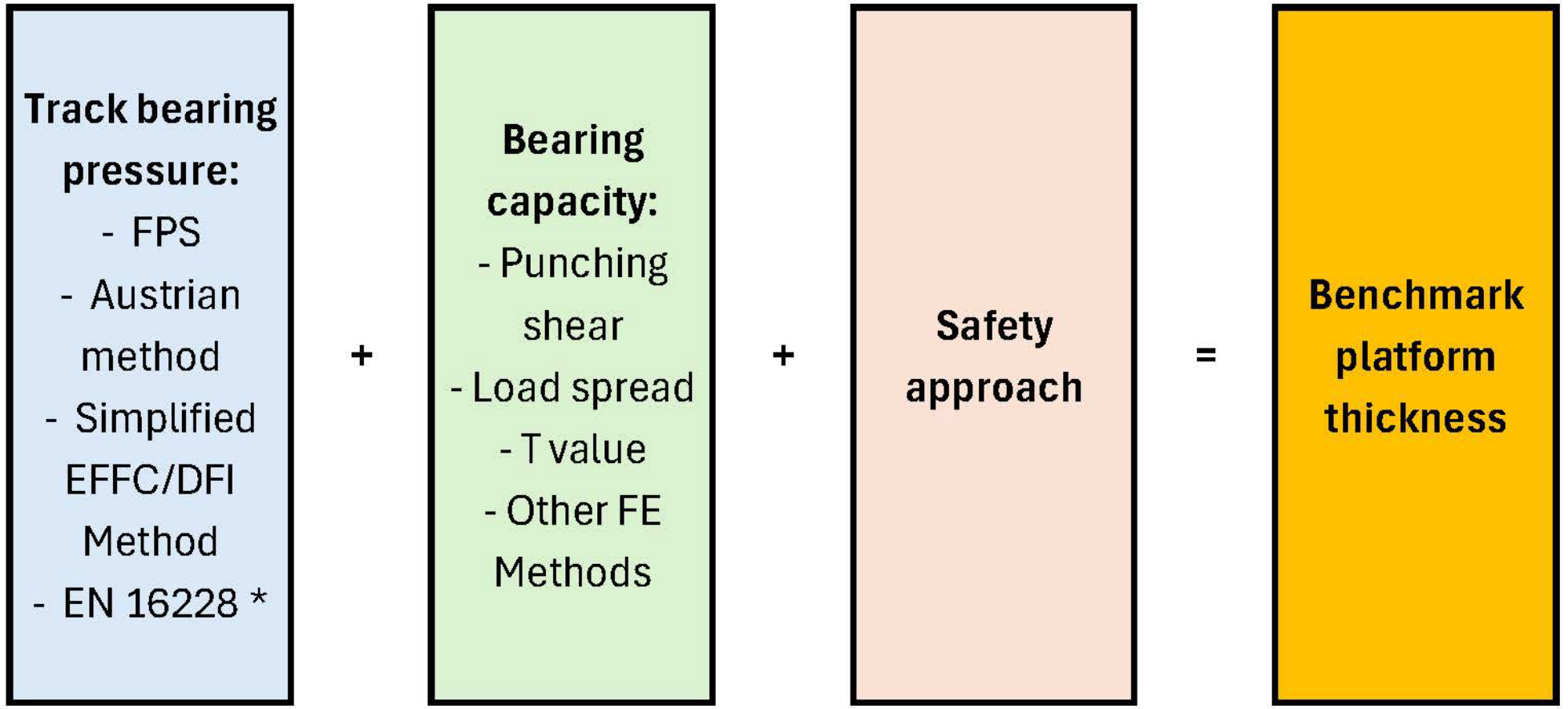
PANEL DISCUSSION ON WORKING PLATFORMS

Stephen Buttling
David Corke
Martin Larisch
Stephen Harkin
Moderator: Amir Shahkolahi

The opinions expressed in this presentation and on the following slides are solely those of the presenter(s) and not necessarily those of DFI. DFI does not guarantee the accuracy or reliability of the information nor endorse the recommendations offered by the presenter(s).

Every platform design method must have a calibrated combination of track pressure, bearing capacity and safety application



1/09/2009 FPS Benchmark Rigs Summary Rev 7.xlsx

WORKING PLATFORMS

BRE METHOD. SUMMARY OF BENCHMARK RIG OUTPUT

SCHEME B. LOAD FACTORS 2.0/1.5, 1.6/1.2

MINIMUM PLATFORM THICKNESS AMENDED

Factor governing platform required	Better platform material required
	Type 1 loading (q1, L1)
	Type 2 loading (q2, L2)
	Minimum of half track width or 0.3m
	Running surface only

NOTES:

RIG LOADING CAN VARY SIGNIFICANTLY FOR ANY RIG TYPE, DEPENDING ON USE, MANUFACTURING VARIATIONS (e.g. DIFFERENT BASE CARRIERS) OR USER MODIFICATIONS.

THIS BENCHMARK RIG DATA IS ONLY INTENDED FOR USE AS A CHECK FOR THE OVERALL RESULTS PRODUCED BY THE BRE DESIGN METHOD AND MUST NOT BE TAKEN AS REPRESENTING ANY SPECIFIC RIG IN USE

WORKING PLATFORM BENCHMARK

PLATFORM Phi = 35 deg

Rig	Track width	q1	L1	q2	L2	Required minimum platform thickness (m)								
	(m)	(kN/sqm)	(m)	(kN/sqm)	(m)	Cu=20	Cu=30	Cu=40	Cu=50	Cu=60	Cu=70	Cu=80	Cu=90	Cu=100
Watson	0.900	118	4.21	265	2.57	1.50	1.28	1.03	0.68	0.30				
BG30	0.800	212	2.90	633	1.24									
CM48	0.700	103	3.15	206	1.85	1.06	0.82	0.46	0.30					
NCK605 DCI	0.915	347	1.73	365	1.09									
R622	0.700	237	2.72	328	1.85									
SM400	0.400	92	1.53	188	0.79									
Ajax Service Crane	0.915	145	3.50	N/A	N/A	1.20	0.90	0.43	0.30					

PLATFORM Phi = 40 deg

Rig	Track width	q1	L1	q2	L2	Required minimum platform thickness (m)								
	(m)	(kN/sqm)	(m)	(kN/sqm)	(m)	Cu=20	Cu=30	Cu=40	Cu=50	Cu=60	Cu=70	Cu=80	Cu=90	Cu=100
Watson	0.900	118	4.21	265	2.57	1.12	0.96	0.77	0.51	0.30				
BG30	0.800	212	2.90	633	1.24	1.69	1.61	1.53	1.44	1.35	1.25	1.14	1.02	0.89
CM48	0.700	103	3.15	206	1.85	0.79	0.61	0.35	0.30					
NCK605 DCI	0.915	347	1.73	365	1.09	1.55	1.45	1.34	1.21	1.08	0.93	0.74	0.49	0.30
R622	0.700	237	2.72	328	1.85	1.17	1.05	0.91	0.74	0.53	0.30	0.30		
SM400	0.400	92	1.53	188	0.79	0.52	0.37	0.20						
Ajax Service Crane	0.915	145	3.50	N/A	N/A	0.904	0.68	0.32	0.30					

WORKING PLATFORM BENCHMARK

FPS:

Based on machine + tools weights and winch loads.

Allows full 360° rig operation, produces triangular or trapezoidal theoretical pressure distribution transformed to UDL.

Maximum track pressures with rig body orientation at 15° to 30° to axis of tracks.

Input as basis of derivation of BR470 loading factors. Compatible with BR470 design

EN16228: (*for rig manufacturers*)

Adds wind loading, dynamic effects and accidental loading to FPS loading input

Produces triangular or trapezoidal theoretical pressure distribution, but no transformation to UDL.

Not comparable with FPS loading. Not used for working platform design.

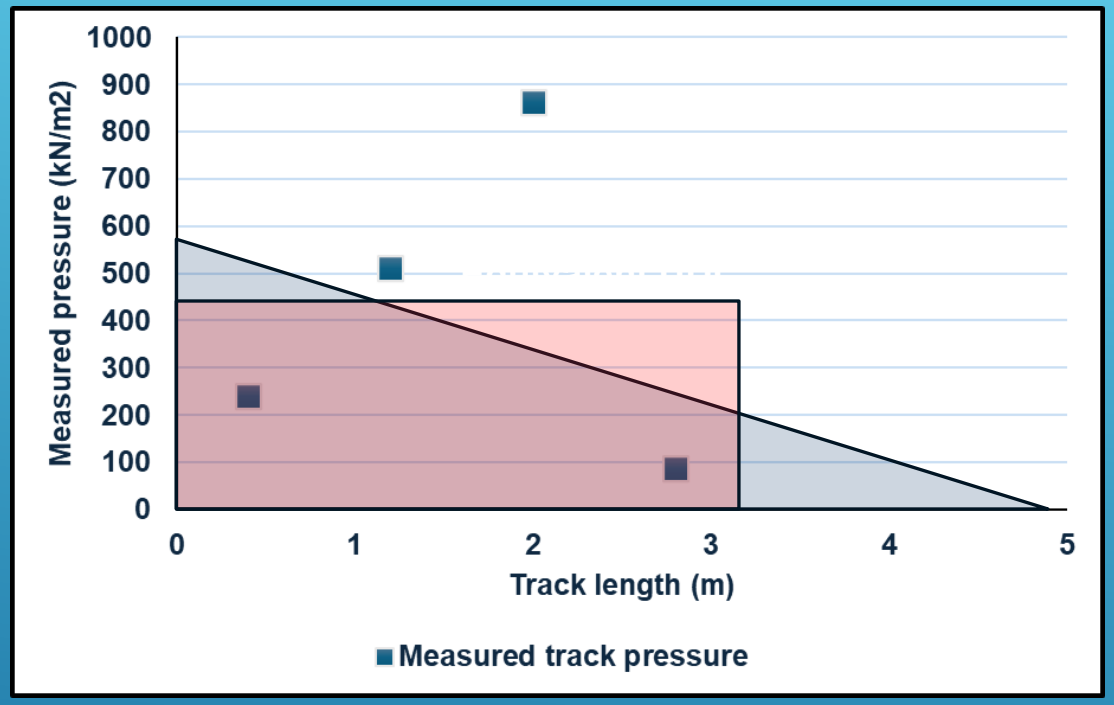
DFI-EFFC WP GUIDE 2nd Edition

Loading tables, Appendix B input data as FPS loading input

- **Considers only rig in line with tracks, only extraction case and only for fixed mast rigs.**
- **Loading due to in line working underestimates maximum loading by around 15%.**
- **Critical design loading may be due to standing, travelling, lifting, extracting or penetrating.**
- **Table has inconsistencies that cannot be analysed due to lack of input data presented.**

Appendix B track loading tables do not represent critical design loading or apply to rigs with moveable masts and should be referred to with great caution.

EXAMPLE MEASURED LOADING



Data from: Field measurements of in-situ equipment track pressure and working platform deformation using earth pressure cells and fiber optics. Faust, Hubbard & Soga, DFI/EFFC, Berlin 2022

FPS TRACK LOADING

Input (rig weights, eccentricities & winch loading) is limited to available data

(doesn't include wind, dynamic, accidental loading as required by EN16228 for rig manufacturers)

Considers Standing, Travelling, Lifting, Penetration & Extraction

Considers full 360° rig operation

Footpad pressure same as maximum UDL (avoids indeterminacy in calculation)

Centroid of UDL coincides with centroid of triangular or trapezoidal loading

Actual track loading is complex

FPS UDL track pressures don't represent reality

DESIGN METHODS - EFFC/DFI GUIDE TO WORKING PLATFORMS 2ND EDITION

The BRE 470 Method and the TWf Guide Method are the only two methods listed in Appendix C of Guide 2, and it needs to be clearly understood that all the other references are to Calculation Methods. They do not generally have a bearing pressure method linked to them, nor do they have a safety approach. It is not possible to determine a safety approach without a rigorous calibration and verification procedure.

FIGURE 7. Comparative platform thicknesses for a cohesive subsoil for applied pressure of 280kPa and track Le=1.40m and B=0.7m (platform with a friction angle of 40°and a density of 20kN/m³)

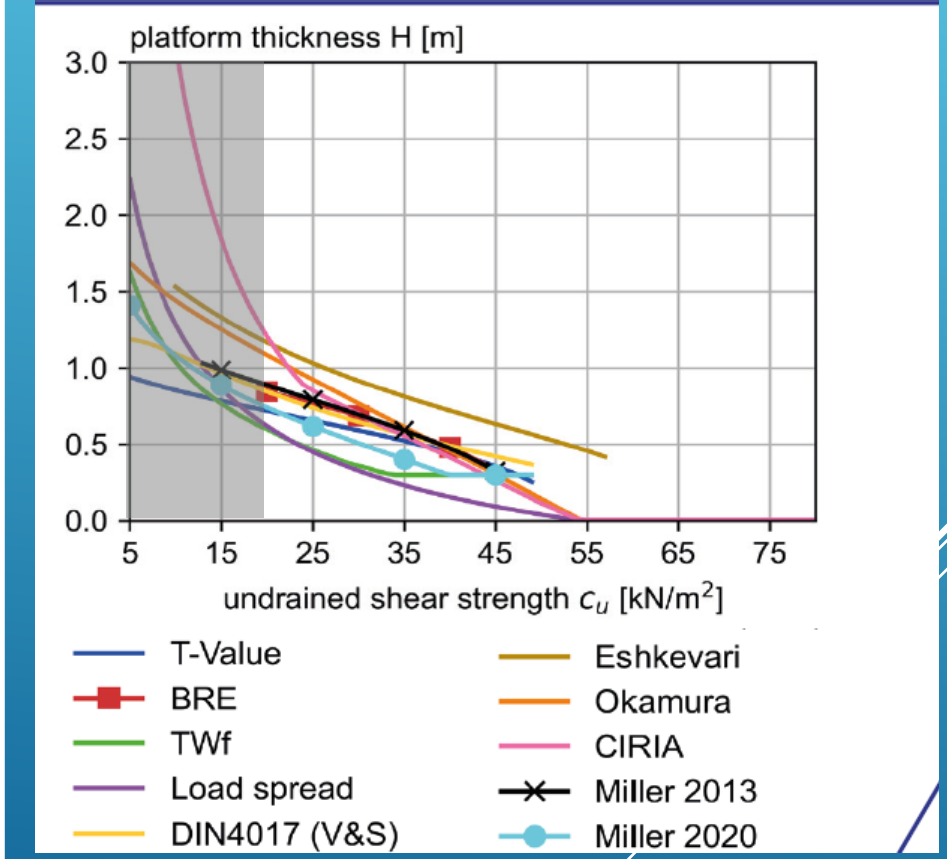
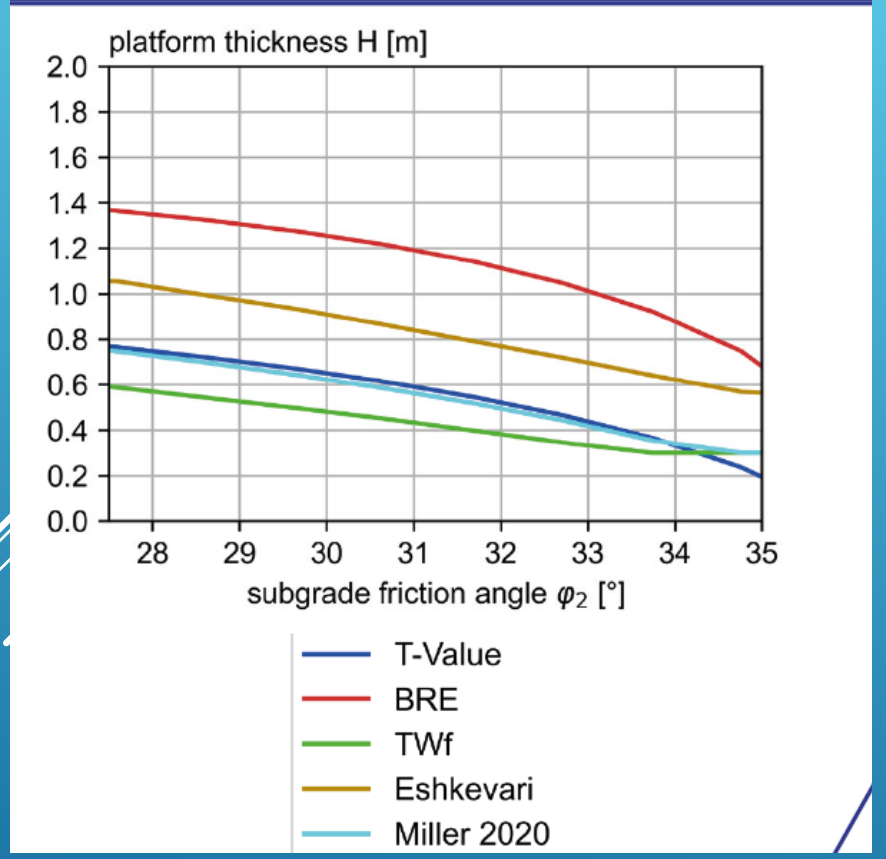


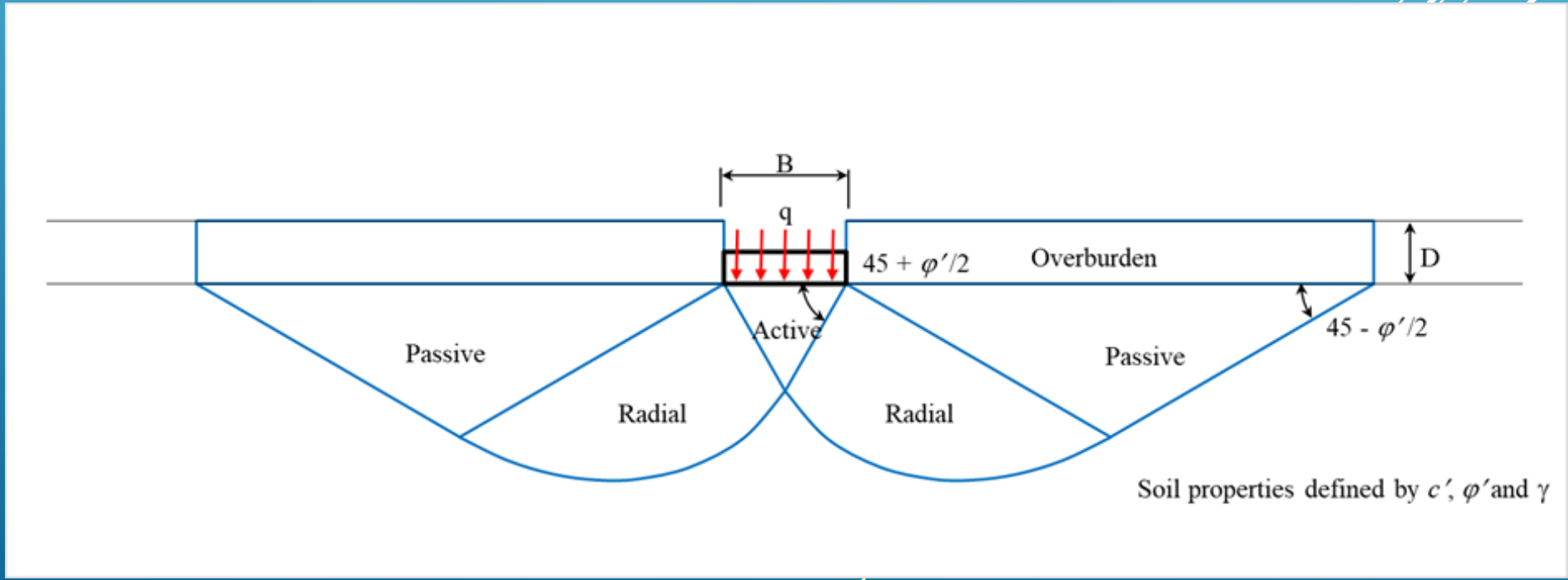
FIGURE 8. Comparative platform thicknesses for a granular subsoil for applied pressure of 440 kPa and track Le=1.70m and B=1.0m (platform with a friction angle of 40°and a density of 20kN/m³)



Economical thickness for GRANULAR working platforms < 1 m???

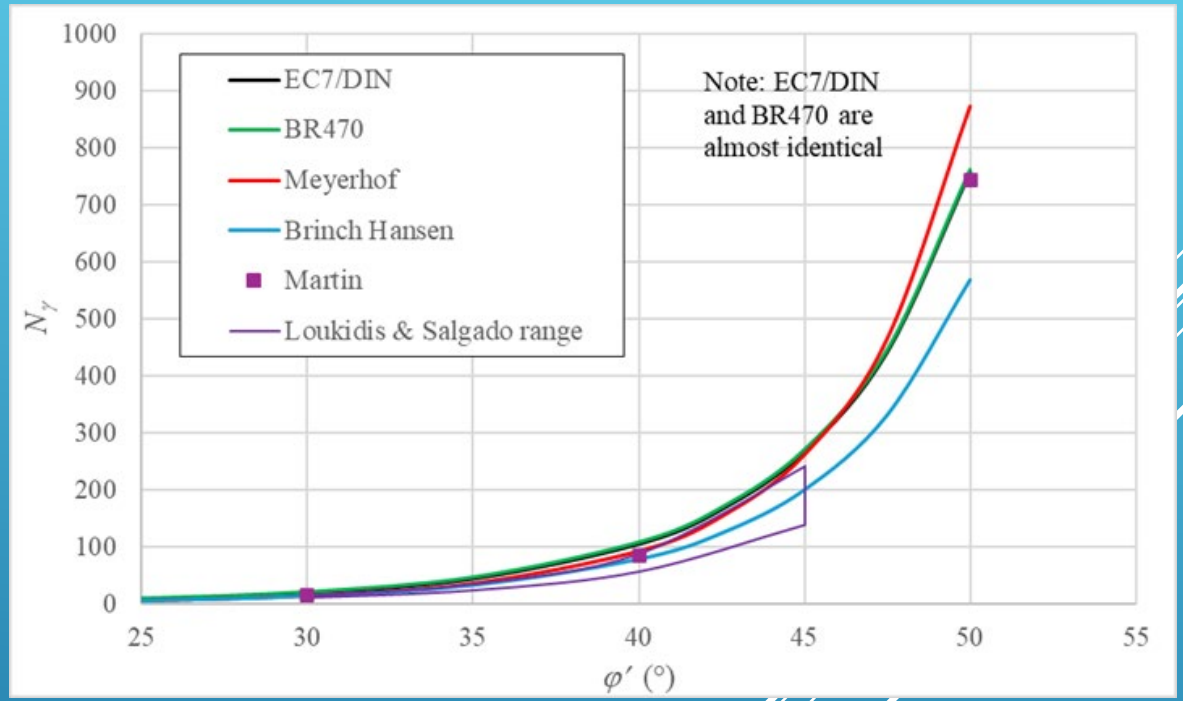
BEARING CAPACITY THEORY

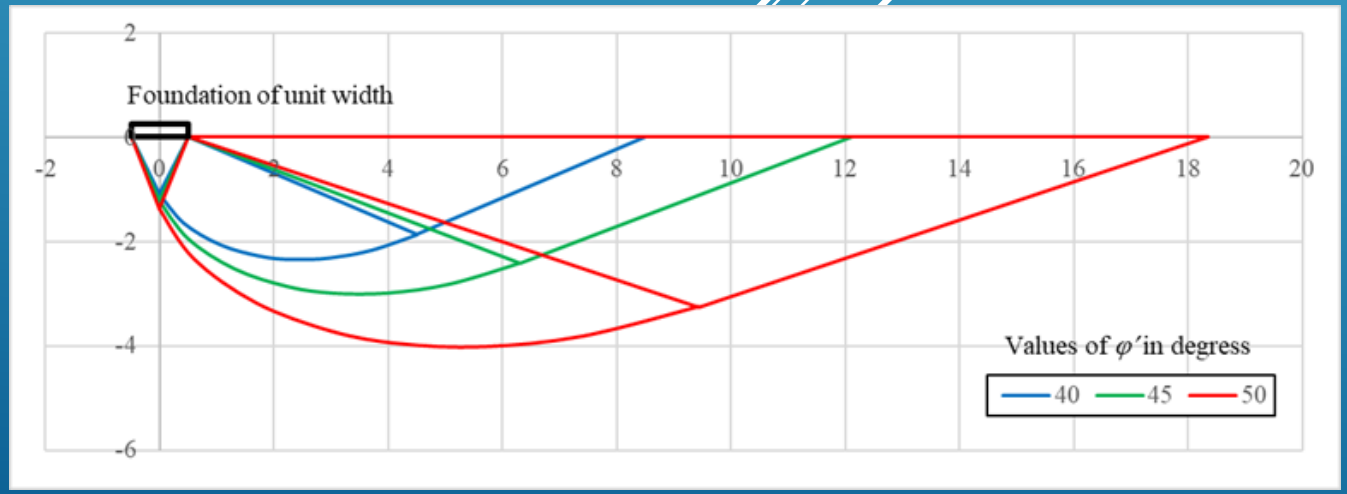
In order to understand the design of working platforms, it is first necessary to understand bearing capacity theory. The solutions to this are very complex, and so require various approximations. It is therefore also necessary to have a grasp of the effect of these approximations, and how they can be minimised by calibration.



BEARING CAPACITY THEORY

The high friction angle materials which are the first choice for working platforms because they lead to reduced thicknesses, are very sensitive to the actual friction angle selected, which has a major effect on the definition of the failure surface. Their performance, testing and specification need to be well understood, and sensitivity analyses need to be carried out.





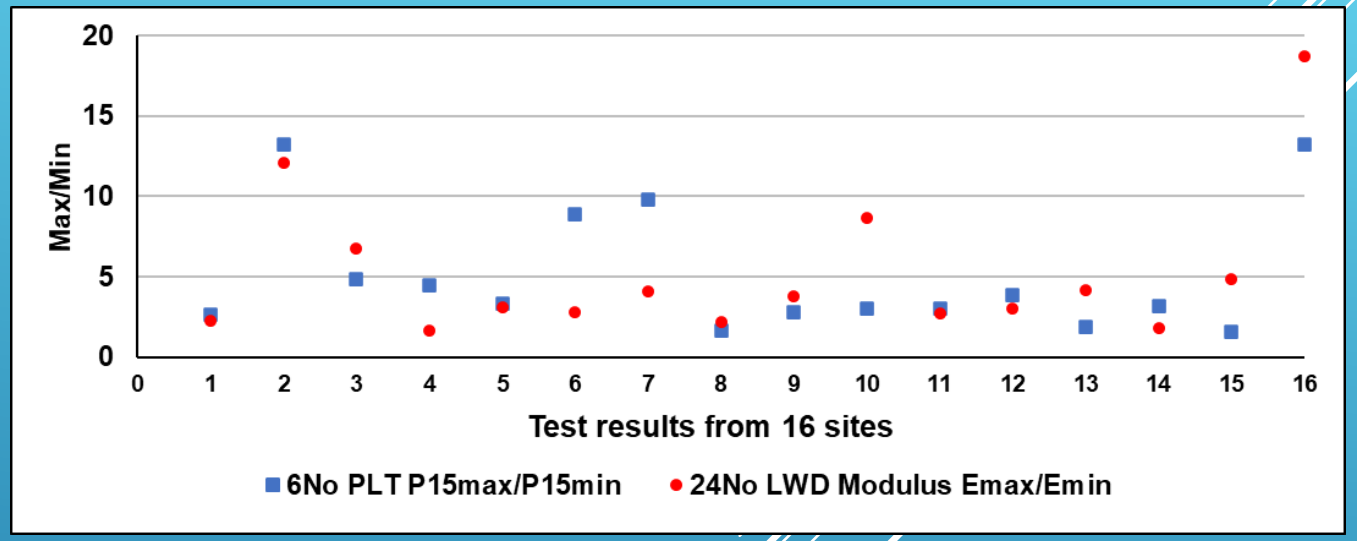
DFI-PFSF SYDNEY 2026 - WORKING PLATFORMS – LIGHT WEIGHT DEFLECTOMETER TESTING

THE VARIABILITY PROBLEM



VARIABILITY QUANTIFIED

Due to differences in grading, distribution & compaction



WHY DO WE TEST PLATFORMS?

Material angle of friction is a critical input parameter for platform design.

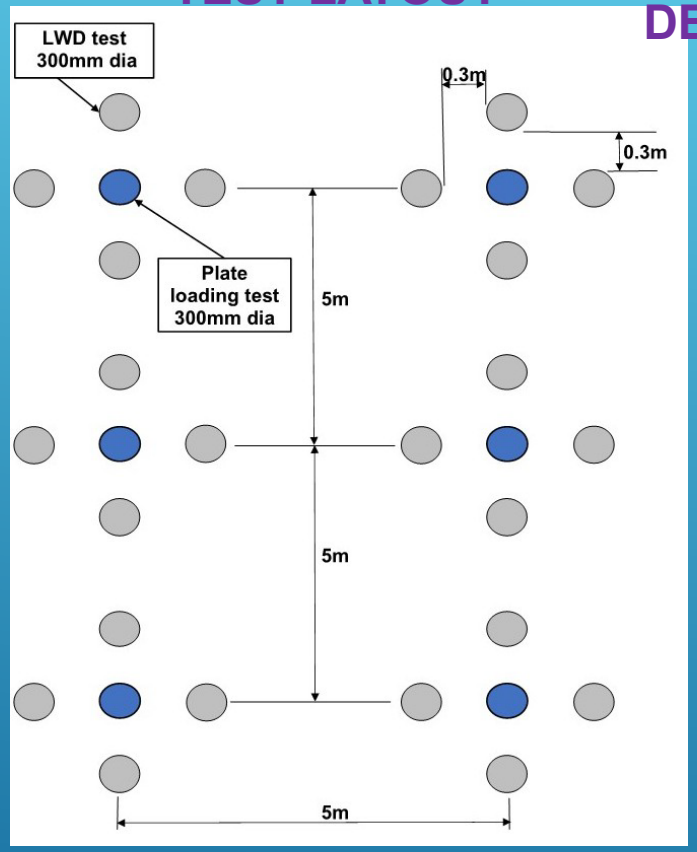
WHY RELIABLE ANGLE OF FRICTION MATTERS:

Platform thickness sensitivity

Platform material angle of friction compatible with BR470 design	40°	42°	44°	46°	48°	50°
BR470 platform thickess relative to thickness for ϕ=50°	1.91	1.72	1.51	1.32	1.15	1.00

DFI-PFSF SYDNEY 2026 - WORKING PLATFORMS DISCUSSION – LIGHT WEIGHT DEFLECTOMETER TESTING

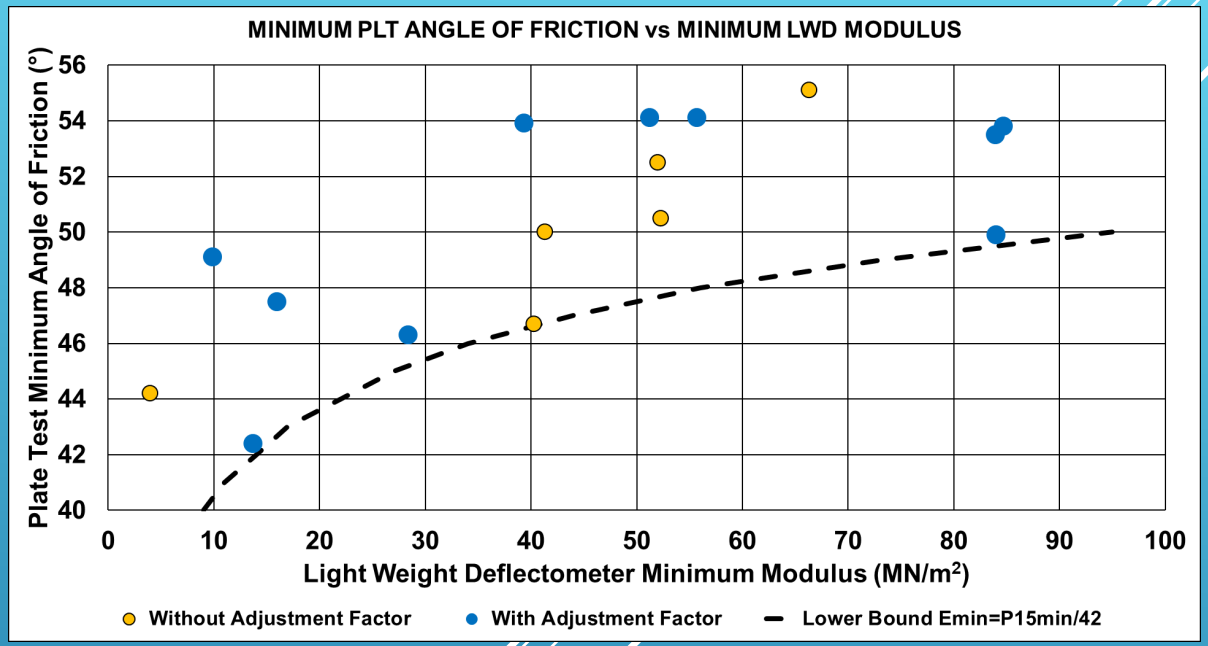
TEST LAYOUT



LIGHT WEIGHT DEFLECTOMETER



TEST RESULTS (each site 6PLT + 24LWD)



Area required 10m x 5m
Max plate load 10t (1400 kPa)
Load increment 1t (140 kPa)
Test arrangement designed to be carried out in one day

PROPOSED SOLUTION - LOOKUP TABLE

Light Weight Deflectometer site minimum modulus (MN/m^2)	≥ 9	≥ 11	≥ 14	≥ 17	≥ 22	≥ 27	≥ 34	≥ 44	≥ 56	≥ 73	≥ 95
Platform material angle of friction compatible with BR470 design	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°

Values shown are for results to date and subject to finalisation on completion of test programme

Wagstaff Piling

Working Platforms

The good, the bad and the in-betweens

David Martel

May 2026

WORKING PLATFORMS

- Working surface for piling rigs, cranes and ancillary equipment to operate on safely.
- Typically constructed from engineered granular fill compacted in layers.
- Working platform should be designed for the biggest imposed pressures.
- Maximum grades should also be considered based on equipment capabilities.



SH25A Shear Key

THE GOOD

- Main contractors appreciate importance of working platforms
- Permit to loads (or equiv.) common from all major contractors, including marked up areas of where you can work.
- Smaller builders still need some work
- Continue to provide working platform certificates and co-signed by main contactor and piling contractor.

PERMIT TO LOAD – GEOTECHNICAL PLATFORM PAGE 1/2

A PERMIT DETAILS COMPLETED BY PERMIT REQUESTER

ORGANISATION NAME:	Spark CJV	PERMIT #:	NEL-PTL-LPR-006
WORK LOCATION:	Lower Plenty Road		
ZONE/AREA:	Lower Plenty	PERMIT REQUESTER:	Sabastian Wakim
START DATE:	06/03/2023	START TIME: 07:00AM	FINISH DATE: 06/03/2024 FINISH TIME: 17:00PM

B PLATFORM DETAILS COMPLETED BY PERMIT REQUESTER

PLATFORM LOCATION DETAILS	LPR Main Box Area – Box 1.1
PLATFORM DESIGN REFERENCE DRAWINGS	NEL-CNT-PSH-2990-STW-DRG-0201 - Project Wide – Working Platforms
PLATFORM DESIGN REQUEST FOR INFORMATION (if applicable)	SPARK-DRFI-SDC-000148 SPARK-CRFI-SDC-000159

C LOADING DETAILS COMPLETED BY PERMIT REQUESTER

DESIGN LOADING TYPE	Case 1: 200t Crawler Crane / D-Wall Rig Tracking Only Case 2: Cutting D-Wall Rig / Grab D-Wall Rig
DESIGN BEARING PRESSURES	Case 1: Up to 262kPa Case 2: Up to 493kPa

D PLATFORM REVIEW COMPLETED BY PERMIT ISSUER

The below Check-Items are to be reviewed by the Senior Project Engineer responsible for the works.

CHECK ITEM	INITIAL	DATE	COMMENTS
Geotechnical platform prepared, proof rolled & confirmed as directed by Geotechnical Engineer (as required)	MW	06/03/23	
Geotextile installed (as required)	N/A	N/A	Not required, given platform thickness
Platform material as specified (as required)	MW	06/03/23	Refer Spark CJV ITP – Nominated Authority Review
Platform correct thickness (as required)	MW	06/03/23	Refer Spark CJV ITP – Nominated Authority Review
Platform material compacted and tested (as required)	MW	06/03/23	Refer Spark CJV ITP – Nominated Authority Review
Platform finished to required profile	MW	06/03/23	
Bog mats / outrigger pads in place if required	N/A	N/A	Refer to relevant lift study
Ground condition suitable for use	MW	06/03/23	
Nearby slopes checked for stability	MW	06/03/23	
Services and retaining walls checked for surcharge loads from construction plant and ok to load	MW	06/03/23	
Applicable Lot Map, denoting the extents of the Platform Area has been prepared for this permit.	MW	06/03/23	

COMMENTS:



SH25A Shear Key

PILING AND FOUNDATION SPECIALISTS FEDERATION

WAGSTAFF PILING

WORKING PLATFORM CERTIFICATE

Project Name	20 Enterprize Rd
Section/Activity	Precast Piling

Part 1 – WORKING PLATFORM DESIGN

Equipment to be used on site:	Banut 700 Piling Rigs (104,105,106,109) Driving Mode – FPS Base Case (Rev 29/05/2013)
Maximum plant loading:	Standing (1) - Q = 280 kPa, L = 1.25m Travelling (1) - Q = 280 kPa, L = 1.25m Handling (1) - Q = 292 kPa, L = 1.25m Note: (1) or (2) refers to BRE Load Case classification.

Note: Reference material developed by the Federation of Piling Specialists to assist with the calculation of bearing pressures is available on www.pilingfederation.org.au – follow the prompts to "Safe Working Platforms"

PART 2 – WORKING PLATFORM INSTALLATION

The Working Platform on the work site detailed above has been designed and installed to safely support the equipment detailed on this certificate and will be maintained and repaired, and reinstated to the as installed condition after any excavation or damage, throughout the period that the equipment is on the site.

Signature		**Name**	Royna LeBrocque
Position	Site Contractor (P.M.)	**Date**	13/5/2025
Organisation	Kotzur	**Address**	66 CONFERENCE ST CAMBRIDGE, TAS

A completed copy of this certificate signed by the Principal Contractor must be given to each user of the specific Working Platform prior to commencement of any works on that platform.

Received by Signature		**Name**	Thomas Whiting
Position	Piling Contractor	**Date**	13/05/2025
Organization	Wagstaff Piling		

WAGSTAFF PILING

45 YEARS 1981 2026 ANNIVERSARY

THE GOOD

- The use of cemented treated aggregates is great. Little to no maintenance required. A slight fall needed to manage water.
- Most major projects use cement treated aggregates now.



SH25A Shear Key

THE BAD

- Platforms not considering the equipment capabilities i.e working grades.
- Working outside of OEM recommendations.
- Quick re-works onsite that can lead to more issues.
- Ensure piling crews don’t “give it a go” for site relationships.





SH25A Shear Key

THE BAD

- Not managing external water or having back-up pumps.
- Not all sites are the same.







SH25A Shear Key

THE BAD

Piling Engineer " Have you checked with your geotechnical engineer if this asphalt is OK to work off"

Builder "She will be right mate we did some tests over there and I've had trucks driving over this without a problem"

Piling Engineer "yeah mate you might want to come over and have a look at where we are working"



SH25A Shear Key

THE IN-BETWEEN

- Flighting of soil.
- **Offsiders need to be on the look out!!**
- If encountered you will need to dig out an area and backfill with stab sand and work off steel plates.
- Undermining of guide walls during Diaphragm Wall construction is a major risk.



SH25A Shear Key

THE IN-BETWEEN

- Geotech engineer coming to site after rain event of 20mm+ and asking to scrape off the wet material to expose dry platform.
- Continually scraping back after rain days and cleaning up at end of day. Down the track the platform thickness is less than design. Big problem for crushed rock pads!
- Smarter approach needed using a bit of common sense.



SH25A Shear Key

THE IN-BETWEEN

- Ballast: the love hate relationship
- Looks amazing when it's first placed and rolled and agreed best solution for over water platforms.
- Machines start working and it all comes apart needing constant maintenance.
- Tough on workers ankles as well.
- Need to check if stones are jammed in between back tires of concrete agis etc

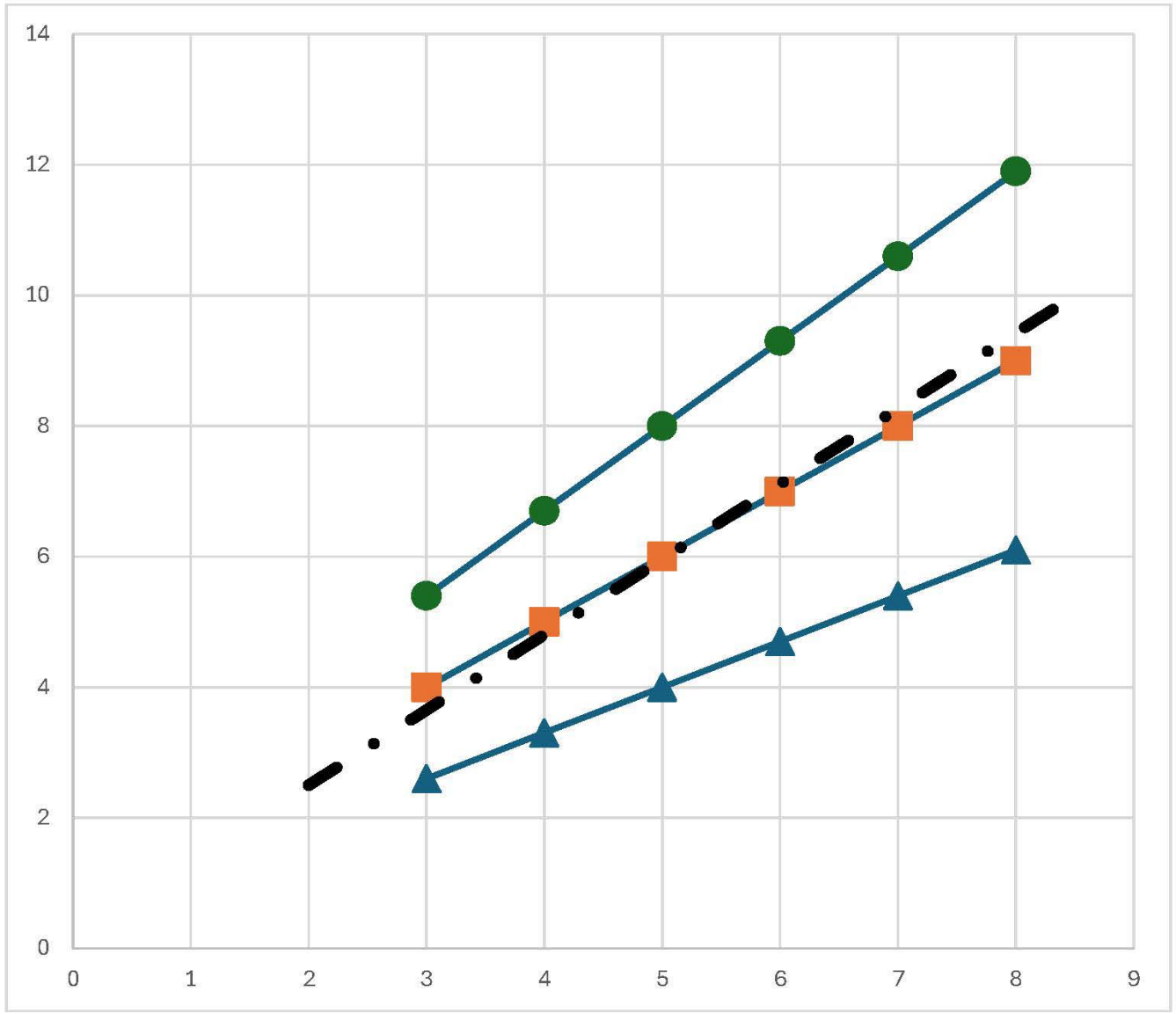




SH25A Shear Key

ADDITIONAL POINTS

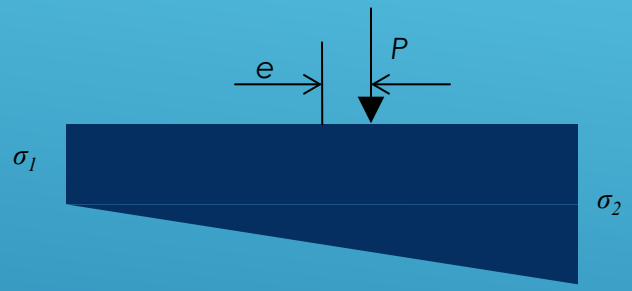
- Bearing capacity calculations are complex
- Can be simplified, e.g. BR470 (punching shear), T-value, Vrettos & Seibel, but simplifications must be rigorous


14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9

Rig Stability Factor and Eccentricity Index



PILING AND FOUNDATION SPECIALISTS FEDERATION



$$e < {}^{d}/_{6}$$

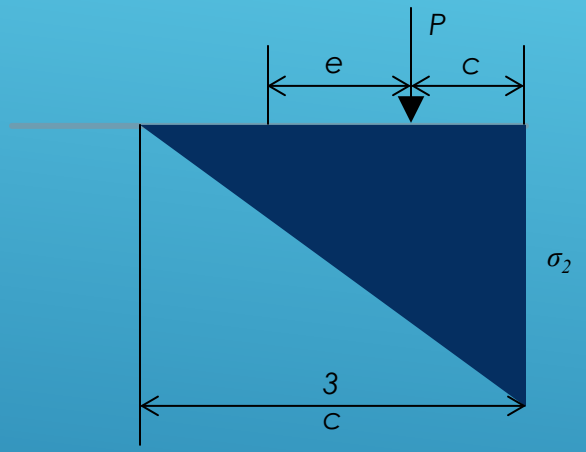
$$\sigma_1 = \frac{P}{bd}\left(1 - \frac{6e}{d}\right)$$

$$\sigma_2 = \frac{P}{bd}\left(1 + \frac{6e}{d}\right)$$

- Ground pressures

RIG STABILITY FACTOR AND ECCENTRICITY INDEX

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$e > {}^{d}/_{6}$

$c = {}^{d}/_{2} - e$

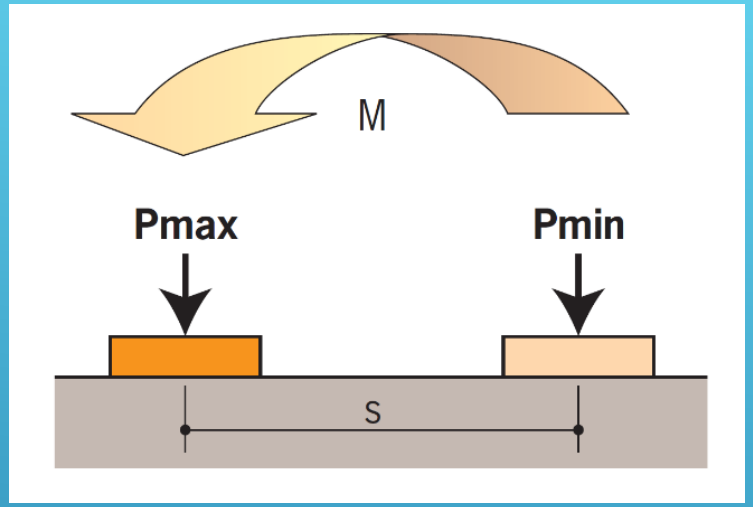
$\sigma_2 = \frac{2P}{3cb}$

- Ground pressures

RIG STABILITY FACTOR AND ECCENTRICITY INDEX

PFSF PILING AND FOUNDATION SPECIALISTS FEDERATION

RIG STABILITY FACTOR AND ECCENTRICITY INDEX



$$Total\ vertical\ load = P_{max} + P_{min}$$

$$Rig\ Stability\ Factor = \frac{M_0}{M_w} = \frac{P_{max} + P_{min}}{P_{max} - P_{min}} > 1$$

RIG STABILITY FACTOR AND ECCENTRICITY INDEX

- When Pmin drops to zero, FPS Spreadsheet gives #######
- This is because RSF = EF = 1 and rig is about to topple

COMMON CAUSES FOR PLATFORM FAILURES

- **Common causes for working platform failures include:**
- **Soft spots**' have not been removed and subgrade strength is weaker than that assessed,
- **No platform was specified** due to pressure on program/ cost,
- The **platform has not been adequately compacted** and is weaker than that initially assessed/ verified
- The **Contractor supplies incorrect loadings** or uses a different rig to that assessed for the working platform design,
- **Operator error**,
- **Local trenches** or other temporary excavations and/or the subgrade have not been **adequately reinstated**
- The **platform and the access** ways have not been adequately designed and/ or maintained.



PLATFORM MATERIAL DESIGN PARAMETERS

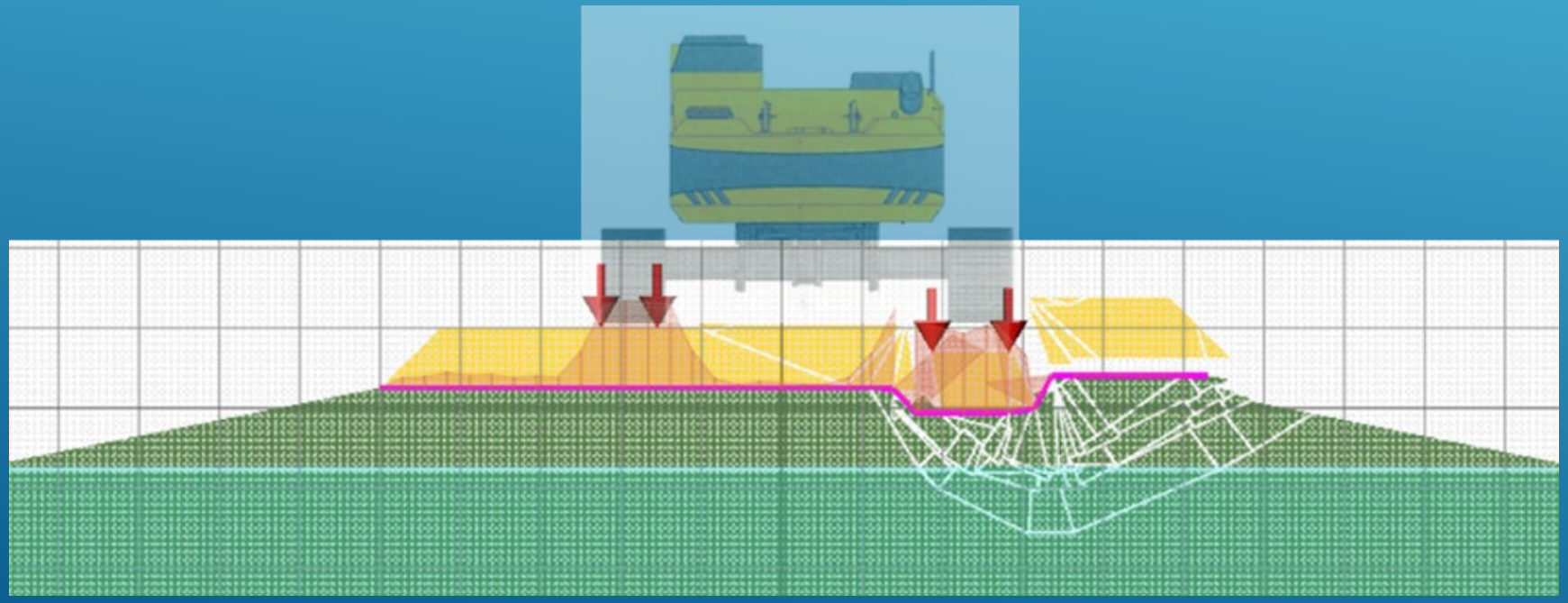
BRE BR470 provides little guidance about the range of friction angles for selected (and available) platform materials. TWf2024:03 provides indicative strength parameters for platform fill.
Site-specific testing is recommended.

Description	Friction angle φ_{fill}	Quality controls
Brick and concrete “hardcore” laid with little to no compaction and not protected from contamination	30-35°	Little to no quality control or maintenance
Specified gap graded material laid with nominal compaction and protected below with geotextile	35-40°	Nominal quality control and maintenance
Specified well-graded material laid and fully compacted to DoT specification and protected below with geotextile	40-45°	Full quality control, regular inspection and maintenance
Specified well-graded material laid and fully compacted to DoT specification, fully tested and protected below with geotextile	>45°	Full quality control, test results reviewed by designer, regular inspection and maintenance



WORKING PLATFORM DESIGN (INTRODUCTION)

For ground conditions outside of standard design guidance, first principles need to be applied. This could be done by numerical analysis, like 'Discontinuity Layout Optimization' (DLO) or others.
This approach covers **platform thickness** assessment, definition of **edge distances** and checking of **global stability** requirements**.**





OPERATIONAL REQUIREMENTS

▶**The completed working platform design should clearly communicate the limitations and operational limits to the contractor**. This may include aspects such as:

- Maximum allowable design loading for the platform.
- Operational restrictions such as slew restrictions or lifting positions for critical lifts.
- Details of plant access routes to the platform, considering grade limits of the specified plant.
- Areas for assembly of plant (boom length should be considered for crawler crane erection).
- Operational constraints for minimum edge distances to side slopes or other hazards.
- **Platform maintenance requirements.**



OPERATIONAL REQUIREMENTS

►It is recommended that an **Inspection and Test Plan (ITP)** is established for the **construction and maintenance** of the working platform. Any inspection and tests that are necessary to confirm the adequacy of the construction should also be stated by the platform designer in a drawing or design report as required/ applicable. **As a minimum, an ITP should include:**

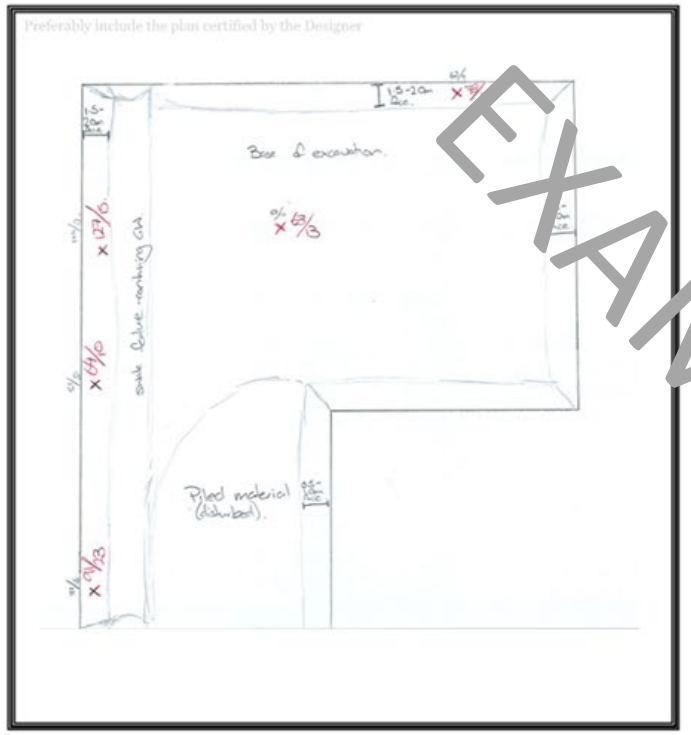
- Reference to the relevant platform design drawings or design report
- Subgrade inspection hold points and any testing requirements
- Any requirements or hold points for proof rolling and walkover inspections for soft spots
- Material specifications for fill and geosynthetics, including material testing/ grading details
- Method of fill placement including number of layers, minimum / maximum layer thicknesses, required compaction plant and compaction tests (including test frequencies).
- Dimensional tolerance checks, including minimum platform thickness and edge distances for the platform, lap lengths of geosynthetics.
- On-going regular maintenance check requirements.

WORKING PLATFORM CERTIFICATE

Working platform certificates can be obtained through the **Federation of Piling Specialists (FPS)** or the **Piling and Foundation Specialist Federation (PFSF).**

SKETCH PLAN OF WORKING PLATFORM

Preferably include the plan certified by the Designer



Working Platform Certificate

Project Name	
Work site	
Section / Activity	

Part 1 – Working Platform Design Parameters

Equipment to be used on site		Track width (m)
	Case 1	Case 2
Unfactored bearing pressures (kPa)		
Effective track length (m)		

Note: These design pressures have been calculated in accordance with the method promoted by the Piling & Foundation Specialists Federation and made available on www.pilingfederation.org.au. This is based on BRE Report 470 (2004) – *Working platforms for tracked plant* and BS EN 996:1995 – *Piling equipment – Safety requirements.*

Part 2 – Working Platform Design and Installation

Designer's name	
Designer's Organisation	

The working platform on the above stated work site has been designed in accordance with the principles set out in BRE Report 470 – *Working platforms for tracked plant*, installed in accordance with that design, as tested, where appropriate, to safely support the equipment detailed on this certificate and it will be maintained and repaired, and reinstated to the as installed condition after any excavation or damage, throughout the period when the equipment is on the site. Overall stability has also been checked.

Signature		**Name**	
Position		**Date**	
Organisation	Principal contractor	**Address**	

Note: A completed copy of this certificate signed by the Principal Contractor must be given to each user of the working platform prior to commencement of any works on site.

Received by Signature		**Name**	
Position		**Date**	
Organization	Piling Contractor		

EXAMPLE



WORKING PLATFORM CERTIFICATE

Guidance on piling platforms

Design

a. The stability of piling rigs and associated plant is primarily dependent upon the provision of a suitable and sufficient working platform. It must be properly designed and installed to a recognized standard. Guidance for this is provided by the BRE in a report commissioned by the FPS entitled "Working Platforms for Tracked Plant – Good practice guide to the design, installation, maintenance and repair of ground supported platforms".

b. Whilst the same type of rig may be operated by different companies the bearing pressures may differ due to the specific configuration of operation of the rig or modifications. The detailed bearing pressures will be provided by the piling contractor in advance of work commencing.

1. The design is extremely sensitive to the bearing pressure and type of fill used in the platform. For example changing the angle of friction of the fill from 35 degrees to 45 degrees can halve the platform thickness required. It is therefore proposed that tests are performed on different fill materials in the field.
2. The working platform must be free draining to prevent the build up of water and slurry.
3. In the case of fine-grained subgrades, a separation/filter membrane should be installed beneath the platform material. This will inhibit 'pumping' and infiltration of the fine-grained soils up into the platform material during wet weather (which can impair platform performance and increase maintenance costs).
4. Proof testing of the platform can be carried out with a 600mm diameter plate subject to the maximum design loading (maximum test load typically 12-15t, often provided by a crawler excavator). Coupled with a cautious design approach, such testing should highlight any gross inconsistencies in platform performance. Potentially significant savings in platform thickness and cost can be realized by adopting a more detailed testing strategy.
5. The working platform must have a specified design life which starts before delivery of the piling equipment and ends on completion of all piling works. This includes load testing, integrity testing, investigation of non conformances and any remedial works.

2. Installation

a. The PFSF Platform Certificate is recommended for all sites where a piling rig or attendant plant operates. It must be signed by an authorized representative of the Principal Contractor. This merely confirms that the legal duties required under the specific workplace health and safety acts and regulations have been carried out.

1. If the working platform is to be constructed or removed in phases while piling works are ongoing, then the extent of the platform must be clearly defined on the certificate (see sketch plan) and if necessary physically on site. This is particularly important where the piling mat is removed from an area previously made available to the piling contractor.
2. The working platform provides access for all piling plant, ancillary plant, deliveries, sub-contractors and personnel associated with the piling operations. Properly installed it will also provide suitable and safe access for following trades for the whole project.
3. One of the main causes of rig instability is a result of poor definition of the edge of the working platform. In general the working platform should extend at least 2m beyond the pile position/edge of the building. This ensures sufficient safe working area for the piling personnel and attendant plant.
4. Where access ramps are used to move between working levels these must be of sufficient width and small enough gradient (generally less than 10%, to allow the piling plant to move safely with the stability constraints of the machine. Ramps must be in a straight line between working areas. Piling rigs and cranes cannot change direction on ramps unless derigged. Where a change in direction is required, this must be on a flat level platform.

3. Maintenance, repair and reinstatement

a. The working platform must be kept free draining. Water and slurry which is allowed to build up on the working platform can hide recently constructed piles, trip hazards, unstable ground and excavations. Slurry can be transferred to personnel and PPE which increases the risk of slips on steps as well as difficult handling of work tools.

b. Obstructions encountered during the piling process will generally require excavation to remove them. This can create a 'soft spot' which can result in the rig overturning. It is important that any excavations made in the working platform are reinstated to the designed standard. This is a major root cause of piling rigs overturning.

PFSF EXAMPLE



FPS TRACK LOADING SPREADSHEET – COMMON PROBLEMS

FOOTPAD LOAD

Manual entry required

"By trial and error, adjust footpad forces to eliminate "error" messages and equalize bearing pressures on both tracks and footpads (highlighted in red boxes).

If footpad load too small track pressure is overestimated but safe (No imbalance warning).

If footpad load too large track pressure is underestimated but safe (Imbalance warning).

WINCH/RAM

Crowd system – Maximum Extraction Force (kN) enter as +ve

Crowd system – Maximum Penetration Force (kN) enter as -ve

Maximum Auxillary Force (kN) enter as +ve

Forces may need to be reduced to limit Eccentricity Index

ECCENTICITY INDEX

Max winch loads may not be safe for all rig slewing

FPS spreadsheet

Eccentricity index - X direction (sideways)	0.73
Eccentricity index - Y direction (forwards/backwards)	0.64

Rig Stability Factor = Moment to overturn / Working overturning moment

FPS Eccentricity Index = 1/Rig Stability Factor

Loading condition	Minimum Rig Stability Factor	Equivalent FPS Eccentricity Index
Case 1	1.6	0.62
Case 2	1.2	0.83

Ref: CORKE, A review of stability factor and eccentricity index for piling rigs. Ground Engineering Dec 2016, pp23-25

Detailed guide to use of FPS spreadsheet available from FPS website: www.fps.org.uk

BR470 EMPIRICAL LOADING FACTORS

(derived by a group of FPS members based on experience)

Rigs analysed with FPS loading input and a range of cohesive and granular subgrades.

Platform materials considered with ϕ = 35°, 40°, 45°, 50°:

- Poorly graded/poorly compacted material which might have ϕ < 40°.
  For ϕ < 40° some rigs failed in bearing capacity within the granular platform.
- Well graded/well compacted material can have ϕ > 60°.
  50° was taken as a maximum value of platform material ϕ as bearing capacity factors become increasingly sensitive above this value.

Angles of friction considered are not ϕ_{peak}, ϕ_{resid} or ϕ_{cv}, just a value that works for BR470

Having considered a range of possible values, loading factors derived for the design of safe and economic working platforms were:

1.6 for more risky Case 1 (standing, travelling and lifting, driver unlikely to aid recovery).

1.2 for less risky Case 2 (extracting and penetrating, driver could aid recovery).



NO BEARING CAPACITY FAILURE

Rig Stability Factor = Moment to overturn / Working overturning moment

FPS Eccentricity Index = 1/Rig Stability Factor

Loading condition	Minimum Rig Stability Factor	Equivalent FPS Eccentricity Index
Case 1	1.6	0.62
Case 2	1.2	0.83

Reference: A review of stability factor and eccentricity index for piling rigs, D J Corke, Ground Engineering, December 2016

Different LWDs can produce slightly different modulus values.

Annual testing benchmarks individual LWDs against a more consistent Falling Weight Deflectometer and provides a Correlation Certificate Adjustment Factor, typically 0.9 - 1.1.

BS 1924-2:2018 Hydraulically bound and stabilized materials for civil engineering purposes
"*BS 1924 provides tests for soil and/or aggregate treatment employing solely or in combination*"

(*"9.2.7.3 For annual off-site correlation, the LWD shall be correlated across its working range and an annual certificate issued. The benchmark for the correlation shall be a representatively determined surface modulus measured using an FWD*" **LWD requirements:** 9.2.3.2 ***Load cell*** **and** 9.2.3.4 ***Deflection sensor***

Correlation certificates provide "Adjustment Factor" to relate LWD output to equivalent FWD modulus

Testing is conducted annually, on behalf of National Highways and Transport Scotland, with correlation certificates valid until the end of the following year. From the latest published listing there are 153 LWDs with correlation certificates, operated by over 80 UK organizations, as shown in the schedule issued by Transport Scotland.

https://www.transport.gov.scot/publication/light-weight-deflectometer-lwd-correlation-trial-report/

BS 1924-2:2025 Unbound, hydraulically bound and stabilized materials for civil engineering purposes
"*9.2 Light weight deflectometer, 9.2.1 Principle. The test determines the in-situ surface modulus for a pavement foundation or a construction site working platform based on the measurement of the surface when tested with an LWD as shown in Figure 9.*" (Figure 9 shows a schematic of the LWD.)

For further details contact: Dr Michael Gordon, Michael.Gordon@wsp.com

MINIMUM MODULUS APPROACH IS NOT NEW:

SPECIFIED FOR ROAD FOUNDATION TESTING

highways england

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Llywodraeth Cymru
Welsh Government

Department for Infrastructure
An Roinn Bonneagair

CD 225, Design for new pavement foundations, (formerly IAN 73/06 revision 1 (2009), HD 25/94), Revision 1, April 2020

Table 3.7 Foundation classes

Foundation class	Assumed long-term confined foundation surface modulus (MPa)
1	≥ 50
2	≥ 100
3	≥ 200
4	≥ 400



Proposed testing method:

- Based on LWD with load cell & deflection sensor (BS1924)
- Provides angle of friction compatible with BR470 design

Plate Load Testing 6 tests/day >>> Deflectometer 60-80 tests/day

Significantly greater site coverage than traditional Plate Load Testing.
Single operator & no plant required for reaction as for PLT
ECONOMIC SOLUTION TO THE PLATFORM VARIABILITY PROBLEM

For platform designers: Validation of angle of friction (check WPC angle)

For platform users: Testing a platform in use in case of degradation or .....poor maintenance affecting rig productivity and safety.

Testing so far has shown the proposed new testing method to be viable.

With a few more sites in 2026 it's hoped to finalise by the end of the year

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