USING ACSW FOR CRANE BASE DESIGN

Guidance Note SSGN007

The Problem of Measuring Stiffness: Cheap and Unreliable or Expensive and Accurate?

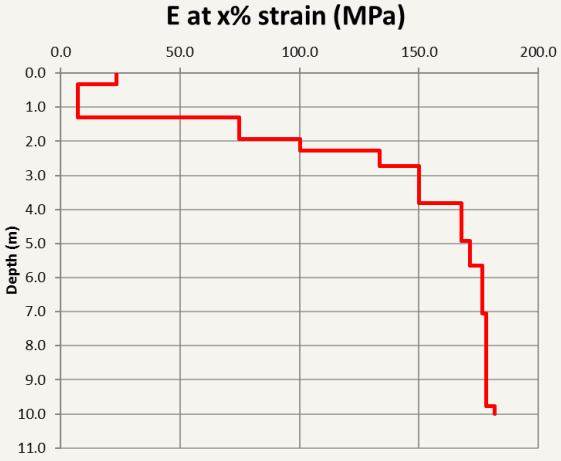
The CIRIA guide *Crane Stability on Site* states: *There is no other item of construction equipment which has the capacity for causing as much damage or injuring so many people as does a crane in an accident*. Design of crane foundations is a rightly safety critical element of safe crane operation, of which the magnitude of any settlements is key.

Predicting ground movement depends on knowledge of ground stiffness, but measuring this accurately by traditional means is difficult. The ground is not a homogeneous material like concrete or steel, it is often disturbed by testing and its stiffness depends on the magnitude of the load being applied ('stiffness is a function of strain').

Yet inaccurate assessment of ground stiffness can lead to unacceptable and potentially damaging movements if overestimated, or unnecessarily large foundations or ground treatment if underestimated. Traditional methods of soil stiffness measurement are either inaccurate (i.e. SPT testing), do not test soils at depth (i.e. plate load tests), are unrepresentative (i.e. laboratory testing) or are expensive (i.e. large-scale load tests).

The ACSW Solution: Accurate, Fast & Cost-Effective

ACSW testing provides a cost effective, non-intrusive means of providing a ground stiffness profile down to depths of typically 10 to 15m using a vibratory source or 'shaker'. Because the ground is not disturbed, measurements are very accurate and yet, since no boreholes or large kentledges, are required it is rapid and very cost effective.



Strain level to softened to: 0.1 %

Vs (m/s)	Depth (m)	Density (kg/m³)	Go (MPa)	v	Eo (MPa)	E at x% strain (MPa)
123	0.0	1800	27	0.26	68.5	23.3
123	0.3	1800	27	0.26	68.5	23.3
69	0.3	1800	8	0.26	21.4	7.3
69	1.3	1800	8	0.26	21.4	7.3
220	1.3	1800	87	0.26	219.6	74.8
220	1.9	1800	87	0.26	219.6	74.8
255	1.9	1800	117	0.26	294.7	100.4
255	2.3	1800	117	0.26	294.7	100.4
294	2.3	1800	156	0.26	392.4	133.6
294	2.7	1800	156	0.26	392.4	133.6
312	2.7	1800	175	0.26	440.7	150.1
312	3.8	1800	175	0.26	440.7	150.1
330	3.8	1800	196	0.26	493.1	168.0
330	4.9	1800	196	0.26	493.1	168.0
333	4.9	1800	200	0.26	503.2	171.4
333	5.6	1800	200	0.26	503.2	171.4
338	5.6	1800	206	0.26	518.2	176.5
338	7.1	1800	206	0.26	518.2	176.5
340	7.1	1800	208	0.26	523.2	178.2
340	9.8	1800	208	0.26	523.2	178.2
343	9.8	1800	212	0.26	533.1	181.6
343	10.0	1800	212	0.26	533.1	181.6

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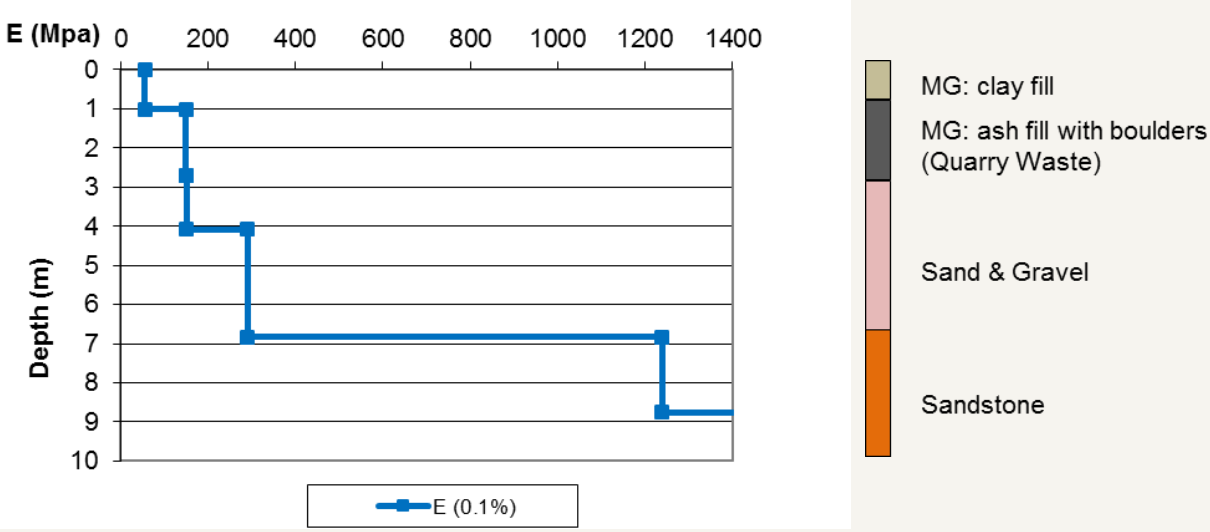
Ground Characterisation Using ACSW

In addition to providing accurate stiffness data ACSW profile data can be used to provide additional information to characterise the ground beneath crane bases. ACSW can be used to confirm the ground profile, useful where intrusive investigations are limited or confirmation of nearby borehole information is required. ACSW can also or give an indication of other design parameters such as undrained shear strength or relative density using published relationships with the shear wave velocity (V_s) profile provided by ACSW data.



Case Study: Efficient Foundation Design Using ACSW

Stiffness investigations were undertaken at a site in Yorkshire using conventional plate load tests and ACSW, giving similar shallow ground stiffnesses. However, by measuring only near surface stiffness the plate load test underestimated the increase in ground stiffness with depth, resulting in a 16mm overestimate of settlement compared to CSW test data in analyses using the same loads. Design at the site was based on ACSW test data.

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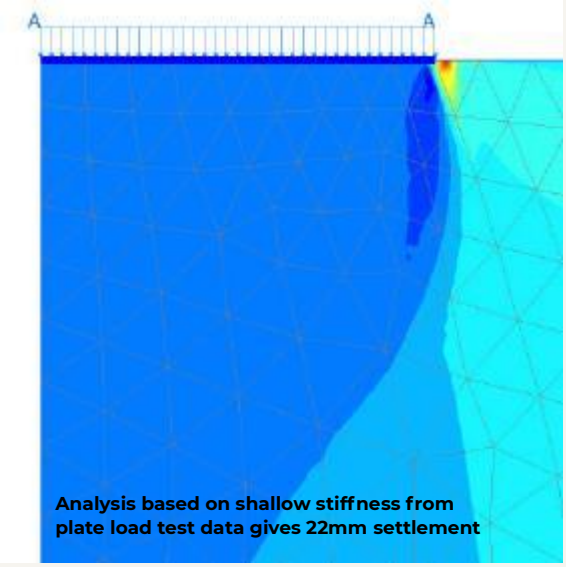
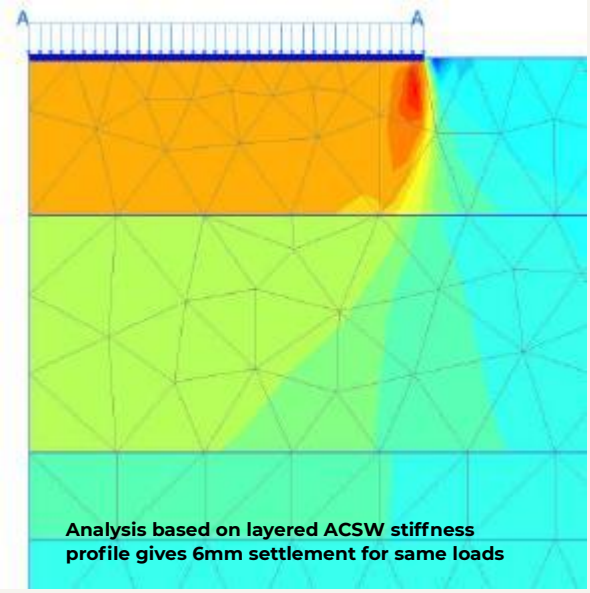


Analysis based on shallow stiffness from plate load test data gives 22mm settlement



Analysis based on layered ACSW stiffness profile gives 6mm settlement for same loads

References

- CIRIA C703: 2003 Crane Stability on Site - an introductory guide
- SS Guidance Note SSGN001: Specifying ACSW testing
- SS Guidance Note SSGN002: Application of ACSW data