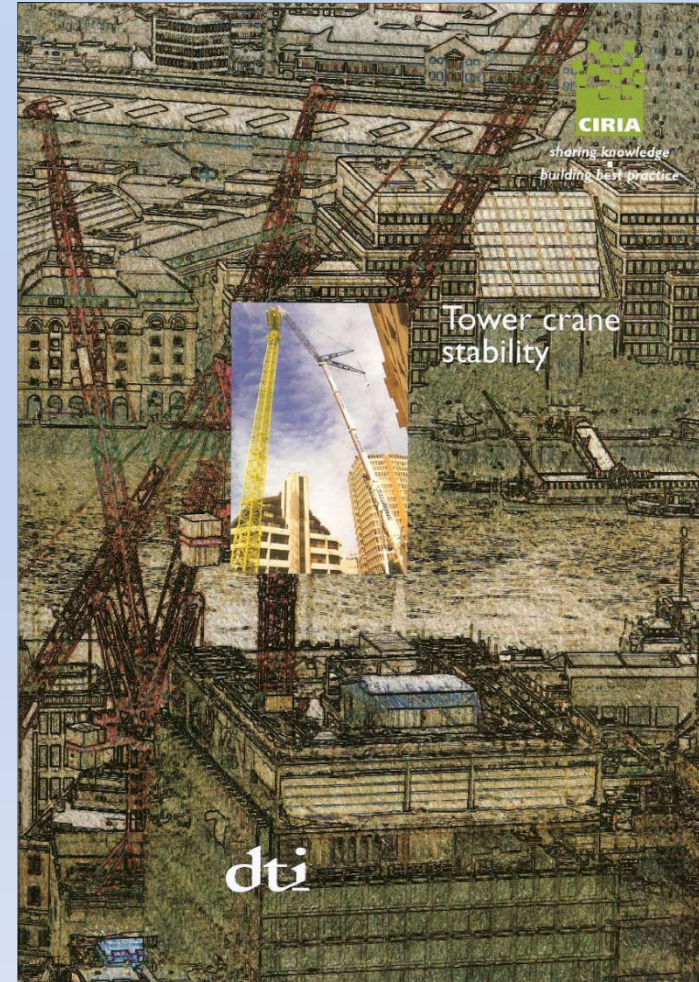
Code of practice for safe use of cranes –

Part 5: Tower cranes

ICS 53.020.20

BSi
British Standards

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TWC

Guidance



Safe Use of Top Slew Tower Cranes



CPA Best Practice Guide



Safe Use of Self Erecting Tower Cranes



CPA Best Practice Guide






Guidance

Maintenance, Inspection and Thorough Examination of Tower Cranes

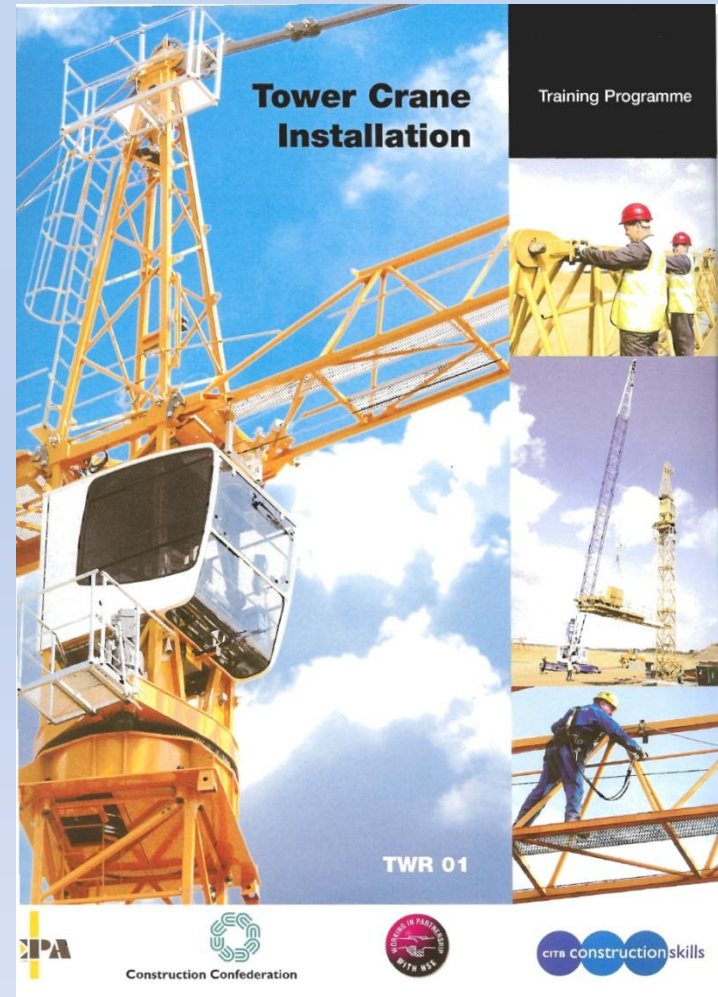
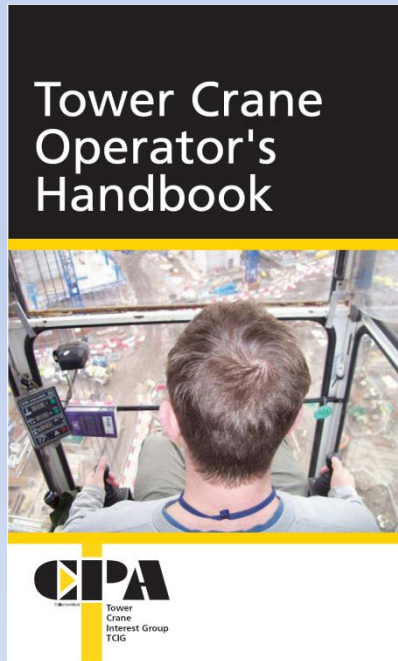


Best Practice Guide



	Construction Plant-hire Association Tower Crane Interest Group					
	<i>Tower Crane Technical Information Note</i>					
TIN 005	Housekeeping on Tower Cranes					
<p>All accessible areas of tower cranes should be kept clean and free of loose material at all times. Loose material on walkways and platforms can be both a trip hazard and a falling object hazard, whilst grease and other liquids can cause slips. Care should also be taken to ensure that tower crane cabs are kept free of paper and other combustible materials. (See Figures 1 & 2)</p> <p>After erection, or whenever work has been carried out on the crane, the person supervising the work should inspect all accessible areas to ensure that surplus material and components have been removed. Where it is essential that materials or components remain for operational or safety reasons, they should be secured in such a way that they do not present a slip, trip or falling object hazard.</p> <p>Where stocks of small materials such as grease guns, grease cartridges and gloves are required on the crane they should be stored in a secure container mounted securely on the counter jib or other suitable area. The container should be weatherproof to IP66, have a top hinged self-latching lid and minimum capacity of 30 litres. An example is shown in Figure 3 below.</p>						
						
Figure 1 – General Loose Material		Figure 2 – Poorly Stored Components				
						
Figure 3 – Storage Container						
TIN No.	005	Issue Date	30.07.07	Issue	B	Page 1 of 1

Guidance



Guidance



The Climbing of Tower Cranes



CPA Best Practice Guide



National Construction College
The training division of  construction skills



**All Construction Plant-hire Association
(CPA) Guidance Documents can be
downloaded free at**

<http://www.cpa.uk.net/p/Safety-Leaflets>



Thank You

