

# Stability of Mobile Cranes

The use of cranes whilst installing flooring components is acknowledged to be a high risk activity. The following information intends to clarify the responsibility of the Contractor (the precast concrete sub-contractor's client) to ensure adequate consideration has been given to the issue of crane outrigger loadings and ground bearing capacities of crane hardstanding areas.

Following input from the HSE, the PFF have introduced the following procedures regarding lifting operations, to aid compliance with BS7121 and LOLER Regulations;

To enable the lift to take place the Client will be required to;

- Sign the Lift Plan upon submission by the precast company;
  - To confirm agreement to the planned crane stand position(s)
  - To confirm that the outrigger loading stated will be referred to a "competent person" to assess the adequacy of the crane hardstanding area
- Confirm whether standard or increased size mats are required following assessment of the hardstand area by the "competent person". This decision should take into account the "standard" and "increased" size options noted on the Lift Plan provided by the precast company. This requirement should be notified to the precast company at the earliest opportunity, to enable provision of "increased" size mats where deemed necessary.
- Sign the Crane Schedule prior to commencement of lifting operations on the day of the lift to confirm;
  - That the crane is rigged in the correct / anticipated position
  - That the outrigger loadings have been assessed by a competent person to withstand the stated tonnes / m2 bearing pressure
  - That consideration has been given to potential hardstand deterioration due to weather / construction activity since the initial investigation / assessment and that it is ok to proceed with the lifting operations



The Contractor must provide a hardstanding of adequate bearing capacity to withstand the anticipated worst case outrigger loadings, as will be notified by the Company Representative (the visiting supervisor of the precast company). All those involved in the accommodation, planning and implementation of lifting operations must understand the issue of outrigger loadings and the careful consideration required to ensure the precast concrete components can be lifted into position in a safe manner.

Unless specifically stated otherwise, where the precast concrete company is contracted to install its components, it will provide an Appointed Person to undertake the necessary planning of the mobile crane lifting operations. British Standard 7121 Part 3 Section 9 (Code of practice for safe use of cranes - 2000) states: "The Appointed Person should ensure that the loads imposed by the crane can be sustained by the ground or any means of support, by assessment of a competent person".

To enable the Appointed Person to fulfil this responsibility, the adequacy of each crane standing position must be confirmed in writing by the Contractor's Site Representative, or other competent person on their behalf, prior to the crane working in that position. This is acknowledged by the PFF Code of Practice for the Safe Erection of Precast Concrete Flooring and Associated Components - Section 10.

Outrigger loadings will be clearly identified on the Lift Plan and the Contractor's Site Representative, or other competent person on their behalf, must sign to confirm adequacy of the hardstanding to receive the stated loading prior to works commencing.

### Stability of Cranes

The suitability of ground conditions is the responsibility of the Contractor, who must ensure that all crane standing positions are prepared in accordance with the loading provided by the Company Representative. The stability of mobile cranes relies on the following factors:

- That the ground is suitably compacted and levelled. Underground services or constructions may suffer damage or collapse due to a crane passing over or nearby, which in turn may lead to the crane overturning. Arrangements must be made to avoid underground services and constructions, basements and embankments.
- That the outrigger beams on the crane are extended to the required lengths or positions in accordance with the crane manufacturer's specified duties and dimensions.
- That the outrigger jacks are extended to raise the crane wheels off the ground and free of weight.
- That adequate support material has been positioned under the outrigger jacks to prevent them sinking into the ground whilst lifting loads.
- That the crane carries out lifting strictly in accordance with the manufacturer's tables of Safe Working Loads, i.e. Duty Charts.
- The outrigger jack loading tables are for guidance only and show the maximum theoretical loads for a selection of various cranes in each category. Loadings for other crane models and specific outrigger loadings are available from the Crane Owner.
- The Crane Supervisor and Crane Operator must monitor ground conditions during the course of erection, paying attention to deterioration as a result of usage and adverse weather.
- If there is doubt about the ground condition, the Crane Operator should be instructed to fully retract the main boom derrick to minimise radius and then slew the counterweight in the direction of each outrigger in turn for two minutes to simulate actual lift.

### Guidance on Crane Outrigger Loadings

In accordance with CPCS Appointed Person training/examination criteria, the outrigger loads noted in the table below are based on the combined gross weight of the crane, plus the weight of the product being lifted.

The table indicates the whole of the load acting in the worst case scenario that is over a single crane outrigger support pad.

As previously stated, it is the Contractor's responsibility to adequately prepare the crane hard standing area. This can be achieved in one of the following ways, depending on the timescale of the crane planning:

- The preferred and recommended method is that the Contractor should confirm the maximum bearing capacity of the crane hard standing to the Appointed Person. The Appointed Person must then specify a minimum crane outrigger mat size, to ensure the outrigger loadings applied by the crane/outrigger mats do not exceed the limits set by the Contractor.
- In the absence of information about the ground bearing capacities, the Appointed Person will specify the minimum ground bearing pressure required for the planned lift, utilising both standard outrigger support mats and "increased size" mats. The contractor must assess and prepare the ground to meet the minimum ground bearing pressure required for the chosen mat size. Prior to commencing lifting operations, the Contractor should confirm in writing that the ground has been prepared to meet the loads specified. If the Contractor confirms that the ground is of inadequate bearing capacity to receive the outrigger loadings specified by the Appointed Person for either mat option, they must seek advice to explore alternatives to enhance the hardstand bearing capacity and / or increase the size of the "increased size" mats where practicable.



Crane Outrigger Loadings / Minimum Ground Bearing Pressure Required Lifting a Component Weighing Up To 4.0 tonnes					
Crane Capacity	Typical Gross Weight Of Crane	Gross Weight Of Crane + 4.0 tonnes Lift = Maximum Potential Outrigger Load / Pad	Typical/ 'Standard' Outrigger Pad Size	Typical/ 'Standard' Outrigger Pad Area	Minimum Ground Bearing Pressure Required
25 tonne	26.5 tonnes	30.5 tonnes	760mm diameter	0.45 m <sup>2</sup>	67.8 tonnes / m <sup>2</sup>
30 tonne	27.7 tonnes	31.7 tonnes	760mm diameter	0.45 m <sup>2</sup>	70.4 tonnes / m <sup>2</sup>
35 tonne	35.7 tonnes	39.7 tonnes	600 x 600mm	0.36 m <sup>2</sup>	110.3 tonnes / m <sup>2</sup>
40 tonne	39.5 tonnes	43.5 tonnes	760mm diameter	0.45 m <sup>2</sup>	96.7 tonnes / m <sup>2</sup>
50 tonne	45.4 tonnes	49.4 tonnes	760 x 760 mm	0.58 m <sup>2</sup>	85.2 tonnes / m <sup>2</sup>
55 tonne	43.0 tonnes	47.0 tonnes	900mm diameter	0.64 m <sup>2</sup>	73.4 tonnes / m <sup>2</sup>
60 tonne	52.5 tonnes	56.5 tonnes	975mm diameter	0.75 m <sup>2</sup>	75.3 tonnes / m <sup>2</sup>
70 tonne	55.8 tonnes	59.8 tonnes	900mm diameter	0.64 m <sup>2</sup>	93.4 tonnes / m <sup>2</sup>
80 tonne	59.7 tonnes	63.7 tonnes	900mm diameter	0.64 m <sup>2</sup>	99.5 tonnes / m <sup>2</sup>
90 tonne	61.0 tonnes	65.0 tonnes	900mm diameter	0.64 m <sup>2</sup>	101.6 tonnes / m <sup>2</sup>
95 tonne	70.0 tonnes	74.0 tonnes	1100mm diameter	0.95 m <sup>2</sup>	77.9 tonnes / m <sup>2</sup>
100 tonne	75.9 tonnes	79.9 tonnes	1000mm diameter	0.79 m <sup>2</sup>	101.1 tonnes / m <sup>2</sup>
120 tonne	77.6 tonnes	81.6 tonnes	1000mm diameter	0.79 m <sup>2</sup>	103.3 tonnes / m <sup>2</sup>

**Please Note:**

- This table refers to loads up to 4 tonnes; for loads greater than this please refer to the PFF Code of Practice.
- Should the Appointed Person be in any doubt regarding the gross weight of the crane being used, this information should be requested from the crane hire company/supplier.
- Loads must include any ancillary equipment, e.g. ballast weights, lifting beams, block grabs, etc.
- Ground load bearing test results for a given area can vary from day to day, as ground moisture content is a major factor in determining load bearing characteristics. It is prudent to apply a factor of safety to all calculations where there is any possibility of ground deterioration after tests have been undertaken.

**Crane planning using "actual" / "predicted" loadings (e.g. LICCON system)**

The practice of planning lifts using crane specific "actual" / "predicted" loadings (e.g. LICCON loads) should be treated with caution;

These loadings are theoretical predicted loadings from crane manufacturers computer software based on the exact lift parameters entered into the computer. The following should be noted where this method is to be considered.

- Loadings provided are for a specific crane make and model – should a different crane be provided for the lift, the outrigger loadings will be incorrect.
- Loadings provided are based on the information provided by the AP regarding radius, weight to be lifted, boom length, counterweights, etc. Different lifting parameters on the day of lifting will result in revised loadings.
- Loadings provided are best case scenario rather than worst case as AP training advocates. i.e. perfectly level crane with zero rigger settlement, no wind loading on load / boom, zero tolerance regarding crane set up position / lift parameters, zero tolerance regarding crane planning.
- The HSE recommend a safety factor of between 1.5 and 3.0 be applied to outrigger loading calculations where LICCON type loadings are to be used. The level of safety factor should reflect the level of evidence / validation of the hardstand bearing capacity (refer to CIRIA C703 Crane Stability on Site for further guidance).



### Example calculations [based on a 50 tonne crane, lifting 4.00 tonnes]

#### 1. A definitive ground bearing pressure is provided by the Contractor in advance:

Ground bearing capacity confirmed following engineer's ground testing is 28.5 tonnes/m<sup>2</sup>

Maximum potential outrigger load/pad (from Table 1) is 49.4 tonnes

Minimum crane mat size required is  $49.4 \div 28.5 = 1.733\text{m}^2$

Standard 50 tonne crane mats = 0.58m<sup>2</sup> therefore inadequate

Larger crane mats required to ensure crane stability, with a minimum area of 1.733m<sup>2</sup> per crane outrigger.

#### 2. A definitive ground bearing pressure is not provided by the Contractor:

Maximum potential outrigger load/pad (from Table 1) is 49.4 tonnes

**Option a)** Utilising "standard" crane mats of 0.58m<sup>2</sup>

Minimum ground bearing pressure required is  $49.4 \div 0.58 = 85.2$  tonnes / m<sup>2</sup>

**Option b)** Utilising "increased size" crane mats of 3.02m<sup>2</sup>

Minimum ground bearing pressure required is  $49.4 \div 3.02\text{m}^2 = 16.4$  tonnes / m<sup>2</sup>

Following the Contractor's assessment of the hardstanding, they must confirm which of the above options is acceptable. This should be provided in adequate time for the precast company to arrange provision of the "increased size" mats, should these be deemed necessary.

In any event, prior to commencement of lifting operations on the day of installation, the Client should confirm that the ground has been assessed by a "competent" person and adequately prepared to withstand the relevant maximum outrigger loading.

Note: Ground load bearing test results for a given area can vary from day to day, as ground moisture content is a major factor in determining its load bearing characteristics. It is prudent to apply a factor of safety to all calculations where there is any possibility of ground deterioration after tests have been undertaken.

This document is for guidance only, for further information refer to section 10 of the PFF Code of Practice.

