



香港專業吊運聯會有限公司
Hong Kong Professional Hoisting Engineering Association Limited

Tower Crane Operation

Speaker

Ir Dr Lee Chun Yu, Jimmy

1st April 2008



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Tower crane operation includes :

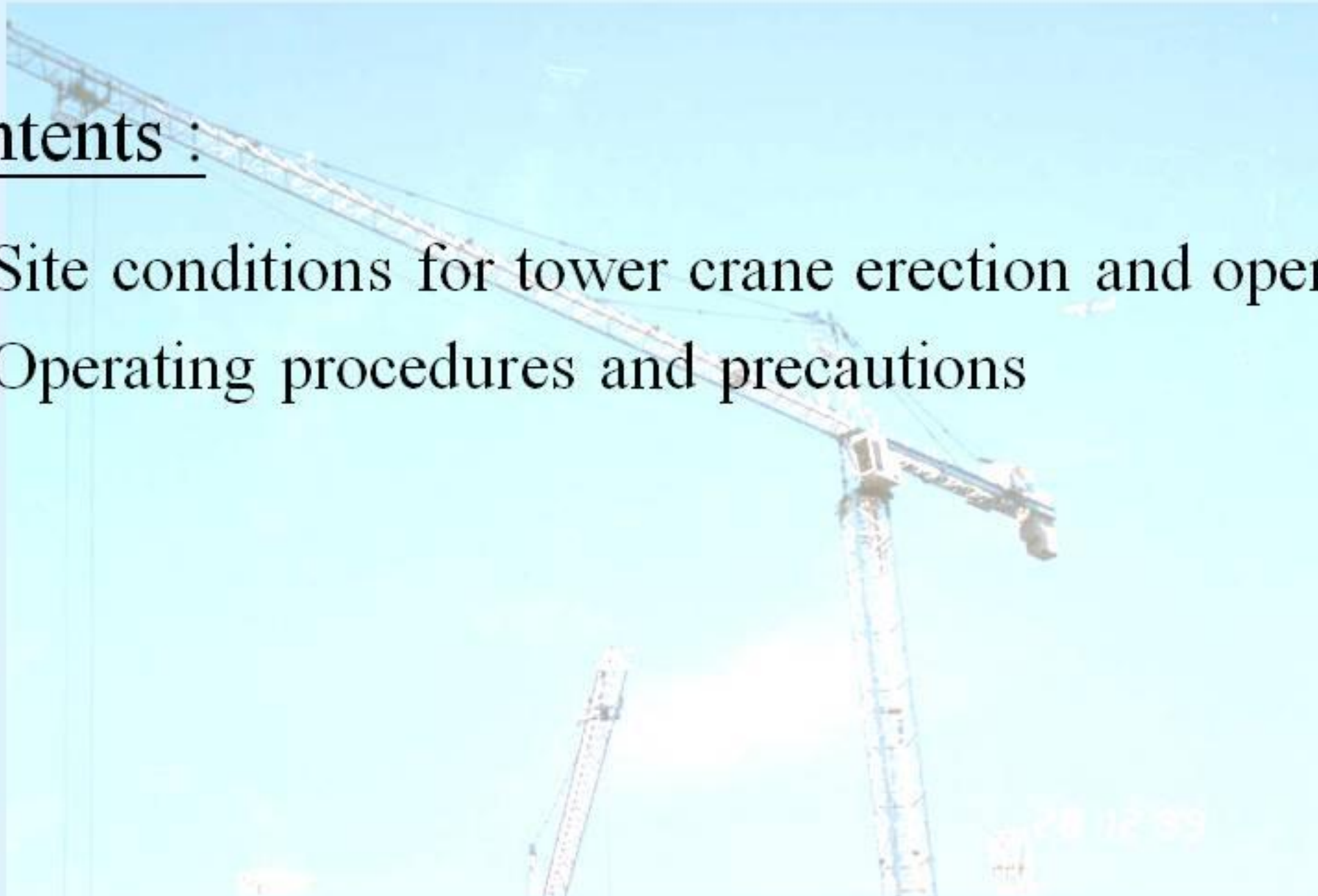
- Establish a safe system of work
- Planning of the lifting operation
- Define the responsibilities / requirements of personnel
- Selection of tower cranes
- Erection, height alteration and dismantling
- Procedures and precautions
- Inspection, examination and testing
- Repair and maintenance



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Contents :

1. Site conditions for tower crane erection and operation
2. Operating procedures and precautions





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Collapsed tower crane New York, USA - 15th March 2008

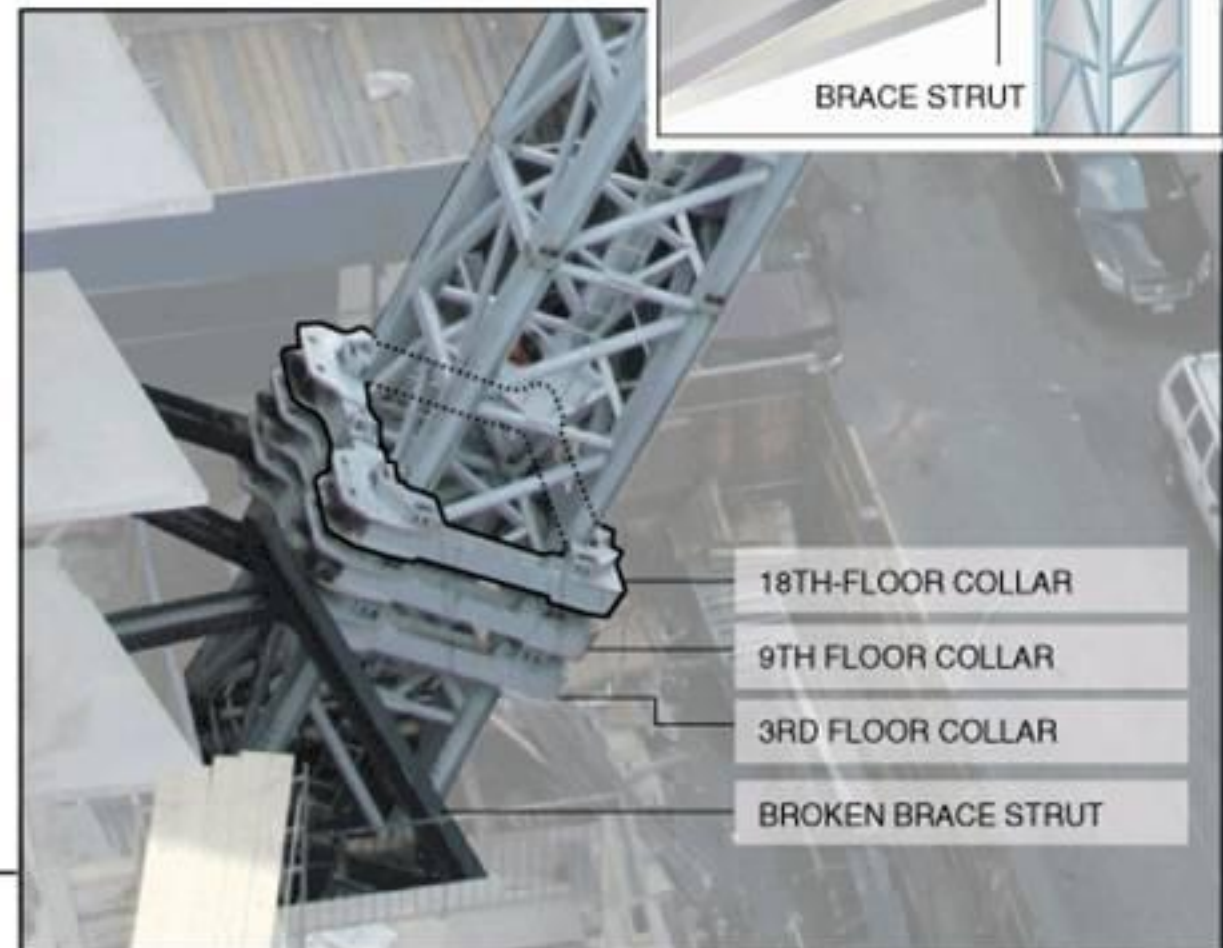
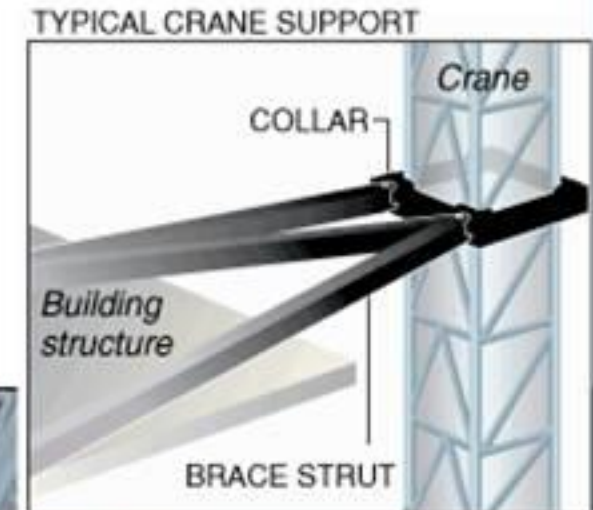
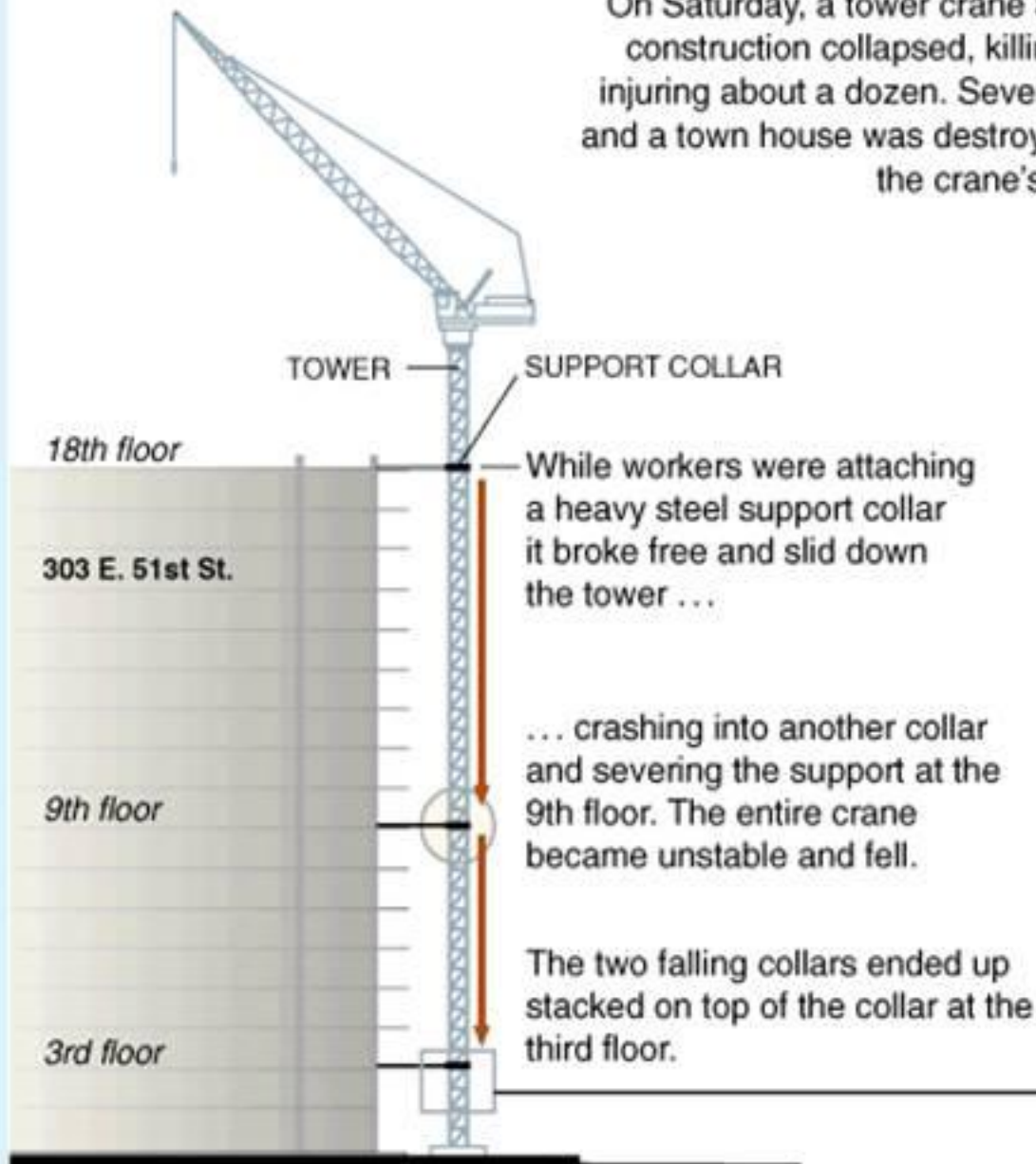




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How the Crane Fell

On Saturday, a tower crane attached to a building under construction collapsed, killing at least four people and injuring about a dozen. Several buildings were damaged, and a town house was destroyed. The details of what led to the crane's collapse:





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Broken nylon sling





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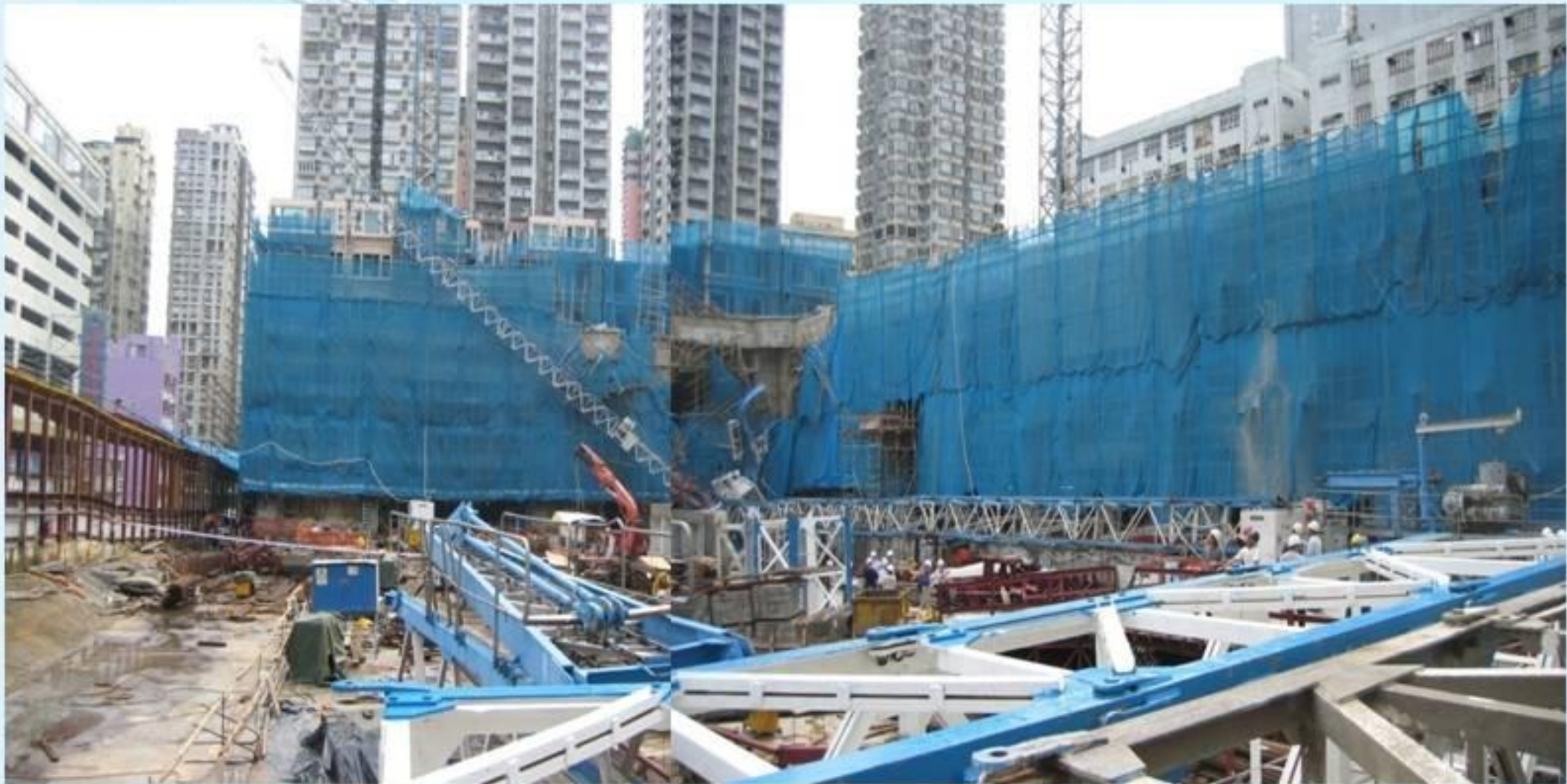
Collapsed tower crane Causeway Bay - 2007





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Collapsed tower crane Kwai Chung - 2005





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Failed jib - 2004





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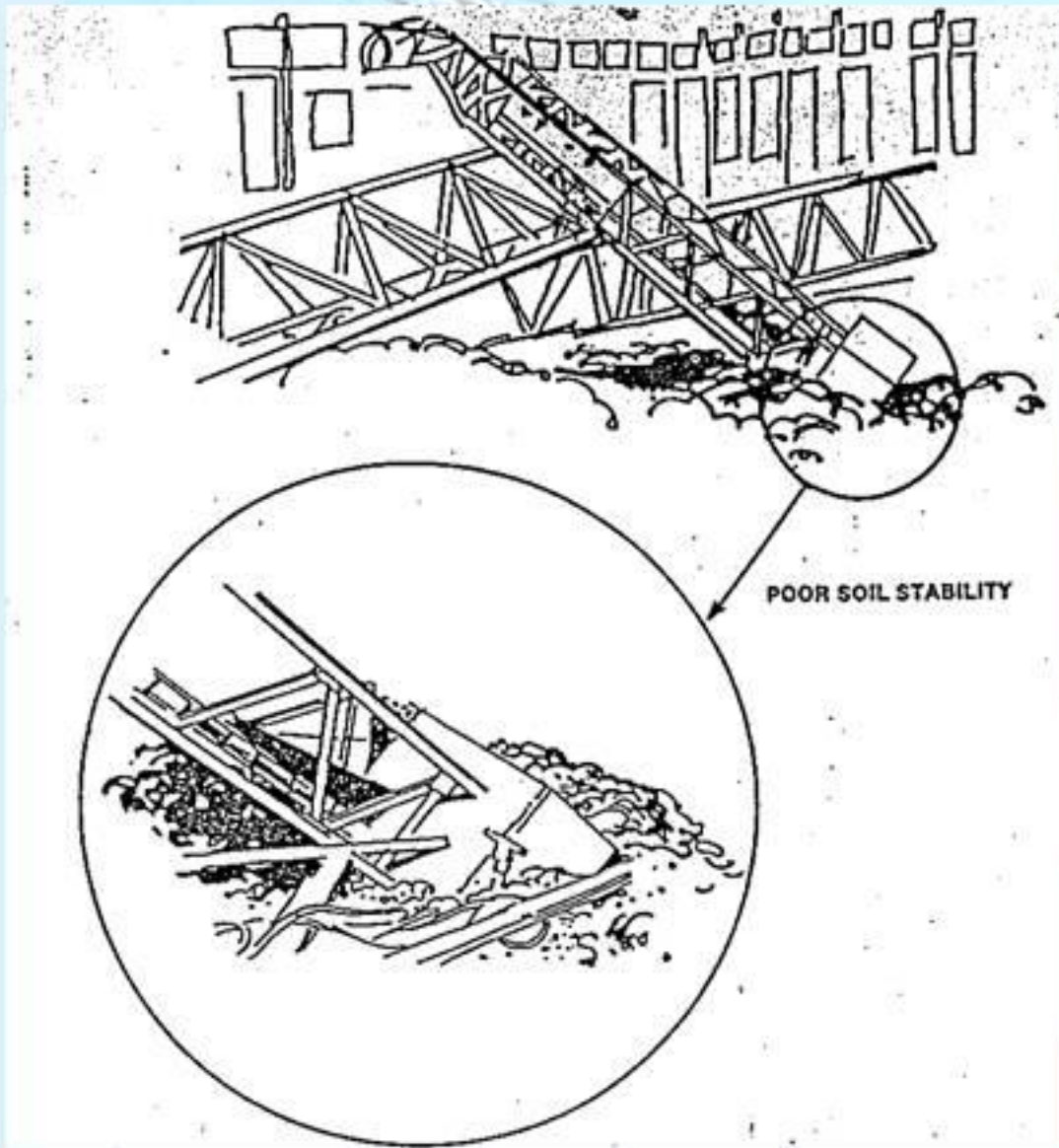
1. Site conditions for tower crane erection and operation





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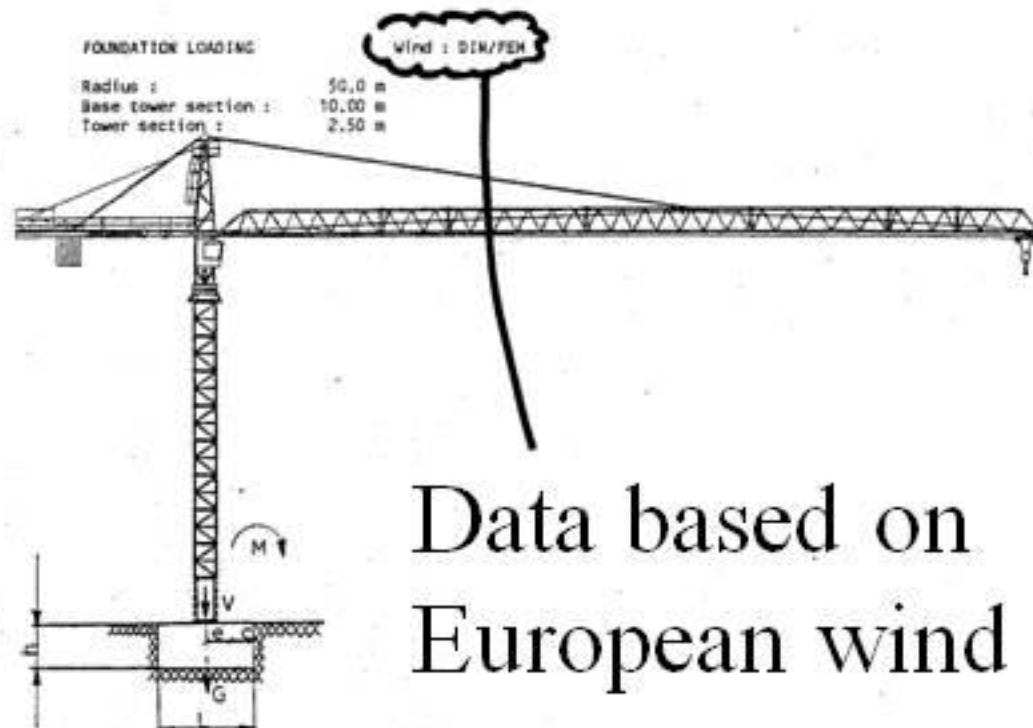
Allowable bearing capacity of ground



Inadequate ground bearing capacity can lead to collapse of tower crane



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Data based on
European wind

Number of tow. sec.	Hook height	Crane in operation			Crane out of operation			Crane in erection		
		M (kNm)	H (kN)	V (kN)	M (kNm)	H (kN)	V (kN)	M (kNm)	H (kN)	V (kN)
0	12.0	1315	20	477	1092	26	457	940	12	258
1	14.5	1366	21	488	1198	30	467	970	13	268
2	17.0	1419	22	498	1314	35	477	1003	13	279
3	19.5	1474	22	508	1493	40	488	1037	14	289
4	22.0	1531	23	519	1611	43	498	1073	15	299
5	24.5	1590	24	529	1743	45	508	1111	16	310
6	27.0	1651	25	539	1945	51	518	1151	16	320
7	29.5	1713	25	549	2098	54	529	1193	17	330

Must carry out design
based on the Hong
Kong Wind Code



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Hong Kong Wind Code



Table 1 : Design wind pressure

Height above site-ground level	Design wind pressure q_z (kPa)
≤ 5 m	1.82
10 m	2.01
20 m	2.23
30 m	2.37
50 m	2.57
75 m	2.73

Example

Crane Height = 50m

Hong Kong = 2.57kPa

European = 1.1kPa

European Wind Code

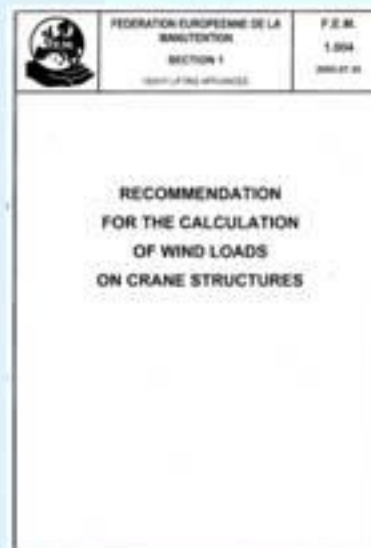


Table T.3.2 — Out-of-service wind speed and pressure

Height above ground level m	Approximate wind speed out of service m/s	Approximate wind pressure out of service N/m ²
0 to 20	36	800
20 to 100	42	1100
more than 100	46	1300



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Space available for transportation and mobile crane





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Space available for erection, operation and dismantling





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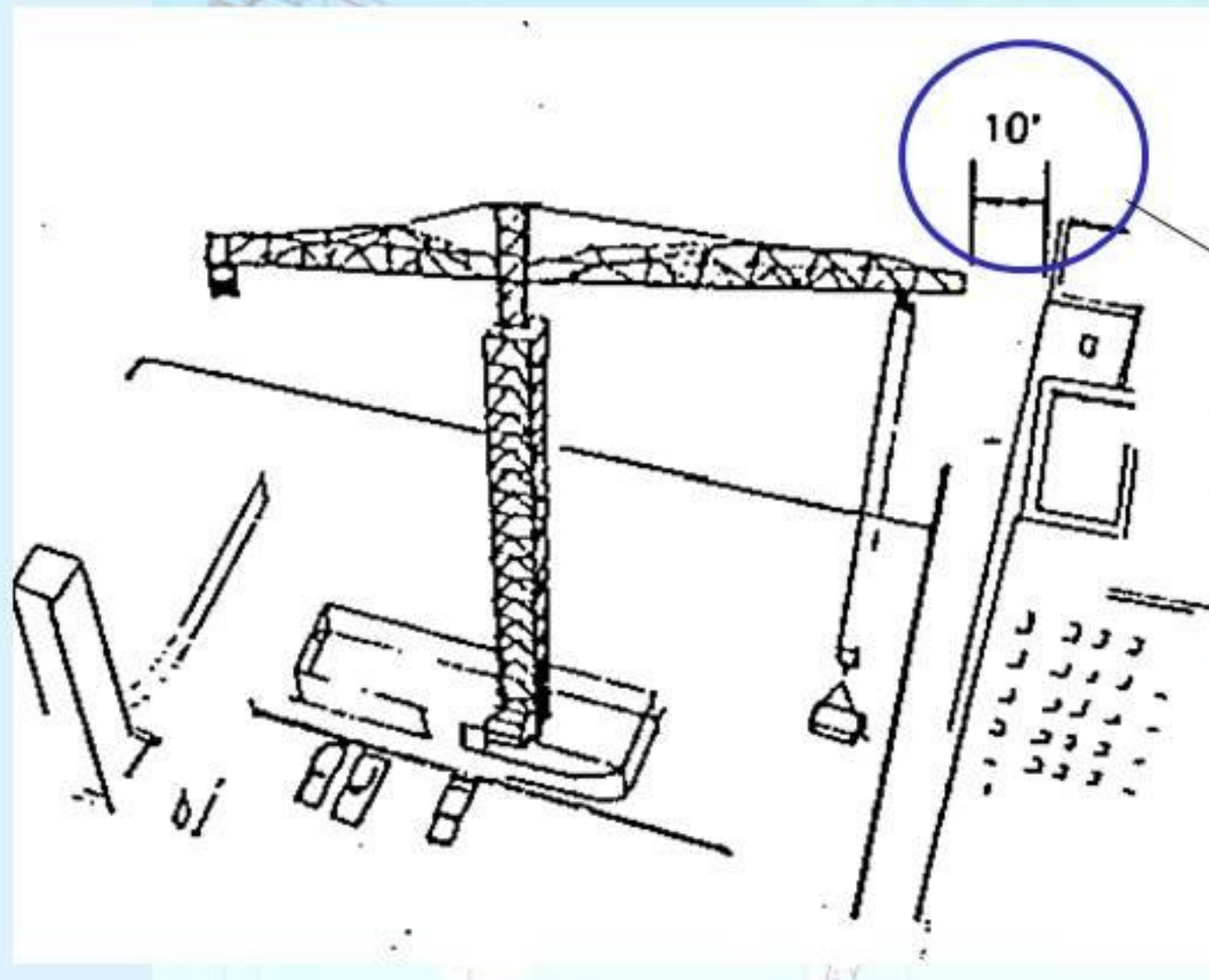


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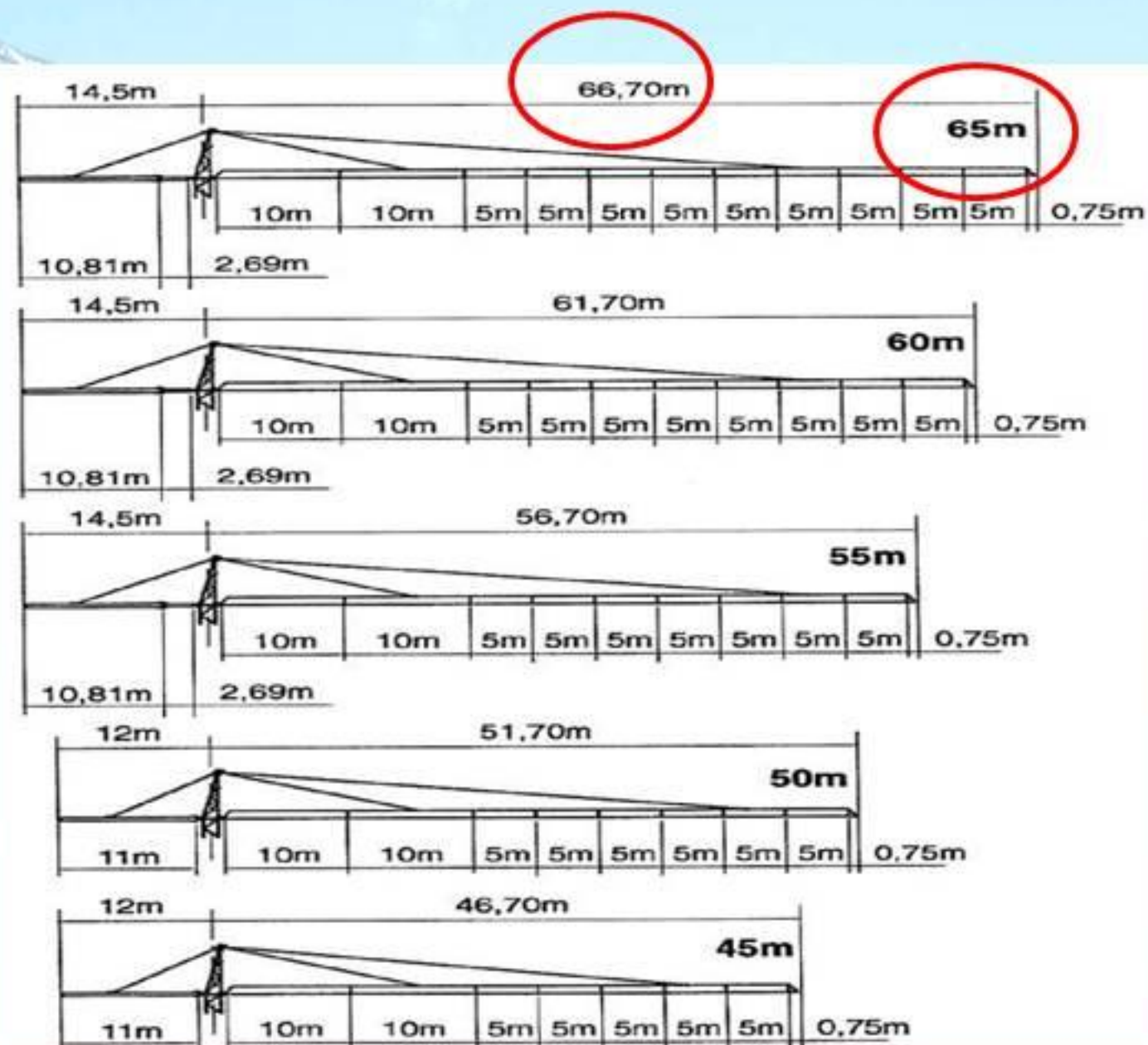


There should be
at least 3m (10ft)
between jib tip
and the nearest
obstacle



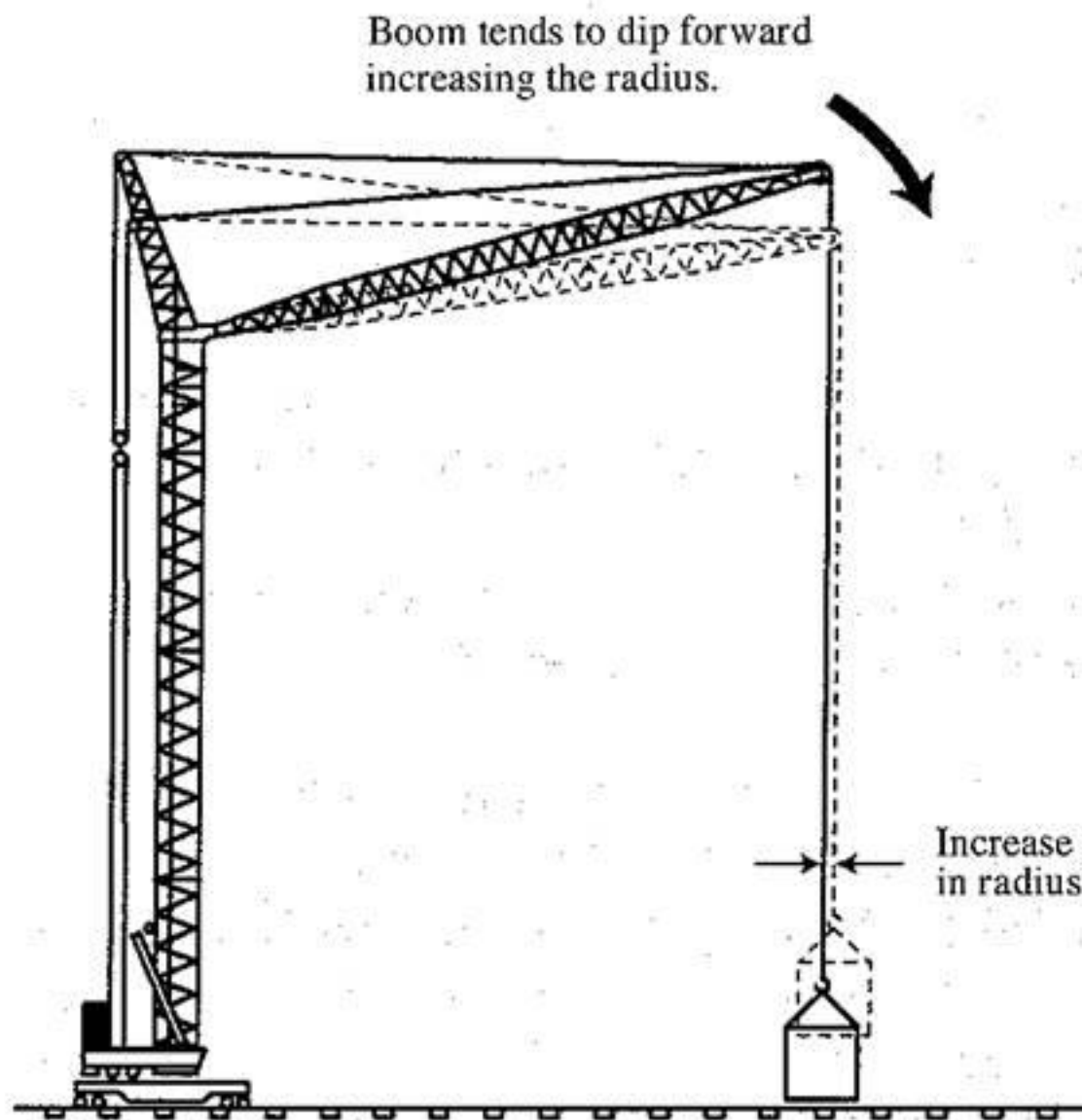
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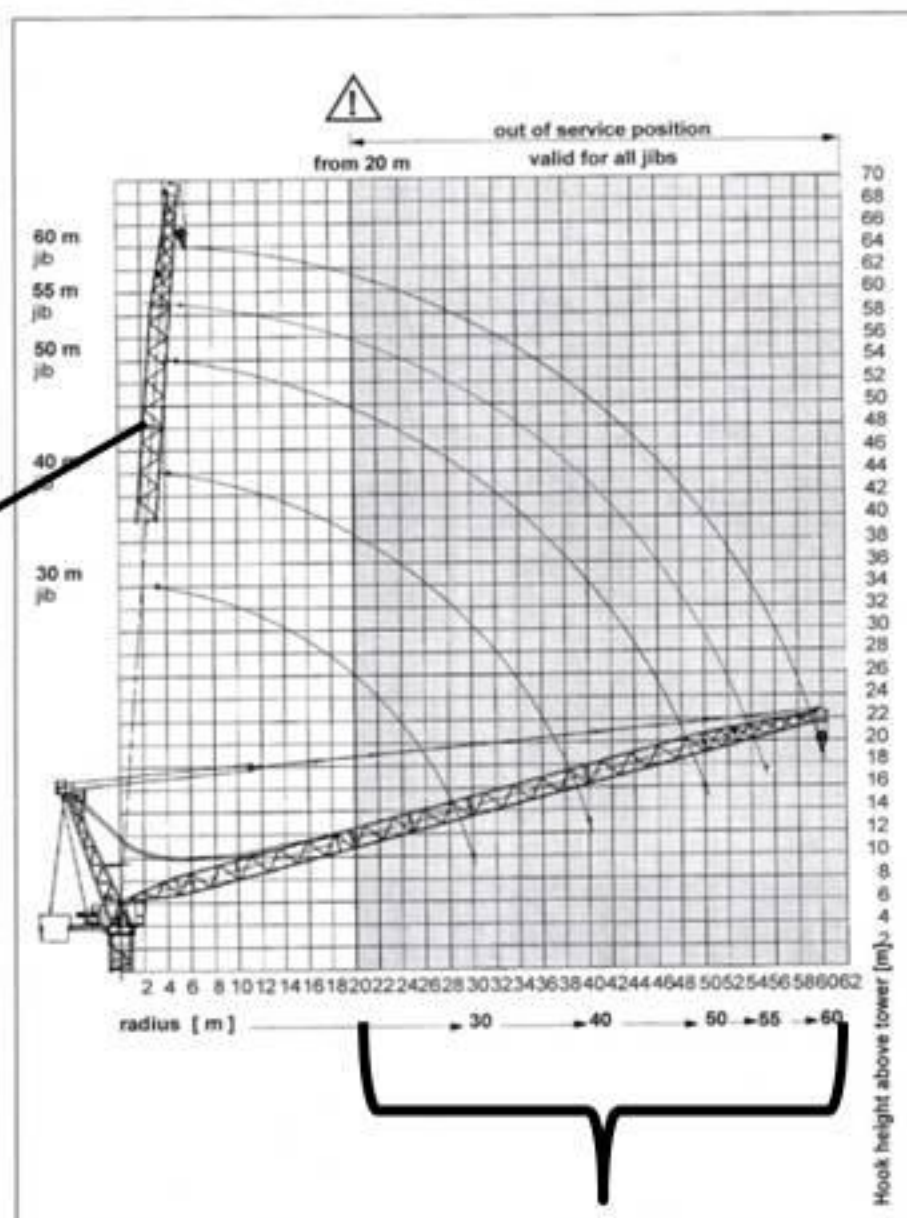
Increasing radius
when loaded



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Minimum radius
for In-operation

Hook positions



Out-of-operation position



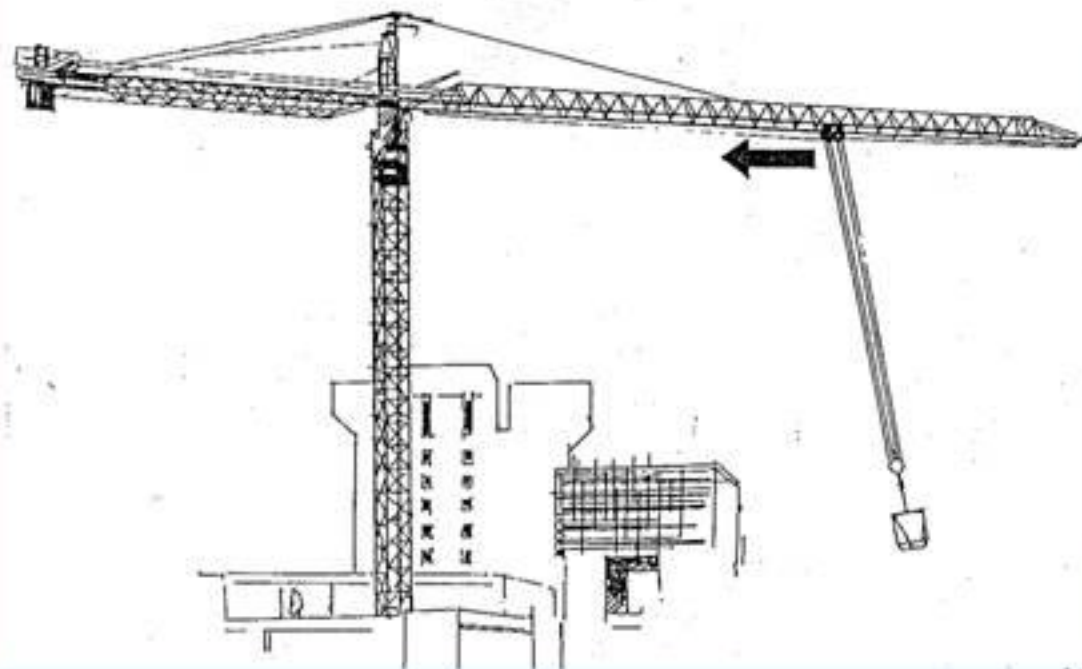
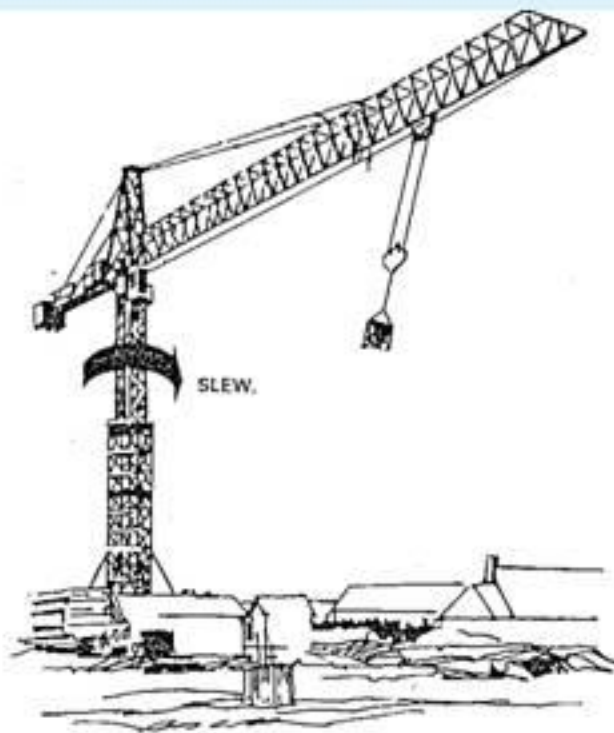
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3. Operating procedures and precautions





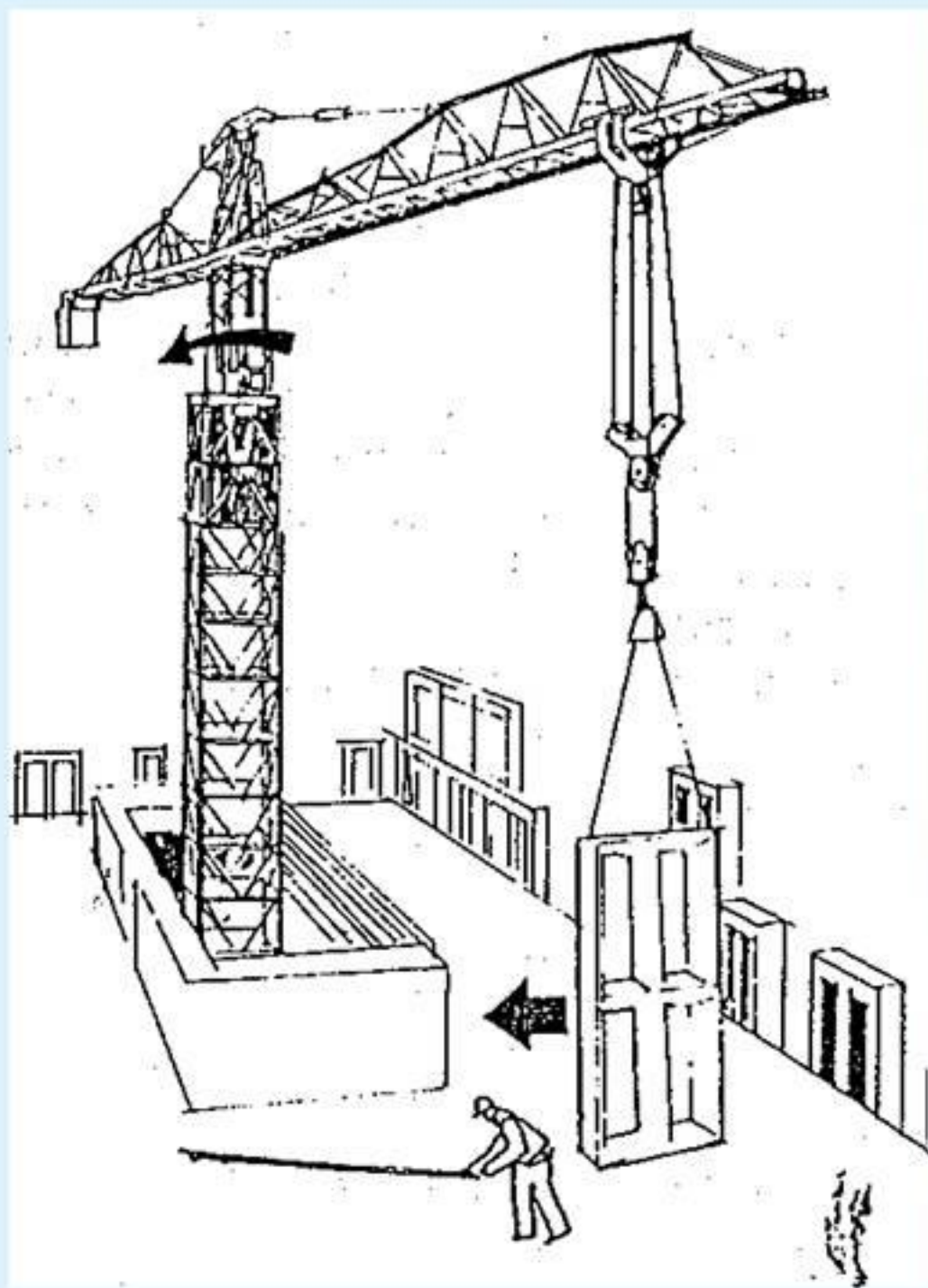
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Keep slew and
trolley speeds low
enough to maintain
control of the load



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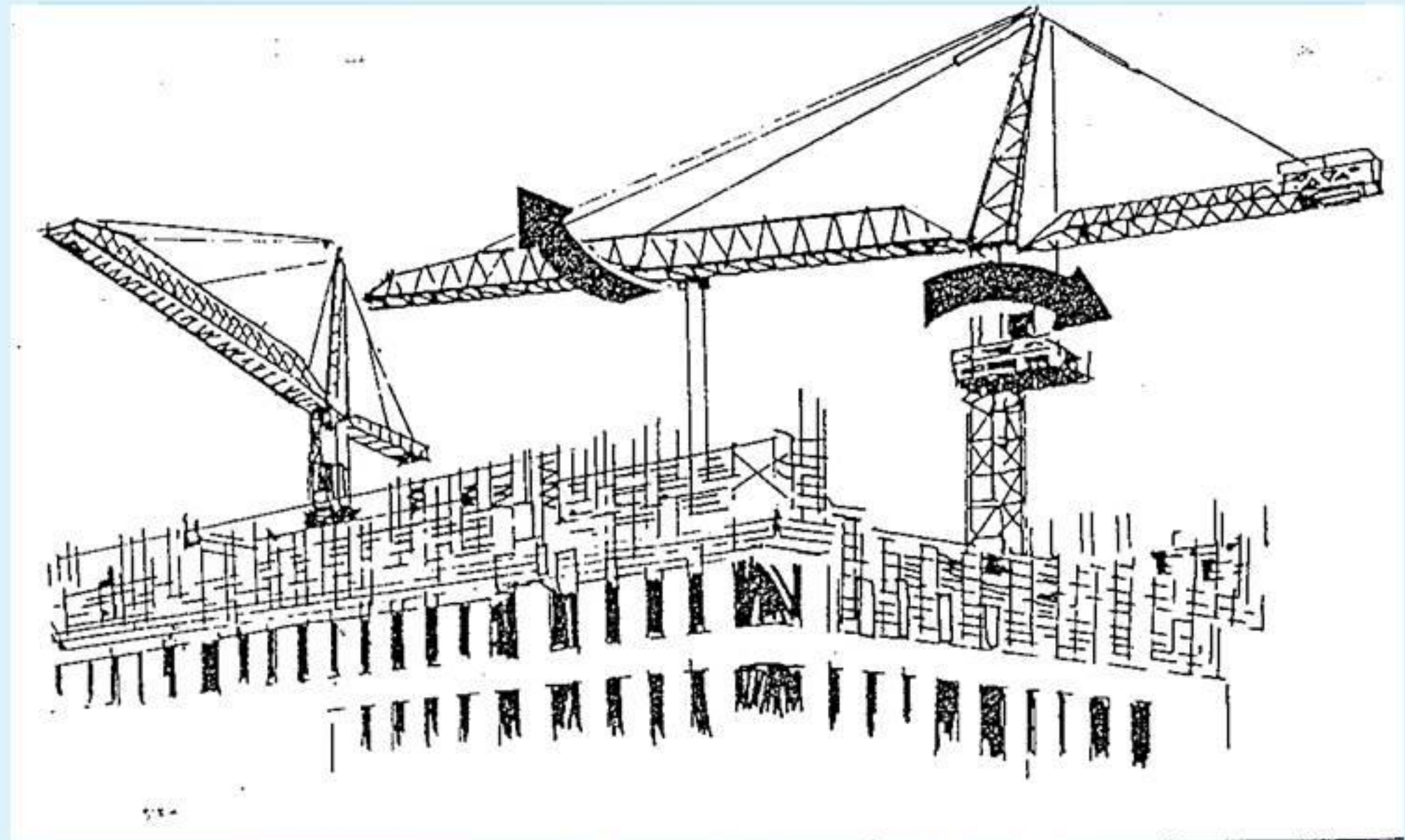


Always keep the
load path clear





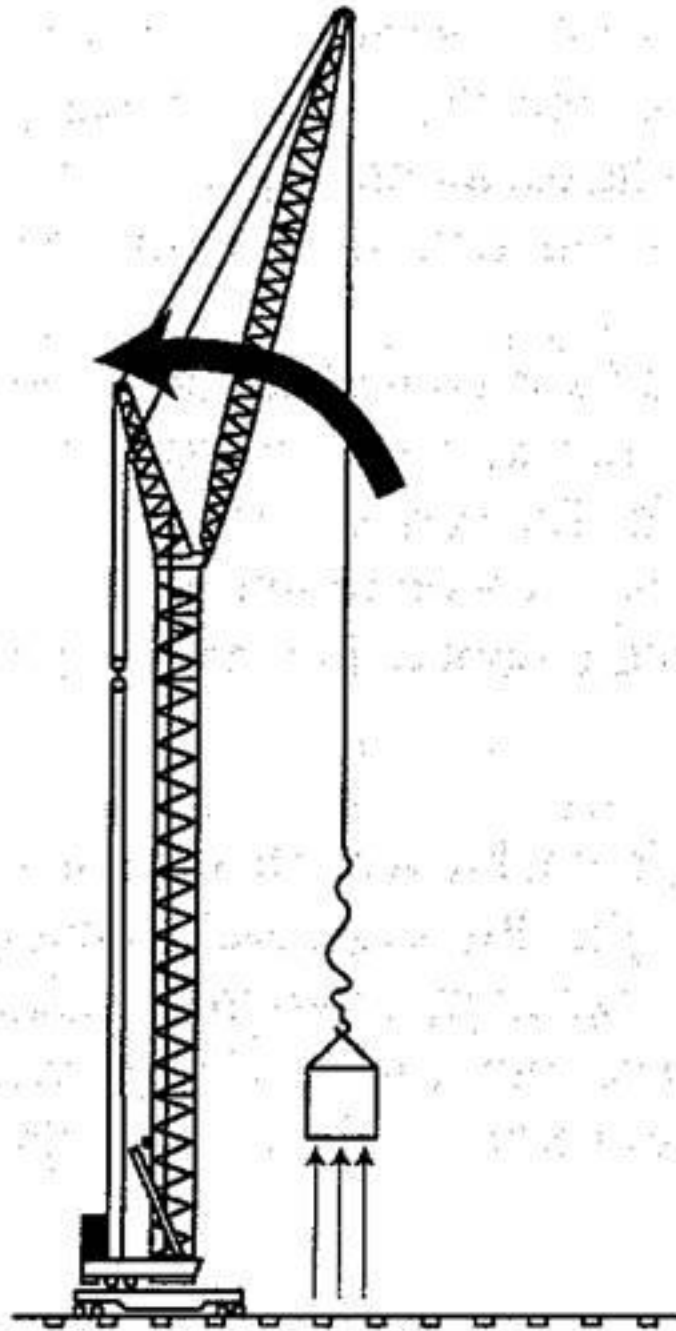
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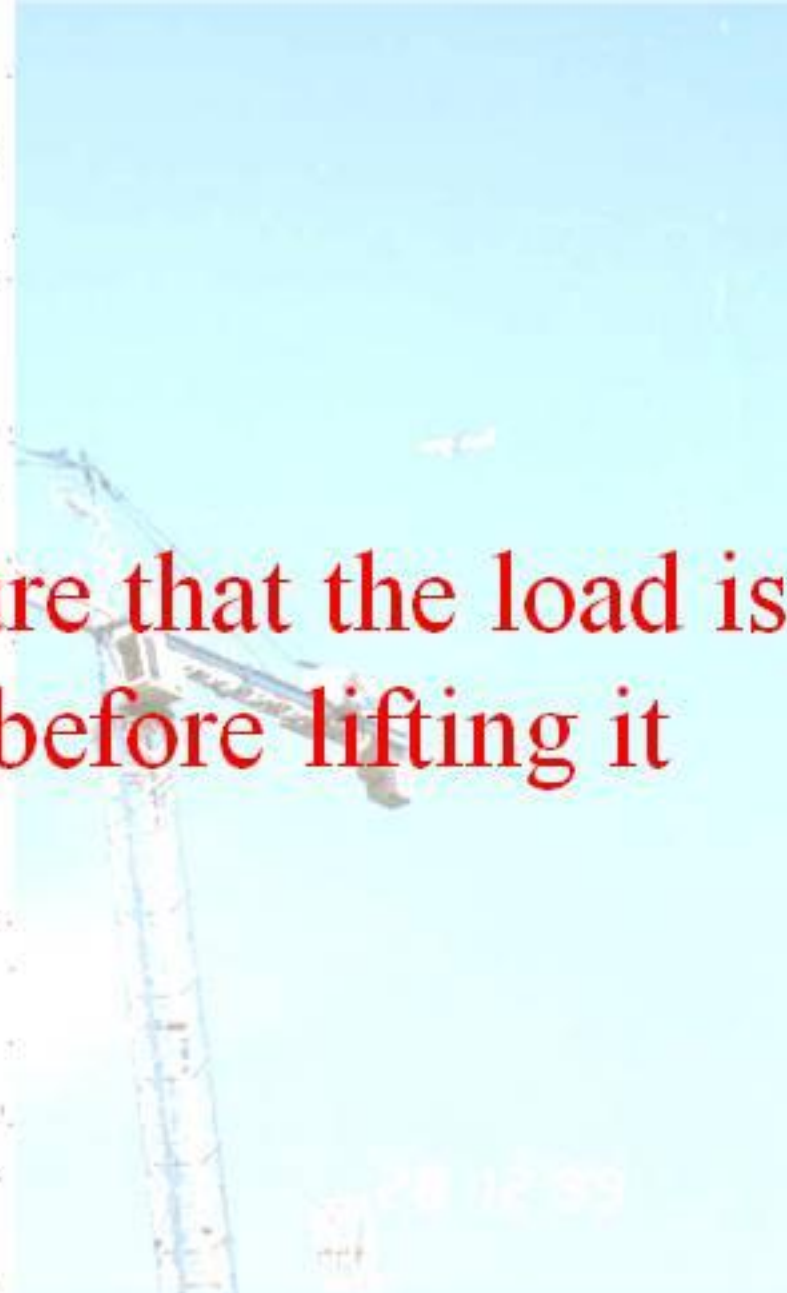
Do not free stuck items by slewing the crane



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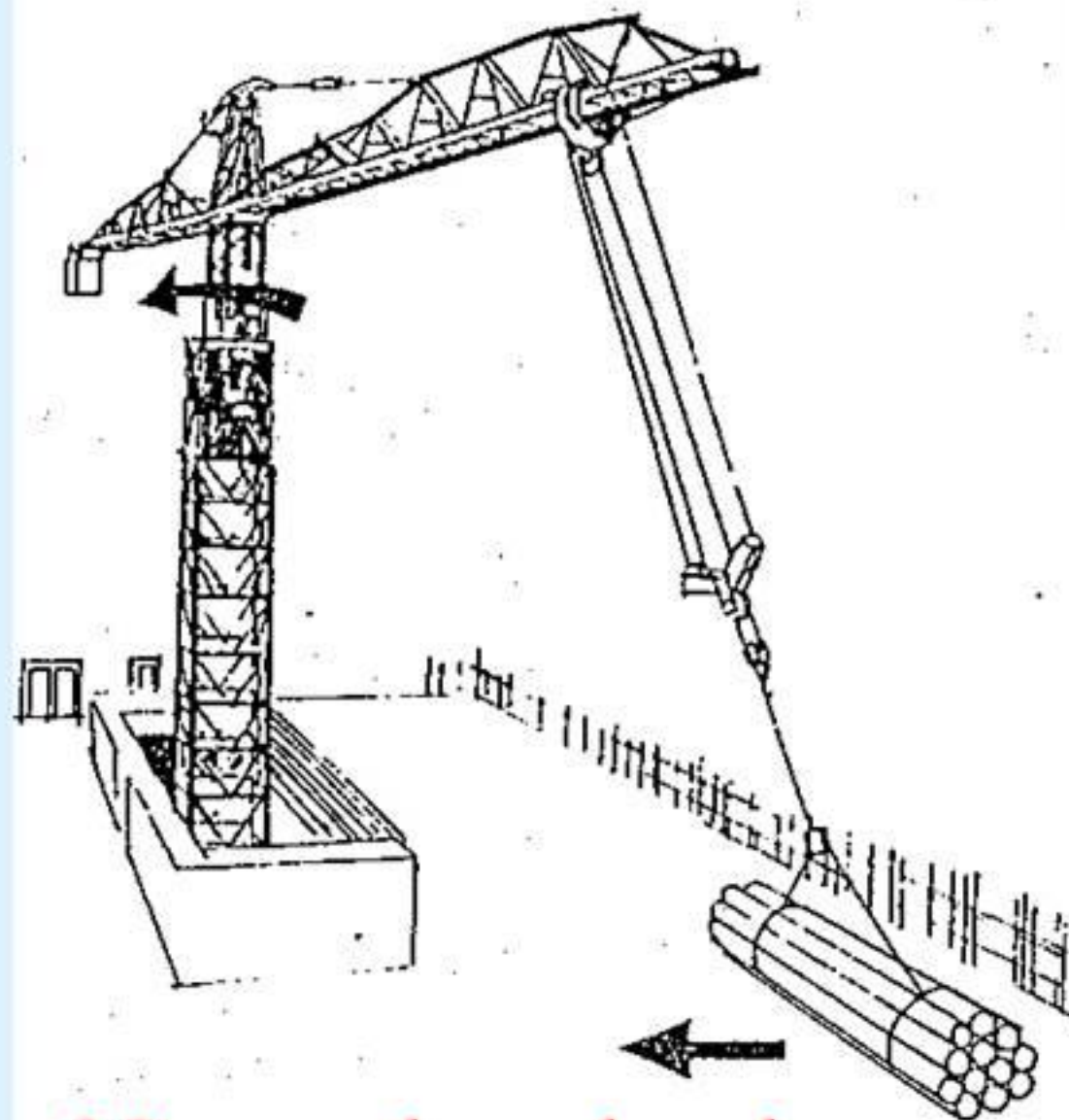


Ensure that the load is
free before lifting it





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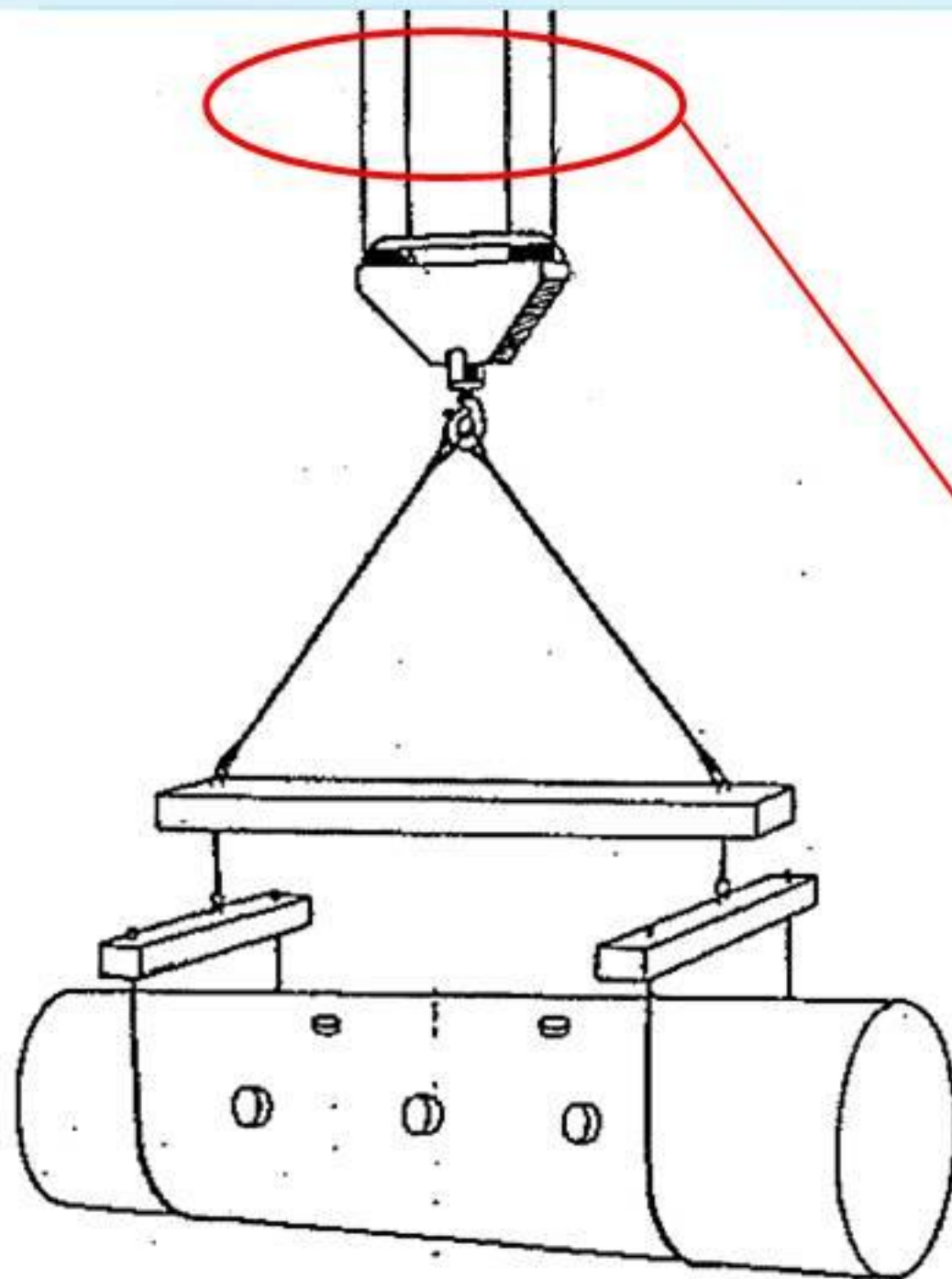
Never drag load

Hang Hau - Year 2004





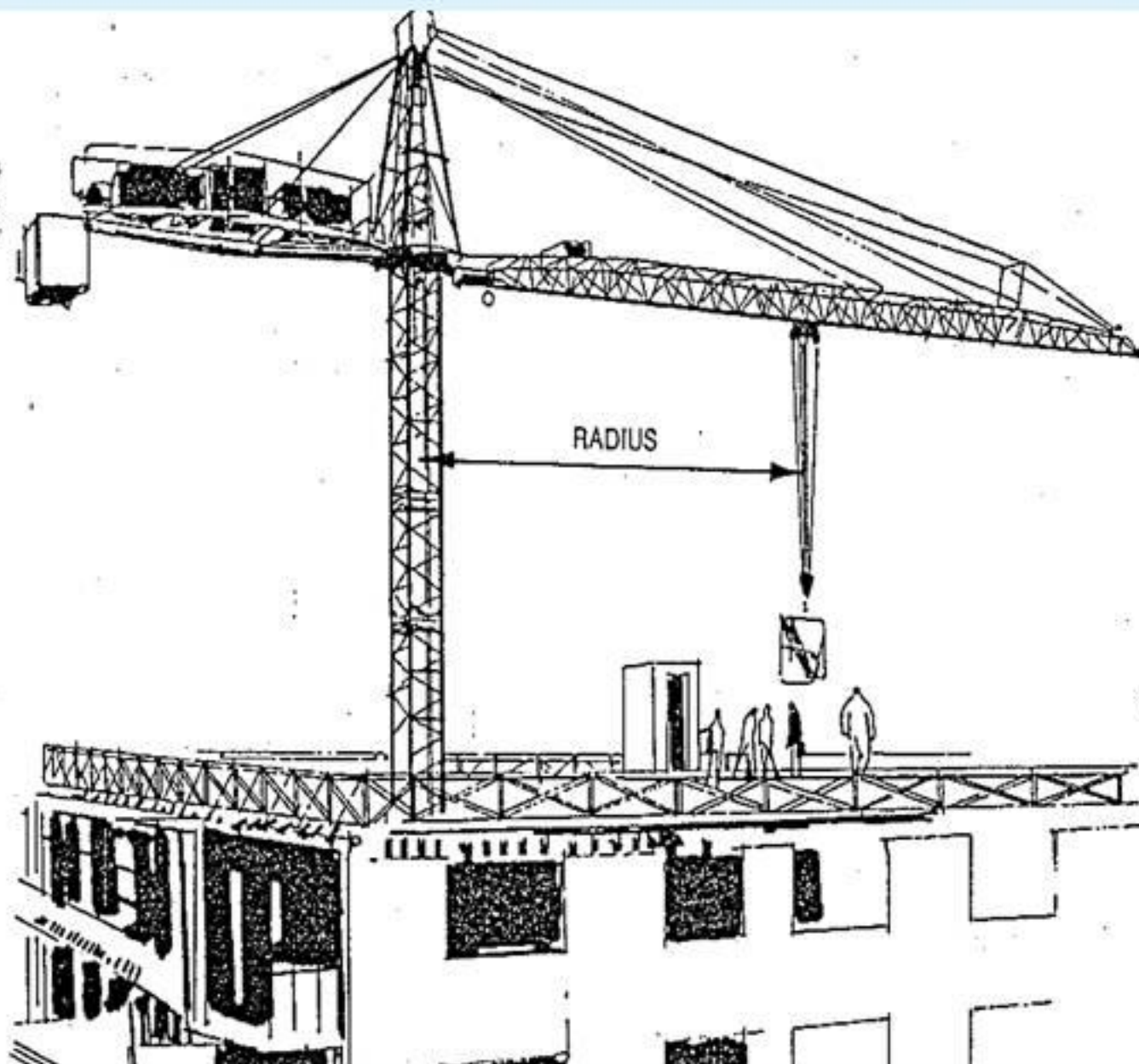
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All lifting tackle
must be counted as
part of the load,
including the
weight of the
crane hoisting
ropes



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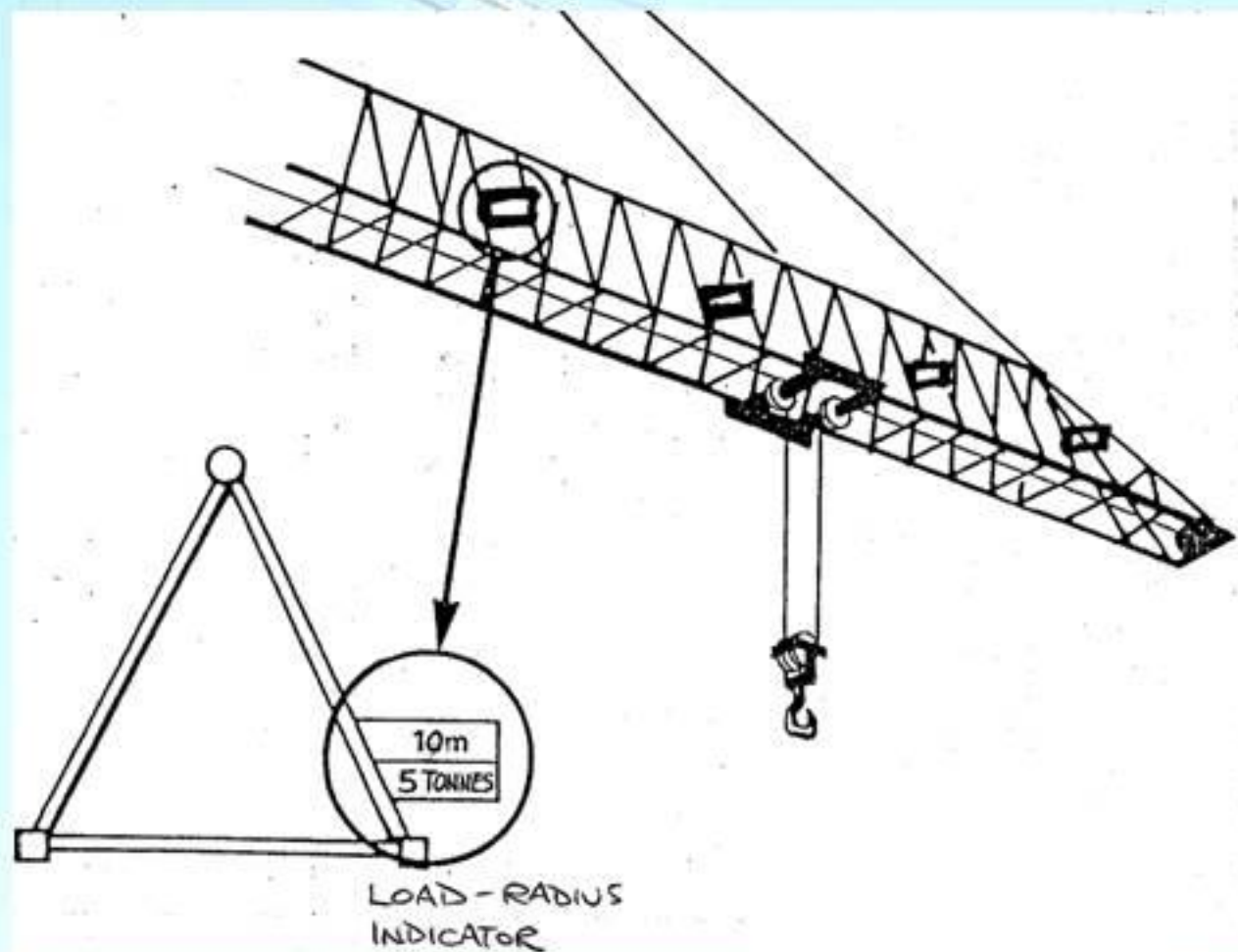


Know the radius
of the load at all
times



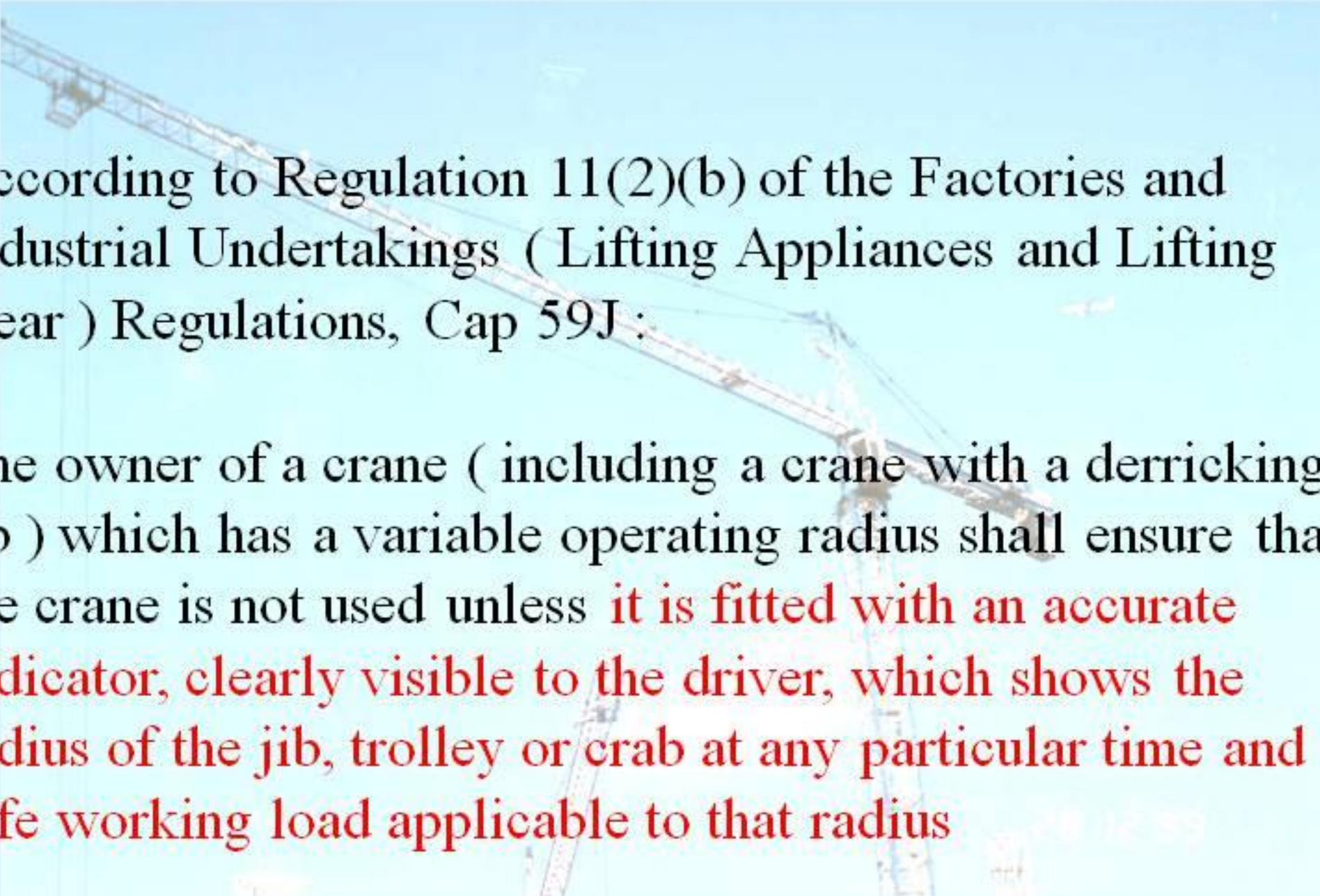
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Load-radius indicators for tower crane





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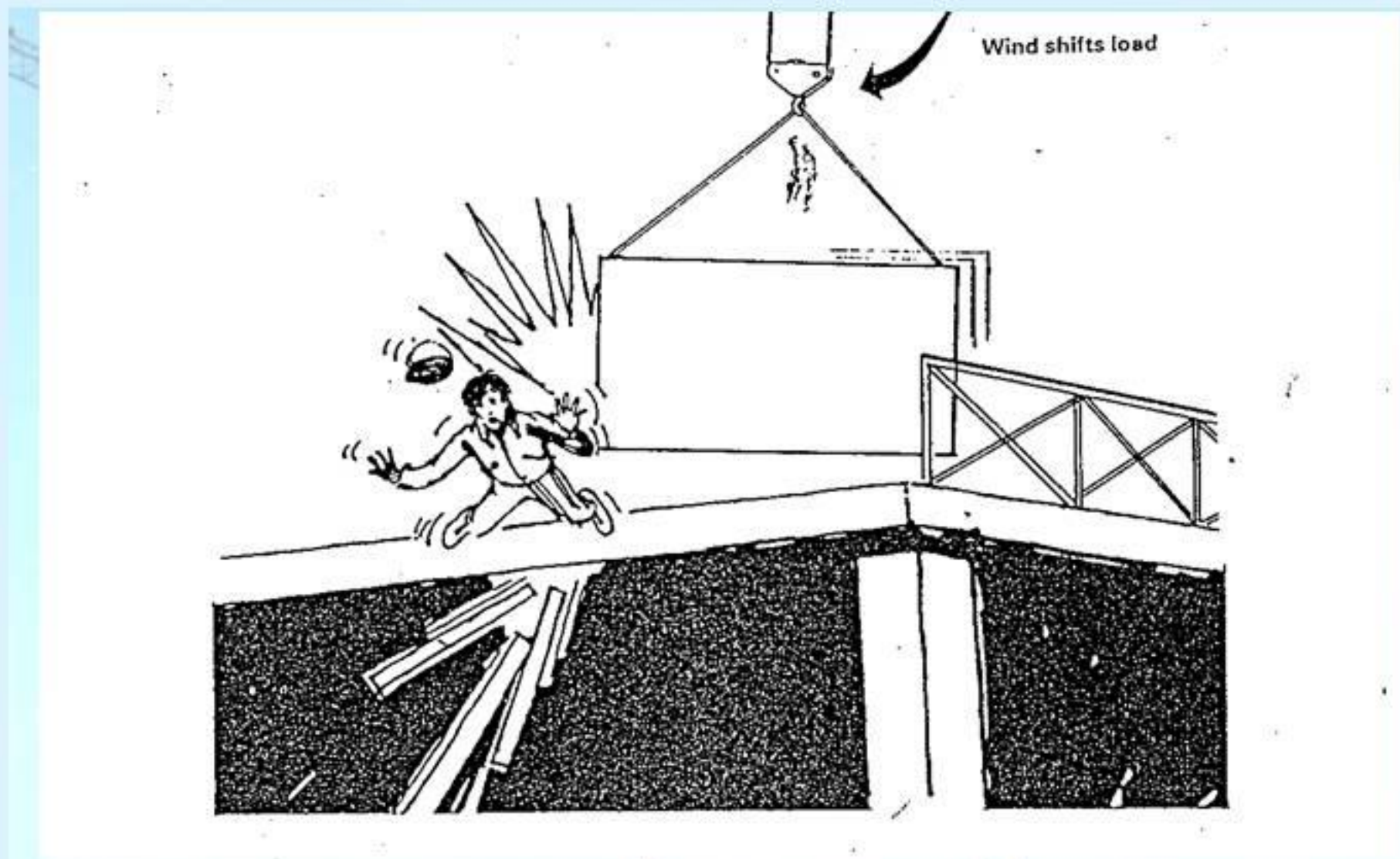


According to Regulation 11(2)(b) of the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations, Cap 59J :

The owner of a crane (including a crane with a derricking jib) which has a variable operating radius shall ensure that the crane is not used unless **it is fitted with an accurate indicator, clearly visible to the driver, which shows the radius of the jib, trolley or crab at any particular time and the safe working load applicable to that radius**



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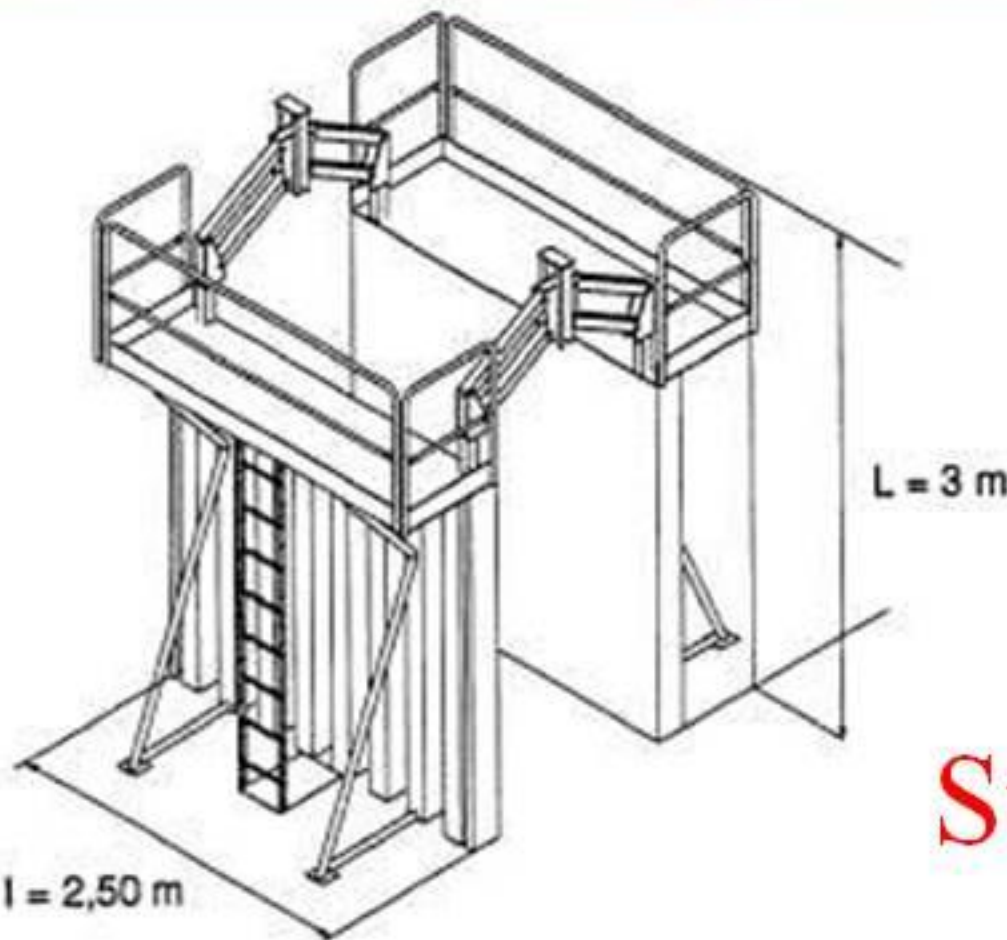
**Do not lift loads with large surface areas
in high or gusty winds**



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Determine the Permissible Wind Speed

- calculate the surface exposed to wind



Example: $S = 3 \text{ m} \times 2,50 \text{ m} = 7,5 \text{ m}^2$

See the tables on the following pages for determining the permissible wind speed in service.

Surface area = 7.5 m^2

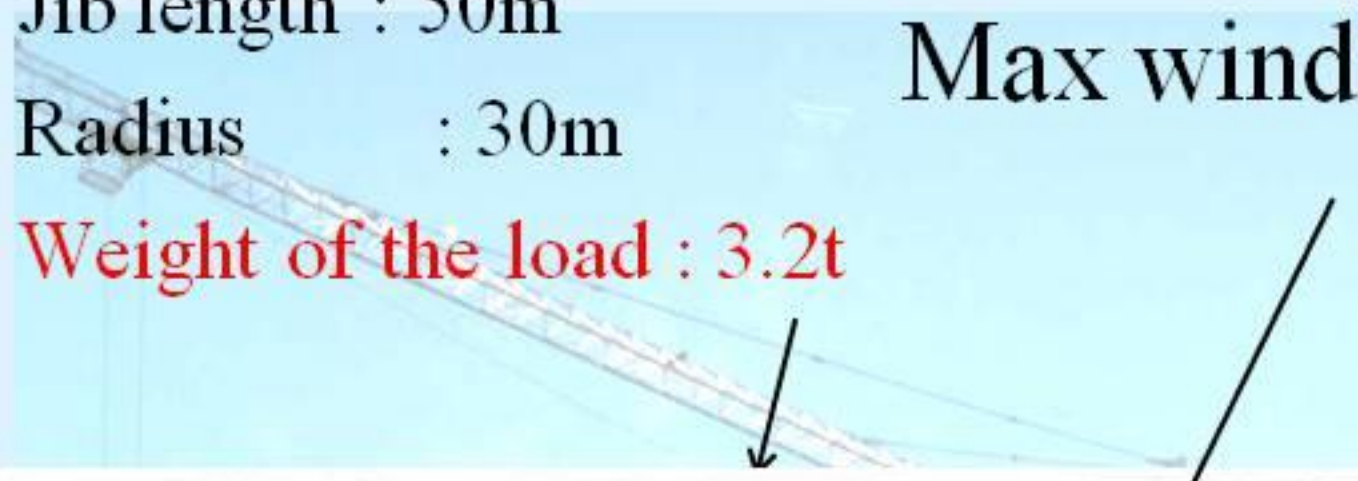


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- Jib length : 50m
- Radius : 30m
- Weight of the load : 3.2t

Max wind speed = 48 km/h



The diagram shows a crane jib of length 50m at a radius of 30m. A load of 3.2t is suspended from the jib. An arrow points from the 'Weight of the load : 3.2t' text to the load in the diagram. Another arrow points from the 'Max wind speed = 48 km/h' text to the value 48 in the table below.

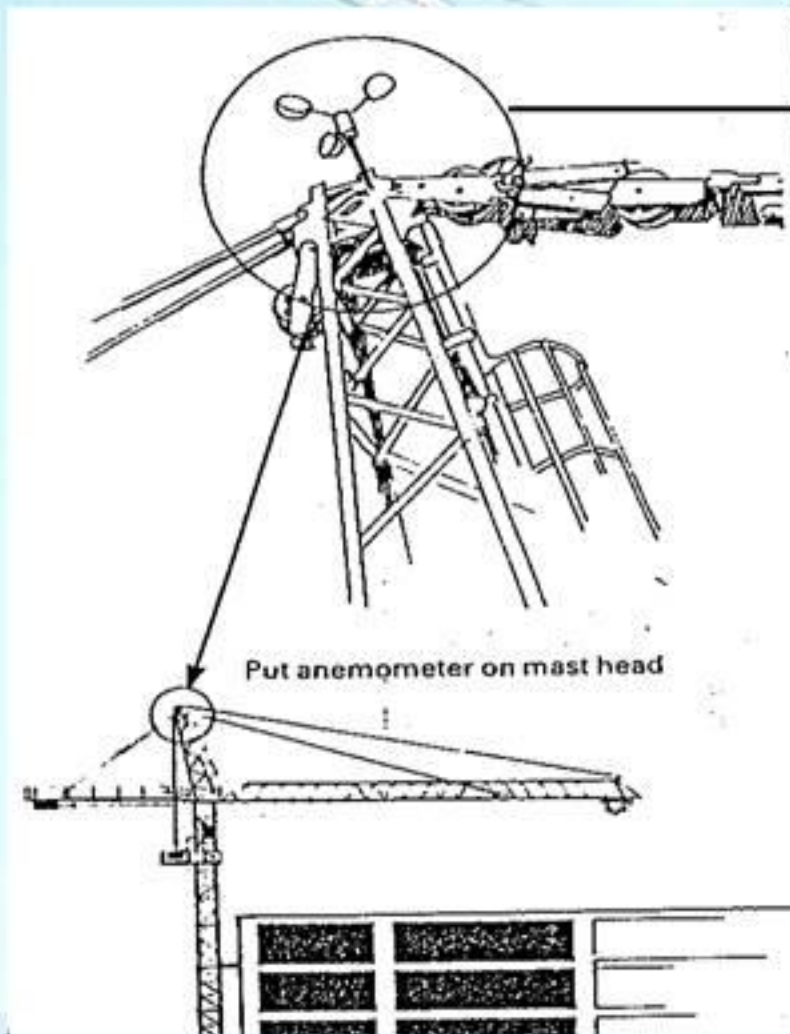
Radli	19	22	25	27	30	32	34	35	37	40	42	45	47	50
Load curve (in t)	6	5,13	4,41	4,03	3,64	3,27	3	3	2,79	2,53	2,38	2,18	2,06	1,9
S (in m ²)	Permissible maximum wind speed in service (in km/h)													
1	72	72	72	72	72	72	72	72	72	72	72	72	72	72
2	72	72	72	72	72	72	72	72	72	72	72	72	72	70
3	72	72	72	72	72	72	72	72	69	66	64	61	60	57
4	72	72	72	72	68	65	62	62	60	57	56	53	52	50
5	72	72	68	65	61	58	56	56	54	51	50	48	46	44
6	72	67	62	59	55	53	51	51	49	47	45	43	42	41
7	67	62	57	55	51	49	47	47	45	43	42	40	39	38
8	62	58	53	51	48	46	44	44	43	40	39	38	37	35

S = Surface of the lifted load in m²



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Anemometer



Wind transmitter



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Wind speed display

(in the crane cabin,
the site office, etc



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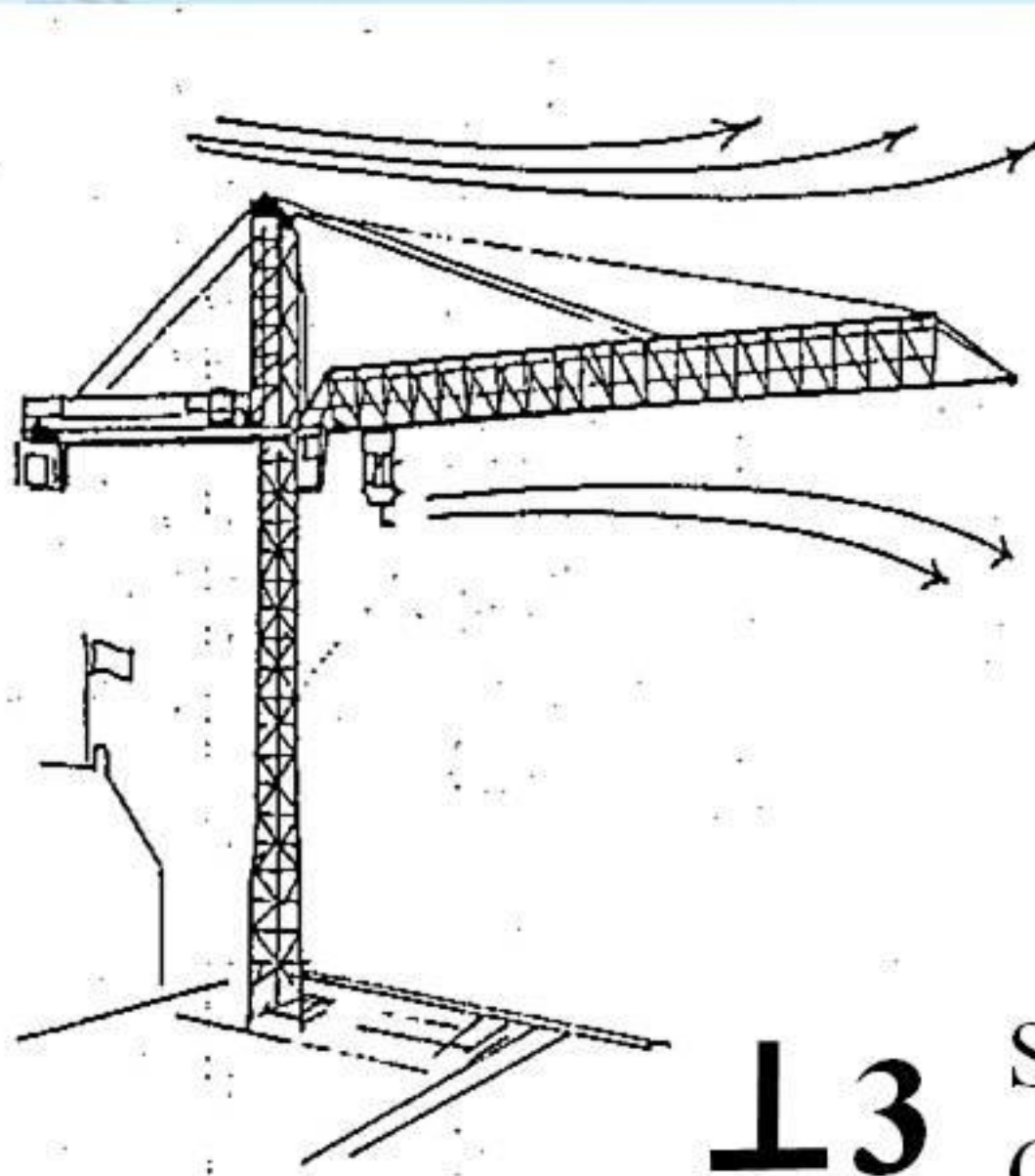
External signaling kit, with
flashing lights and siren



Wind speed display with
visual and audible alarm
at specified threshold



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For strong wind conditions, jib must be free to align itself with the wind direction

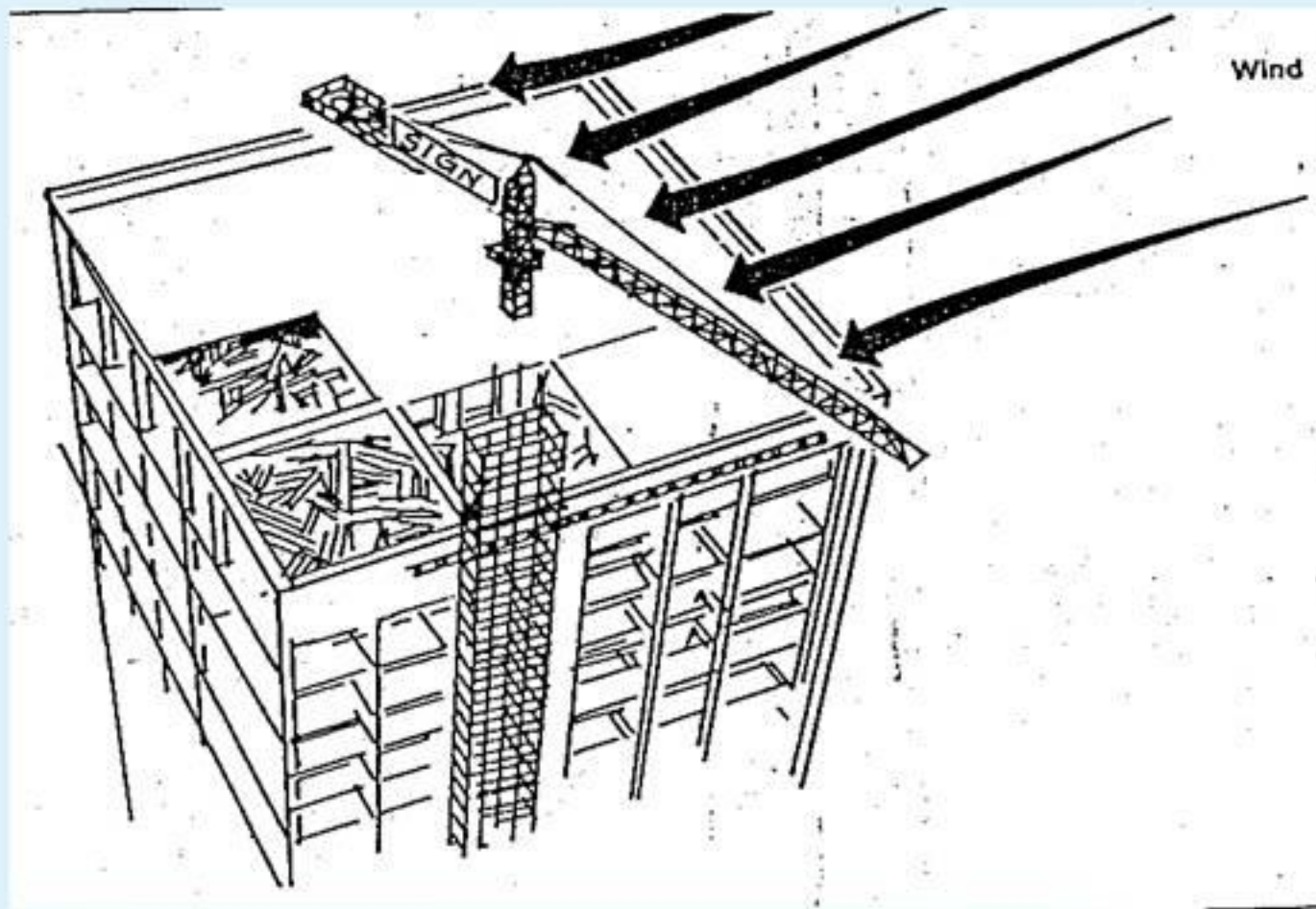
⊥ 3

Sustained speed 41-62 km/h
Gusts may exceed 110km/h





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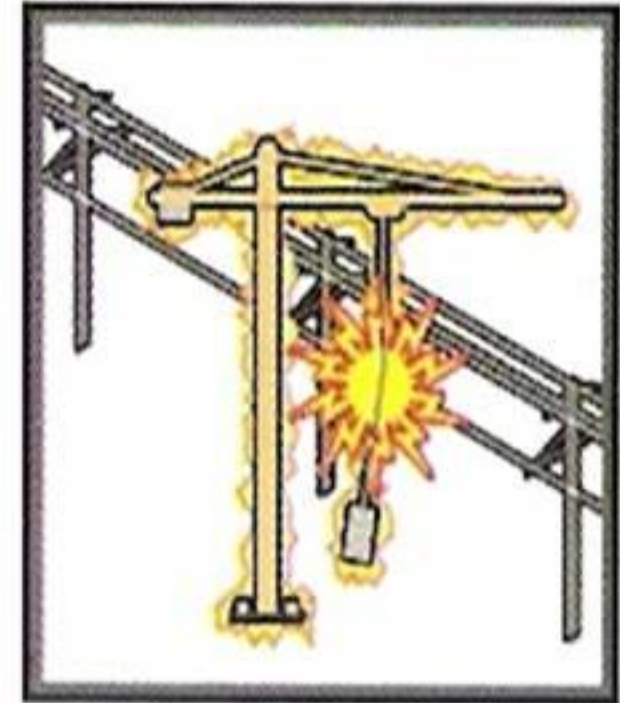
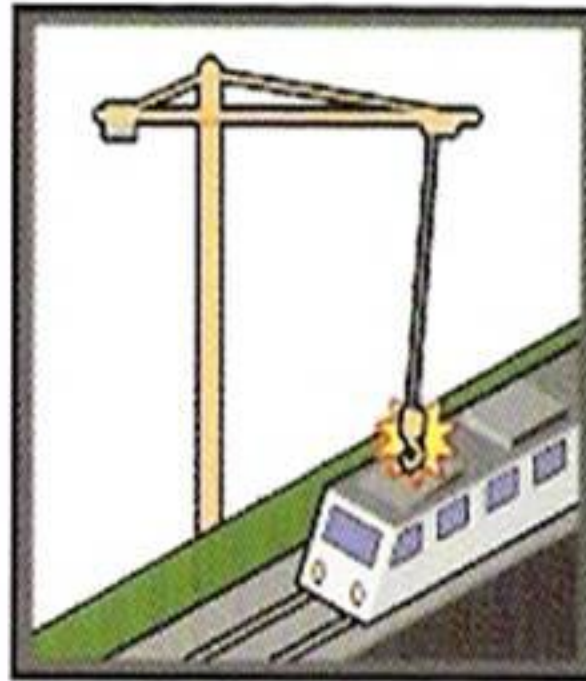
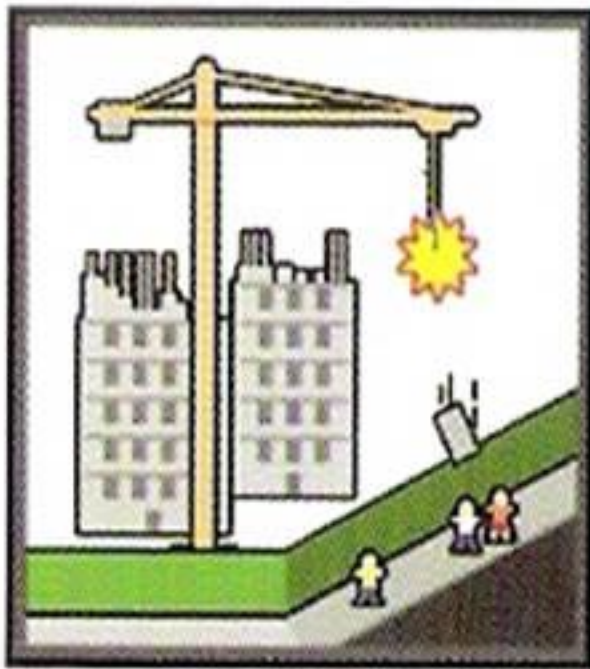
Large sign on the counter-jib may prevent the crane from weathervaning

Name boards or other items presenting a wind catching area should not be fitted to the jib, counter-jib, or the tower without manufacturer's approval



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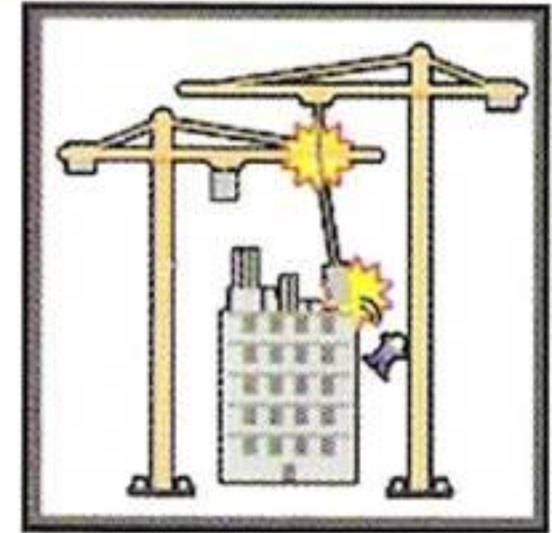
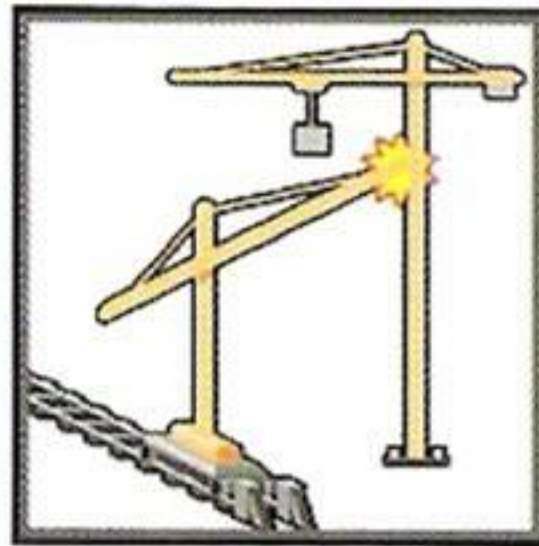
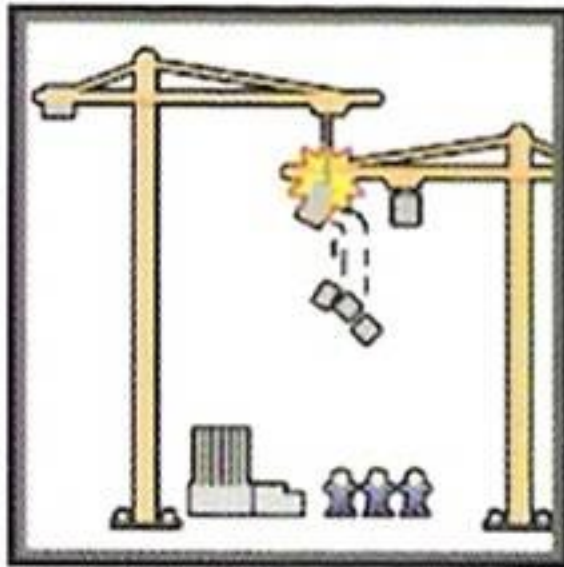
Zoning and anti-collision device



Risks : The hook of the crane enters
potentially dangerous areas



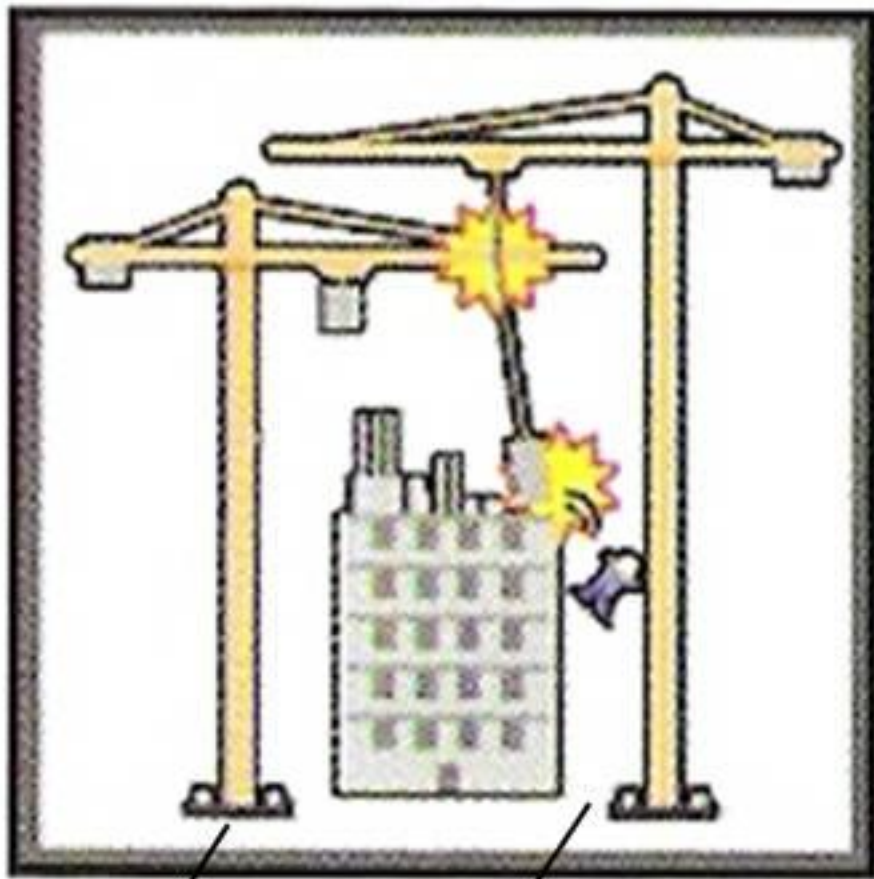
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Risks : Collision between adjacent cranes



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High crane stationary

Low crane slewing

Fatal accident

Date : March 1999

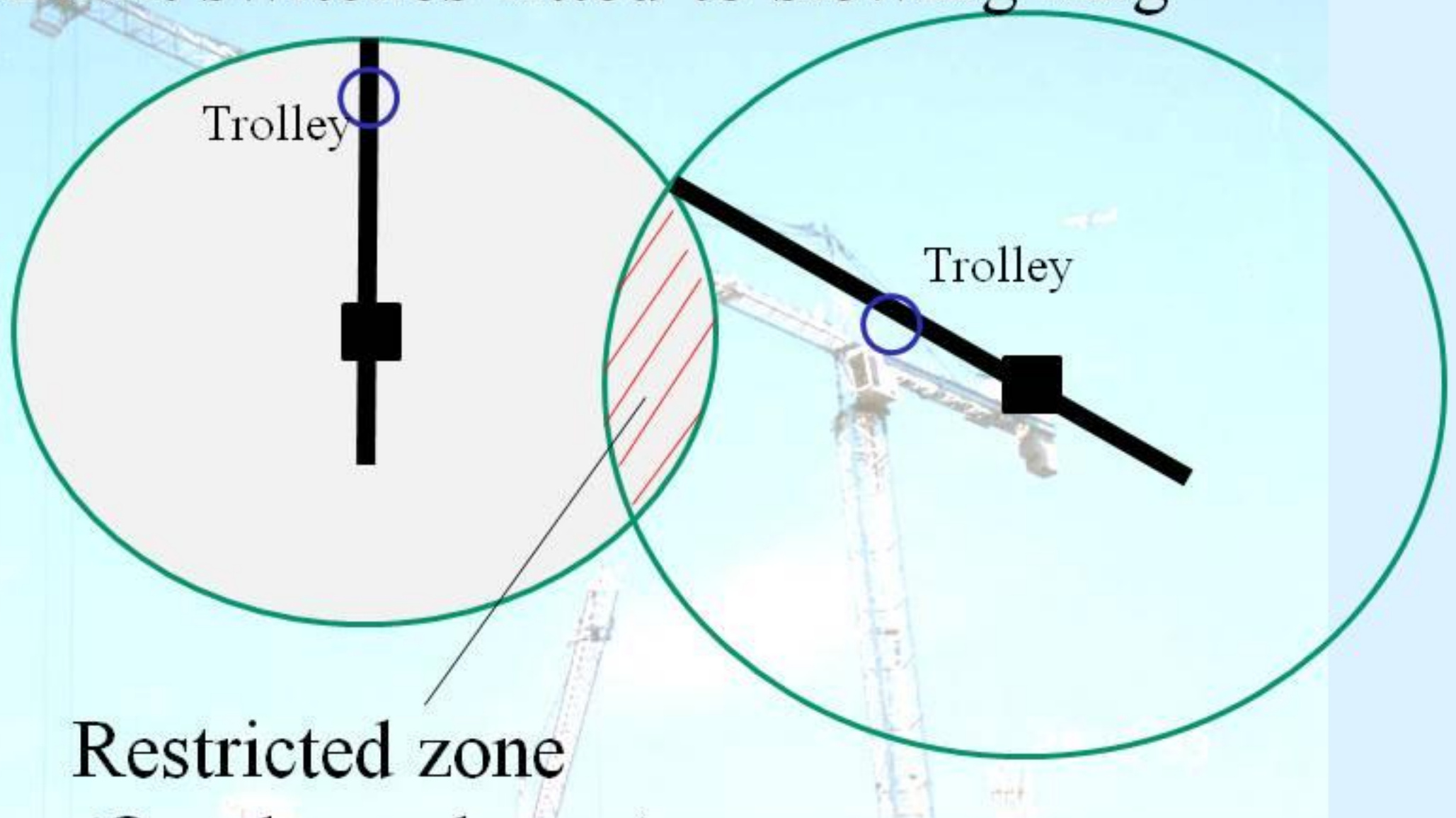
Location : Sau Kei Wan





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Limit switches fitted to slewing ring

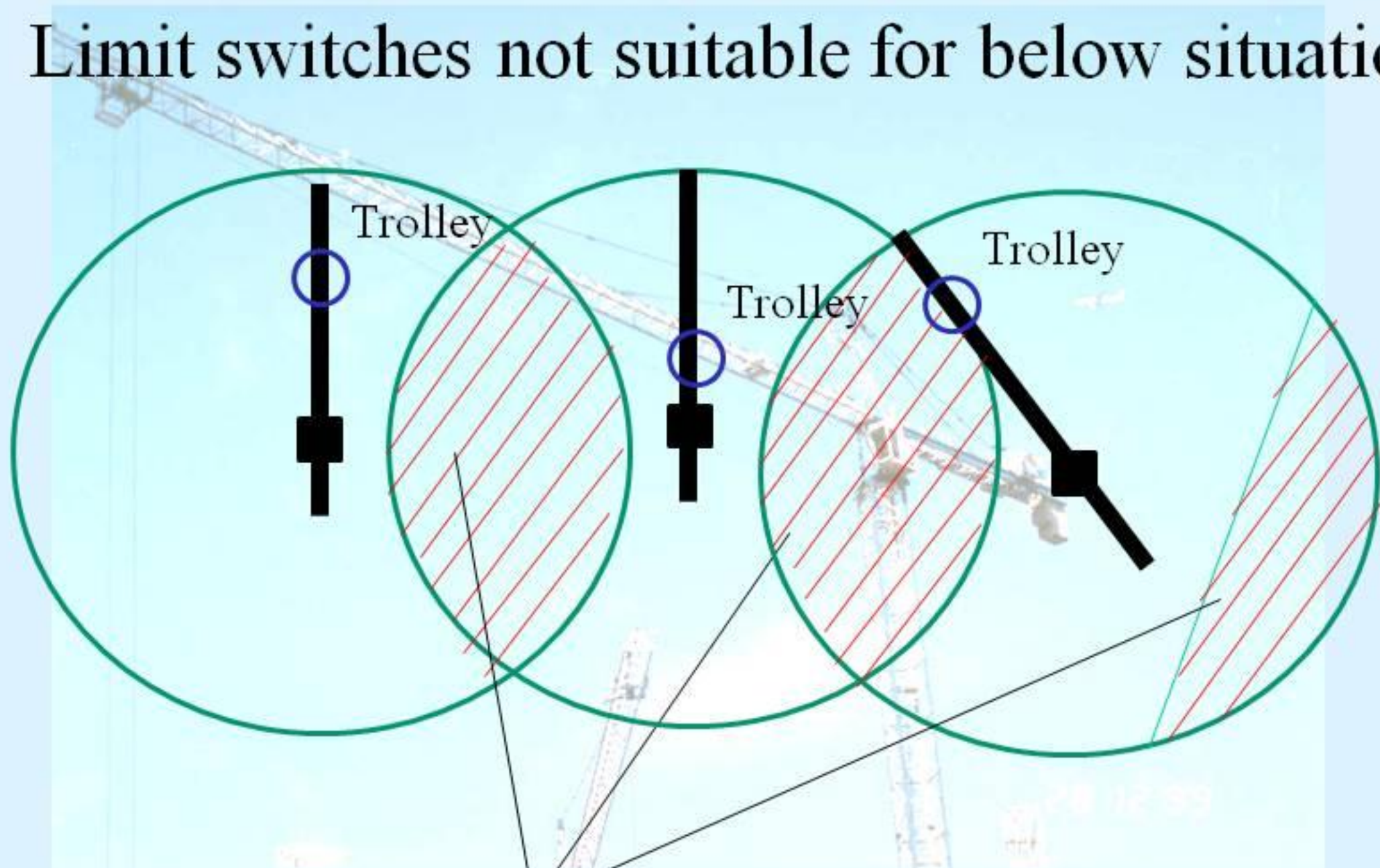


Restricted zone
(Overlapped zone)



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Limit switches not suitable for below situation

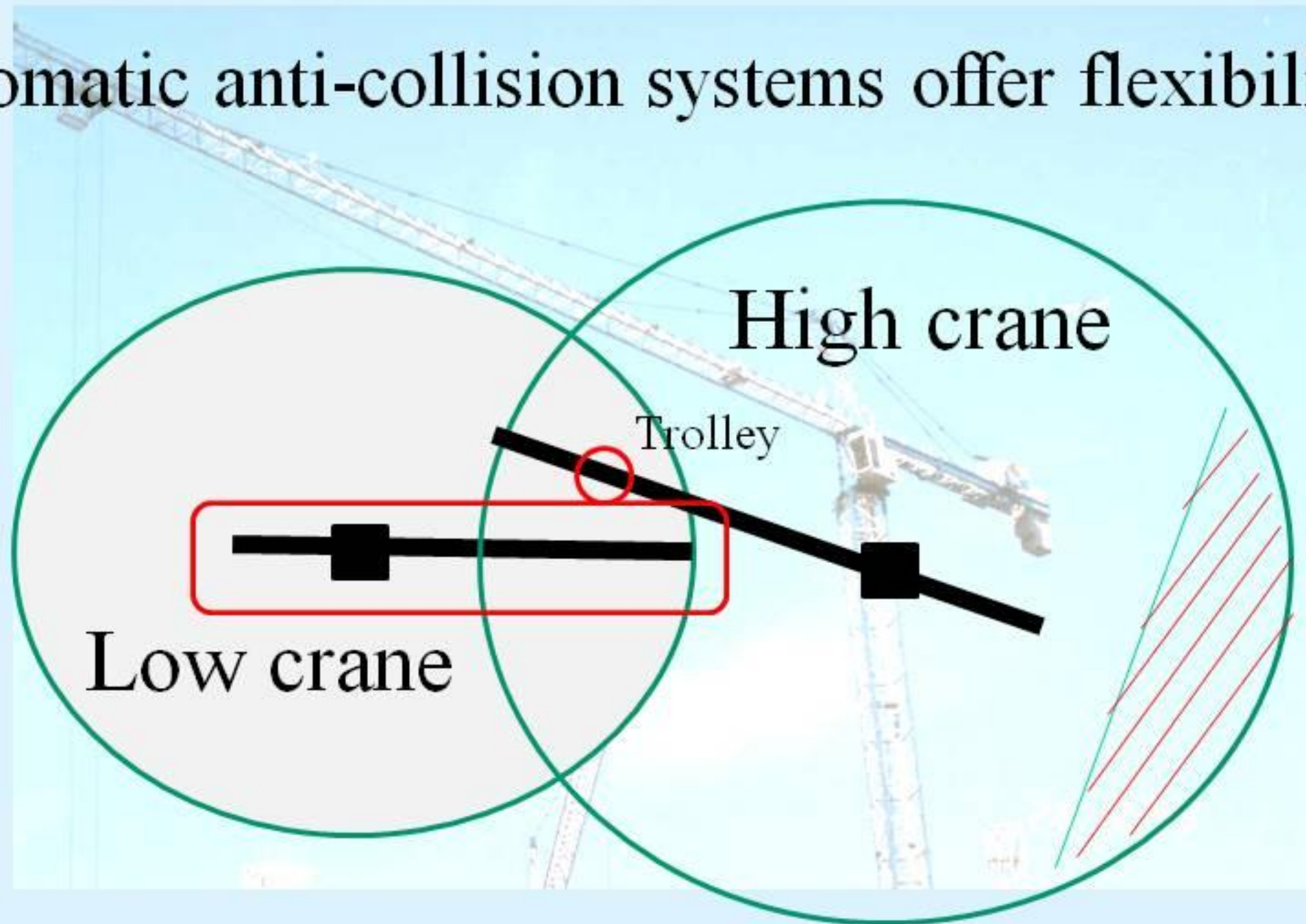


Restricted zones



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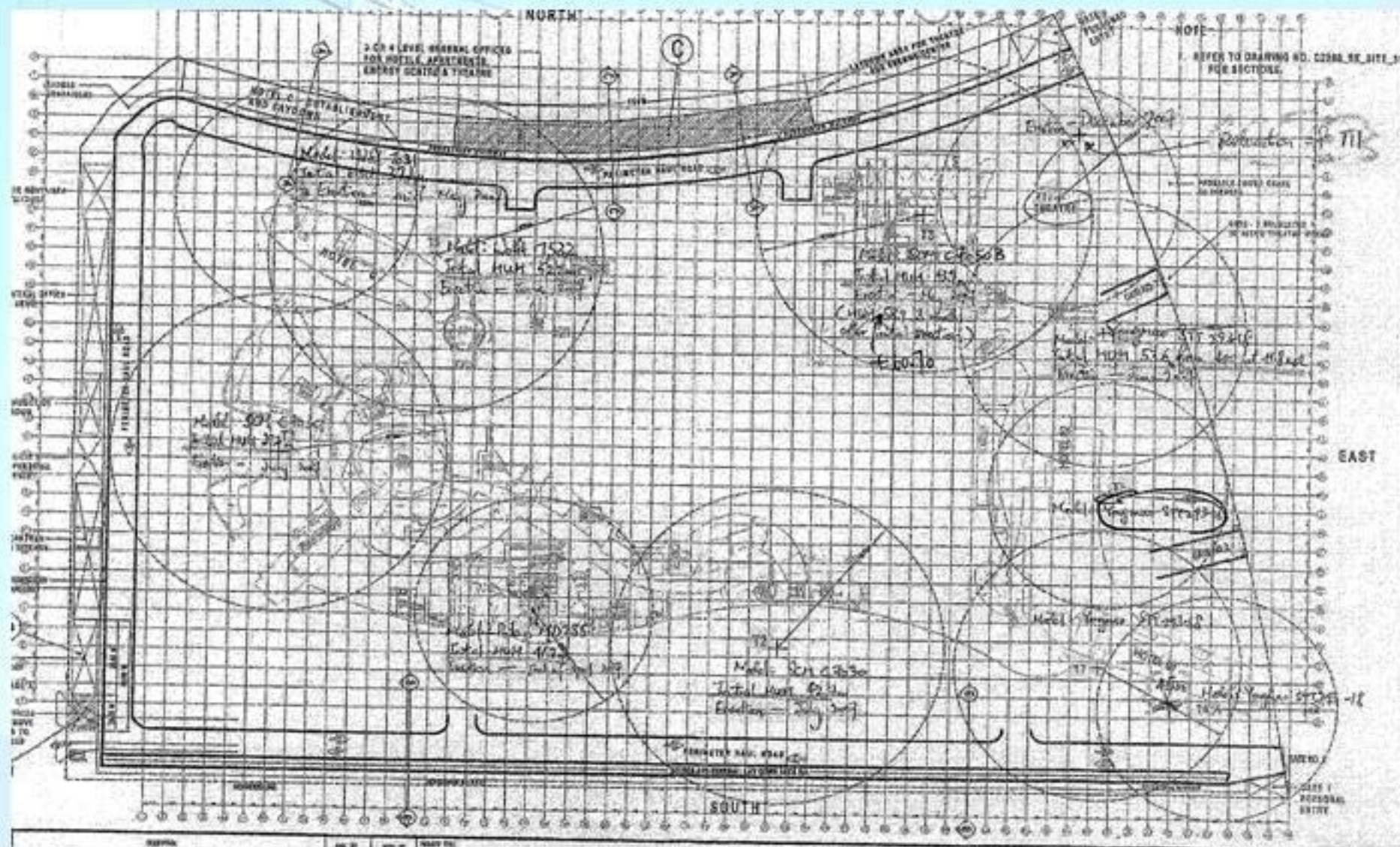
Automatic anti-collision systems offer flexibility





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Automatic anti-collision systems can handle complex situations





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Thank You