CICA – Vic / Tas Branch
Crane Safety Bulletin
#287 June 2021

Greetings all. Continuing from last bulletin, today's bulletin is about ground pressure.

Crane stability often depends on the integrity of the ground on which it stands. Effective assessment of ground condition is essential to assist with safe set up and operation of cranes.

There are several factors that need to be considered when assessing ground conditions.

Crane manufacturers develop mobile crane rated capacity charts for when they are operating on a firm, level (max.1% slope / 0.6 °) and uniform surface (if no deration chart or instruction is given on side slope operation, the crane shall not be operated on side slope). If setting up a crane on uneven, sloping ground, risk control measures must be in place to ensure crane stability.

Video Segment 3 - Siting the Travel Tower or Crane

Ground factors also need to be considered. Positions of underground services need to be identified. Previous works on the ground that could change the ground bearing capacity should be investigated and control measures need to put into place.

Video Segment 4 – Ground Factors

Ground condition inspection should provide permissible ground pressure. Where reasonably practicable, this inspection should be done by a geotechnical engineer. This inspection should assess bearing capacity of the ground including surface conditions, as well as the layers of the ground underneath the surface that could influence ground bearing capacity. The ground can have weak layers below the surface and these underlying layers of weak or soft ground can possibly lead to a collapse. The inspection should also outline the estimated settlement due to the load and whether the settlement would cause any instability of the crane during the lift. If the ground is found to be not suitable, additional measures must be taken before proceeding with the task. These may include but not limited to:

- design measures to reduce imposed loads, i.e. re-sizing of the crane mat used, repositioning of the crane, reduction of task loads (e.g. splitting of loads), re-selection of the crane.
- design measures to ensure ground suitability, i.e. soil stabilization, grouting, dynamic compaction.

The Queensland Mobile Crane Code of Practice 2006 provides guidelines on calculating pressure applied by outriggers. Although this is a code of practice from another state, it provides a useful reference, as the formulas are based on industry experiences.

A reasonable approximation for maximum ground pressure (P_{out}) applied by the outriggers is detailed below:

$$P_{out}=\frac{0.65\times(total\ crane\ mass+lifted\ load)}{individual\ outrigger\ area}$$

When the maximum permissible ground pressure is known, the minimum area required under the outrigger pad can be calculated as follows:

$$Area=\frac{0.65\times(total\ crane\ mass+lifted\ load)}{maximum\ permissible\ ground\ pressure}$$

The Table below lists typical maximum permissible ground pressure for different ground types as a reference for crane crews.

Ground type	Maximum permissible ground pressure (t/m²)	Maximum permissible ground pressure (kPa)
Hard rock	200	2000
Shale rock and sandstone	80	800
Compacted gravel—with up to 20% sand	40	400
Asphalt	20	200
Compacted sand	20	200
Stiff clay (dry)	20	200
Soft clay (dry)	10	100
Loose sand	10	100
Wet clay	Less than 10	Less than 100

Typical maximum permissible ground pressure for different ground types

Video Segment 6 - Maximum permissible ground pressure

As mentioned in the last bulletin, CICA has developed a ground pressure app called "CICA outrigger app" to calculate ground pressure or crane mat size based on the formulas and ground pressure capacity estimates provided in the Queensland Mobile Crane Code of Practice 2006 (see formulas above).

This app is freely available from a phone's App store, is easy to use and is a handy tool for crane crews to assess ground conditions on site.

Stay Safe - CICA