Rogers Geotechnical Services Ltd www.rogersgeotech.co.uk **AIDE MEMOIR FOR REPORTING GEOTECHNICAL DESIGN GUIDES**	Section: 7	Data Sheet No: 7.8.1
	Issue No: 1	Issue Date: 20/11/2018
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Title:

WORKING PLATFORM DESIGN – General Information

For the design of working platforms or outrigger pads for crane lifts, we are often asked to undertake plate load tests, which is not the most appropriate method of investigation. Interestingly, there are two types of plate load tests, as follows:

- Load Maintained Test
- Constant Rate of Penetration Test

For further information see Data Sheet No 4.4 Plate Load Testing.

Load Maintained Test.

In this test the plate is subject to a series of loads, up to 150% of the design stress, with each load (or stress) being maintained until little of no settlement is evident before uploading to the next stage. This test will establish the overall settlement of the plate (450mm up to 750mm in diameter) due to a specified load. The limitations of this test are that it will only significantly stress the soil to a depth of about 1.5 x the plate diameter. Moreover, in order to undertake the test, kentledge is required to provide a reaction to the load applied to the plate. Unfortunately, it is generally the case that the load on the outrigger pad, for example, is relatively high, necessitating either a heavy kentledge (expensive) or a relatively small plate. We try to employ 360^{o} tracked excavators weighing 13T or more as kentledge, thus typically this could only support a 450mm diameter plate, which would stress the ground to about 675mm depth. The outrigger base will be significantly larger, say 2m to 3m square, which will stress the ground to between 3m and 4.5m depth.

If the strata conditions at the site improve with increasing depth, then this type of test may assist in design, although there are limitations. However, if there is a crust of reasonably competent ground over poor material, which is often the case, then the use of a plate test could seriously overestimate the stiffness of the soil within the zone of influence of the outrigger pad. Therefore, without knowledge of the actual strata sequence, it would not be possible to establish with surety if shear failure of the ground will occur under loading.

Constant Rate of Penetration Test

During this test the load (stress) on the plate is increased gradually and the penetration of the plate against stress measured. From these results, the stress on the plate at 1.25mm penetration can be established and from this information the modulus of subgrade reaction, $k_{(762)}$ ($MN/m^2/m$) may be calculated. In this context, 762 relates to the diameter of the plate in mm and should a plate of smaller diameter be employed a correction factor is required. The modulus of subgrade reaction can be employed directly in floor slab design, but using a simple correlation it can also be converted to an approximate California Bearing Ratio (CBR).

With this test the same limitations with respect to stressed depth as noted above will still apply. Moreover, the CBR value (however obtained), will not assist in the design of a working platform or the outrigger pads. The CBR is only employed in the design of the sub-base thickness of pavements, where transient wheel loads, which stress very small areas, are required. For working platforms and outrigger bases the loads act over a larger area and arguably a longer time period, thus it becomes a bearing capacity problem, which requires an understanding of the shear strength of the soil with depth.

So what should be done?

The loads applied to working platforms or outrigger pads will, or are most likely to, occur rapidly, thus the most prevalent failure mechanism will be the shear failure of the underlying soil. This is not the case the construction of a house, for example, where the foundation is subject to incremental loading during construction. In this case, consolidation of the ground beneath the foundation will occur as the load increases, which stiffens the ground, making it less likely to fail in shear. As the build proceeds, the foundation load increases, further stiffening the ground, which further reduces the possibility of shear failure. Therefore, with incremental loading, shear failure is most unlikely, and the foundation will fail as a consequence of excessive settlement.

In view of the above, the most appropriate investigation for crane outriggers or working platforms is by way of boreholes (to say 4m depth) to establish the composition and consistency of the soil. The results of this work can then be used to establish the bearing potential of the ground within the depth of influence of the loaded area (track or pad). Interestingly, during many investigations, starter pits to 1.2m depth are required to clear services. Thus there is often limited data on the strength of soil at shallow depth, which is required to enable an appropriate design to be formulated. Therefore, our preferred method of investigation is to undertake windowless sample boreholes with adjacent dynamic probes at the position of the crane outriggers or randomly in the area of the working platform. These should be taken from ground level, thus a good understanding of the location of services is required prior to the site works. From this information the bearing capacity of the ground within the zone of influence of the outrigger pad or track may be established. For working platforms the thickness of the granular sub-base may then be calculated using the approach defined by the Federation of Piling Specialists. For outriggers the size of the pad to ensure that shear failure of the soil does not occur can be established.