HEALTH & SAFETY BULLETIN

INCIDENT TYPE: **MOBILE CRANE STABILITY**
Crane Appointed Persons and Site Managers Beware

GLEESON

Do you have a mobile crane on your site?
Are you in charge of co-ordinating or setting up / supervising cranes on your site? - if so read on

1. Are you aware of the ground bearing capacity of your site?
2. Are you in possession / have knowledge of the force the crane will exert through its outriggers in tonnes? (from the crane hire company)
3. Is your lifting plan specific for the size and use of your mobile crane on site?
4. Does your lifting plan detail the size of outrigger pads that are required to spread the weight adequately onto the ground?
5. Has a person with a geotechnical knowledge and experience been involved with assessing your ground on site?
6. Are you using specific outrigger pads, the size of which has been determined by your calculations?

Picture of a crane that **Nearly** overturned on a MJ Gleeson site

Outrigger punched through the ground

- If you have answered **NO** to one or more of questions 1-6 your crane could be at risk from overturning.
- An Overturning Crane is not only very dangerous but is also reportable to the Health and Safety Executive.

A crane does not need to be working out-with it's safe limit to overturn, as a rule of thumb; plastic pads supplied with the crane are inadequate in size when standing a crane on typical cohesive or granular soil. Your outrigger pad must be of sufficient area to spread the load from the crane to the ground. This calculation must be included in the lifting plan and can be carried out simply, by using the ground bearing capacity (which can be calculated using the attached document below) for the area where the crane is to be used against the maximum weight through the outrigger (available from the crane hire company).

If in any doubt please speak to your Safety Adviser

Mobile crane stability on site

The following recommendations are taken from CIRIA Special Publication 131 Crane Stability on Site.
If in any doubt about crane operation or stability, refer to the full publication.

Step One – obtain or assess ground parameters at the crane position

If possible – obtain representative ground parameters from site investigation & testing records

Ground conditions can be estimated from the following:

Soil type	Description	SPT value	Strength	Guidance on assessment
Granular	very loose	<4	& < 278	
(sands &	Loose	4 - 10	& = 27-308	Easily dug with spade; 50mm peg easily driven
gravels)	med dense	10 - 30	& = 30-358	Can be dug with spade with effort
	Dense	30- 50	& = 35-408	Needs breaking with pick; 50mm peg hard to drive
	very dense	>50	& > 408	Steel pin hard to drive
Cohesive	very soft	< 5	C < 20 kN/m^2	Will squeeze through fingers
(clays &	Soft	5 - 10	C = 20-40 kN/m^2	Easily moulded by light finger pressure
silts)	Firm	10 - 18	C = 40-75 kN/m^2	Can be moulded by strong finger pressure
	Stiff	18 –35	C = 75-150 kN/m^2	Can be dented by thumb or forefinger
	very stiff	> 35	C > 150 kN/m^2	Can be scratched or dented with fingernail

(C = undrained shear strength)

Step Two – obtain or assess loading on outrigger for this lift

If possible – obtain maximum outrigger load from crane supplier

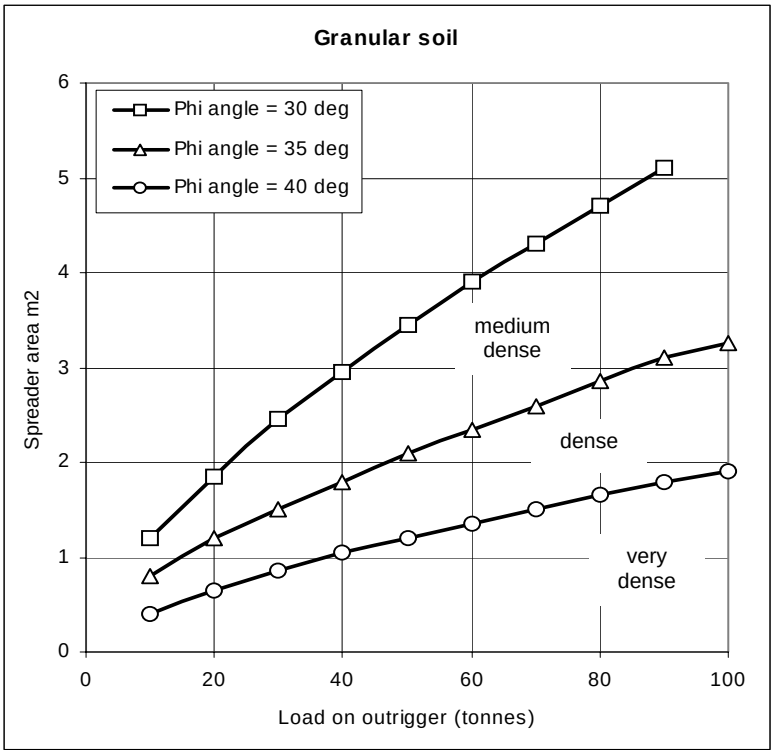
At 75% of tipping load, jib square across outriggers, max outrigger load = 0.44 x (weight of crane + load)
At 75% of tipping load, jib diagonally across outriggers, max outrigger load = 0.52 x (weight of crane + load)

CIRIA obtained the following maximum values for cranes from a range of manufacturers:

crane max capacity (tonnes):	30t	50t	80t	120t	160t
max outrigger load (tonnes):	33t	40t	61t	80t	95t

Step Three – calculate suitable size for spreader pad

The charts below (from CIRIA SP131) give guidance on the area over which the outrigger load must be spread:



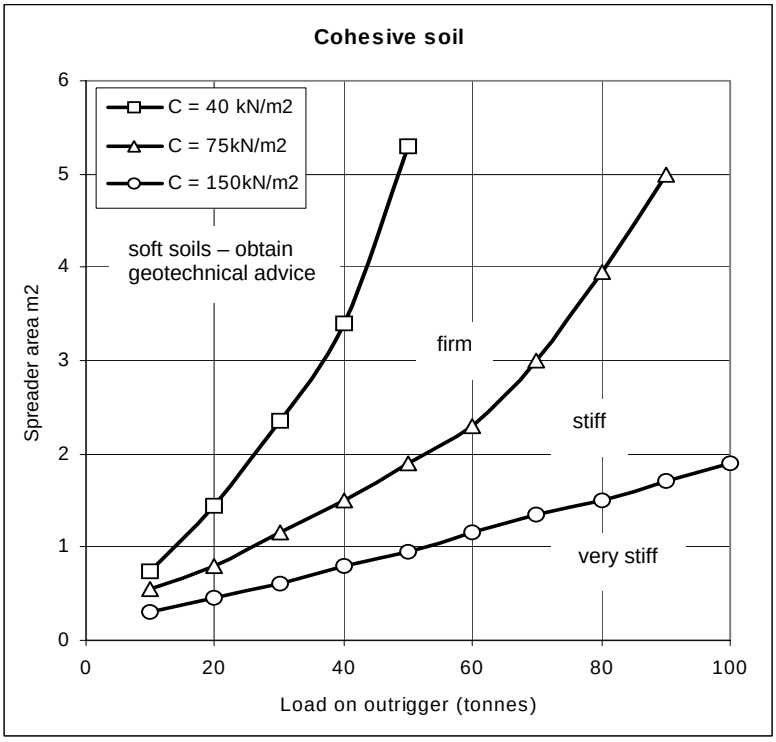
Granular soil – modification factors

Where ground is variable, engineering parameters are estimated, or if settlement would be critical,
MULTIPLY AREA 3 1.5

Where ground is wet, or depth to groundwater is less than width of spreader,
MULTIPLY AREA 3 2

Where both the above cases apply,
MULTIPLY AREA 3 3

Loose soils (& < 308) may not be suitable for crane loadings without special measures being taken – seek specialist advice.



Cohesive soil – modification factors

Where ground is variable, engineering parameters are estimated, or if settlement would be critical,
MULTIPLY AREA 3 1.5

Where ground is wet, or site is liable to flooding,
MULTIPLY AREA 3 1.5

Where both the above cases apply,
MULTIPLY AREA 3 2.25

Soft soils ($C < 20kN/m^2$) may not be suitable for crane loadings without special measures being taken – seek specialist advice.

If there is hard surfacing or a stone blanket at ground level, the loading on the underlying stratum should be assessed (based on load spreading at 1:1 through the surface material), and the loaded area of the underlying ground checked as above, to ensure that the outrigger cannot punch through the surface layer under load.

Dividing outrigger load by spreader pad area gives the bearing pressure on the ground. For comparison:
A 12-stone / 75 kilogram engineer standing with weight on <u>one heel</u> exerts approx 150 kN/m^2 = 15 $tonnes/m^2$
A 12-stone / 75 kilogram engineer standing with weight on <u>one foot</u> exerts approx 35 kN/m^2 = 3.5 $tonnes/m^2$

Step Four – obtain or design spreader pad or other foundation

The spreader pads provided with most cranes are not of sufficient area on anything other than hard surfaces.

They may be supplemented by use of:

<u>Properties of sound timber sleepers</u>

allowable bending moment	= 10.3 kNm
allowable shear force	= 45.7 kN
allowable bearing stress	= 5 N/mm^2

- timber railway sleepers in sound condition – generally sleepers are only adequate to spread a concentrated load over about half a sleeper length (see properties box)
- proprietary timber crane mats, excavator mats or “navvy” mats
- proprietary steel crane pads if available from the crane hirer
- steel grillages – universal column sections are preferable to universal beams – may require web stiffeners to resist web buckling or crushing and ensure stability
- mass concrete pads – these will spread load at approximately 1 on 1 (458) through their thickness
- reinforced concrete pads, with mesh or bar reinforcement to bottom (tension) face – these should be designed in accordance with the requirements of BS 8110

Step Five – check for local hazards

The loaded ground below an outrigger forms a cone with the outrigger at the point. This cone may spread laterally at as much as 2 horizontally: 1 vertically. The cone should ideally not intersect with any open excavations, cut slopes, buried structures, retaining walls, cofferdams, recently backfilled excavations or trenches, drains, pipes, ducts or anything else which may not be capable of carrying the resulting increase in loading. The increase in stress in the ground is greatest directly below the outrigger, reducing to zero at the edge of the cone and reducing with depth. Any structure within the cone should be designed or assessed for the increase in load on it.