Guide to **Working Platforms**

By the joint **EFFC/DFI** Working Platforms Task Group

EUROPEAN FEDERATION OF FOUNDATION CONTRACTORS

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Finally, the group acknowledges all those that work on site, often in testing conditions. It is hoped that this guide will make their job safer, easier and more productive.

Words importing the masculine gender only shall include the feminine gender and vice versa as applicable.

This guide is available to download for free at www.effc.org and www.dfi.org

1 / Background

The importance of the stability of large and tall equipment when working on construction projects is undeniable. As the gruesome image below shows, the consequences of unstable platforms can be devastating.

FIGURE 1. Accident Involving a Piling Rig

In addition to the physical consequences, a rig toppling will certainly have a financial impact, it may lead to a delay to the project, have reputational ramifications and lead to civil claims or even criminal prosecution. A major cause of rig instability is a poor site surface or working platform. This may be due to a lack of design, poor quality installation, or a lack of maintenance or inspection. Given the consequences of a rig falling over, most would agree that each of these aspects should be carried out thoroughly and by competent people, yet on many sites, in many countries, this is still not done.

Nevertheless, there are examples of good practice that if shared and followed would do much to improve the quality of working platforms, not just for geotechnical equipment, but for all users of the site surface. However, because of the fragmented nature of the construction industry and its regional approach, it is not easy to effect a change for the better.

Therefore, this guide is not intended to prescribe or dictate the way in which working platforms should be managed, but rather pools the experiences from across the membership of the European Federation of Foundation Contractors (EFFC) and Deep Foundations Institute (DFI) to increase awareness of what has been achieved.

Whilst foundations contractors naturally focus on piling rigs and other geotechnical equipment, a working platform is used by everyone that accesses site. So the considerations highlighted in this document apply equally to cranes, concrete pumps, mobile access platforms, concrete trucks, delivery vehicles and even personnel. A properly designed and installed working platform benefits all and will enhance the efficient working of a site as well as ensuring a safe environment.

It is hoped that the document will provide a stimulus for how this important aspect of how we work is tackled by our industry and outline some possible tools for implementation. Fundamentally, we all wish to make photographs like *Figure 1* a thing of the past.

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2 / Purpose and Scope

On a typical construction site, the provision of a safe surface to work on involves and affects a number of the contracting parties, and as a consequence, the organisation of its design, installation and maintenance can be complex. As it concerns money and liability it is often a contentious issue, but nonetheless one that needs to be addressed.

The parties that may get involved in the provision of a working platform are:

The client. Some clients such as a national railway authority may have specifications that need to be met. Some may include an item in their bill of quantities for the provision of a working platform, whilst other clients will simply expect the general contractor1 to have included for it in the price.

The principal designer. In some jurisdictions the designer of the scheme may have an over-arching safety co-ordination role. Regardless of whether there is this legal responsibility, the choice of foundation type and size will be a determining factor in deciding what equipment is necessary to install the works, and hence the requirements of the working platform.

The general contractor. In accordance with the European 'Construction Sites' Directive [*Appendix 1*] the general contractor is likely to be the coordinator for safety and health matters in the project execution stage. This extends to the temporary works on the site and hence the working platform.

The specialist geotechnical contractor. Again, under EU law, the geotechnical contractor will be responsible for the health and safety of their employees and this will extend to the provision of a safe place of work.

The working platform designer. If it is not the principal designer, then a separate organisation or person may carry out the design for the platform (which is a part of the temporary works).

The working platform installer (earthworks contractor). This is usually a subcontractor to the general contractor.

The platform tester. In some cases, the platform might be tested to demonstrate its suitability. This might be done by an independent testing company.

The platform maintainer. Once the platform is in use it is likely that it will need some maintenance. This would be either because it is heavily trafficked or perhaps it might have deteriorated because of weather conditions.

So, in summary, the provision of something that would seem to be basic and straightforward - namely a platform for the site to use and work from, actually becomes a difficult thing to arrange and look after. Several steps are necessary to make sure that the whole process can be properly executed.

Footnote 1. General contractor includes the common terms Principal Contractor, main contractor or "GC". He is generally the "Controlling Entity" on the site.

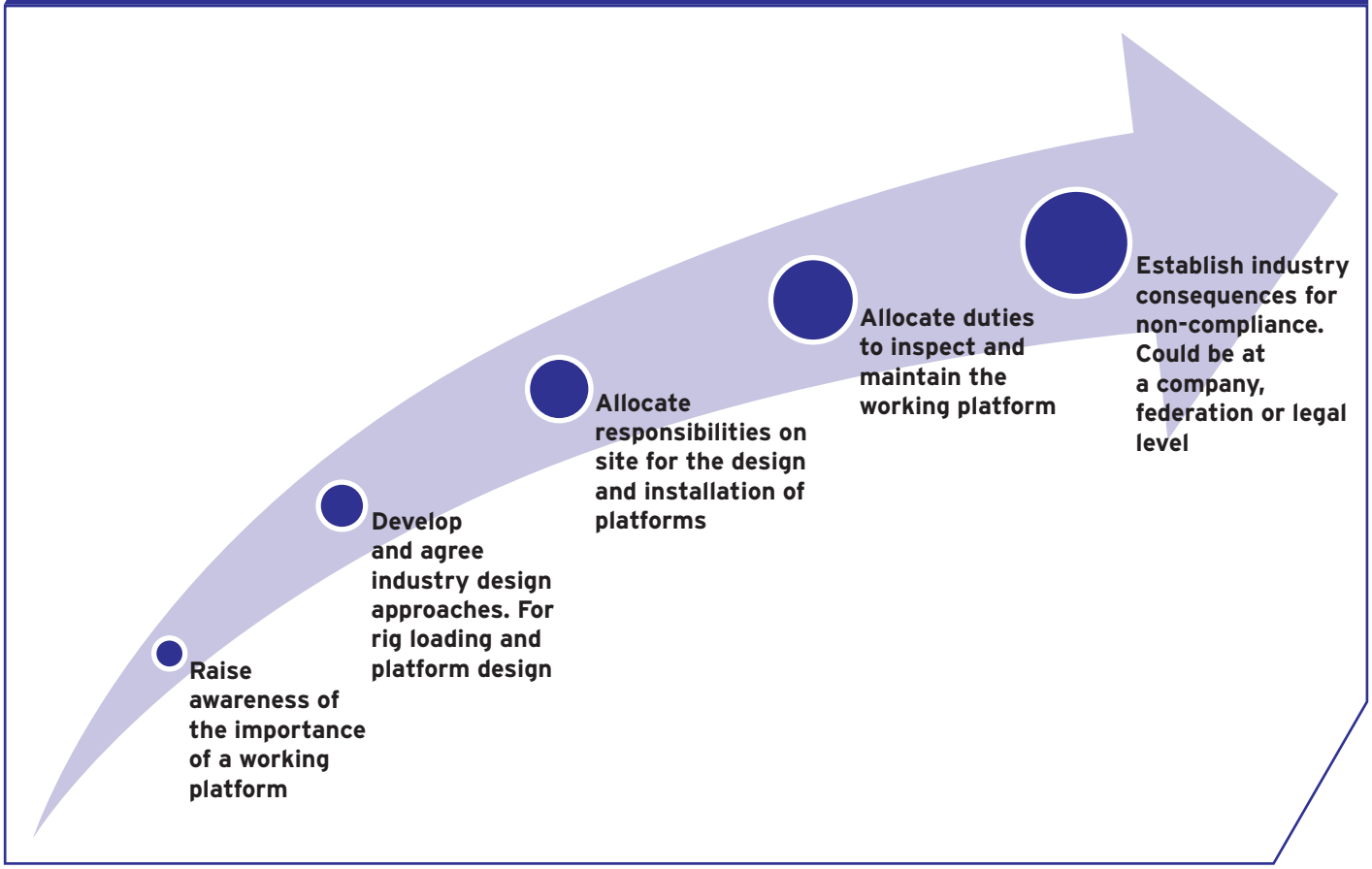
2 / Purpose and Scope

This document takes each step in turn and describes what good practice is, with reference to documents and resources that have been made available through the EFFC and DFI. In compiling this information responses have been collated from foundation contractors from; France, United Kingdom, the Czech Republic, Germany, Netherlands, Poland, Portugal, Romania, Sweden, Austria, Belgium, Denmark, Hungary, Italy and Sweden, USA and Canada.

The guide is set out in a chronological manner; that is it starts with the calculation of rig loads and platform design and then moves through installation and testing to maintenance. Contractual responsibility is covered, as is enforcement, albeit this can be a contentious subject. Finally some suggestions for training and improving general awareness are made.

Unsurprisingly different countries are at different levels of maturity, but the sequential process or the journey in *Figure 2* that needs to followed is broadly the same wherever you are. It is worth noting that each and every step should be properly considered and implemented prior to the next. Rushing the process or missing steps out is unlikely to be successful.

FIGURE 2. Steps in Implementing Effective Working Platforms



More and more countries are adopting this approach and it is not just in Europe. Recently (November 2018) the main geotechnical federations in the U.S. (comprising the ADSC-IAFD (International Association of Foundation Drilling), the DFI (Deep Foundations Institute) and the PDCA (Pile Driving Contracts Association)) endorsed such a process [*Appendix 2*]. Similarly, Canadian regulations are addressing the issue head-on [*Appendix 15*]

3 / Tracked Plant Loading

It is necessary to provide the designer with loadings (amongst other things) so that the thickness of the platform may be determined. For tracked equipment this is not just the "dead-weight" of the machine spread over the contact or surface area of the tracks.

Since 2014 and the introduction of EN16228: Drilling and Foundation Equipment - Safety, the rig and equipment manufacturers should provide rig bearing pressures with all new equipment. However, older rigs may not have this information or modifications may mean that the working bearing pressures are changed.

Calculating the rig bearing pressure can be complex, as the way in which the rig is operated will have an impact upon the loading pattern. It is likely that different load cases will apply as the ancillary equipment carried by the machines (such as an auger or a hammer) will vary from time to time, even possibly on the same project. Consequently, there are a number of variables which need to be modelled if a precise assessment of rig bearing pressure is to be made.

The Federation of Piling Specialists (FPS) in the UK has developed a method of calculating track bearing pressures which is freely available [*Appendix 3*]. This is an excel spreadsheet into which the user can input the particular rig characteristics to derive the bearing pressure. From time to time the FPS also offers training in the use of the tool.

FIGURE 3. Other Users of the Platform

Another simple estimate especially useful for older equipment is:

1. TRACKING

$$\text{Ground Pressure} = \frac{(\text{Rig Weight including counterweights+tools})}{(\text{Track Width}*\text{Track Length})}$$

In the equation the entire load is on one track, to estimate the effect of eccentricity. The Track Length is the full flat length in contact with the ground surface. The result is double the average pressure.

2. DRILLING

$$\text{Ground Pressure} = \frac{(\text{Rig Weight including counterweights+tools+extraction force})}{(\text{Track Width}*\text{Track Length})}$$

Again, all the load is on one track to estimate the effect of eccentricity. The Track Length is the full flat length in contact with ground surface.

However, there are ways of defining more generic rig bearing pressures. For example, the Association Belge des Entrepreneurs de Fondation (ABEF) simply requests a 25MPa pressure resistance [*Appendix 4*] whilst the Austrian Research Association for Roads, Railways and Transport (FSV) has compiled a list of loading details for typical generic geotechnical equipment ranging from piling rigs, to diaphragm walls and from micro-piling to ground anchoring [*Appendix 5*]. The Ontario regulations require an engineering analysis when any piece of equipment exerts a pressure of 200 kPa under its ties, tracks or outriggers.

One thing to be wary of is changes in rig types or rig configurations after the piling or working platform has been installed. This could arise in the event that a rig has to be replaced, perhaps in the case of a plant breakdown, or if the diameter or depth of the foundation changes for some reason. In these cases the new bearing pressure must be checked to ensure that the working platform is still adequate for the new loading. When thinking about rig loading it is also useful to consider the other users of the platform. For example, a fully loaded ready mix concrete truck or tipper truck carrying spoil may well exert a higher bearing pressure than the rigs.

4 / Working Platform Design

In the EU, the design of the platform is a temporary works consideration and hence its co-ordination falls under the requirements of the EU Directive 92/57/EEC 1992; the 'Construction Sites Directive'. In this context, co-ordination means arranging the design and ensuring that the requirements of that design are met on the site. Ordinarily, these obligations fall to the general contractor.

In the US, whilst the design of the platform is not yet covered by a legal framework or standard, the OSHA Construction Standard Subpart R, CFR 1926.752 assigns the responsibility for, "A firm, properly graded, drained area, readily accessible to the work with adequate space for the safe storage of materials and the safe operation of the erector's equipment" to the "controlling entity".

The design of the platform should be carried out by a competent geotechnical engineer and they may use any form of analysis they deem appropriate and there are some established methods ranging from a simple spread footing calculation based on Terzaghi's principles to finite element analyses.

The design brief should be developed as required for any other temporary works design, but in particular the following information should be supplied:

- Plant data sheets (dimensions, configurations, weights etc.);
- Track ground bearing pressures, outrigger or mast foot loads;
- Ground investigation report;
- Plan of the working platform and haul roads;
- Topographical survey;
- Existing services survey (above and below ground);
- Existing structures survey (below ground chambers, retaining walls, etc.);
- Constraints on reduced levels (formation, top of platform);
- Proposed compaction plant / method;
- Period of use (duration);
- Any information on existing shallow mining activities or other potential voids (i.e. chalk or salt dissolution, etc.);
- General construction traffic and their payloads including type of lorries, wagons, etc.
- Any works that may involve excavating through the platform and the planned method of reinstatement.

The most commonly used form of analysis is the Building Research Establishment's (BRE) good practice guide BR 470. [*Appendix 7*]. This guide was published in June 2004 with the principal objective of improving safety by promoting the implementation of minimum design, installation and maintenance standards. In the guide the following limits are suggested:

- for unreinforced platforms the minimum platform thickness should be the lesser of 300mm [1ft] or half the track width; the maximum thickness is 1.5x track width;
- for reinforced platforms the minimum platform thickness should be 300mm [1ft]; the maximum thickness is the track width, and;
- the minimum cover over a geosynthetic reinforcement should be 300mm [1ft].

However, some criticise the guide as being overly conservative and there are concerns about the way in which the effect of geosynthetic reinforcement is evaluated. In these situations the manufacturers of geosynthetic products may be able to offer a cost-effective design, but it is important to identify where responsibility lies for the design, placement and operation of the platform. Indeed, Tensar have developed their own method of calculating the thickness of a platform, the "T Method". Details of this are included in *Appendix 20*, and a link to their app is in the references.

The French federation (SOFFONS) has published a method [*Appendix 6*] and this includes an easy-to-use excel spreadsheet. This document broadly follows the BRE document but with further details regarding the bearing capacity assessment based on pressuremeter tests and cone penetration tests which are more common in France.

4 / Working Platform Design

More recently, the UK's Institution of Civil Engineers (Temporary Works Forum) has been working on an improvement to the methods mentioned above and has issued a Guide to Good Practice TWf2019: 02 [*Appendix 8*]. This would appear to give more economical results than BR470, and suggests some other methods of analysis, which is to be welcomed; a competent designer could adopt its recommendations should they so decide.

Regardless of the method used, someone has to carry out the design of the working platform. In some jurisdictions this is a challenge as the principal geotechnical engineer may be employed by the client, and will be conflicted in some way. Other consultants may be unwilling to take on the design as frankly the task is too small to be commercially worthwhile. Where this is the case, it may fall to the geotechnical specialists to develop this service in-house. This can then be offered to the project, with an appropriate fee.

In some markets where the practice has been common place for a longer time, a market for smaller specialist geotechnical designers has developed and these organisations regularly design platforms, usually for the general contractors. The cost of the working platform is not insignificant and so a competitive design is a distinct advantage.

5 / Installation and Testing

Often the platform is installed by another contractor who is not the geotechnical specialist nor the general contractor. Indeed, the platform is likely to have been laid well before the geotechnical specialist even comes to site. Therefore, knowing whether the platform has been installed in accordance with the design becomes more difficult. Consideration needs to be given to how this assurance can be realised.

FIGURE 4. Plate Load Test Equipment

The UK federation (FPS) has the Working Platform Certificate [*Appendix 9*] which is widely used in the industry. This has a section (Part 2) which is to be signed by the general contractor as a verification that the platform has been installed in accordance with the design. The Dutch federation (NVAF) has a similar document [*Appendix 10*]. Also see the Ontario certificate [*Appendix 15*]. In reality the signing of a piece of paper can only go so far in validating the quality of the entire platform, but this procedure focusses people's minds and makes everyone understand their obligations.

In order to obtain a higher level of assurance, testing could be specified. Presently the most common test is the Plate Load Test shown in *Figure 4*. Whilst this is easy to conduct some caution is necessary as the plate loading test equipment is normally not representative of the loaded area, particularly in the case of rig tracks. It is possible that a test using the normal plate size (300 to 450mm [1 - 1.5ft] diameter), applied to the surface of a working platform, will have little influence on the sub-grade. However, research is currently being carried out on this particular subject which may provide some comfort on this point. The Dutch federation reports using a "penetrologger", which may provide an alternative.

Proofrolling in combination with other appropriate verification techniques (such as the previously mentioned plate load test) could be considered to provide a higher level of assurance. A major cause of rig toppling is a lack of demarcation and the rig is inadvertently tracked to close to, or even off the edge of the platform. It is good practice that the working platform extends at least 2m [6.5ft] beyond the built footprint of the site to ensure sufficient safe working area.

6 / Inspection and Maintenance

Once the platform has been installed, it has to be maintained. Often the piling operation itself will result in the platform deteriorating and the excavation of obstructions and services can lead to soft spots. Several of the rig overturns that have been reported by the members of the EFFC and DFI were caused by a lack of maintenance rather than a poorly designed or constructed platform.

Systems should be in place to ensure that monitoring of the platform takes place regularly and this should involve a visual assessment of the performance of the platform and operating plant. It is a moot point as to who should carry out this inspection, although whoever does carry it out needs to be competent to do so. There are a number of proforma available for this purpose [*Appendix 9*] for example.

Drainage is key. Water and slurry that is allowed to build up on the surface can hide hazards such as recently constructed piles or uneven ground, and a poorly drained platform will deteriorate quickly.

A common cause for instability is where the platform has had to be excavated for some reason and then not reinstated properly. Perhaps an obstruction has had to be removed, or a service relocated. In these situations it is essential that reinstatement is done to the original design standard, including any geosynthetic reinforcement. It is good practice to include a sign off for this work, ideally on the inspection log.

On some sites platforms are now constructed using stabilised materials. These comprise hydraulically bound materials (HBM), including cement bound materials (CBM). It should be noted that HBM materials are likely to have very low permeability and hence drainage design is critical, to ensure that the platform remains suitable for use and does not become waterlogged, potentially creating plant instability and hazards to operatives. A slope or a fall can be constructed into the platform by means of grading during final compaction and large areas may require falls to several intermediate drains to keep the surface free from standing water.

In colder climates winter working needs consideration and in terms of stability particularly during thawing conditions. During prolonged periods below zero degrees the platform is likely to be solid and stable, but may become very soft as temperatures rise. This thawing of the platform is also likely to be uneven, so one track of a machine may be on solid frozen ground, whilst the other is on soft thawed soil. In terms of rig stability this is the arguably the worst case scenario and needs to be designed for.

Whilst this document focusses rightly on rig stability, the platform must also be used by pedestrians. Due consideration should be given to providing a surface that can be easily walked upon without trip hazards (such as protruding reinforcement or wire often associated with demolition waste). Drainage should be adequate to keep the surface free from surface water that would make traversing it by foot dangerous. Holes in the platform should be backfilled and not allowed to fill up with water.

7 / Responsibility

Any working platform scheme is unlikely to be successful if it creates a responsibility that otherwise did not exist. We must use the contractual relationships and the legal frameworks that are already in place to increase the understanding of where the existing obligations of the various parties to a project already lie. This is about seeking clarity on the relationships between the parties and fundamentally making sure individuals know what their obligations are, rather than changing them.

Some observers make the argument that their insurers would be reluctant to support a working platform scheme. General contractors suspect that their liability is increased in some way and designers are concerned about professional indemnity cover. In fact the insurance community is fully supportive of improving working platforms as they collectively see it as a way of preventing loss. As the insurers often re-insure or layer insurance between them, at some point in time they all suffer, so the primary objective is to avoid the loss from occurring in the first place, regardless of who is initially liable. This is discussed in a document by HSB Engineering [*Appendix 11*].

Contractual arrangements should ensure that the platform is properly designed, installed, maintained and, as necessary, repaired throughout its working life. The respective roles of the various parties should be clearly understood and the responsibilities and liabilities of all parties should be defined in the relevant contract. This should start with the tender documents and several federations have useful standard terms and conditions that incorporate working platform requirements. The NVAF's version is appended [*Appendix 12*] as is OSHA clarification [*Appendix 14*].

But, in terms of influencing the debate around which party is responsible for what, it is interesting to consider their relative positions:

The client

Under general health and safety law and in particular the European 'Construction Sites' Directive [*Appendix 1*] the client has certain obligations with regards to safety co-ordination for his project. Moreover, most clients would be very keen to avoid any bad publicity that an over-turned rig could result in, quite apart from any safety concerns. In this regard, larger corporate and governmental clients are the most readily persuaded that they need to make provisions in their contracts for proper working platforms. Some however, will consider that health and safety, particularly for the temporary works is a matter solely for the contractors.

The general contractor

The general contractor is likely to be the "controlling entity" in terms of health and safety and under EU as well as US law this is ordinarily the coordinator for safety and health matters during the project. The European 'Construction Sites' directive requires them to, at the execution stage, *"coordinate implementation of the general principles of prevention and safety…when technical aspects are being decided, in order to plan the various items or stages of work which are to take place simultaneously or in succession". Also the coordinator shall, "coordinate implementation of the relevant provisions in order to ensure that employers apply the principles referred to [selected text below] in a consistent manner:*

(a) *keeping the construction site in good order and in a satisfactory state of cleanliness;*
(b) *choosing the location of workstations bearing in mind how access to these workplaces is obtained, and determining routes or areas for the passage and movement and equipment..;*
(d) *technical maintenance, pre-commissioning checks and regular checks on installations and equipment with a view to correcting any faults which might affect the safety and health of workers;*
(e) *the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are concerned;*
(g) *the storage and disposal or removal of waste and debris…"*

7 / Responsibility

Thus it is clear that the general contractors already have a legal obligation both in the application of the European 'Construction Sites' Directive and also more generally in other health and safety legislation. In the US, there are several ANSI Standards that also set out similar responsibilities. The main concern is that not all general contractors understand this. Hence any platform scheme has to be designed not to impose additional obligations on the parties, but rather to ensure that everyone is clear on what the legal duties already are.

The FPS Working Platform Certificate sets out to do just this [*Appendix 9*]. The first section, Part 1, requests the name of the individual that has carried out a design of the platform. It does not ask for the design, nor even the installation criteria. This is done, so that liability for checking is not inadvertently passed down to other parties to the contract (such as the specialist geotechnical contractor). The act of asking for a name, is poignant as this is not a "tick-box" exercise; few people would write a name on the form unless they were satisfied that they had carried out the design and were competent to do so. This is not imposing any additional liability on the general contractor, no signature is required, it merely confirms that a temporary works design has been done and who completed it.

Part 2 also simply confirms that the general contractor has carried out their coordination role properly. It does not demand that the general contractor has to directly himself design, install, maintain, inspect or repair the platform, all of these duties may and often are subcontracted. But, it is the responsibility of the general contractor, the coordinator, to make sure that someone is fulfilling these roles.

The geotechnical specialist

The geotechnical specialist has a duty to supply the correct loading and to ensure that the loading patterns remain as originally intended. If rig changes are made then it is important that the platform design is reassessed. It is imperative that the right information is passed to the platform designer.

There is also a duty of care of the geotechnical contractor to flag-up any unsafe conditions that are identified either before or during the works. If there is a defect in the platform that is manifest, then the geotechnical specialist cannot simply rely on the platform certificate and assume that everything is fine with the working surface. Typical obligations of the specialist site management might include:

- Daily visual inspection of the working platform;
- Daily maintenance of the platform (housekeeping, ground levelling, keeping the platform as dry as possible;
- Briefing site personnel on the risks related with unsafe working platforms;
- Ensuring exclusion zones are maintained around rigs and cranes and reducing the number of people required to work around these machines;
- Carrying out risk assessments in the case of new rigs arriving on site or the presence of additional machines, and ultimately;
- Stopping the work if the working conditions are unsafe. Everyone on the site should have the authority to stop the work. From analyses of several years' of rig overturns, we have learned that in several cases someone on the site knew that something was wrong, but they continued and took the risk nevertheless.

All of these relationships need to be understood in order to properly embed a working platform scheme in the industry. Getting the responsibilities clear and agreeing which party takes on which role is critical to success. Ignoring the problem and hoping for the best is not the answer.

Nevertheless, some may still be tempted to take shortcuts. It is hoped that by making sure the parties truly understand the risks, then this temptation can be avoided. Regardless, working platforms can represent a significant cost and hence, like any other part of the construction process, need to be engineered with value in mind. Economic designs that are not too conservative will help and so proficient platform designers are in demand. Geotechnical specialists also have their part to play. Compromises between the weight, size and stability of the rig and the installation process are now part of the value judgement, as well as the economy of the foundation solution itself.

8 / Enforcement

To give any scheme "teeth", consideration should be given to enforcement measures. Where platform initiatives have been most successful there are ramifications for not following best practice.

The first level is to decide at a company level what stance is to be taken. In some jurisdictions it may be possible to be insistent that every site has to have a platform certificate before the rig is even erected or rigged up. In other regions this may be more difficult to enforce. For interest, Keller's Group policy is attached in [*Appendix 23 and 24*].

It may be possible to persuade some client bodies to implement a scheme that applies to their sites or across a country. The Austrian Transport Guide [*Appendix 5*] is a good example of this.

Could the national federations do more to enforce a standard working platform approach? In the UK (back in 2004) the members of the FPS resolved that, *"work shall not commence until the Working Platform Certificate, properly completed, is passed to an authorised person representing the Member Company"*. In order to check compliance, the members are visited by an independent auditor that checks that certificates are in place on current sites and may ask to see historical paperwork for completed sites (as part of a wider three year membership audit programme).

Once this more systematic approach to providing working platforms is accepted by the industry, it becomes best practice and arguably this allows it to pass into law. Clearly, this is a powerful level of enforcement and becomes a good argument for the adherence to a scheme. Indeed in the UK there have been several prosecutions of general contractors (and indeed geotechnical specialists) relating to poor standards of working platform provision, where the requirements of the FPS Working Platform Certificate scheme were cited.

9 / Training and Awareness

Finally, to assist all the members of the EFFC, and DFI there is already a plethora of training material that may be used, adapted or copied, such as:

- Site posters to deliver the message to the workforce, as in *Figure 5/6/7*.
- Material for site briefings and tool box talks.
- Driver and Banksman (Operator and Oiler) training.
- Project Manager training
- Webinars on how to use the BRE calculator

As mentioned in the design section there may be some Federations that are willing to support others with designer training.

The Polish federation (PZWFS) produced an excellent video showing the effects of an over turned rig and the importance of a proper working platform. This has been widely shared and a link to the video is included in *Appendix 13*. The German federation has also produced a comprehensive guide "Stopp Maschinen Umstürze", a link to which is found at *Appendix 21*.

FIGURE 6. ADSC Poster Campaign

FIGURE 5. Keller Poster Campaign

FIGURE 7. PFSF Poster Campaign

10 / Summary

The provision of a proper working platform is essential to the safe (and often efficient) execution of geotechnical works. However, as this impacts upon a number of stakeholders in a project it is not always easy to ensure and there are sometimes conflicts of interest, not least led by the cost implications.

However, experience from around the world shows it is possible to influence the main players and bring the construction industry up to standard. In order to move forwards, a number of steps need to be taken, sequentially. Skipping a step will cause inertia and result in conflict later on. These are:

Raise Awareness

- Working with the national federation, identify the magnitude of the problem. If possible obtain statistics as to the number of rig over-turns per year in the market and also case studies. Photographs are always useful.
- Present to audiences comprising general contractors, large clients and governmental bodies.
- Involve unions and enforcement authorities.
- Impress upon those involved that the risk of rigs overturning due to poor working platforms can be mitigated almost entirely with the right scheme and everyone's commitment.

Establish the Rig Loading Parameters

- Evaluate the sources of rig loading. What will be done where the manufacturers' loading details are not available?
- The FPS (UK federation) Spreadsheet method could be adopted, or;
- Consider specifying a range of generic rig loading as promoted in the Austrian FSV guidance, or;
- Alternatively, a blanket loading requirement may be a good starting point, see the ABEF (Belgian federation) requirements.

Design the Working Platform

- Identify the current methods of design and promote a discussion amongst designers as to how to produce economic designs.
- If needed, create a market for a platform design service, supplied by the established consultants or perhaps independent geotechnical professionals;
- Otherwise, it may be necessary to develop internal competence, but this could be income generating.
- Devise a system whereby the "safety co-ordinator" (usually the general contractor) confirms that the design has been done.

Implement Checks on the Platform Installation

- Develop a sign-off sheet to validate that the platform has been installed in accordance with the design.
- Produce guidance that covers the other requirements of the platform, such as it should be free draining, suitable for pedestrians, have maximum slope angles and have demarcation.
- Decide on testing requirements, whether this is necessary and if so what tests should be employed.

Inspect the Working Platform

- Identify who shall inspect the platform and how frequently.
- Establish a means of recording the inspection and how repairs to the platform are managed.

Enforce the Process

- Decide upon your own company's policy.
- Persuade the federation to take a stance and come up with sanctions.
- Persuade general contractors or general contractor organisations to adopt the procedures.
- Encourage enforcement agencies to follow best practice and prosecute those who do not comply.
- Write working platform requirements into local specifications and codes.

Train and Promote

- Train your workforce and set out your expectations.
- Work with the federation to produce industry wide training material.
- Identify specific training needs outside your immediate influence, such as training on platform design methods.
- Copy the existing training material that exists!

11 / Route Forward

This guide is a compilation of current thinking in the our industry, but further work is required. For example, we need to develop other options for testing other than the plate load test, which may lead to academic research. Similarly, we could investigate the actual bearing pressures under the rigs during operation and, on a connected matter, we will need to gauge our response to those modern rigs that give the driver real-time feedback on the rig bearing pressures. It is therefore envisaged that this document will be updated to include these developments.

It is acknowledged that improving the situation is difficult and it takes time and persistence. But the ultimate objective in reducing the number of rigs that topple over is a worthwhile and important one. The steps that are detailed provide a road map but to make them effective still needs will and determination to drive the necessary changes.

However, change is possible and some jurisdictions have managed to implement comprehensive schemes and systems that have had a huge impact in improving the standard of working platforms. To support this statement and to provide some final encouragement, if it were needed, some photographs of good practice are included in [*Appendix 25*].

Section 12

Appendices

12 / Appendices

1. EU Directive 92/57/EEC: the implementation of minimum safety and health requirements at temporary or mobile constructions sites. 1992 amended 2007.
2. US Consensus Deep Foundation Industry Position on Working Platforms for Foundation Construction. 2018. By ADSC/PDCA/DFI.
3. Federation of Piling Specialists (FPS): Calculation of track bearing pressures for Platform Design. Includes excel calculation spreadsheet – https://www.fps.org.uk.
4. Association Belge des Entrepreneurs de Fondation (ABEF): Responsibilities of the client in order to guarantee a stable working platform and a safe working procedure, ABEF doc. 2016-11-22. 2016.
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Appendix 1

►**B**

COUNCIL DIRECTIVE 92/57/EEC

of 24 June 1992

on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

(OJ L 245, 26.8.1992, p. 6)

Amended by:

		Official Journal		
		No	page	date
►**M1**	Directive 2007/30/EC of the European Parliament and of the Council of 20 June 2007	L 165	21	27.6.2007

Corrected by:

►**C1** Corrigendum, OJ L 15, 23.1.1993, p. 34 (92/57/EEC)

►**C2** Corrigendum, OJ L 33, 9.2.1993, p. 18 (92/57/EEC)

Appendix 1

▼B

Article 5 (c) to take account of the progress of the work and any changes which have occurred;

(d) organize cooperation between employers, including successive employers on the same site, coordination of their activities with a view to protecting workers and preventing accidents and occupational health hazards and reciprocal information as provided for in Article 6 (4) of Directive 89/391/EEC, ensuring that self-employed persons are brought into this process where necessary;

(e) coordinate arrangements to check that the working procedures are being implemented correctly;

(f) take the steps necessary to ensure that only ►C1 authorized persons are ◄ allowed onto the construction site.

Article 7

Responsibilities of clients, project supervisors and employers

1. Where a client or project supervisor has appointed a coordinator or coordinators to perform the duties referred to in Articles 5 and 6, this does not relieve the client or project supervisor of his responsibilities in that respect.

2. The implementation of Articles 5 and 6, and of paragraph 1 of this Article shall not affect the principle of employers' responsibility as provided for in Directive 89/391/EEC.

Article 8

Implementation of Article 6 of Directive 89/391/EEC

When the work is being carried out, the principles set out in Article 6 of Directive 89/391/EEC shall be applied, in particular as regards:

(a) keeping the construction site in good order and in a satisfactory state of cleanliness;

(b) choosing the location of workstations bearing in mind how access to these workplaces is obtained, and determining routes or areas for the passage and movement and equiment;

(c) the conditions under which various materials are handled;

(d) technical maintenance, pre-commissioning checks and regular checks on installations and equipment with a view to correcting any faults which might affect the safety and health of workers;

(e) the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are concerned;

(f) the conditions under which the dangerous materials used are removed;

(g) the storage and disposal or removal of waste and debris;

(h) the adaptation, based on progress made with the site, of the actual period to be allocated for the various types of work or work stages;

(i) cooperation between employers and self-employed persons;

(j) interaction with industrial activities at the place within which or in the vicinity of which the construction site is located.

Article 9

Obligations of employers

In order to preserve safety and health on the construction site, under the conditions set out in Article 6 and 7, employers shall:

Appendix 1

▼B

ANNEX IV

MINIMUM SAFETY AND HEALTH REQUIREMENTS FOR CONSTRUCTION SITES

Referred to in Article 9 (a) and Article 10 (1) (a) (i) of the Directive

Preliminary remarks

The obligations laid down in this Annex apply wherever required by the features of the construction site, the activity, the circumstances or a hazard.

For the purposes of this Annex, 'rooms' covers, *inter alia*, hutted accommodation.

PART A

GENERAL MINIMUM REQUIREMENTS FOR ON-SITE WORKPLACES

● 1. *Stability and solidity*

1.1. Materials, equipment and, more generally, any component which, when moving in any way, may affect the safety and health of workers must be stabilized in an appropriate and safe manner.

1.2. Access to any surface involving insufficiently resistant materials is not authorized unless appropriate equipment or means are provided to enable the work to be carried out safely.

2. *Energy distribution installations*

2.1. The installations must be designed, constructed and used so as not to present a fire or explosion hazard; persons must be adequately protected against the risk of electrocution caused by direct or indirect contact.

2.2. The design, construction and choice of equipment and protection devices must take account of the type and power of the energy distributed, external conditions and the competence of persons with access to parts of the installation.

3. *Emergency routes and exits*

3.1. Emergency routes and exits must remain clear and lead as directly as possible to a safe area.

3.2. In the event of danger, it must be possible for workers to evacuate all workstations quickly and as safely as possible.

3.3. The number, distribution and dimensions of emergency routes and exits depend on the use, equipment and dimensions of the site and of the rooms and the maximum number of persons that may be present.

3.4. Specific emergency routes and exits must be indicated by signs in accordance with the national regulations implementing Directive 77/576/EEC ([1]).

Such signs must be sufficiently resistant and be placed at appropriate points.

3.5. Emergency routes and exits, and the traffic routes and doors giving access to them, must be free from obstruction so that they can be used at any time without hindrance.

3.6. Emergency routes and exits requiring illumination must be provided with emergency lighting of adequate intensity in case the lighting fails.

([1]) OJ No L 229, 7.9.1977, p. 12. Last amended by Directive 79/640/EEC (OJ No L 183, 19.7.1979, p. 1).

Appendix 1

Appendix 2

Consensus Deep Foundation Industry Position on Working Platforms for Foundation Construction and Related Equipment in the United States of America and Canada

The ADSC-IAFD, the International Association of Foundation Drilling, is a United States-based industry organization for deep foundation construction subcontractors specializing in drilled shafts, anchored earth retention, and micropiles. PDCA, the Pile Driving Contractors Association, is an international association that exclusively represents the driven pile industry. DFI, Deep Foundations Institute, is an international, multi-disciplined professional organization of individuals and corporations assembled to find common ground and create a consensus voice for continual advancement in the deep foundations industry. Together these associations represent the heart of the foundation construction industry in the U.S. A primary component of the vision of these organizations includes safety and quality being held at their highest value. As such, these associations support the development and adoption of an established policy for the evaluation of working platforms for construction equipment. Furthermore, the responsibility for providing a safe working platform should be acknowledged by controlling entities (general contractors, construction managers, and owners) as being an integral cost for every project. Specialty subcontractors should not be left with the unknown risk and cost of creating safe working platforms without due consideration. The goal is to reduce the risk that proper evaluation and preparation may not occur and consequently corresponding safety risks could increase. To effect widespread implementation of suitable procedures, the ADSC-IAFD, PDCA, and DFI resolve the following:

- That a typical analysis methodology has neither been established nor codified in the United States. At present, the ADSC-IAFD, PDCA, and DFI will support the general guidelines used in United Kingdom, as outlined in "BRE 470 Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms" as the general standard of practice. Assignments of responsibility outlined in the document that are specific to British law and regulatory bodies will not be included in this adoption of practice. We recognize that the design of working platforms and site stability for foundation construction equipment is a geotechnical design process and shall be carried out by competent persons or firms in that civil engineering area of specialization.

- That the mechanism for ensuring safe working platforms as an established policy lies in three areas: recognition of the need for proper analysis and preparation of working platforms by controlling entities and acknowledgement of responsibility for such tasks; common use of appropriate contract language for prime contracts and subcontracts; and for the present, informal enforcement through industry consensus.

- That ongoing enforcement of OSHA standards for cranes (CFR 1926.1401 and 1926.1402 (all parts)) and adherence to existing ANSI Standards (A10.23-2014 for drilled shafts and A1019-2017 for pile installation and extraction) will support and reinforce facilitation of safe working platform evaluation and implementation for all specialty construction equipment.

Appendix 2

- That the ADSC-IAFD, PDCA, and DFI anticipate that the engineering design community will be aware of the importance of working platform safety and will incorporate appropriate data and general recommendations relative to construction-phase subgrade conditions into geotechnical reports and construction plans.

- That the ADSC-IAFD, PDCA, and DFI anticipate that deep foundation contractors and their equipment suppliers will fully and readily present the real working loads, geometries, and operating conditions of their drilling equipment to allow for realistic assessments of working platform safety to be made.

- That the ADSC-IAFD, PDCA, and DFI will support effective adoption of working platform policies through a program of internal education and external communication with appropriate industry groups.

Support of this consensus position by the foundation construction industry is demonstrated and affirmed by the signatures of the Executive Directors and/or Presidents of the above-mentioned associations.

ADSC-IAFD
The International Association of Foundation Drilling

BY: _____

Name/Title: Michael D. Moore, CEO

Dated: 5 May 2018

PDCA
Pile Driving Contractors Association

BY: _____

Name/Title: STEVAN A HALL, EXEC. DIR.

Dated: 11-6-2018

DFI
Deep Foundations Institute

BY: Dan A. Brown

Name/Title: Dan A. Brown, President

Dated: Nov. 8, 2018

Appendix 2

Appendix 3

CALCULATION OF TRACK BEARING PRESSURES FOR PLATFORM DESIGN

This document sets out the basic procedure for calculating the track bearing pressures for a crane or piling rig for use in the working platform design process set out in the BRE Report BR470, Working Platforms for Tracked Plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms.

It should be noted that the track bearing pressures calculated by the appropriate method for use in the BRE design method are commonly much higher than given by a simple calculation of the total rig weight divided by the total track area.

The calculation of the track bearing pressures in an appropriate manner consistent with the BRE design method is a fundamental requirement of its use, and the use of bearing pressures calculated by any other means could potentially lead to an unsafe working platform design.

All of the figures below are general examples. Platform designs must be based on the actual rig loadings supplied by the piling contractor and the FPS can take no responsibility for any use made of the example information shown.

BEARING PRESSURE DESIGN PROCESS

1. Introduction

The calculation of the bearing pressures under the tracks of a piling rig or crane requires a number of stages.

The first stage is to calculate the theoretical bearing pressure. Using the weights of the various components, for example the undercarriage, main body, counterweight, mast etc. and the eccentricity of the component from the centre of rotation, the overturning moment can be calculated. This needs to be done for the range of operations that will be carried out, e.g. standing, travelling, handling, penetrating, extracting, with all possible jib or mast orientations considered.

Then, by applying the calculated overturning moments to the section provided by the track geometry, the theoretical bearing pressures can be calculated.

This process has to be carried out for all types of envisaged operations and orientations of the rig or crane mast relative to the direction of the tracks.

2. Calculation of theoretical bearing pressures

The factors that need to be considered are broadly:

a) Weight and dimensions of rig / crane components, e.g. mast assembly, base machine
b) Moment arm to centre line of rotation
c) Forces due to line pull, crowd forces
d) Use of stabilising mast foot or outriggers, if any

For convenience, the information required and the basic calculation of the moments generated by the various rig components or forces involved, can be set out as in the following example.

Schedule of Rig Components				
Rig Manufacturer: Digger Cranes		**Rig Type:** DC 007		
		Operation Mode: CFA		
Completed by: ABC		01/01/05	**Checked by:** DEF	
MAIN COMPONENTS				
ITEM		**Weight (kg)**	**Moment Arm(m)**	**Moment (kN.m)**
UPPER WORKS	Mast assembly	5,600	2.74	150
LOWER WORKS	Base machine	21,700	-0.55	-117
SUSPENDED	Auger	5,000	3.41	167
EQUIPMENT	Rotary head	2,150	3.41	72
COUNTERWEIGHT	Counterweight	4,000	-2.45	-96

Information is also required to define the geometry of the tracks and any bearing pads that can be lowered to improve stability.

Track ground bearing length (m)	3.814		
Track pad width (m)	0.700		
Distance between centrelines of tracks	3.300		
Front foot pad bearing area (sqm)	1.500	Dimensions:	1.2m x 1.25m
Front foot pad maximum load (kN)	450	Shape	Rectangular
Front foot pad moment arm (m)	2.74	Moment (kNm)	1,233
Rear foot pad bearing area (sqm)	0	Dimensions:	None
Rear foot pad maximum load (kN)	0	Shape	None
Rear foot pad moment arm (m)	0	Moment (kNm)	

Finally, the forces or loading that may be applied to the rig or crane need to be defined, reflecting a range of operating conditions to be considered.

Load	Force (kN)	Moment Arm(m)	Moment (kN.m)
Maximum extraction force	392	4.000	1,568
Maximum Line pull	10	4.000	40
Maximum penetration force	29	4.000	116
Maximum auxiliary force	10	4.000	40

These factors need to be considered for the various modes of operation, e.g. travelling, lifting, drilling, extracting casing etc. The BRE process considers the various loading conditions under two class headings.

CASE 1 LOADING
These loading conditions may apply when the rig or crane operator is unlikely to be able to aid recovery from an imminent platform failure.

Operations in which this type of loading condition applies could include:

- Standing
- Travelling
- Handling (in crane mode, e.g. lifting a precast concrete pile into the leader, handling casings and reinforcement cages)

Appendix 3

CASE 2 LOADING
These loading conditions may apply when the rig or crane operator can control the load safely, for example by releasing the line load, or by reducing power, to aid recovery from an imminent platform failure.

Operations in which this type of loading condition applies could include:

- Installing casing
- Drilling
- Extracting an auger
- Extracting casing
- Rig travelling or slewing with a fixed mast which has a foot or fixed load (e.g. pile held in the leader) close to the platform surface.

Also, as the rig / crane may be able to operate with the direction of its mast ranging between parallel and perpendicular to the axis of the tracks, all possible orientations must be considered.

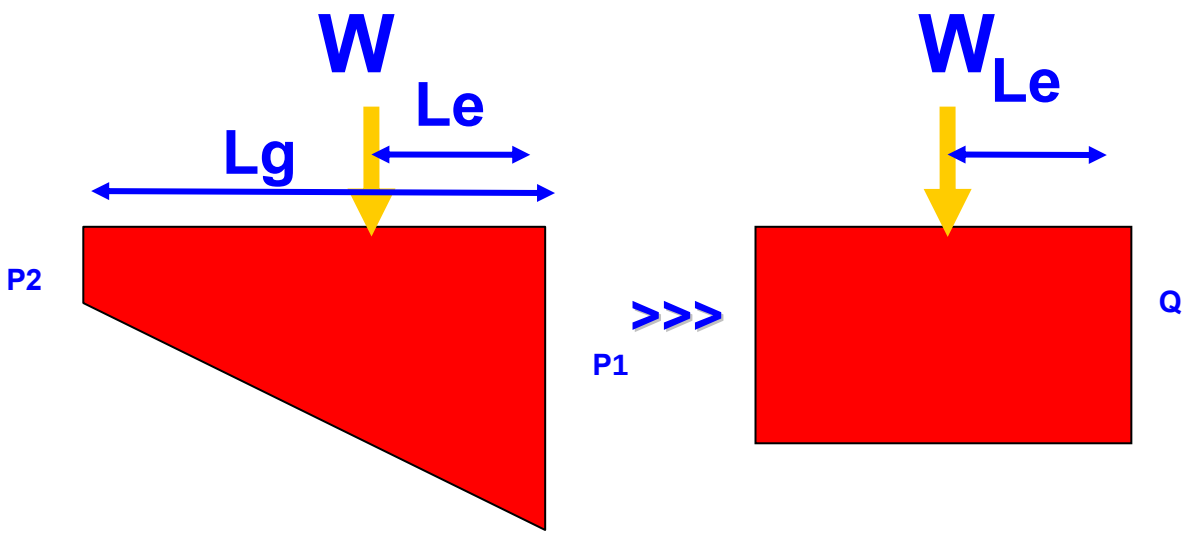
The process of calculating the theoretical pressure under the tracks should follow the basic principles set out in EN 791:1996 Drill rigs – safety and EN 996:1996 Piling equipment – safety requirements. The net moment due to the various weights and forces involved is applied to the area of the tracks in order to calculate the maximum and minimum pressures on each of the tracks.

These pressure distributions may be either rectangular, triangular or trapezoidal, and not necessarily the same pressure will be present under each track.

It may be found that for some loading conditions, the loaded length for each track may be smaller than the full track length that could be in contact with the ground.

3. Calculation of design bearing pressures

The calculated non-uniform theoretical loading can be transformed into equivalent uniform loading using the method described by Meyerhof (1953).



Total track load W = (P1 + P2).Lg/2

Eccentricity of load centroid Le = Lg.(P1 + 2.P2)/(3.(P1 + P2))

Equivalent uniform bearing pressure for use in design Q = W/(2.Le)

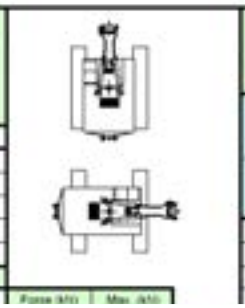
Equivalent track bearing length for use in design L = 2.Le

Appendix 3

4. Example Calculation

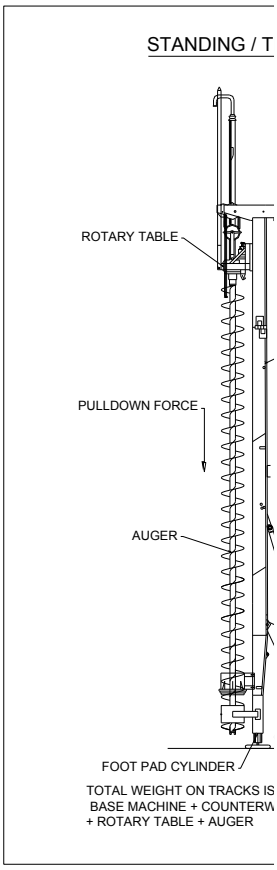
The following example shows how a design process may be set out, to calculate how the applied loading produces a range of equivalent bearing lengths and pressures, for use in the BRE design method. This process needs to be carried out for each activity envisaged, and the critical combinations found to give the required minimum platform thickness.

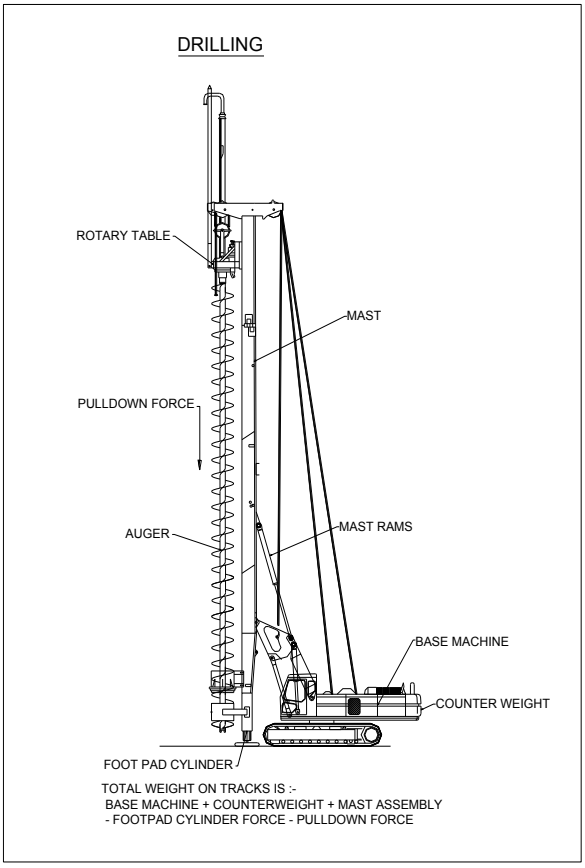
Digger Cranes DC 007	Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)
Lower Works	21700	-0.550	-117
Counterweight	4000	-2.450	-98
Upper Works	8400	2.740	151
Other	0	0.000	0
Pipe / Kelly / Chain Suspended	7150	3.410	239
Machine Weight (kg)	30450	0.460	170



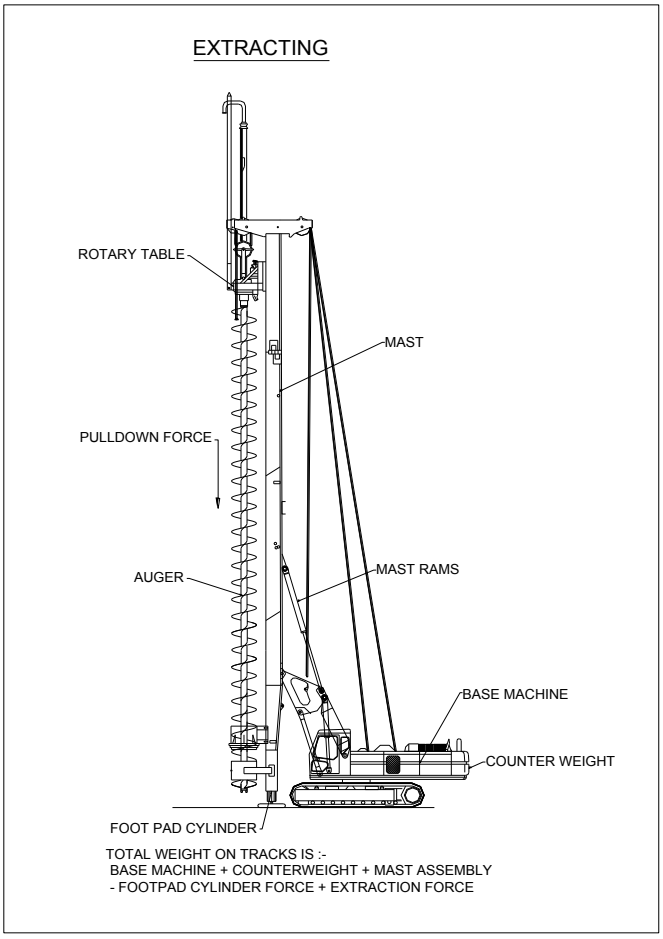
Mode : CFA Extracting								
Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L in track (kN/m^2)	Bearing pressure at rear of L in track (kN/m^2)	Bearing pressure at front of R in track (kN/m^2)	Bearing pressure at rear of R in track (kN/m^2)	Max Track loading dimensions: ecc (m)	Max Track loading dimensions: Bearing Len. (m)	Equivalent Bearing: L (m)	Equivalent Bearing: Q (kPa)
0	240	0	240	0	1.121	2.359	1.573	189
15	189	0	269	0	1.082	2.474	1.649	202
30	133	0	270	0	0.970	2.810	1.873	202
45	88	0	250	0	0.792	3.344	2.229	189

Transformation from triangular or trapezoidal to an equivalent rectangular pressure distribution under track maintaining the load centroid





Appendix 3



This guidance has been produced by the Federation of Piling Specialists It is not intended to be used as a design method. Platforms should be designed according to the actual rig loadings supplied by the piling contractor. If expert assistance is required, the services of a competent professional should be sought. Although every effort has been made to check the accuracy and validity of the above guidance, neither the authors nor the Federation of Piling Specialists accept any responsibility for mis-statements contained herein or misunderstandings arising herefrom.

September 2005
www.fps.org.uk

Appendix 3

Appendix 4

Responsibilities of the client in order to guarantee a stable working platform and a safe working procedure

Stability of the working platform (safety of machinery)

Considering the size, weight and height of our rigs and the possible presence of bentonite installations, the working platforms should be sufficiently stable.

This means that:

- the bearing capacity of the working platform should be sufficient to ensure the stability of our rigs, also after bad weather conditions (rain, etc.). Therefore, the working platform shall meet the requirement of **25 MPa** pressure resistance resulting from measurements by means of a plate load test. If it appears to be impossible to stabilise the working platform, even when constructed with geotextile and a (50 cm) rubble layer, additional measures may be considered to work on crane mats; on the condition that it has been discussed at a commercial level. There shall be sufficient crane mats, connected to each other and perpendicular to the driving direction.
- before our arrival, the nature of the working platform should be checked for the possible presence of cavities (e.g. cellars). If such cavities exist, they shall be filled correctly in order to - as mentioned in the preceding point- guarantee the required stability (25 MPa).
- any existing foundations or other obstacles shall be removed from the site prior to arrival, except if such removal work forms an integral part of the contractor's scope of works.
- Inclinations of possible slopes shall always be subject to preliminary discussions and shall be approved by the contractor. This is also the case for the minimum distance between the foundations to be carried out and the top of the slopes.

	Compliant with **chapters 2 & 3** of the general conditions of ABEF concerning **"The installation and maintenance of a dry, flat and stable working platform"**	

Presence of underground cables

Depending on the agreements with the client/general contractor, the CICC/KLIM-request has to be done. (CICC/KLIM is the Belgian federal cable and pipeline information database).

Accessibility of working platforms (personal safety)

- **+/- 50%** ot the total number of **accidents at work** within the piling sector are due to tripping or slipping on the ground, or working platform.
- As a preventive measure it is of utmost importance that the working platform:
  - Consists of an upper layer of fine grained aggregate → prevention of ankle sprains
  - is free from protruding rods → prevention of tripping and falling
  - contains no water or mud → prevention of slipping and falling
  - is free from any form of pollution (e.g. asbestos) → prevention of health risks
  - has sufficient storage space → prevention of lifting and manipulation incidents
  - is maintained and repaired. This includes repairs after poor weather conditions, changes in the execution phases and/or adapted installation of the construction site.
- Pedestrian access ways to and from the work side shall be free of obstacles and separated from the traffic on the work site.
- During the winter, sufficient lighting shall be provided.

Appendix 4

- An evaluation of the working platform by the contractor is necessary prior to the supply of material in order to discuss any modifications.
- The common final goal remains the qualitative completion of our projects without any incident, accident or injury.

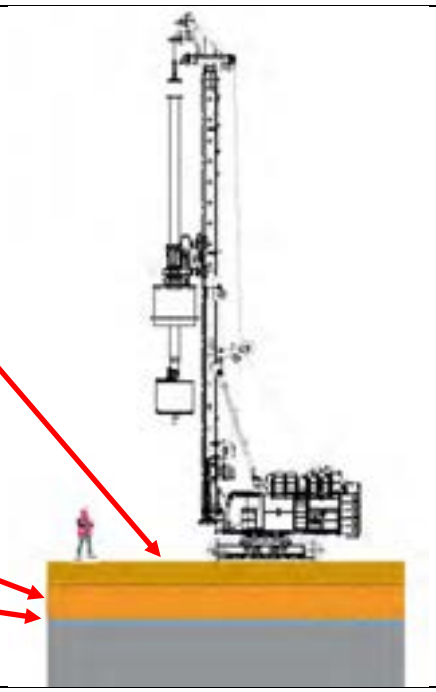
HAZARDOUS SITUATIONS

Stability → insufficient accessibility → high risk

GOOD EXAMPLES

Top layer of fine calibre gravel

Layer of crushed stone



WORKING ON CRANE MATS

Risk of injuring feet and ankles

Appendix 5

PLATFORMS FOR GEOTECHNICAL WORKS RVS 08.21.02

Edition 1. August 2018

Technical Contract Conditions
Special Foundations
Platforms for Geotechnical Works

Table of Contents

0 Foreword

Products from any EFTA-state, which is a contracting party of the EEA-agreement, as well as products, which were lawfully put into circulation in another member state of the European Union or Turkey, are mutually recognised taking into account the required levels of protection (see ABl. C 265). The RVS 01.01.11 applies.

AG: Brückenbau
AA: Leistungsbeschreibung Brückenbauten
Ausgabe 1. August 2018
Die Verbindlicherklärung dieser RVS erfolgt mittels Erlass durch das BMVIT.
Details können der Homepage der FSV www.fsv.at entnommen werden.

Appendix 5

1 Scope

This RVS is to be used for the design, construction and maintenance of platforms and the herefore necessary measures for the following geotechnical works (specialist foundation construction):

- well building water supply
- sheet pile
- soldier pile walls
- bored piles
- displacement pile
- diaphragm walls
- jet grouting
- deep compaction (deep vibration compaction / vibro-replacement compaction)
- vertical drains
- deep soil stabilization
- thin cut-off wall
- water management
- tension (micro) piles and nails
- prestressed anchor
- bored drainage
- geotechnical grouting
- micro-piles
- shallow geothermal energy

This RVS is not valid for special platforms e.g. raised platforms for anchors.

2 Terminology and Definitions

Platforms

Direct contact area with sufficient ground bearing capacity for the machines, which are to be used for any performed geotechnical construction works (specialist foundation construction) according to section 1.

Access Routes

Connecting routes to and between construction site access and individual platforms.

3 Design

The design of the platforms must be carried out, at the latest, prior to the commencement of geotechnical works (Specialist foundation engineering, trade according to LB-VI).

3.1 Design basis

3.1.1 Foundation ground

Appendix 5

As a basis for the design of geotechnical works (Specialist foundation engineering, trade according to LB-VI) the client must perform a subsoil exploration according to ÖNORM B 1997-2 and the relevant execution standards.

3.1.2 Machine Specifications

Depending on the geotechnical works (Specialist foundation engineering, trade according to LB-VI) which must be performed, the required standard machinery according to the Annex must be determined. The hereby resulting soil pressure must be considered during platform design.

The space required for the machines used in execution of geotechnical works must be taken into consideration.

3.2 Required specifications by the designer

The design must provide the following specifications, which are necessary for the construction of platforms.

For the chosen technology, and resulting loads of its standard machinery, the platform must exhibit sufficient bearing capacity (proof of overall stability according to ÖNORM B 1997-1-5) as well as serviceability (settlement and differential settlement according to ÖNORM B 443-1).

The corresponding access routes for the individual trades within the construction site must also be considered.

3.2.1 Soil improvement measures

If the founding soil does not provide sufficient bearing capacity or serviceability for the loads incurring from the planned machine types, soil improvement measures are necessary.

For soil improvement, the following methods may be considered:

- Soil compaction
- Mechanical soil improvement
- Soil replacement
- Installation of geotextiles
- Soil improvement with binders – lime stabilization
- Solidification with hydraulic binders

The type and thickness of soil improvement must be specified during the design process in such way that the load capacity and water resistance are guaranteed.

Detailed specifications herefore may be found in RVS 08.03.01, section 5.10.

3.2.2 Earth removal works

During the design process the embankment slope inclination and, if necessary, embankment slope stabilization procedures required for the removal process during the working platform construction must be specified.

Furthermore, the expected soil classes according to ÖNORM B 2205 must be given.

3.2.3 Earth fill works

For the required earth works on the unimproved and improved soil, the design phase shall specify the filling material to be used and the construction and compaction specifications.

Appendix 5

3.2.3.1 Material requirements

The materials should be chosen in such manner that the bearing capacity and serviceability of the earth fill can be guaranteed for the specified machine type.

For the earth fill material, as a minimum, the soil classification according to ÖNORM B4400-1 should be provided. If the stability analysis results in special requirements for shear strength, the minimal, required shear parameters (friction angle and cohesion) must be provided.

3.2.3.2 Construction and compaction requirements

The required compaction values result from the load capacity and serviceability verifications. For the construction of the earth fill the designer should specify, as a minimum, the maximum layer thickness and minimum requirements for compaction (E_{Vd}, E_{V1}).

3.2.3.3 Geotextiles

When using geotextiles, it should be taken into account that penetration difficulties may occur.

This should be considered when selecting the geotextile types to be used or e.g. the boring points should be left out from the geotextile spread.

3.2.4 Working platform, top layer

During the design phase the specifications for drainage and compaction requirements must be established.

3.2.4.1 Material requirements

For the top layer of laid working platform material, soils with soil classification Gr,W; Gr,G; si´ Gr; cl´, Gr or quarry rocks according to ÖNORM B 4400-1 are permitted.

For working platforms in existing soils with soil classification Gr,W; Gr,G; si´ Gr; cl´, Gr or quarry rocks are also permitted, otherwise soil improvement measures according to section 3.2.1. must be stipulated.

The maximum aggregate size should be in accordance with the planned construction project.

To prevent the softening induced by the execution of geotechnical works as well as to reduce the ingress of precipitation into the working platforms surface (and hereby minimise the maintenance work) water-sensitive materials are not permitted.

This is valid for earth fill as well as earth removal works.

3.2.4.2 Compaction requirements

The required compaction values result from bearing capacity and serviceability verifications. The dynamic/static deformation modulus of the dynamic/static plate loading test (see RVS 08.03.04 or ÖNORM B 4417) must be specified.

Since the direct base area is subjected to the highest loading from the selected machines, the compaction requirements must be established by the planner.

3.2.4.3 Diversion of precipitation water

Water accumulation on the working platform should be avoided, to prevent softening.

Furthermore, sufficient drainage must be guaranteed.

If necessary, drainage ditches or drains must be constructed and connected to the sump pits constructed in or next to the working platform and the incidental water must be continually pumped out.

Appendix 5

3.2.5 Installations and installation protection

Underground installations (active or decommissioned) and/or known engineering structures (cellar, cavities, etc.) and the hereby required securing measures must be considered during the design of the working platforms.

4 Execution

The working platforms must be constructed according to the design established by the planner.

In addition, the specifications given in ÖNORM B 2205 and RVS 08.05.01 comply correspondingly.

5 Testing for the construction of individuals platforms

The RVS 08.03.01, section 6 applies except for the subsequently specified scope of testing.

5.1 Suitability Testing

Before construction commences suitability testing of the complete earth fill material must be performed. This is also the case for already existing material within the working platform, if no further earth fill works are planned.

5.2 Conformity Testing

Conformity testing such as compaction tests must be performed by an expert chosen by the contractor. The testing should be performed using dynamic/static plate loading tests, whereby at least one test every 1,500 m^2 and at least four tests in total should be performed. This applies for each working platform and layer. The test results must be documented and handed over to the client prior to Acceptance Testing. The same applies, when no layers are intended.

5.3 Acceptance Testing

Promptly before beginning the geotechnical construction works, the client must initiate an Acceptance Testing program, that must be carried out by an accredited or recognized testing laboratory.

The contractor must be given prior notice of the testing in a timely manner. The testing should be performed using dynamic/static plate loading tests, whereby at least one test every 1,500 m^2 and at least four tests in total should be performed per working platform.

6 Maintenance during construction activity

The working platform should be maintained during the construction activity in such manner, that the load bearing capacity and suitability are continuously ensured. If required, the corresponding repairs should be performed.

The user of the working platform must visually inspect the load bearing capacity of the surface on a daily basis and take note of this in the daily report. If any doubts regarding load bearing capacity arise, additional dynamic or static plate loading tests must be performed.

The test results as well as the repairs undertaken must also be documented and taken note of in the daily report. A photographic record is recommended.

7 Referenced guidelines and standards

LB-VI	Standardized traffic infrastructure specifications of works
RVS 01.01.11	General, Basics, Regulations, Regulations for the EEA and Turkey
RVS 08.03.01	Technical Contract Conditions, Earth-Removal and Earth-Moving Works, Earth-Moving Works
RVS 08.03.04	Technical Contract Conditions, Earth-Removal and Earth-Moving Works, Compaction Proof with Dynamic Plate Loading Test
RVS 08.05.01	Technical Contract Conditions, Foundation Works, Piles, Micro-Piles and Diaphragm Walls
ÖNORM B 1997-1-5	Geotechnical design - Part 1-5: Overall stability of embankments, slopes and steps of terrain
ÖNORM B 1997-2	Geotechnical design - Part 2: Ground investigation and testing (consolidated version)
ÖNORM B 2205	Earthworks - Works contract
ÖNORM B 4400-1	Geotechnics - Part 1: Identification, description and classification of soil
ÖNORM B 4417	Geotechnics - Soil investigation - Plate loading test (Static load plate test)
ÖNORM B 4431-1	Geotechnical engineering (foundation engineering); permissible soil pressures; analysis of settlements of shallow foundations

8 Annex: Load details for standard machines for geotechnical construction (specialist foundation engineering)

LG	ULG	Item	Name	LOAD [1] [kN]	accountable surface foundation [2]	
					width [m]	length [m]
13			**WELL BUILDING WATER SUPPLY**	1600	1	5,3
19			**PIT EXCAVATION AND EXCAVATION SUPPORT**			
	19.21		sheetpile	850	0,7	4,2
	19.24		soldier pile wall	1100	0,8	4,7
20			**SPECIALIST FOUNDATION ENGINEERING**			
	20.01		**BORED PILE**			
		20.01.20	**cased cast-in-place pile**			
			up to DM 60	700	0,6	3,8
			DM 88	1100	0,8	4,7
			DM 118	1600	1	5,3
			DM 150	1750	1	5,3
			greater DM150	1950	1	5,5
		20.01.21	**uncased cast-in-place pile**			
			up to DM 60	700	0,6	3,8
			DM 88	1100	0,8	4,7
			DM 118	1600	1	5,3
			DM 150	1750	1	5,3
			greater DM150	1950	1	5,5
		20.01.22	**continuous flight auger pile[4]**			
			DM 62	1400	0,7	4,6
			DM 90	1800	0,8	4,6
			DM 120	2250	1	5,3
		20.01.24	**slurry supported piles**			
			DM 88	1100	0,8	4,7
			DM 118	1600	1	5,3
			DM 150	1750	1	5,3
			greater DM150	1950	1	5,5
	20.03		**Diaphragm wall /**			
		20.0314 A-H	Trench construction up to 40/50cm	800	0,7	4,612
		20.0314 I-P	Trench construction 60/80cm	1050	0,7	4,947
		20.0314 Q-T	Trench construction 100cm	1400	0,8	5,36
		20.0314 U-X	Trench construction >100cm	1800	1	5,4
	20.05		jet grouting	550	0,6	3,8
	20.06		deep compaction – deep vibration compaction [4]	650	0,65	3,7
	20.07		deep compaction – vibro-replacement compaction [4]	650	0,65	3,7
	20.08		vertical drains	550	0,6	3,8
	20.09		deep soil stabilization	1250	0,7	4,4

Appendix 5

Appendix 5

LG	ULG	Item	Name	LOAD [1] [kN]	accountable surface foundation	
					width [m]	length [m]
	20.10		**thin cut-off wall** [4]			
		20.10.15A+16A+17A	thin cut-off wall depth level 0-10 m [4]	850	0,7	4,2
		20.10.15B+16B+17B	thin cut-off wall depth level 0-20 m [4]	1100	0,7	4,4
		20.10.15C+16C+17C	thin cut-off wall depth level 0-30 m [4]	2600	1	6
	20.12		MICRO-PILES	550	0,6	3,8
	20.20–20.27		DISPLACEMENT PILES OF „X“	1800	0,8	4,6
21			**WATER MANAGEMENT AND WATER DIVERSION**			
	21.03		Dewatering with drilled wells	1600	1	5,3
	21.04		dewatering with ejectors lances	**Truck: E_{Vd} 38 MN/m², E_{v1} 35 MN/m²** [5]		
22			**ANCHOR WORKS AND INJECTION WORKS**			
	22.01		tension (micro) piles and soil nails	550	0,6	3,8
	22.02		prestressed anchor	550	0,6	3,8
	22.03		bored drainage	550	0,6	3,8
	22.05		geotechnical grouting	550	0,6	3,8
23			**SHALLOW GEOTHERMAL ENERGY**			
	23.01		deep sounding	**Truck: E_{Vd} 38 MN/m², E_{v1} 35 MN/m²** [2, 5]		
	23.03		building components in contact with soil	**Truck: E_{Vd} 38 MN/m², E_{v1} 35 MN/m²** [2, 5]		
	23.04		special forms	**Truck: E_{Vd} 38 MN/m², E_{v1} 35 MN/m²** [2, 5]		

COMMETNS // NOTES regarding the load table:

[1] The column „LOAD“ is the sum of: TARE WEIGHT, the weight of the TOOLS and the max. possible TENSILE FORCE.
[2] The column „accountable surface / foundation pressure“ is the surface of a SINGLE CRAWLER or ONE TRUCK-side!
[3] For the calculation of the working platforms 2/3 of the „accountable surface / foundation pressure“ must be used.
[4] In Procedure exceptions (*no machine change is possible after work commencment!*) half of the „accountable surface / foundation pressure“ must be used for the calculation of the working platforms.
[5] In the case of registered trucks an E_{vd}-value of 38 MN/m² or an E_{v1}-calue of 35 MN/m² may be considered sufficient. By compliance with these values the separate groundbreak- and settlement calculation may be dropped.

Appendix 5

Developed in Task Group „Bridge Construction“,
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Appendix 5

Appendix 6

ACCOTEC

BUREAU
D'INGENIERIE D'ÉTUDES ET DE CONSEILS

Mécanique des sols, Hydrogéologie
Environnement et Pollution
Adaptation aux sites
Géotechnique

SOFFONS

LES PLATES-FORMES DE TRAVAIL EN MATERIAUX GRANULAIRES POUR ENGINS SUR CHENILLES

1ère ébauche d'une règle professionnelle

COMITÉ DE RÉDACTION :

B.E. ACCOTEC : Monsieur JUILLIÉ
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SOLÉTANCHE BACHY : Monsieur MONLEAU
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SEPTEMBRE 2009

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UIG

VOLET GEOTECHNIQUE

Table des matières

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I - GENERALITES

I.1 - Définition

La plate-forme de travail (y compris les pistes d'accès) est constituée par une couche de renforcement (*) ou par le terrain naturel, capable de supporter le trafic et le travail des engins lourds de façon pérenne et sécurisée pendant la durée du contrat de l'entreprise utilisatrice.

(*) le terme "couche de renforcement" a été choisi pour ne pas la confondre avec la "couche de forme" qui supporte des ouvrages et qui est soumise à des critères de dimensionnement plus stricts.

I.2 - Préambule

Le présent document doit permettre dans un premier temps d'améliorer la sécurité sur les chantiers et permettre un travail dans de bonnes conditions. Il reste à ce stade un document pratique qui se veut simple d'utilisation.

Il devra probablement à terme être complété pour devenir normatif et opposable à tous les intervenants, utilisateurs de la plate-forme, maître d'œuvre concepteur de la plate-forme et entreprise chargée de l'entretien. Il devra également, à terme, être visé par un contrôleur S.P.S. et partie intégrante du P.G.C.. Il devra également être visé par le géotechnicien concepteur et le contrôleur technique.

I.3 - Objectifs

Les objectifs de ces règles sont d'assurer la sécurité de tous les engins lourds sur chenilles en condition de travail extrême ou de déplacement sur une plate-forme. Sa conception doit donc être assurée par une série d'investigations, de calculs et de contrôles qui sont exposés dans ce document. La démarche qui y est exposée doit donc être suivie dans tous ces aspects.

I.4 - Séquence des tâches nécessaires à la validation de plate-forme de travail

Les différentes étapes à franchir pour aboutir à la validation finale de la plate-forme de travail par tous les intervenants sont exposées au paragraphe III. Ces étapes sont imbriquées dans toutes les phases de la conception du projet, depuis l'avant-projet jusqu'à la réception.

Les prestations d'études et de construction de la plate-forme de travail devront donc être intégrées par le maître d'œuvre dans le C.C.T.P. et le descriptif des travaux.

I.5 - Définition des cas à étudier

Chaque entreprise utilisatrice doit pouvoir intervenir sur la conception de la plate-forme de travail au regard des engins qu'elle utilise. Seuls les cas de charge les plus contraignants devront être retenus. La version SOFFONS concerne les engins sur chenilles de 200 à 2 000 kN exerçant une pression au sol variant de 100 à 1 000 kPa.

N.B. : Les engins sur chenilles utilisés par les entreprises du SOFFONS sont parmi les plus lourds de ceux intervenants sur le chantier. On peut donc admettre que cette plate-forme de travail pourra servir ultérieurement à d'autres engins et donc être soumise à d'autres critères.

II - INTERVENANTS ET ROLE DANS L'ELABORATION DE LA PLATE-FORME DE TRAVAIL

A chaque intervenant incombe une responsabilité dans l'élaboration de la plate-forme de travail.

II.1 - Le maître d'ouvrage

Il a la responsabilité du terrain à construire, des aléas et risques afférents. Il est généralement le commanditaire de la première étude géotechnique, de l'étude d'avant-projet (G12) nécessaire (mais généralement pas suffisante) à l'élaboration du projet et des prescriptions constructives. Cette étude doit permettre d'établir des préconisations préliminaires sur les ouvrages provisoires tels que la plate-forme de travail (P.F.T.). L'étude géotechnique de projet (mission G2) est également normalement à la charge du maître d'ouvrage et inclue dans les prestations du maître d'œuvre ou du contractant général.

II.2 - Le bureau d'études géotechniques

Il peut intervenir à la demande du maître d'ouvrage directement, et dans ce cas, devra obtenir un maximum de renseignements sur le projet et anticiper les différentes phases de travaux pouvant nécessiter des ouvrages spécifiques (telle qu'une plate-forme de travail).

L'étude d'avant projet (mission G12) doit collecter suffisamment de données géotechniques pour permettre un prédimensionnement de la plate-forme de travail qui se fera dans le cadre d'une étude géotechnique de projet (mission G2). Cette étude donne les grandes lignes des prescriptions constructives. Elle est utilisée ultérieurement dans la phase de diagnostic géotechnique (mission G5 voir paragraphe IV) par l'entreprise constructeur de la plate-forme qui doit décider si l'étude est suffisante ou non.

II.3 - Le maître d'œuvre de conception

C'est à lui qu'incombe la préparation de la liste exhaustive de tous travaux, ouvrages provisoires et études nécessaires à la construction. A ce titre, il doit prévoir les plates-formes de travail en fonction du type de travaux et d'engins utilisés. Il fera procéder à l'étude géotechnique de projet (mission G2) en tenant compte des éléments de l'étude d'avant-projet. Il devra vérifier en accord avec le géotechnicien et les entreprises utilisatrices :

- l'étendue des plates-formes de travail par rapport au projet de construction,
- la fréquence et la profondeur des essais géotechniques,
- la nature des matériaux constitutifs des futures plates-formes,
- les caractéristiques des engins utilisés.

Il devra faire compléter les études pour permettre une conception de la plate-forme de travail conforme aux règles de l'art.

N.B. : pour des chantiers de taille importante exécutés en conception réalisation, c'est l'entreprise spécialiste qui doit concevoir et réaliser sa propre plate-forme de travail.

II.4 - L'entreprise constructeur de la plate-forme de travail

Deux cas peuvent se présenter :

- la plate-forme de travail est à la charge du donneur d'ordre et elle est intégrée dans le lot particulier (travaux préparatoires, terrassement…) et construite selon les directives du C.C.T.P.. En principe, l'entreprise n'a de responsabilité que l'objectif de résultats en terme de :
    - qualité des matériaux mis en œuvre,
    - épaisseur de la couche de renforcement,
    - compacité et portance.
- la plate-forme de travail est à la charge de l'entreprise utilisatrice. Dans ce cas, elle doit en assurer la conception et la bonne exécution ou la sous-traiter selon un cahier des charges précis.

Elle doit s'assurer de la qualité de la plate-forme de travail, la faire valider le cas échéant par le géotechnicien, le bureau de contrôle, le contrôleur S.P.S..

II.5 - L'entreprise utilisatrice de la plate-forme de travail

Il lui incombe de réceptionner la plate-forme de travail (P.F.T.). Elle assiste donc aux essais de réception réalisés contradictoirement.

II.6 - Autres intervenants

D'autres intervenants sont possibles pour les phases de diagnostic et de conception, tels que le B.E. V.R.D., services des carrières, des mines, services techniques de Mairie, concessionnaires divers, etc.... Ils seront consultés au stade de l'avant projet par le maître d'ouvrage ou le maître d'œuvre.

N.B. : La sous-traitance d'une mission complète à un B.E. géotechnique ou pluridisciplinaire est "un plus" pour assurer une cohérence au projet et permet de ne pas diluer les responsabilités.

III - ETAPES POUR LA CONCEPTION, LA CONSTRUCTION ET L'ENTRETIEN DE LA PLATE-FORME DE TRAVAIL

La séquence logique de conception de la plate-forme de travail est présentée sous forme d'un organigramme de tâches page suivante.

III.1 - Diagnostic géotechnique

Cette mission, classée G5 dans la norme NF P 94-500 révisée en décembre 2006, permet d'évaluer les aléas et risques associés aux contextes géotechniques et préciser les paramètres de portance caractérisant le sol support (c_u, ø, p_{LM}, q_c, q_d, etc....).
Si les paramètres sont insuffisants en nombre ou qualité, elle devra être complétée par une étude spécifique (étude de projet – mission G2). Elle est détaillée dans le paragraphe IV.

III.2 - Evaluation préliminaire

Cette phase permet de valider la séquence logique de conception avec trois cas :

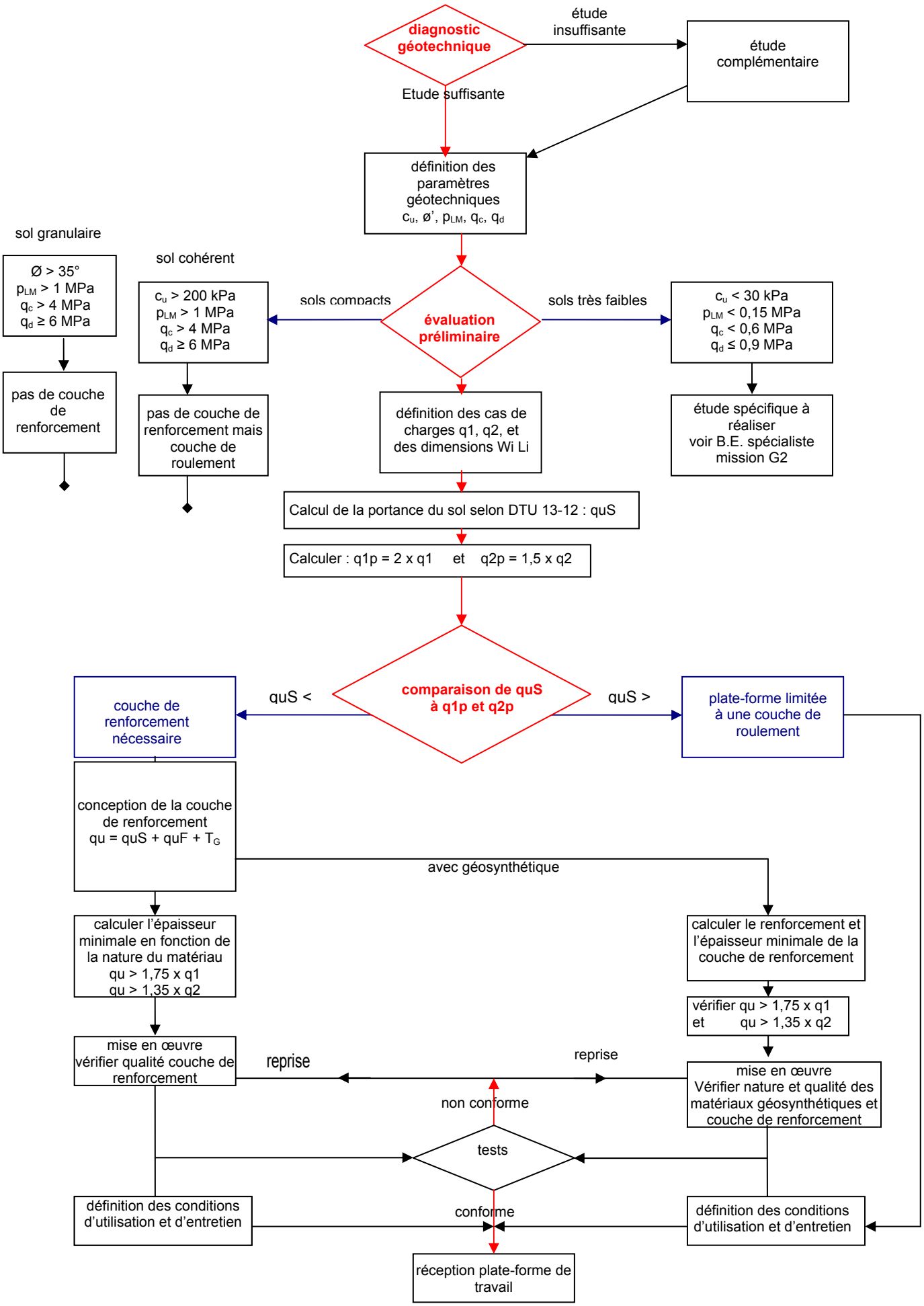
1) sol support très faible :
   - nécessité d'une étude spécifique, arrêt de la séquence logique de conception,
2) sol support faible à moyen :
   - poursuite de la séquence logique,
3) sol support bon :
   - pas de nécessité de mettre en place une couche de renforcement. Par contre, une couche de roulement peut être nécessaire pour des plates-formes en matériau argileux, limoneux ou marneux sensibles à l'eau, avec intercalation d'un géosynthétique anti-contaminant.

Si on se trouve dans le cas n°2, on poursuit la séquence des tâches.

III.3 - Vérification de la portance du sol

Cette mission est effectuée selon DTU 13-12 et établissement de la valeur "quS".

SEQUENCE LOGIQUE POUR LA CONCEPTION D'UNE PLATE-FORME DE TRAVAIL 5



III.4 - Cas de charge

Etablissement, par l'entreprise utilisatrice, des cas de charges correspondant à l'engin sur chenille le plus lourd ou ayant la contrainte au sol la plus élevée.

Les cas de charge q1 et q2 sont déterminés par l'entreprise par la méthode de la semelle équivalente (voir annexe n°3) :

- q1 : en déplacement ou au travail sans pouvoir intervenir sur la stabilité. Cette charge doit être pondérée par un coefficient de 2, soit :

$$q1p = 2 \times q1$$

- q2 : en traction sur le treuil de levage avec possibilité de réduire ou relâcher la traction :

$$q2p = 1,5 \times q2$$

III.5 - Evaluation secondaire

- si q1p et q2p sont inférieures à quS, on peut limiter la couche de renforcement à une couche de roulement,

- si q1p et/ou q2p sont supérieures à quS, il faut poursuivre la séquence d'étude.

III.6 - Couche de roulement

Elle a deux objectifs :

- protection durable de la plate-forme de travail pendant le chantier,

- permettre la circulation tout temps des véhicules de chantier.

Elle sera composée de matériaux granulaires drainants compactables de type grave 0/30 mm à 0/60 mm, son épaisseur dépendra de l'homogénéité du sol support et ne sera pas inférieure à 0,1 m, cas des sols support sableux, et 0,2 m, cas des sols support argilo-marneux. Dans ce dernier cas, on interposera un géosynthétique anti-contaminant.

N.B. : si le sol support à une nature graveleuse, la couche de roulement pourra être ignorée si après compactage les valeurs suivantes sont atteintes :

$$EV_2 > 30 \text{ MPa}$$
$$EV_{2\ moyen} \geq 35 \text{ MPa}$$

III.7 - Conception de la couche de renforcement

La couche de renforcement est conçue en épaisseur et qualité à partir de trois termes :

- la contrainte ultime du sol support "**quS**" définie plus haut,
- la résistance au cisaillement dans la couche de renforcement "**quF**",
- la résistance à la traction mobilisable dans un géosynthétique de renforcement placé à la base de la couche de renforcement (**T_G**).

Deux cas peuvent se présenter :

- couche de renforcement sans géosynthétique,
- couche de renforcement + géosynthétique de renforcement.

La fiche de calcul pour dimensionner ces deux cas sont données en annexe n°3.
Le paramétrage de cet ouvrage sera donné dans une note de calcul : "Etude d'exécution" (mission G3).

Les critères définissant la couche de renforcement sont les suivants :

- nature : classe granulométrique, pourcentage de fines, argilosité.

  Les classes de matériaux acceptables sont les suivantes selon la classification G.T.R. :

  D_1, D_2, B_3, D_3,
  R_{11}, R_{12}, R_{41}, R_{61} et F_{31}, F_{61} et F_{71}

- propriétés mécaniques : angle de frottement interne ø', densité relative et éventuellement la valeur Los Angeles ou Micro-Deval des graves constitutives.
- épaisseur : déterminée par le calcul, pour assurer la stabilité au poinçonnement en fonction de l'angle de frottement interne et de la compacité.

III.8 - Mise en œuvre de la couche de renforcement

Elle sera mise en œuvre selon les recommandations de l'étude d'exécution et selon les recommandations du G.T.R.. Une approche du dimensionnement est donnée en annexe n°7 avec les exemples d'application à divers types de matériaux.

Ensuite l'entreprise de terrassement procédera aux contrôles internes et externes et aux reprises jusqu'à obtention des critères (qualité q4 et 95% de γd OPN).

III.9 - Réception de la plate-forme de travail

Cette réception doit être contradictoire entre l'entreprise utilisatrice et l'entreprise constructeur de la plate-forme de travail et sous le contrôle éventuel du maître d'œuvre ou de l'entreprise générale. Elle se fera au moyen :

- d'essais à la plaque,
- d'essais au pénétromètre statique ou dynamique.

Les critères à obtenir au minimum sont les suivants et caractéristiques d'une PF1 :

$EV_2 > 30$ MPa
$EV_{2\ moyen} \geq 35$ MPa
$q_d \geq 6$ MPa à -0,3 m
qualité q4

IV - DEFINITION ET CONSISTANCE DES ETUDES GEOTECHNIQUES

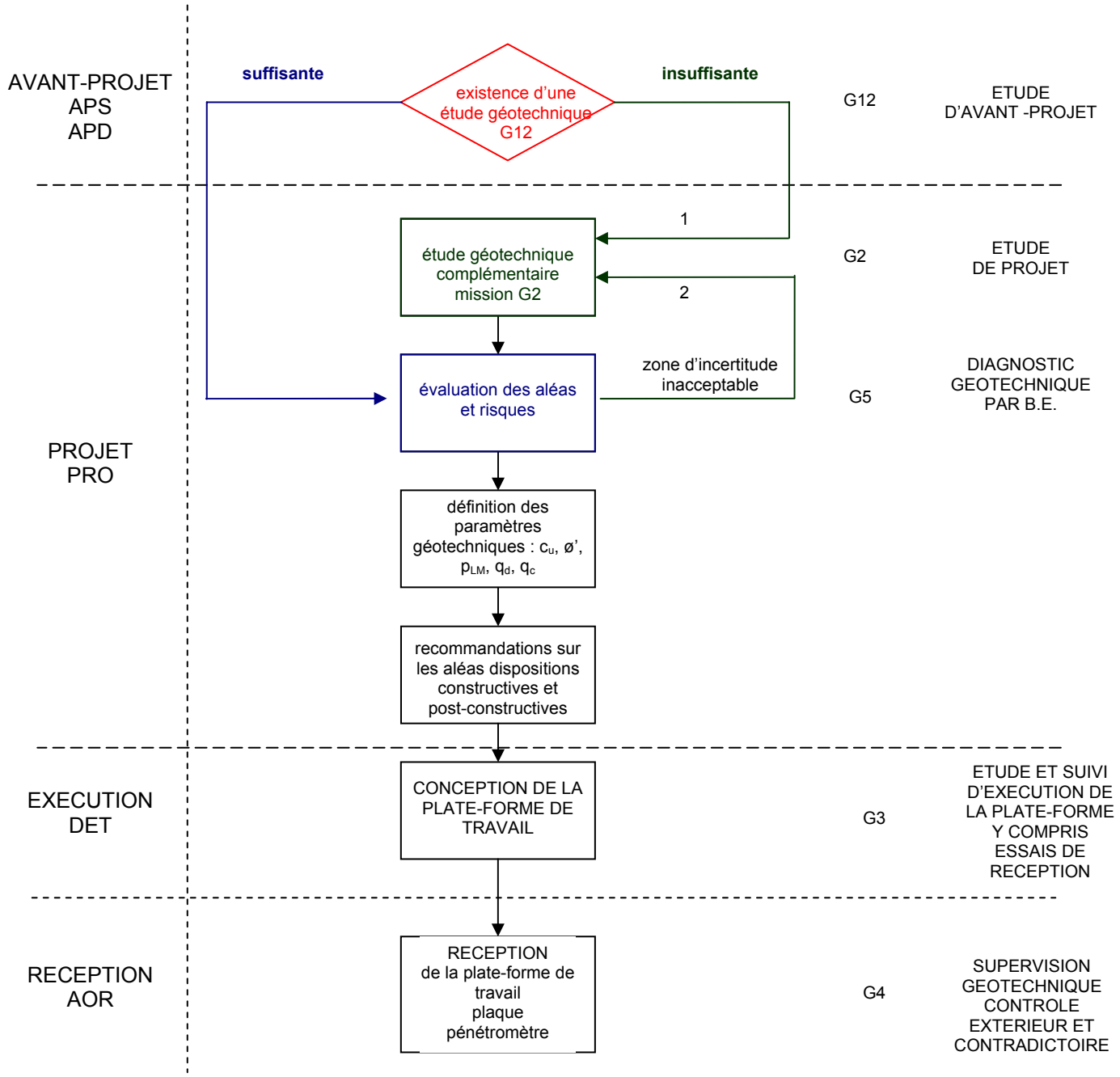
Trois étapes sont distinguées dans les études géotechniques :

- l'étude géotechnique générale du terrain et du projet de construction qui permet de déterminer la nature et les propriétés physico-mécaniques des couches superficielles – étude d'avant-projet mission G12,
- l'étude de diagnostic géotechnique - mission G5 : elle doit permettre une évaluation détaillée du sol support à partir de l'étude géotechnique d'avant-projet - mission G12, et de définir la nécessité ou non d'une étude plus détaillée,
- la conception de la couche de renforcement :
  - étude géotechnique de projet (mission G2) à la charge du maître d'œuvre) et/ou
  - étude géotechnique d'exécution (mission G3), à la charge de l'entreprise constructeur de la plate-forme de travail,
- les contrôles d'exécution et de réception des travaux : supervision d'exécution - mission G4.

L'enchaînement logique de ces missions est donné dans l'organigramme page suivante.

N.B.$_1$: les études, suivis et supervision des travaux (missions G3 et G4) sont confiées à un B.E. ou un ingénieur ayant une compétence en géotechnique, cela peut être le B.E. ou un ingénieur géotechnicien de l'entreprise.
N.B.$_2$: l'étude géotechnique d'avant-projet (mission G12) doit être confiée à un B.E. géotechnique extérieur aux entreprises car elle concerne la totalité du projet de construction.

ETAPE POUR L'EVALUATION DES ALEAS ET L'ACQUISITION DES PARAMETRES GEOTECHNIQUES - MISSIONS G12 + G5



IV.1 - Inventaire des aléas

Le géotechnicien aura à établir lors de la phase de diagnostic et d'étude de projet (missions G5 + G2), la liste des aléas et risques géotechniques devant faire l'objet d'une évaluation, à savoir :

- nature des sols et propriétés mécaniques,
- hétérogénéité,
- compressibilité,
- profondeur et fluctuations de la nappe,
- risque de venues d'eau par résurgence, ruissellement et artésianisme,
- présence de cavités d'origine naturelle ou anthropique,
- présence d'anciennes tranchées - réseaux, ou archéologiques,
- présence de remblais, d'affouillement, de points durs,
- présence de talus pouvant être instables,
- risque d'inondation,
- affaissabilité,
- retrait / gonflement,
- agressivité chimique des sols au regard des traitements et des géosynthétiques.

Une fiche d'évaluation géotechnique préliminaire est donnée en annexe.

L'inventaire des aléas doit aboutir à une série de recommandations adaptées pour la conception de la plate-forme de travail.

IV.2 - Détermination de la profondeur d'investigation

Les couches composant le sol support doivent être connues :

- de façon détaillée dans la zone d'influence des chenilles (profondeur supérieure à quatre fois leur largeur et à au moins 3 m),

- de façon générale si possible jusqu'au substratum incompressible (éléments disponibles dans l'étude d'avant-projet - mission G12).

On peut donc admettre que la connaissance générale du site assurée par l'étude d'avant-projet, est suffisante. Par contre, il pourra s'avérer nécessaire de procéder à une série de sondages courts complémentaires (pénétromètre, pressiomètre, ...) jusqu'à -3 m de profondeur.

IV.3 - Nature des essais à réaliser et fréquence

L'analyse de la capacité portante des sols pourra être effectuée à partir des paramètres intrinsèques c_u et ø', ou à partir de la résistance à la rupture mesurée ou dérivée des essais in-situ, tels que pénétromètre statique (q_c), pénétromètre dynamique (q_d) ou pressiomètre (p_{LM}).

La fréquence des points de sondages dépendra de la surface couverte par la future plate-forme de travail (P.F.T.), de l'hétérogénéité des sols d'assise et du poids des machines.

*PFT ≤ 500 m²	2 sondages dont 1 profond
500 ≤ PFT ≤ 2 500 m²	1/500 m² dont 1 profond
2 500 m² ≤ PFT ≤ 10 000 m²	courts : 3 points + 1/1 000 m² profonds : 1 point 3 000 m²
PFT ≥ 10 000 M²	courts : 10 points + 1 pour 2 000 m² au-delà de 10 000 m² profonds : 1 point pour 4 000 m²

Ils prennent en compte les sondages de l'étude d'avant-projet et peuvent être effectués à la réception de la P.F.T..

V - CONCEPTION DE LA COUCHE DE RENFORCEMENT

V.1 - Généralités

La couche de renforcement est dimensionnée pour obtenir la contrainte ultime qu supérieure ou égale à la contrainte apportée par les chenilles de l'engin avec un coefficient de sécurité suffisant :

$$qu \geq q_1 \times SF1$$
$$qu \geq q_2 \times SF2$$

Où SF1 et SF2 sont les coefficients de sécurité (SF1 = 2 et SF2 = 1,5).

V.2 - Les trois composantes de qu

La contrainte ultime est la somme des trois composantes :

$$qu = quS + quF + T_G$$

(1) - la résistance du sol support : quS

(2) - la résistance au cisaillement de la couche de renforcement : quF

(3) - la résistance à la traction du géosynthétique placé à la base de la couche de renforcement : T_G

V.3 - Coefficients de sécurité

L'interposition d'une couche de renforcement d'angle de frottement interne élevé et connu peut permettre de réduire les coefficients à :

SF1 = 1,75
SF2 = 1,35

V.4 - Résistance ultime du sol - "quS"

Elle est calculée selon le DTU 13-12, à savoir :

- à partir des paramètres intrinsèques c_u et ø' c' :

$$quS = c_u\ Nc\ Sc + 0{,}5\ \gamma\ I\ N\ N\gamma\ S\gamma$$

- de p_{LM}' la pression limite mesurée au pressiomètre :

$$quS = 0{,}8\ p_{LM}'$$

- de q_c la résistance de pointe au pénétromètre statique :

$$quS = q_{c\ \text{équivalent}} \times kc$$

- ou de q_d la résistance de pointe au pénétromètre dynamique :

$$quS = q_{d\ \text{equivalent}} / kd$$

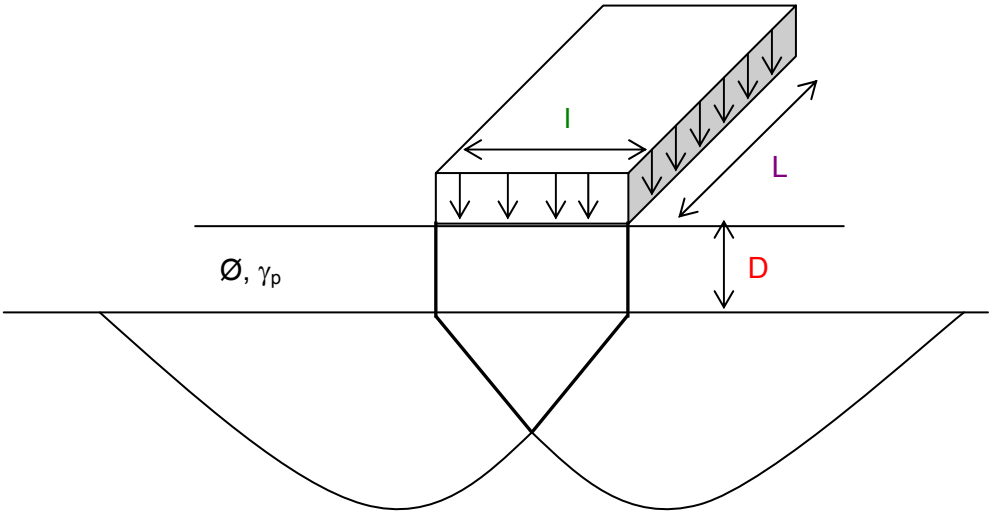
avec :

- Nc, Nγ, facteur de portance dépendant de l'angle de frottement interne,
- kc = 0,22 pour l'argile,
  = 0,08 pour les sables,
- kd = 5 pour l'argile,
  = 7 pour les sables,
- Sγ = 1 - 0,3 (I/L)
- Sc = 1 + 0,2 (I/L)

V.5 - Résistance au poinçonnement de la couche de renforcement - quF

Le terme de résistance au poinçonnement de la couche de renforcement est donné par l'application de la méthode de Meyerhof :

$$quF = (\gamma_p D^2 / l) \, Kp \tan \delta \, Sp$$



Où :

D : épaisseur de la couche de renforcement
l : largeur équivalente de la chenille
L : longueur équivalente de la chenille
Sp : coefficient de forme = 1 + (l / L)
Kp tan δ : coefficient calculé d'après la formulation de Meyerhof, avec : δ = 2/3 ø'
γ_p = poids spécifique du matériau de la couche de renforcement

V.6 - Résistance du géosynthétique - T_G

Les géosynthétiques sont décomposés en trois catégories :

- géotextiles tissés,
- géotextiles non tissés,
- géogrilles.

La résistance du géosynthétique au poinçonnement :

$$T_G = 2 \, \sigma_G / l$$

Avec : $\sigma G = \sigma_{G\,ult} / 2$ par sécurité

V.7 - Calcul d'optimisation

Le calcul de vérification s'effectue de façon interactive, avec :

q_1 et $q_2 \leq quS + quF + T_G$
voir fiche de calcul en annexe

En fonction du coût des matériaux d'apport, on pourra privilégier ou non l'adjonction d'un géosynthétique (T_G).

VI - VERIFICATION DE LA PLATE-FORME DE TRAVAIL

VI.1 - Réception

Le sol support étant considéré comme connu et invariable, l'entreprise qui recevra la plate-forme de travail devra procéder aux vérifications selon l'une ou plusieurs des méthodes suivantes :

- densité relative : 90% de l'O.P.M.,
  95% de l'O.P.N.,
- qualité de compactage selon courbes QUIBEL q4 (pénétromètre dynamique),
- pénétromètre,
- module de plaque : $EV_1 \geq 15$ MPa
  $EV_2 \geq 35$ MPa PF1
  $EV_2/EV_1 \leq 2,5$
- essai de déflexion - chantier d < 300/100ème mm (*voir annexe n°5),

Elle devra vérifier que les hypothèses du diagnostic sont toutes vérifiées, notamment :

- nature des matériaux constitutifs et homogénéité,
- épaisseur de la couche de renforcement,
- profondeur de la nappe.

VI.2 - Entretien

L'entreprise utilisatrice de la plate-forme de travail devra s'assurer du maintien des caractéristiques de la plate-forme, notamment en cas :

- de forte pluie ou de remontée de la nappe,
- d'orniérage.

Un entretien avec purge, compactage et drainage si nécessaire devra être réalisé.

ANNEXE N°1

Symboles, définitions et unités

Appendix 7

bre press

Working platforms for tracked plant

BRE

constructing the future

Appendix C

BRE
Garston, Watford, WD25 9XX

2004

Working platforms for tracked plant:

good practice guide to the design, installation, maintenance and repair of ground-supported working platforms

BRE

constructing the future

Appendix

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Alan Bell	Keller
David Corke	Bachy Soletanche
Ken Cromwell	Rock & Alluvium
Rab Fernie	Cementation Foundations Skanska
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Bob Handley	Aarsleff
Chris Jenner	Tensar International
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Soilmec UK
Institution of Civil Engineers
Tensar International
Galliford Try

Although serious incidents involving working platforms are relatively rare, fatalities have occurred. This guide is intended to promote safety in the design, installation and operation of these platforms.

The Federation of Piling Specialists (FPS) has initiated a drive to improve practices related to the use of piling and associated specialist plant; the guide has been prepared at the instigation of the FPS following the recognition of the need for safety initiatives to improve the approach to the provision of working platforms. In using the guide, it should be recognised that these platforms are subject to complex loading conditions and are difficult to design; specialist advice is needed. This guide is not intended to replace or reduce the designer's input, but rather to promote the implementation of minimum design, installation, maintenance and repair standards.

The guide was prepared under a contract let by FPS to Building Research Establishment Ltd (BRE). A co-ordinated approach to the problem was required involving the whole construction supply chain. BRE is pleased to acknowledge those who have helped in the preparation of the guide.

The guide has been prepared by a BRE project team working under the direction of a Steering Group appointed by FPS.

The Health and Safety Executive (HSE) has worked closely with the FPS and supports the principle of reducing accidents by the use of properly designed, prepared and maintained working platforms.

Appendix

Appendix 8

Working Platforms

Design of granular working platforms for construction plant

A guide to good practice

Published – April 2019

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NOTE: If you need to print this document, be aware that the pages are prepared with alternate (even) pages offset for your duplex (double sided) printing.

Temporary Works forum

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Appendix 8

Foreword

Temporary granular platforms for construction plant (including haul roads and general hard standings) are a necessary feature of almost all construction sites but the need to ensure that they are adequate for the intended use is often overlooked. Furthermore, the design is frequently only derived from previous experience. This has, on occasions, resulted in significant incidents of over-turning plant that result in, at best, cost and delay or, at worst, injury and/or death.

While current methods for the technical design of granular working platforms have proved generally reliable, it is recognised that there is a lack of consistency on how and when they are applied, resulting in varying degrees of economy (and possibly un-economic design in certain instances). In addition, the introduction of the 'Eurocodes' (although not entirely applicable) has brought about an increased expectation that temporary structures should be designed in line with current national standards.

It is not intended here to replace current guidance but it is hoped that this document will supplement current guidance and provide an overall approach that addresses the aforementioned issues.

This guide is, therefore, aimed at:

- providing recommendations for the overall design of working platforms;
- improving the application of current structural design methods;
- suggesting a suitable method for the application of Eurocodes;
- considering ways of achieving greater economy while maintaining a suitable level of reliability with regard to the particular risks under consideration;
- providing an introduction to related health and safety and sustainability issues.

The guidance offered here is intended primarily for temporary works designers, in particular less experienced engineers. It is also, however, intended to act as an aid to others involved in the procurement and use of granular working platforms.

Acknowledgements

The Temporary Works Forum gratefully acknowledges the contribution made by members of the working party in the preparation of this guidance.

We also wish to express our gratitude to the various interested parties that engaged with the working group, for their contribution to and endorsement of this document.

Additionally, thanks are expressed to Dr Hitesh Halai of City, University of London, who – at the request of the TWf directors - undertook a peer review of the text to provide an opinion on whether the 'TWf method' provides a valid and safe approach to the design of granular working platforms.

Thanks also go to John Allen (Group Technical Services, MACE) for his assistance with proof-reading.

Disclaimer

This TWf Guide is not a design code, but is intended to be used in conjunction with the current British Standards and other referenced documents as a guide to good practice. It is in no way intended to preclude the use of other codes and methods of design or the application of alternative solutions. Designers are expected to use their own engineering judgement to determine the best solution and appropriate methods for design.

Although the Temporary Works Forum (TWf) does its best to ensure that any advice, recommendations or information it may give either in this publication or elsewhere is accurate, no liability or responsibility of any kind (including liability for negligence) howsoever and from whatsoever cause arising, is accepted in this respect by the Forum, its servants or agents.

Readers should note that the documents referenced in this TWf Guide are subject to revision from time to time and should therefore ensure that they are in possession of the latest version.

Appendix 8

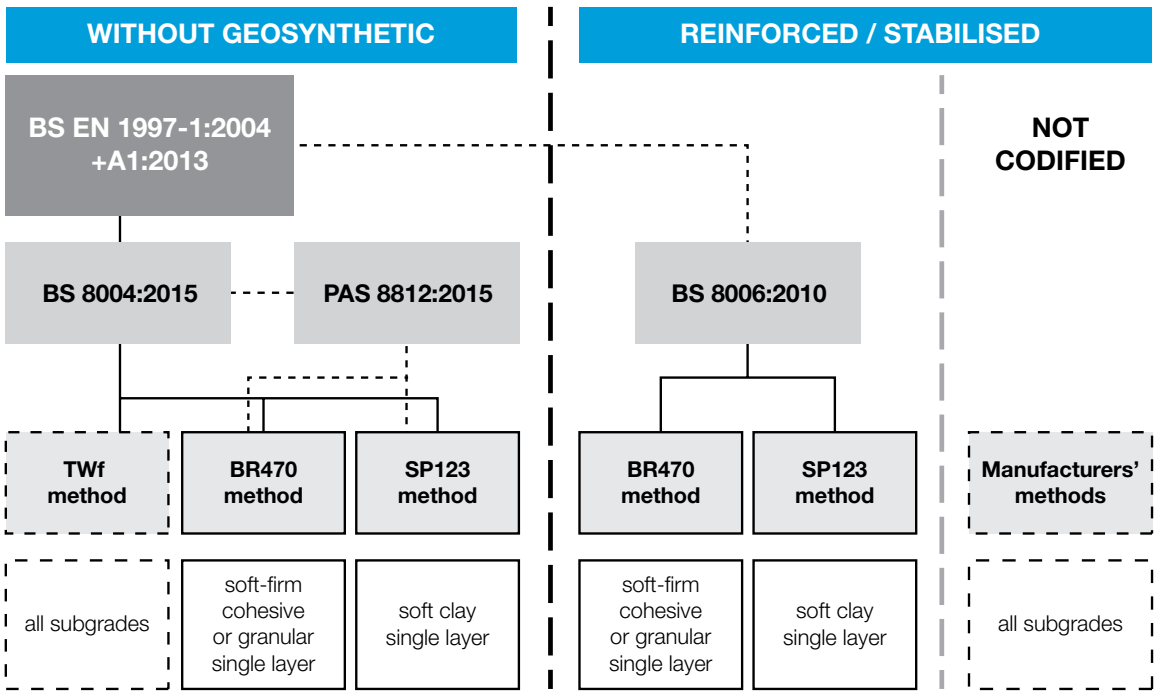

Figure 7 - Relationship of UK design codes to recommended methods for the analytical design of working platforms

- existing methods are not accepted as they are not EC7 compliant;
- multiple soil layers are present.

The details of the TWf method are fully described in **Section 4.7. Sections 4.2** to **4.6** are intended to provide the reader with background information as an aid to understanding the basis of the suggested method.

4.2 Platform and foundation mechanics

4.2.1 The granular platform

The fundamental mechanism employed in providing support to plant and vehicles with a granular platform is the same as that for any other pavement structure. The platform is constructed using material that is stronger than the formation and is intended to reduce the ground pressure imposed on the underlying formation to an acceptable level.

The required thickness of the platform depends on the strength and stiffness of the platform and that of the underlying subformation. In general, the required platform thickness is determined on the basis of a limiting bearing capacity. Alternatively, a limiting deformation/settlement can also be used.

It should be recognised that the load bearing capacity and deformation/settlement are related to the soil-structure interaction. On the one hand, a certain amount of deformation is needed to mobilise the internal strength of both the fill material and the underlying subformation soil. On the other hand, deformation needs to be kept within reasonable limits which in turn limits the bearing capacity.

The mode of failure for a granular platform is that of general downward and outward movement of the platform and underlying formation, as shown in **Figure 8**, leading to:

- vertical deformation of the platform and subgrade beneath the load;
- corresponding upward heave of the formation and platform adjacent to the load;
- outward horizontal strain at the formation.

The horizontal strain at the formation level is indicative of: (a) the development of tensile horizontal strains in the subgrade beneath the footing; and (b) the development of confining passive lateral pressure in the surrounding platform material. Depending on the equilibrium strain condition there may be a certain amount of horizontal shear that develops in the

Appendix 9

Working Platform Certificate (FPS/WPC/4d)

FEDERATION OF PILING SPECIALISTS

Project Name	
Work area covered by this certificate	

(A sketch or marked up pile layout drawing may be attached to this certificate. Include haul roads and gridlines.)

Part 1 – WORKING PLATFORM DESIGN (INCLUDING RAMPS AND ACCESS ROUTES)

Equipment to be used on site.	
Maximum plant loading	

(Note: BR470 'Working Platforms for Tracked Plant: Good practice guide to the design, installation, maintenance and repair of ground-supported platforms' is available from IHS BRE Press – Tel 01344 328 038)

Designer Name		Tel No.
Designer Organisation		
Specification of testing required to verify the design		

Part 2 – VERIFICATION BY PRINCIPAL CONTRACTOR

The working platform detailed above has been designed, installed to the design and, if specified, tested to safely support the equipment detailed in Part 1 above. The limits of the platform have been clearly identified on site as necessary.

The working platform will be REGULARLY INSPECTED, MAINTAINED, MODIFIED, REPAIRED, and REINSTATED to the as-designed condition after any excavation or damage, throughout the period when the equipment is on the site. A completed copy of this certificate signed by an authorised person from the Principal Contractor shall be given to each user of the working platform prior to commencement of any works on site.

Name & Position		Date
Organisation		Signature

The HSE has worked closely with the FPS to develop this initiative and supports the principle of reducing accidents by the certification of properly designed, prepared and maintained working platforms

Working Platform Regular Inspection Log

(To be completed by an authorised representative of the Principal Contractor)

The working platform has been inspected *prior to handover and provides safe access for people and plant*. All necessary maintenance, modification, repair or re-instatement of the working platform is to the as-designed installed condition. If necessary, a revised Working Platform Layout Drawing has been issued to the specialist contractor.

Date	Organisation	Name & Position	Signature	Comments (include key details of alteration, modification, maintenance, repair, date of next inspection, and whether or not revised drawing issued etc. as appropriate)

Appendix 9

Working Platform Certificate (FPS/WPC/4d)

Guidance on working platforms for tracked plant

1. Design

1.1. The HSWA 1974 and CDM Regulations 2015 require the Principal Contractor to appoint competent Designers in respect of Working Platform design. This legislation explains how competence can be assessed by reference to professional qualifications or professional memberships and by reference to practical experience of the design of working platforms. Principal Contractors must be satisfied that a competent Designer has been appointed by them in accordance with the relevant legislation before they complete and sign the WPC.

1.2. The stability of tracked plant is fundamentally dependent upon the provision of a suitable and sufficient working platform. It must be properly designed and installed to a recognised standard. Whilst the same type of rig may be operated by different companies, the design bearing pressures may differ due to the specific operating configuration of the rig and/or any modifications. Details of the plant to be used and bearing pressures will be provided by the specialist contractor in advance of work commencing.

1.3. Working platform 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.) It is therefore advised that the Designer may have to adopt conservative/cautious estimates of platform shear strength unless higher values can be demonstrated by testing or with reference to appropriate published data.

1.4. The working platform must be *safe for pedestrian access and* free draining to prevent the build-up of water and slurry. It must be free from harmful materials and contaminants. In the case of fine-grained sub-grades, a separation/filter membrane should be installed beneath the platform material to 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).

1.5. Proof testing of the platform can be carried out with a suitably sized circular plate subjected to the maximum design loading. Such testing, as part of an appropriately designed testing regime, should highlight any gross inconsistencies in platform performance. Potentially, significant savings in platform thickness and cost may be realised by adopting a more detailed testing strategy.

1.6. The working platform must have a 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.

1.7. The specialist contractor is to advise the Principal Contractor at the earliest practicable opportunity should the specialist contractor become aware of any circumstances relating to the working platform that renders it unsafe.

2. Installation

2.1. The FPS Working Platform Certificate is mandatory for all sites where a rig or attendant plant operates. It must be signed by an authorised representative of the Principal Contractor. This signature confirms that the legal duties required under CDM have been carried out.

2.2. 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 and, in accordance with good practice, physically on site. This is particularly important where the platform material is removed from an area previously made available to the specialist contractor.

2.3. The working platform *must* provide *safe* access for all plant deliveries, sub-contractors and personnel associated with the specialist operations. Properly designed and installed, the working platform could also provide suitable and safe access for following trades for the whole project.

2.4. Poor definition of the edge of the working platform is a major cause of tracked plant instability. It is good practice that the working platform should extend at least 2m beyond the pile position/edge of the building to ensure sufficient safe working area for the specialists personnel and attendant plant. Where having to work within this 2m zone is unavoidable the Designer is to be informed of the requirement to design the platform for working up to its edge.

2.5. Where access ramps are used to move between working levels these must be of sufficient gradient and width to allow the plant to move safely with the stability constraints of the machine. Ramps must be in a straight line between working areas. Rigs and cranes cannot change direction on ramps. Where a change in direction is required, this must be on a flat level platform.

3. Maintenance, modification, repair and reinstatement

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

3.2. Obstructions encountered during installation of the piling works will generally require excavation to remove them. This can create a 'soft spot' which can result in the rig overturning. It is essential, therefore, that any excavations made in the working platform are reinstated to the designed standard, including any reinforcement and separation filter/membrane.

3.3. The working platform shall be subject to regular inspection by a competent individual appointed by the Principal Contractor (e.g. the Temporary Works Co-ordinator) throughout its design life and after any reinstatement or any works which might have modified it. Any damaged or inadequate areas identified must be reinstated to the designed standard. Following the regular inspection, the Working Platform Regular Inspection Log shall be signed by an authorised representative of the Principal Contractor and issued to the specialist contractor with a layout drawing of the working platform amended as appropriate.

4. Working Platform Layout

4.1 Items that must be included and properly located on the working platform layout drawing and be notified by the Principal Contractor to the specialist contractor would include: detail of platform edges and 2m delineation, trial pits, services or voids, areas of backfilling, known underground basements; areas that are covered by the certificate or permit, test locations (if specified by the Designer of the platform) and any other feature that may affect the safety of operations.

Appendix 9

Appendix 10

Oktober 2016

Het Bouwterreincertificaat (BTC) Nederland

Naar een beter ontwerp van het werkterrein voor de inzet van funderingsmachines

Appendix 10

Colofon
Het Bouwterreincertificaat Nederland is een initiatief van de Nederlandse Vereniging Aannemers Funderingswerken
Ceintuurbaan 2, 3847 LG Harderwijk
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F 0341 456 208
E secretariaat@nvaf.nl

Eindredactie: mr. H. de Koning
Harderwijk, 1 oktober 2016

Beoordeling draagkracht

Al in 2009 constateerde de toenmalige Arbeidsinspectie (thans Inspectie SZW) in haar rapportage van het Project Fundering 2009, dat 38% van de bezochte bedrijven meldde dat zij in de afgelopen acht jaar 1 tot 10 keer hebben meegemaakt dat een machine omviel; in twee van de drie situaties speelde hierbij de draagkracht van de ondergrond een rol. Anderzijds bleek dat 78% van de desbetreffende bedrijven de draagkracht van de grond altijd vooraf beoordeelde. In welke mate en op grond van welke gegevens dat geschiedde vermeldt het rapport niet.

Slechte bouwputten en bouwterreinen vormen al heel lang een bron van klachten en problemen van funderingsbedrijven. Zij zijn niet zelden een van de eersten op het werk en treffen vaak een slecht voorbereide werkvloer aan. De toegankelijkheid van de bouwput of het bouwterrein laat ook vaak te wensen over. Weliswaar wordt in het kader van de NVAF-opstellingskeuring (uit te voeren door een deskundige van het bedrijf of een externe instantie) het bouwterrein in de werkvoorbereiding én bij aanvang van het werk ‘meegenomen’, met een visuele controle ben je er niet. Gericht (grond)onderzoek dient plaats te vinden op basis waarvan concrete maatregelen moeten worden genomen.

WPC

Ook in het Verenigd Koninkrijk leeft deze problematiek al vele jaren. Daar rapporteerden FPS[1]-leden dat een derde van alle gevaarlijke situaties betrekking had op het bouwterrein. Elke gevaarlijke situatie en elk ‘bijna-ongeval’ met betrekking tot het bouwterrein vormen een potentieel incident of ongeval. Men kwam tot de conclusie dat bouwterreinen (bouwputten) moeten worden ontworpen, correct aangelegd, regelmatig geïnspecteerd en onderhouden om een voldoende draagkracht te kunnen blijven garanderen. Dit bracht de FPS er toe om het ‘Working Platform Certificate’ (WPC) te ontwikkelen om dit te bevorderen. Inmiddels wordt dit al enige jaren met succes toegepast.

BTC Nederland

Het Bouwterreincertificaat (BTC) Nederland is de Nederlandse versie van het WPC. De NVAF heeft dit systeem, dat is ontwikkeld door de FPS en de HSE[2], in Nederland geïntroduceerd. Het betreft een verklaring dat het bouwterrein behoorlijk is ontworpen en aangelegd in overeenstemming met het ontwerp en regelmatig wordt geïnspecteerd en behoorlijk onderhouden, zodat de begaanbaarheid en draagkracht van het bouwterrein gewaarborgd zijn. Het certificaat vereist de handtekening van de opdrachtgever (N.B.: dat is doorgaans de hoofdaannemer) en moet worden overhandigd aan de aannemer van de funderingswerkzaamheden voorafgaand aan diens werkzaamheden op de bouwplaats.
In feite is voorafgaand aan elk werk een bouwterreincertificaat vereist, zeker wanneer funderingsmachines en andere kranen met zware lasten en een hoogliggend zwaartepunt worden ingezet.

Onderzoek

Bij het ontwerp van het bouwterrein moeten de gronddrukgegevens van de gebruikte machine en de ondergrondcondities waarop gebouwd wordt in aanmerking worden genomen. Dit moet worden gemaakt door een deskundige ontwerper die beschikt over voldoende geotechnische kennis.
In het Verenigd Koninkrijk wordt bij het ontwerp van het bouwterrein uitgegaan van de BRE-handleiding BR470 ‘Working Platforms for Tracked Plant: Good practice guide to the design, installation, maintenance and repair of ground-supported platforms’, verkrijgbaar bij IHS BRE Press, www.brebookshop.com.
In Nederland is een vergelijkbaar document ontwikkeld door SBRCURnet, richtlijn 689:2016 ‘begaanbaarheid van bouwterreinen’. Het bouwterreincertificaat maakt nu deel uit van deze richtlijn en verwijst voor het ontwerp ook naar de berekeningsmethoden in de richtlijn.

Arbocatalogus funderingen

De volgende stap is opname in de arbocatalogus funderingen. In de huidige tekst is nog sprake van het CUR/CROW/Arbouw-rapport 2014-1. Als voorbereiding van een update waarin sprake is van het bouwterreincertificaat is dit besproken met de Inspectie SZW. In EFFC[3]-verband is meermalen aandacht besteed aan het Britse systeem, zodat mag

[1] *Federation of Piling Specialists*
[2] *Health & Safety Executive*
[3] *European Federation of Foundation Contractors*

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Summary

BTC (Nederland) stands for 'Bouwterreincertificaat', which is an initiative of the Dutch Association of Foundation Contractors. It has been derived from the Working Platform Certificate, which was developed by the British FPS – Federation of Piling Specialists – in co-operation with the Health & Safety Executive in the UK.

Before the implementation of the certificate one third of all dangerous occurrences reported by the FPS Membership were related to working platforms. Every dangerous occurrence and every 'near miss' involving a platform is a potential fatality. Therefore, working platforms must be designed, properly constructed, regularly inspected and maintained for the plant which will use them. The FPS Working Platform Certificate confirms that the working platform has been properly designed, constructed in the accordance with the design, and will be regularly inspected and adequately maintained to ensure the integrity of the platform. It requires the signature of the Principal Contractor, in his capacity as the Temporary Works Co-Ordinator and must be handed to the Piling Contractor before piling (or other work) commences on site.

The design of the working platform must take account of the bearing pressures of the plant which will use it and the ground conditions on which it will be constructed. It should be undertaken by a competent designer with appropriate geotechnical expertise.

A BRE Guide 'Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms' (IHS BRE Press, www.brebookshop.com) gives guidance for the design. In the Netherlands a similar guideline has been developed by SBRCURnet called 'Begaanbaarheid van bouwterreinen' (roughly translated as: Stability of Working Platforms), which exclusively is related to the deployment of foundation rigs for piling, drilling and other similar activities. The Health & Safety Authorities in the Netherlands reported in 2009 already that two third of all incidents with foundation rigs were related to the capacity of the surface.

The introduction of the certificate system seeks to contribute to the design and preparation of safe sites.

worden verwacht dat ook andere nationale federaties tot invoering over zullen gaan.
Daarnaast is in de nieuwe 'Algemene voorwaarden voor de aanneming van funderingswerken' (AVAF 2016) toepassing van de SBRCURnet-richtlijn en het bouwterreincertificaat voorgeschreven.

Wetgeving

Opdrachtgevers en ontwerpers moeten al in de ontwerpfase van het bouwproces rekening houden met de veiligheid en gezondheid van de werknemers die het ontwerp later op de bouwplaats moeten uitvoeren. In de ontwerpfase worden veiligheids- en gezondheidsrisico's voor werknemers door de opdrachtgever en de ontwerper vaak niet voldoende onderkend, bijvoorbeeld blootstelling aan schadelijke stoffen of een te hoge fysieke belasting, maar ook de begaanbaarheid van het bouwterrein voor mens én machine.
In de uitvoeringsfase zijn op een bouwplaats meestal verschillende bedrijven gelijktijdig of kort na elkaar aan het werk. Naarmate het werk vordert, verandert de werksituatie. Werkzaamheden die verspreid over de bouwplaats worden verricht, in combinatie met het tijdelijke karakter ervan, vormen risicoverhogende factoren voor de veiligheid.
Het Arbobesluit streeft met de verplichtingen die zijn toegewezen aan de diverse partijen een keten van verantwoordelijkheden tijdens het totale bouwproces na. Dit verplichtingentraject loopt vanaf het initiatief tot bouwen, de ontwerpfase, de uitvoeringsfase, tot aan de opleverings-, beheer- en onderhoudsfase. Daarvoor is de betrokkenheid van alle partijen noodzakelijk, van opdrachtgever, ontwerper, constructeur en adviseur tot elk uitvoerend bedrijf en zijn werknemers. Betrokken partijen dienen na te denken over alle omstandigheden op het werk, inclusief de belangen van diegenen die het werk uitvoeren.

Bij het bouwproces is dus een groot aantal partijen betrokken. Niet alleen de werkgevers in de hoedanigheid van aannemer, nevenaannemer en onderaannemer en hun werknemers, maar met name ook opdrachtgevers, ontwerpers en constructeurs. Het Arbobesluit Bouwproces (artikelen 2.23-2.36) heeft een aantal verplichtingen bij de opdrachtgever neergelegd.

In artikel 1.1. lid 2 van het Arbobesluit worden de

Grondonderzoek

Volgens de SBRCURnet-richtlijn dienen voor de grondmechanische berekeningen de dikte, de samenstelling en de eigenschappen van de grondlagen bekend te zijn. Hiervoor wordt een grondonderzoek uitgevoerd. De laagscheidingen worden bij voorkeur t.o.v. het NAP gemeten. Deze gegevens worden in grondprofielen (rekenprofielen) verzameld en vastgelegd. Het aantal profielen voor een bouwlocatie moet zijn afgestemd op de variatie in de grondopbouw en grondeigenschappen. In ieder geval moeten de maatgevende (slechtste) situaties beschouwd worden.

Voor de berekeningen zijn per profiel en per bodemlaag grondeigenschappen benodigd:
- laagdikte en niveau van de laagscheidingen
- de grondwaterstand
- hoek van inwendige wrijving
- schijnbare cohesie
- ongedraineerde schuifsterkte
- samendrukkingseigenschappen
- volumiek gewicht (nat en droog)

De omvang van het grondonderzoek (afstand tussen de onderzoeksplaatsen) dient zodanig te zijn dat met zekerheid gesteld kan worden dat slechte plekken in de bodem gedetecteerd zijn. Aangezien de variatie in de bodemopbouw groter is en vaker voorkomt naarmate zij zich dichter onder de oppervlakte bevindt (invloedsgebied van de machine), kan er geen minimum aan de omvang van het onderzoek gesteld worden. Als indicatie kan een raster worden aangehouden met een grootte gelijk aan het grondoppervlak van de funderingsmachine. Voor machines op een schottenbed kan een raster gelijk aan de wielbasis x de schotlengte worden aangehouden.

Wanneer een werkvloer of grondverbetering wordt aangebracht, dienen van elke aanvullaag het toegepaste materiaal en de verkregen verdichting gecontroleerd te worden.

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volgende partijen genoemd:
- de opdrachtgever: degene voor wiens rekening een bouwwerk tot stand wordt gebracht;
- de opdrachtgever-consument: de natuurlijke persoon die niet handelt in de uitoefening van een beroep of bedrijf, voor wiens rekening een bouwwerk tot stand wordt gebracht;
- de ontwerpende partij: degene die zich jegens de opdrachtgever, of jegens de opdrachtgever-consument, verbonden heeft om in het bouwproces de ontwerpende functie te vervullen;
- de uitvoerende partij: degene die zich jegens de opdrachtgever, of jegens de opdrachtgever-consument, verbonden heeft om in het bouwproces de uitvoerende functie te vervullen. Dit is de (hoofd) aannemer. De funderingsaannemer is soms (hoofd)aannemer, maar veelal onderaannemer. Voor de funderingsaannemer is de hoofdaannemer vaak zijn opdrachtgever. Het is van belang dit in de gaten te houden als het gaat om het afgeven van een bouwterreincertificaat.

Wettelijke verplichtingen kunnen niet via privaatrechtelijke contracten aan een andere partij worden overgedragen. De opdrachtgever kan desgewenst wel de taken die samenhangen met zijn wettelijke verplichtingen overdragen aan een andere partij, maar hij is en blijft verantwoordelijk en aansprakelijk voor de uitvoering van die verplichtingen. Dat wil zeggen dat de opdrachtgever te allen tijde verantwoordelijk blijft dat een uitvoerende partij wordt aangewezen die verantwoordelijk is voor het aanstellen van een V&G-coördinator uitvoeringsfase.

Als een werkgever/aannemer al vroeg in de ontwerpfase bij het project is betrokken, bijvoorbeeld in een bouwteam of bij een geïntegreerd contract (Design & Build, DBM, UAVgc e.d.), kan hij een aantal taken uitvoeren die samenhangen met de verplichtingen van de opdrachtgever. In dat soort gevallen kan de werkgever/aannemer optreden als ontwerpende partij en/of coördinator ontwerpfase. Ook in dergelijke gevallen blijft de opdrachtgever juridisch eindverantwoordelijk voor deze taken. Dat geldt ook als de opdrachtgever instemt met een door de werkgever/aannemer ingediend alternatief ontwerp.

Het certificaat

Het certificaat is een verklaring van de opdrachtgever (in veel gevallen de hoofdaannemer), dat het bouwterrein, zoals in het certificaat omschreven, zodanig is ontworpen en aangelegd, dat de werkzaamheden met het materieel zoals in het certificaat benoemd veilig kunnen worden uitgevoerd. ‘Het bouwterrein zal door of namens de opdrachtgever voldoende worden geïnspecteerd en onderhouden en zal, waar nodig, zodanig worden hersteld dat de draagkracht gedurende de werkzaamheden gewaarborgd blijft.’
Na een ontgraving of beschadiging moet het bouwterrein op basis van het oorspronkelijke of een nieuw ontwerp inclusief draagkrachtberekening worden aangepast of hersteld. Voordat met de werkzaamheden op het terrein wordt begonnen moet een kopie van dit certificaat ondertekend door een bevoegde persoon door of namens de opdrachtgever aan iedere gebruiker van het bouwterrein worden verstrekt.

Handleiding

Het bouwterreincertificaat is een tamelijk beknopt document, maar hieraan is een handleiding toegevoegd met een aantal spelregels. Zo wordt uitgebreid ingegaan op de specifieke gevaren verbonden aan de inzet van zware machines voor de begaanbaarheid van het bouwterrein en de stabiliteit van de machines. Voor het bouwterrein moet een gespecificeerd ontwerp worden gemaakt voor de totale duur van het werk. Onder omstandigheden moet het ontwerp worden herzien of aangepast. Zie voor de volledige tekst van de handleiding het bouwterreincertificaat, pagina 15.

Wat is vlak?

Moderne funderingsmachines hebben een zeer hoog gelegen zwaartepunt. Hierdoor kan, ook bij een geringe helling van het maaiveld, het zwaartepunt van de machine een substantiële verschuiving in ongunstige richting ondergaan, waardoor het risico op instabiliteit van de machine toeneemt. Het spreekt voor zich dat voor een goede toetsing van de machinestabiliteit, de vlakheid van het terrein met lengte- en dwarsprofielen ingemeten behoort te worden.

In het algemeen moet een funderingsmachine opgesteld worden op een vlakke ondergrond. Onder vlak wordt verstaan een helling van het terrein ≤ 1 op 200.

Regelmatige inspecties van het bouwterrein

Het bouwterrein moet regelmatig worden gecontroleerd door een competente medewerker die wordt aangesteld door de opdrachtgever (bijv. de coördinator uitvoeringsfase) gedurende de volledige duur van het werk en na werkzaamheden die veranderingen met zich mee hebben gebracht. Beschadigde of ongeschikte delen moeten worden teruggebracht naar het oorspronkelijke ontwerp. Bij het certificaat hoort een logboek voor regelmatige inspecties van bouwterreinen. Dit moet worden bijgehouden en ondertekend door een geautoriseerde vertegenwoordiger van de opdrachtgever en samen met een ontwerptekening met veranderingen aan het bouwterrein, indien van toepassing, worden afgegeven aan de gespecialiseerde aannemer. Onder regelmatig wordt verstaan na elke fase in de uitvoering van het werk, na elke tussentijdse grondophoging of afgraving (ofwel grondroeren) of na een flinke regenbui, storm, vorst e.d.
Een model voor een ‘logboek voor regelmatige inspecties’ is opgenomen op pagina 17.

Wet- en regelgeving verband houdende met begaanbaarheid

Burgerlijk Wetboek: Artikel 7:658

1. De werkgever is verplicht de lokalen, werktuigen en gereedschappen waarin of waarmee hij de arbeid doet verrichten, op zodanige wijze in te richten en te onderhouden alsmede voor het verrichten van de arbeid zodanige maatregelen te treffen en aanwijzingen te verstrekken als redelijkerwijs nodig is om te voorkomen dat de werknemer in de uitoefening van zijn werkzaamheden schade lijdt.
2. De werkgever is jegens de werknemer aansprakelijk voor de schade die de werknemer in de uitoefening van zijn werkzaamheden lijdt, tenzij hij aantoont dat hij de in lid 1 genoemde verplichtingen is nagekomen of dat de schade in belangrijke mate het gevolg is van opzet of bewuste roekeloosheid van de werknemer.
3. Van de leden 1 en 2 en van hetgeen titel 3 van Boek 6, bepaalt over de aansprakelijkheid van de werkgever kan niet ten nadele van de werknemer worden afgeweken.
4. Hij die in de uitoefening van zijn beroep of bedrijf arbeid laat verrichten door een persoon met wie hij geen arbeidsovereenkomst heeft, is overeenkomstig de leden 1 tot en met 3 aansprakelijk voor de schade die deze persoon in de uitoefening van zijn werkzaamheden lijdt. De kantonrechter is bevoegd kennis te nemen van vorderingen op grond van de eerste zin van dit lid.

Arbowet: Artikel 3. Arbobeleid

1 De werkgever zorgt voor de veiligheid en de gezondheid van de werknemers inzake alle met de arbeid verbonden aspecten en voert daartoe een beleid dat is gericht op zo goed mogelijke arbeidsomstandigheden, waarbij hij, gelet op de stand van de wetenschap en professionele dienstverlening, het volgende in acht neemt:
c. de inrichting van de arbeidsplaatsen, de werkmethoden en de bij de arbeid gebruikte arbeidsmid-

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delen alsmede de arbeidsinhoud worden zoveel als redelijkerwijs kan worden gevergd aan de persoonlijke eigenschappen van werknemers aangepast;

Arbowet: Artikel 5 Inventarisatie van risico's

1. Bij het voeren van het arbeidsomstandighedenbeleid legt de werkgever in een inventarisatie en evaluatie schriftelijk vast welke risico's de arbeid voor de werknemers met zich brengt. Deze risico-inventarisatie en -evaluatie bevat tevens een beschrijving van de gevaren en de risico-beperkende maatregelen en de risico's voor bijzondere categorieën van werknemers.
3. Een plan van aanpak, waarin is aangegeven welke maatregelen zullen worden genomen in verband met de bedoelde risico's en de samenhang daartussen, een en ander overeenkomstig artikel 3, maakt deel uit van de risico-inventarisatie en -evaluatie. In het plan van aanpak wordt tevens aangegeven binnen welke termijn deze maatregelen zullen worden genomen.

Bijlage 8, behorend bij de ministeriële regeling van 19 juli 2012, nr. G&VW/GW/2012/10964, houdende wijziging van de arbeidsomstandighedenregeling in verband met de gefaseerde invoering van het stelsel van certificatie (fase 3)

Bijlage XVIIh behorend bij artikel 7.7, tweede lid onder h, Arbeidsomstandighedenregeling

Werkveldspecifiek certificatieschema voor het persoonscertificaat Machinist Grote Funderingsmachine Document: WSCS-VT Machinist Grote Funderingsmachine: 2012, versie 01

3.3 Risicoanalyse en afbreukrisico
Het uitvoeren van funderingswerken is een risicovolle activiteit. Er zijn in het proces van werkzaamheden met grote funderingsmachines verschillende omstandigheden te onderscheiden met daarbij behorende specifieke risico's:

Arbowet: Artikel 19. Verschillende werkgevers

1. Indien in een bedrijf of een inrichting verschillende werkgevers arbeid doen verrichten, werken zij onderling op doelmatige wijze samen teneinde de naleving van het bij of krachtens deze wet bepaalde te verzekeren.

Arbobesluit (Afdeling 5 Bouwproces): Artikel 2.26. Algemene uitgangspunten inzake veiligheid en gezondheid bij het ontwerpen van een bouwwerk
De opdrachtgever zorgt ervoor dat in de ontwerpfase rekening wordt gehouden met de verplichtingen voor de arbeidsomstandigheden die gelden in de uitvoeringsfase, in het bijzonder de verplichtingen, bedoeld in de artikelen 3, 5, eerste en derde lid, en 8 van de wet.

Arbobesluit (Afdeling 5 Bouwproces): Artikel 2.28. Veiligheids- en gezondheidsplan

1. De opdrachtgever zorgt ervoor dat ten aanzien van bouwwerken die voor de veiligheid en gezondheid van werknemers bijzondere gevaren met zich meebrengen als bedoeld in bijlage II bij de richtlijn of een bouwwerk ten aanzien waarvan een melding verplicht is, een veiligheids- en gezondheidsplan wordt opgesteld.
2. Afhankelijk van de voortgang in het bouwproces, worden in het veiligheids- en gezondheidsplan ten minste vermeld:
   a. een beschrijving van het tot stand te brengen bouwwerk, een overzicht van de betrokken ondernemingen op de bouwplaats, de naam van de coördinator voor de ontwerp- en uitvoeringsfase;
   b. een inventarisatie en evaluatie van de specifieke gevaren die het gevolg zijn van de gelijktijdige en achtereenvolgende uitvoering van de bouwwerkzaamheden en in voorkomend geval van de wisselwerking met doorgaande exploitatiewerkzaamheden;
   c. de maatregelen die volgen uit de risico-inventarisatie en -evaluatie, bedoeld onder b;
   d. de afspraken met betrekking tot de uitvoering van de maatregelen, bedoeld onder c;
   e. de wijze waarop toezicht op de maatregelen wordt uitgeoefend;
   f. de bouwkundige, technische en organisatorische keuzen die in verband met de veiligheid en gezondheid van de werknemers in de ontwerpfase worden gemaakt;
   g. de wijze waarop voorlichting en instructie aan de werknemers op de bouwplaats wordt gegeven.

Bijlage II bij de richtlijn

BIJLAGEN I EN II BIJ RICHTLIJN NR. 92/57/EEG (RICHTLIJN TIJDELIJKE EN MOBIELE BOUWPLAATSEN)

BIJLAGE I

NIET-VOLLEDIGE LIJST VAN CIVIELTECHNISCHE WERKEN EN BOUWWERKEN BEDOELD IN ARTIKEL 2, ONDER A)

1. Graafwerken
2. Grondwerken
3. Bouw
4. Montage en demontage van geprefabriceerde elementen
5. Inrichting of outillage
6. Verbouwing
7. Renovatie
8. Reparatie
9. Ontmanteling
10. Sloop
11. Instandhouding
12. Onderhouds-, en schilder- en reinigingswerken
13. Sanering

Appendix 10

BIJLAGE II

NIET-VOLLEDIGE LIJST VAN WERKEN DIE VOOR DE VEILIGHEID EN DE GEZONDHEID VAN DE WERKNEMERS BIJZONDERE GEVAREN MEDEBRENGEN BEDOELD IN ARTIKEL 3, LID 2, TWEEDE ALINEA

1. Werken die de werknemers aan gevaren van bedelving, vastraken of vallen blootstellen, welke gevaren bijzonder groot zijn door de aard van de werkzaamheden of van de gebruikte procedés of door de omgeving van de arbeidsplaats of de werken (*).
2. Werkzaamheden die de werknemers blootstellen aan chemische of biologische stoffen die een bijzonder gevaar voor de gezondheid en de veiligheid van de werknemers inhouden, of ten aanzien waarvan toezicht op de gezondheid wettelijk verplicht is.
3. Elk werk met ioniserende stralingen waarvoor de aanwijzing is vereist van gecontroleerde of bewaakte zones als omschreven in artikel 20 van Richtlijn 80/836/Euratom (**).
4. Werkzaamheden in de nabijheid van hoogspanningskabels.
5. Werkzaamheden die de werknemers blootstellen aan verdrinkingsgevaar.
6. Graven van putten, ondergrondse en tunnelwerken.
7. Werkzaamheden met duikuitrusting.
8. Werkzaamheden onder overdruk.
9. Werkzaamheden waarbij springstof en worden gebruikt.
10. Werkzaamheden in verband met de montage of demontage van zware geprefabriceerde elementen.

(*) Ter uitvoering van punt 1 kunnen de Lid-Staten cijfermatige indicaties vaststellen betreffende bijzondere simulaties.
(**) PB nr. L 246 van 17.9.1980, blz. 1, Richtlijn laatstelijk gewijzigd bij Richtlijn 84/467/Euratom (PB nr. L 265 van 5.10.1984, blz. 1).

Arbobesluit (Afdeling 5 Bouwproces):
Artikel 2.30. Taken coördinator voor de ontwerpfase
De coördinator voor de ontwerpfase heeft tot taak om:
a. de uitvoering van artikel 2.26 te coördineren;
b. een veiligheids- en gezondheidsplan als bedoeld in artikel 2.28 op te stellen of te laten opstellen;
c. een dossier samen te stellen dat is bestemd voor degene die beslist over de uitvoering van latere werkzaamheden aan het bouwwerk. In dit dossier staan de bouwkundige en technische kenmerken die van belang zijn voor de veiligheid en gezondheid van werknemers die latere werkzaamheden verrichten.

Arbobesluit (Afdeling 5 Bouwproces):
Artikel 2.32. Aanvullende verplichtingen opdrachtgever
1. De opdrachtgever neemt zodanige maatregelen dat:
   a. de coördinator de taken, bedoeld in artikel 2.30, naar behoren kan vervullen;
   b. de coördinator de taken, bedoeld in artikel 2.30, naar behoren uitoefent;
   c. het veiligheids- en gezondheidsplan, bedoeld in artikel 2.28, deel uitmaakt van het bestek betreffende het bouwwerk en vóór aanvang van de werkzaamheden op de bouwplaats beschikbaar is.
2. De opdrachtgever zorgt ervoor dat de verplichtingen voor de uitvoerende partij, bedoeld in de artikelen 2.29 en 2.33, zijn vastgelegd in een schriftelijke overeenkomst met de uitvoerende partij.

Arbobesluit: Artikel 3.3. Stabiliteit en stevigheid
2. De arbeidsplaats is zodanig ingericht, dat de daar aanwezige voorwerpen of stoffen geen gevaar voor de veiligheid of de gezondheid opleveren door instorten, verschuiven, omvallen of kantelen.

Arbobesluit:
Artikel 7.3. Geschiktheid arbeidsmiddelen
Bij de keuze van een arbeidsmiddel houdt de werkgever niet alleen rekening met de geschiktheid van het arbeidsmiddel voor de werkzaamheden, maar ook met de gevaren die het arbeidsmiddel met zich mee kan brengen. Hierbij houdt de werkgever rekening met de risico-inventarisatie en -evaluatie. Arbeidsmiddelen worden uitsluitend gebruikt voor het doel en op de wijze waarvoor ze zijn bestemd. Als het redelijkerwijs niet mogelijk is de gevaren bij het gebruik van arbeidsmiddelen te voorkomen, dan treft de werkgever zodanige maatregelen dat de gevaren zoveel mogelijk worden beperkt.

Arbobesluit:
Artikel 7.4. Deugdelijkheid arbeidsmiddelen en ongewilde gebeurtenissen
1. Een arbeidsmiddel bestaat uit deugdelijk materiaal.

2. Een arbeidsmiddel is van een deugdelijke constructie.
3. Een arbeidsmiddel is zodanig geplaatst, bevestigd of ingericht en wordt zodanig gebruikt dat het gevaar dat zich een ongewilde gebeurtenis voordoet zoals verschuiven, omvallen, kantelen, getroffen worden door het arbeidsmiddel of onderdelen daarvan, oververhitting, brand, ontploffen, blikseminslag en directe of indirecte aanraking met elektriciteit zoveel mogelijk is voorkomen.

Uitgewerkt via TCVT, Certificatieschema Keuring Funderingsmachines W6-01
Het TCVT certificatieschema W6-01 Keuring Funderingsmachines omvat de volgende typen keuringen:
- eerste ingebruikname keuring (conform artikel 7.4, 7.4a eerste vijfde en zesde lid en artikel 7.5 van het Arbeidsomstandighedenbesluit);
- periodieke keuring (conform artikel 7.4a, tweede, derde, vierde, vijfde en zesde lid en artikel 7.5 van het Arbeidsomstandighedenbesluit).

Arbobesluit:
Artikel 7.32. Bedienen van torenkranen, mobiele kranen en funderingsmachines
- Een torenkraan, mobiele kraan of funderingsmachine met een maximumbedrijfslastmoment van 10 ton meter of meer mag alleen bediend worden

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door een persoon die in het bezit is van een certificaat van vakbekwaamheid en in een zodanige lichamelijke en geestelijke toestand verkeert dat hij in staat is de aan de bediening van het betreffende arbeidsmiddel gebonden gevaren te onderkennen en te voorkomen. Onder mobiele kranen worden verstaan: mobiele kraan op rupsen, autotruck / ruwterreinkraan / wegterreinkraan, grondverzetmachine met hijsfunctie, autolaadkraan en verreiker met hijsfunctie.
- Het certificaat van vakbekwaamheid of een kopie daarvan is op de arbeidsplaats aanwezig.

Arbobesluit:
Artikel 9.6. Verplichtingen van de opdrachtgever
De opdrachtgever is verplicht tot naleving van de voorschriften welke zijn opgenomen in de artikelen 2.26 tot en met 2.29 en 2.32.

Arboregeling:
Artikel 7.6. Categorieën torenkranen, mobiele kranen en mobiele hei-installaties
Voor het besturen van een torenkraan, mobiele kraan en mobiele hei-installatie met een maximumbedrijfslastmoment van 10 ton meter of meer moet de machinist een certificaat van vakbekwaamheid bezitten, zoals bedoeld in Arbobesluit artikel 7.32. Onder mobiele kranen worden verstaan: mobiele kraan op rupsen, autotruck / ruwterreinkraan / wegterreinkraan, grondverzetmachine met hijsfunctie, autolaadkraan en verreiker met hijsfunctie.

Arboregeling:
Artikel 7.7. Afgifte certificaat van vakbekwaamheid (en bijlagen XVIIg en XVIIh)
Het certificaat van vakbekwaamheid als bedoeld in Arbobesluit artikel 7.32 voldoet aan de eisen die zijn opgenomen in de certificatieschema's van de stichting Toezicht Certificatie Verticaal Transport (TCVT).

Uitgewerkt via TCVT, Zie bijvoorbeeld WSCS-VT Machinist Grote Funderingsmachine: 2012, versie 01 (Staatscourant 2012 nr. 15581 26 september 2012)
3.3 Risicoanalyse en afbreukrisico ad. 2

Ad 2. Toestand van het werkterrein
Een vlak en draagkrachtig bouwterrein is van groot belang voor de begaanbaarheid en beloopbaarheid. De conditie van het bouwterrein is direct van invloed op de stabiliteit van het in te zetten materieel, maar ook op de arbeidsomstandigheden van het betrokken personeel. Helaas komen er nog elk jaar ongelukken voor door omvallend materieel, soms zelfs met dodelijke afloop. Verder leiden slechte arbeidsomstandigheden tot onder andere nek- en rugklachten en klachten aan het bewegingsapparaat.
Om de risico's die voortvloeien uit slechte begaanbaarheid van bouwterreinen te beheersen vindt eerst – dit ter beoordeling van een deskundige – een normvaststelling plaats aan de hand van de meet- en beoordelingsmethode volgens CUR/CROW/Arbouw 2004-1[4].
Een deskundige is een voldoende opgeleid en ter zake kundig persoon, die bevoegd is inspectie-, beproevings- of keuringswerkzaamheden te verrichten. Als deskundige kan worden aangemerkt de machinist van de funderingsmachine, in bezit van het certificaat machinist grote funderingsmachine.

Ad 3. Instabiliteit van de machine
Funderingsmachines hebben over het algemeen een hoogliggend zwaartepunt. De stabiliteit van deze machines wordt beïnvloed door verschillende factoren. Hierbij is de stabiliteit van de ondergrond in de eerste plaats van belang en dient deze volgens de bestaande methoden te worden bepaald.
De machine (en de giek) wordt instabiel door het uitvoeren van de funderingswerkzaamheden, het hijsen en zwenken. Er is dan sprake van grote drukverplaatsingen door de machine. Instabiliteit kan leiden tot het wegzakken c.q. omvallen van de machine. Een van de oplossingen is het werken op goede schotten. Daarnaast zorgen overbelasting en het werken bij zware wind voor problemen.

Ad 5. Funderingsmachines in elkaars valbereik
Het werken van machines en personen in elkaars directe omgeving leidt altijd tot een verhoogd risico. Het is altijd veiliger als deze situaties worden vermeden. Toch kan niet altijd worden voorkomen dat economische en/of planmatige omstandigheden leiden tot de keuze van een werkwijze, waarbij zulke situaties noodzakelijk of zelfs onvermijdelijk zijn. Indien in dergelijke situaties de volgende maatregelen worden getroffen, kan het werken binnen het valbereik van funderingsmachines, maar ook het werken met hijskranen en mobiele kranen, waarbij gevaar door omvallen aanwezig is, tot een aanvaardbaar risico worden teruggebracht.
De risico's moeten worden onderkend, vastgelegd in een TRA (taak-/risicoanalyse), besproken met betrokkenen en dienovereenkomstige maatregelen (m.n. draagkrachtig werkniveau) worden genomen dat het risico van omvallen, aanstoten etc. tot bijna nihil wordt teruggebracht. Het funderingsbedrijf dient zijn personeel duidelijk te instrueren en de hiervoor genoemde risico's en aanbevelingen ter voorkoming van gevaren vast te leggen in werkinstructies.

Arbocatalogus
Portaal Proces. Bijlage 6. Funderingsmachines en de bouwplaats onderdeel begaanbaarheid (en bij bijna alle hoofdstukken bij bijvoorbeeld "omvallen machine")

Begaanbaarheid
Een vlak en draagkrachtig bouwterrein is belangrijk voor de begaanbaarheid en beloopbaarheid. De conditie van het bouwterrein is direct van invloed op de stabiliteit van het materieel, maar ook voor de arbeidsomstandigheden van het personeel. Helaas komen er nog elk jaar ongelukken voor door omvallend materieel, soms zelfs met dodelijke afloop. Verder leiden slechte terreinomstandigheden tot onder andere nek- en rugklachten en klachten aan het bewegingsapparaat.

Om risico's door de slechte begaanbaarheid van bouwterreinen te beheersen wordt de werkwijze toegepast volgens CUR/CROW/Arbouw 2004-1[5].

Bij de begaanbaarheid van het bouwterrein is het volgende belangrijk:
- de kwaliteit van de toplaag; onder de toplaag wordt de eerste 50 tot 80 cm vanaf maaiveld verstaan. De kwaliteit wordt bepaald door de grondsoort, het weer en op welke wijze met de toplaag omgesprongen wordt;
- de draagkracht van de (onder)grond; deze wordt niet alleen door de toplaag bepaald, zeker niet wanneer de invloed van de belasting dieper reikt dan de toplaag of wanneer de toplaag van betere kwaliteit is dan de onderliggende laag;
- het type voertuig.

Met een handsondeerapparaat of penetrologger kan snel een eenvoudig inzicht worden verkregen in de toplaag. Uit tabellen met voertuiggegevens, bodemtype en grondwaterstanden kan de begaanbaarheid worden afgelezen. Hiermee kan worden bepaald of veilig gewerkt kan worden of maatregelen getroffen moeten worden. Voorbeelden van maatregelen zijn: het werken op grotere draglineschotten, grondverbetering etc. Paragrafen 5.2.3 en 5.5.4 van het Vakboekje veilig funderen geven meer specifieke informatie.

[4] *Te vervangen door SBRCURnet-richtlijn 689:2016 'Begaanbaarheid van bouwterreinen'*

[5] *Te vervangen door SBRCURnet-richtlijn 689:2016 'Begaanbaarheid van bouwterreinen'*

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Bouwterreincertificaat (BTC) Nederland

Projectnaam	
Bouwterrein waarop dit certificaat betrekking heeft	

(Aan dit certificaat kan een schets of een gemarkeerde palenplantekening worden gehecht incl. opritten en rasterlijnen)

Deel 1 – Ontwerp bouwterrein

In te zetten machines op het bouwterrein	
Maximale belasting machine(s)[i]	

Naam ontwerper van het bouwterrein			Tel.: E-mail:
Organisatie ontwerper van het bouwterrein			
Vindt er onderzoek naar de draagkracht van het bouw-terrein plaats?	Ja / nee	Zo ja, geef hier kenmerk en datum van het rapport en/of de tekening van de inrichting van het bouwterrein.	

Deel 2 – Verificatie door de opdrachtgever

Het bouwterrein zoals hierboven beschreven is zodanig ontworpen en aangelegd, dat de werkzaamheden met het materieel zoals hierboven genoemd veilig kunnen worden uitgevoerd. Het bouwterrein zal door of namens de opdrachtgever voldoende worden geïnspecteerd en onderhouden en zal, waar nodig, zodanig worden hersteld dat de draagkracht gedurende de werkzaamheden gewaarborgd blijft.
Na een ontgraving of beschadiging zal het bouwterrein op basis van het oorspronkelijke of een nieuw ontwerp inclusief draagkrachtberekening worden aangepast of hersteld. Voordat met de werkzaamheden op het terrein wordt begonnen, moet een kopie van dit certificaat ondertekend door een bevoegde persoon door of namens de opdrachtgever aan iedere gebruiker van het bouwterrein worden verstrekt.

Naam en functie		Datum
Bedrijf		Handtekening

Bouwterreincertificaat (BTC) Nederland

Handleiding voor bouwterreinen voor funderingsmachines op rupsen

1. Ontwerp

1.1 Artikel 2.28 van het Arbobesluit vereist dat de opdrachtgever een inventarisatie en evaluatie opstelt van de specifieke gevaren die het gevolg zijn van de (gelijktijdige en achtereenvolgende) uitvoering van bouwwerkzaamheden. Er moet van worden uitgegaan dat de uitvoering van funderingswerkzaamheden door de inzet van zware machines specifieke gevaren met zich meebrengt ten aanzien van de begaanbaarheid van het bouwterrein en de stabiliteit van machines. Opdrachtgevers moeten gerichte maatregelen treffen dat die gevaren door onderzoek in beeld worden gebracht, voordat zij het BTC kunnen invullen en ondertekenen.

1.2 De stabiliteit van machines op rupsen wordt in hoge mate bepaald door een geschikt bouwterrein dat in voldoende mate kan worden belast. Dit moet adequaat ontworpen zijn en aangelegd op basis van *SBRCURnet Richtlijn 689:16 Begaanbaarheid van bouwterreinen*. Hoewel een bepaald type funderingsmachine in gebruik kan zijn bij verschillende bedrijven, kunnen de belastingen verschillen als gevolg van een specifieke configuratie van de funderingsmachine en/of eventuele aanpassingen. Voordat met het ontwerp en de inrichting van het bouwterrein wordt begonnen, worden de specifieke gegevens van de in te zetten funderingsmachine, waaronder het totaalgewicht van de machine, de belastingen en de positie van het overall-zwaartepunt in zowel belaste als onbelaste toestand, door de gespecialiseerde aannemer verstrekt.

1.3 Het draagvermogen van het bouwterrein is sterk afhankelijk van de bodemopbouw en de aangebrachte materialen. Aanbevolen wordt om het ontwerp van het funderingswerkgebied en de rijwegen op conservatieve waarden van de grondeigenschappen te baseren. Alleen bij beschikbaarheid van betrouwbare gemeten waarden, kunnen deze in het ontwerp toegepast worden.

1.4 Het bouwterrein moet veilig begaanbaar, berijdbaar en draineerbaar zijn, zodat opeenhoping van water en slib kan worden voorkomen. Bij funderingen met een fijne korrel moet een scheidings-/filtermembraan worden geplaatst onder het oppervlak om een ‘pompeffect’ en infiltratie van de ondergrond met fijne korrel in het oppervlak tijdens nat weer te voorkomen (dit kan de prestaties van het bouwterrein negatief beïnvloeden en de onderhoudskosten verhogen).

1.5 Beproeving van het terrein, in het bijzonder het deel voor het funderingswerk, kan plaatsvinden:
- door middel van een sondering/technisch bodemonderzoek;
- door proefbelastingen;
- of met behulp van een handsondeerapparaat/penetrometer of -logger.

1.6 Voor het bouwterrein moet een gespecificeerd ontwerp worden gemaakt voor de totale duur van het werk wat begint vóór het aanvoeren van het materieel en eindigt na afronding van alle funderings-werkzaamheden en de demobilisatie van het materieel. Hierbij zijn inbegrepen eventuele paaltesten, het controleren op afwijkingen en het uitvoeren van eventuele herstelwerkzaamheden.

1.7 De gespecialiseerde aannemer dient de opdrachtgever bij de eerste gelegenheid te waar-schuwen, indien hij omstandigheden m.b.t. het bouwterrein constateert die hij als onveilig beschouwt.

2. Funderingswerk

2.1. Het Bouwterreincertificaat is verplicht voor alle bouwplaatsen waar een funderingsmachine werkzaam is. Dit moet worden ondertekend door een geautoriseerde vertegenwoordiger van de opdrachtgever. Door middel van deze handtekening wordt bevestigd dat aan alle wettelijke verplichtingen is voldaan.

2.2 Als het bouwterrein fasegewijs moet worden opgebouwd of verwijderd tijdens de funderings-werkzaamheden, moet de omvang van het terrein duidelijk op het certificaat en op de best denkbare wijze fysiek op de locatie worden uitgezet/aangegeven. Dit is met name belangrijk wanneer grond wordt verplaatst van een eerder beschikbare locatie naar de locatie van de gespecialiseerde aannemer.

2.3 Het bouwterrein moet voorzien in een veilige toegang voor alle leveranciers, onderaannemers en personeel betrokken bij de gespecialiseerde werkzaamheden. Wanneer het bouwterrein correct is ontworpen en geprepareerd, kan het voor het complete project een geschikte en veilige toegang bieden voor aansluitende werkzaamheden.

2.4 Wanneer de rand van het bouwterrein onduidelijk wordt aangegeven, vormt dit een belangrijke oorzaak voor instabiliteit van de machine op rupsen. Bij een goede werkwijze moet het bouwterrein ten

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minste 2 m buiten de machinepositie/rand van het gebouw uitsteken om een voldoende veilig werkoppervlak voor het gespecialiseerde personeel en de aanwezige machine(s) te garanderen. Wanneer er moet worden gewerkt binnen een afstand van deze 2 m.-zone, dient de ontwerper altijd te worden verzocht het terrein zodanig te ontwerpen dat er tot aan deze rand kan worden gewerkt.[ii]

2.5 Wanneer er hellingbanen worden gebruikt tussen de werkniveaus, moeten deze over een juiste hellingshoek en breedte beschikken om de machine veilig te kunnen verplaatsen, rekening houdend met de stabiliteitsvoorwaarden van de machine. De hellingbanen tussen werkoppervlakken moeten in een rechte lijn zijn aangebracht. Funderingsmachines kunnen hun rijrichting op hellingbanen niet veranderen. Wanneer de rijrichting van de funderingsmachine halverwege de hellingbaan moet worden aangepast, dient hiervoor een vlak (horizontaal) draaipunt ontworpen te worden.

3. Onderhoud, aanpassing, reparatie en herplaatsing

3.1 Het bouwterrein moet draineerbaar zijn. Er kunnen zich water en slib vormen op het bouwterrein. Dit kan gevaren aan het zicht onttrekken zoals nieuwe heipalen, struikelgevaar, een ongelijke of instabiele ondergrond, services en graafwerkzaamheden. Slib kan worden meegevoerd naar de werkuitrusting. Dit vergroot het risico van het wegglijden van traptreden en een moeizaam gebruik van werkgereedschappen.

3.2 Obstakels die tijdens de uitvoering van de funderingswerkzaamheden worden ontdekt, moeten meestal worden weggegraven. Dit kan een ‘zwakke plek’ veroorzaken, waardoor de funderingsmachine kantelt. Het is daarom cruciaal dat uitgravingen in het bouwterrein worden teruggebracht in de staat naar het oorspronkelijke ontwerp, inclusief pakketten en scheidingsfilter/-membranen.

3.3 Het bouwterrein moet regelmatig worden gecontroleerd door een competente medewerker die wordt aangesteld door de opdrachtgever (bijv. de coördinator uitvoeringsfase) gedurende de volledige duur van het werk en na werkzaamheden die veranderingen met zich mee hebben gebracht. Beschadigde of ongeschikte delen moeten worden teruggebracht naar het oorspronkelijke ontwerp. Het *logboek voor regelmatige inspecties van bouwterreinen* moet worden ondertekend door een geautoriseerde vertegenwoordiger van de opdrachtgever en samen met een ontwerptekening met veranderingen aan het bouwterrein (indien van toepassing) worden afgegeven aan de gespecialiseerde aannemer. Onder regelmatig wordt ten minste verstaan na elke fase in de uitvoering van het werk, na elke tussentijdse grondophoging of afgraving en na elke flinke regenbui, storm, vorst etc.

4. Ontwerp bouwterrein

4.1 De volgende items moeten zorgvuldig op de ontwerptekening van het bouwterrein zijn vermeld en door de opdrachtgever aan de gespecialiseerde aannemer worden doorgegeven: details van de bouwterreinranden, een afbakening van de 2 m.-zone, proefkuilen, kabels, leidingen of holten, opvuldelen, bekende ondergronden, delen die zijn afgedekt door het certificaat of de werkvergunning, testlocaties (indien aangegeven door de ontwerper van het terrein) en andere kenmerken die van invloed kunnen zijn op een veilige werkwijze.
Verder dienen op de ontwerptekening van het bouwterrein aangegeven te worden:
- opstelposities en posities voor het op- en afbouwen van de machines;
- machinerijbanen;
- rijwegen en opslagplaatsen voor prefab palen, damwand, betonmixers, etc.

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[i] N.B. De bodembelasting door een funderingsmachine op schotten is niet alleen van haar gewicht incl. giek, makelaar, hijslast, etc. afhankelijk, maar ook van het toegepaste schottenbed, de excentriciteit van het massa-zwaartepunt t.o.v. het hart van de draaikrans en de excentriciteit waarmee de machine op het schottenbed is opgesteld. Dit aspect is van groot belang bij de toetsing van het bodemdraagvermogen. De stabiliteit is o.a. afhankelijk van de grootte van het schottenbed en de positionering van de machine daarop.

[ii] N.B. Bedacht moet worden dat de belastingen zich tot beduidend verder dan deze 2 m-zone uitstrekken. Het ontwerp en de opbouw van het bouwterrein dienen ten minste de volledige invloedzone van de funderingsbelastingen te omvatten.

Bouwterreincertificaat (BTC) Nederland

Logboek voor regelmatige inspecties van bouwterreinen

Het bouwterrein is geïnspecteerd. Alle noodzakelijke inspecties, onderhoud en herstelwerkzaamheden van het bouwterrein geschieden volgens het oorspronkelijke ontwerp. Indien noodzakelijk is een herziene werktekening van het bouwterrein aan de gespecialiseerde aannemer ter beschikking gesteld.

Datum	Organisatie	Naam & functie	Handtekening	Opmerkingen (zoals belangrijke aandachtpunten m.b.t. wijziging, aanpassing, onderhoud, reparaties, datum van de volgende inspectie en of al dan niet een herziene tekening is verstrekt)

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Publicaties van de NVAF:

Arbocatalogus funderingen, ‘Kies een proces’, Funderingsmachines en de bouwplaats, www.arbocatalogus-funderingen.nl

NVAF-richtlijn voor drijvend funderingsmaterieel, 2016

NVAF-richtlijn veilig hijsen bij funderingswerkzaamheden, 2016.

NVAF-richtlijn voor funderingswerk in de publieke omgeving, 2016

Ontwerpcriteria heitraversen, NVAF, 2005

NVAF-TCVT Opstellingskeuring Funderingsmachine, www.tcvt.nl

Vakboekje Veilig Funderen, NVAF, 2e druk, 2013

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Nederlandse Vereniging Aannemers Funderingswerken

Ceintuurbaan 2
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F 0341 456 208
E secretariaat@nvaf.nl
www.funderingsbedrijf.nl

bouwen aan betrouwbaarheid

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Appendix 11

Risk Solutions

Piling rigs overturning on construction sites

A guide to loss prevention

Appendix 11

HSB Engineering Insurance

Munich RE

Modern piling rigs can weigh as much as 200 tonnes and have a high centre of gravity. The 'leader' part of a rig can be up to 30 metres high, thus the high centre of gravity, high static weight, and the forces exerted while rigs operate or move mean that the ground conditions beneath such rigs is a critical safety issue.

Each year, piling rigs topple causing significant property damage and potential business interruption claims. This is usually due to inadequately prepared or maintained site surfaces.

A guide to loss prevention

The stability of tracked plant depends on the provision of a well prepared, inspected and maintained site surface.

Good co-ordination between piling companies and the principal site contractors is essential. Details of the plant to be used and bearing pressures must be provided, and the site surfaces must be correctly prepared in advance of work commencing.

Safety co-ordination requires:

- Planning: Sufficient time must be spent on planning the safety of the construction operations.
- Space on site: Working schedules can be tight; foundation contractors may be asked to arrive with several piling rigs simultaneously at a site that is too small to accommodate them.
- Space around the site: Stability of equipment is crucial due to the height of the rigs.

Common terms

Piling rig: A construction machine mainly used to drill/create piles in soil, clay, etc. Widely used for cast-in-place piles, diaphragm walls, and foundation reinforcement. Max. pile diameter typically 1.5-4m, max. pile depth from 60-90m. Generally with crawler chassis, box-type mast, and telescopic drill pipe. Mainly used in foundation engineering of elevated roads, bridges, industrial and civil buildings, slope protection, etc.

Working platform: Temporary geotechnical structures providing a stable working surface for piling rigs, mobile cranes and other heavy construction equipment. A working platform is the foundation for a piling rig which may weigh up to 200 tonnes.

Working Platform Certificate: A certificate which confirms the working platform has been properly designed and constructed in accordance with the design, and that it will be adequately maintained to ensure the ongoing integrity of the platform.

It requires the signature of the main contractor on the project and must be handed to the piling contractor before piling or other foundation work commences. The certificate introduces a system for highlighting specific responsibilities, increasing safety awareness and highlighting the importance of maintaining the platform in good condition.

Key components of a safe piling rig operational plan include:

1. Adequate pre-planning
The following arrangements should be made prior to arriving on site. Safe set-down areas need to be established within reach of the rig; as does an area accessible to vehicles with sufficient space to unload items up to 20m in length.

2. Working platform
A working platform is the name given to the designated area of the site over which the piling rig will travel during its delivery to site, piling operations, and removal.

The design, installation, maintenance and repair of the working platform should be the responsibility of the main contractor. The ground needs to be checked and its stability confirmed. This may include load and integrity testing, investigation of any irregularities and any necessary remedial works. The ground must be free-draining to prevent the build-up of water and slurry. In certain cases, separation/filter membranes may need to be installed beneath the platform material to prevent damage/weakness of the ground strength.

3. Working Platform Certificate
The use of 'Working Platform Certificates' is increasingly being seen as a way to ensure the following:

- the correct procedures have been followed
- the ground is adequate to support the piling rig
- there are no irregularities that could result in local subsidence and toppling

A visual inspection can only check the ground surface. It is important to check the underlying material, the quality of the fill, its construction and depth (and the application of any membrane material if required). The piling contractor should advise what rigs are to be used, including the bearing pressures, dimensions and working space required. These details should be summarised on the Working Platform Certificate.

4. Inspection of piling equipment prior to the start of piling operations
A review of the general condition should be supplemented by daily checks using a checklist form. Equipment should be inspected at the start of each shift or during operations; for example, where the operator suspects that hydraulic hoses have become snagged during piling operations.

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5. Inspection of the site during piling
The ground surface can deteriorate over time. Excavations, trenches, or other holes dug must be properly backfilled to avoid creating soft spots that might give way under the tracks of a piling rig. A 1sq.m soft spot can be sufficient to unbalance a piling rig and cause it to topple over. The edge of the ground to be used by the piling rig needs to be clearly defined (ground preparation should extend beyond the working area required) and should be regularly inspected to identify and correct any degradation.

6. Risk assessment
A task specific Risk Assessment and Method Statement should be conducted to include all hazards and foreseeable risks relating to the delivery to site, erection, use, movement, dismantling, and removal from site of the piling rig.

7. Operator training
All workers involved (e.g. the piling rig operator; lifting supervisor; rigger and signalman/banksman) should be trained and competent in their specific duties. Both the operator and his supervisor should be made familiar with the operational controls and the supplier's instructions for the specific piling equipment in use.

UK Building Research Establishment - BR 470 'Working platforms for tracked plant'
ISBN 1 860817 009
Provides good practice guidance on the design, installation, maintenance and repair of ground supported working platforms constructed of granular material for the use of tracked plant. Development of the BR 470 design method included a rigorous benchmarking process, using a range of types and sizes of piling rigs, to verify that the platform thicknesses calculated would be economical and safe.

8. Permits to Work
The Permit to Work should be prepared by a person familiar with the piling work procedures, the hazards involved and the precautions to be taken. A review of the Risk Assessment and 'Working Platform Certificate' should be essential aspects that are checked prior to sign-off.

9. Qualified banksman
Piling rig movements should be supervised by a qualified banksman who must always be in the line of sight of the operator. The banksman also needs to have sight of the tracks and the ground it will be moving over whenever movement of the rig is planned.

10. Pre-planning for maintenance and refuelling
Pre-planning should include consideration of mobile maintenance and refuelling stations so that such operations can be brought to the rig and conducted without tracking the rig backwards and forwards to fixed maintenance or refuelling points.

Practical considerations

There have been a number of instances on construction sites of piling rigs toppling over while operating on unbound working platforms. Investigations following such incidents have often found that inherent, isolated areas of weakness or ground collapse have been the actual causes of failure, which were not indicated by load testing. For this reason, it is essential that contractors carefully inspect and check sub-grades such as old pits or trenches for evidence of localised weak areas prior to any work commencing.

Case study: Piling rig falls across live passenger/freight railway lines

During piling works on a major railway infrastructure project, a CFA piling rig fell across adjacent live passenger and freight railway lines.

Ground conditions at the piling site were somewhat marsh-like and a critical geotextile membrane was relied upon to prevent the stone working platform being displaced into the peat.

To remove an obstruction the contractor dug a trench in the piling platform, which damaged the critical geotextile membrane. The trench was then poorly backfilled. When the rig crossed the trench, the ground settled under one side causing the piling rig to overturn across the live railway lines; bringing down a 25,000 volt overhead catenary during rush hour.

A passenger train had passed by just two minutes earlier - fortunately there were no injuries; however, the railway line was closed for three days. A prosecution and substantial fine ensued. The subsequent investigation found that a significant contributing factor was the breakdown of communication between senior and junior site managers, who were not aware how critical the piling platform and design was, or the need to involve the platform design engineer in any repairs.

References:

- Federation of Piling Specialists (UK): www.fps.org.uk
- ADSC – The International Association of Foundation Drilling: www.adsc-iafd.com
- European Federation of Foundation Contractors: www.foundationworld.org.uk
- Working Platform Certificate: www.fps.org.uk/fps/guidance/platforms/platforms.php

HSB-LCE-RGN-007 Rev: 0 Date: 10/03/2014

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www.hsbeil.com

For more information contact our HSB Engineering Insurance office:

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Dublin
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NOT IF, BUT HOW

HSBEI-1294-0314

Appendix 11

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General terms and conditions for foundation works

Clause 1. PELSC

1.1 By declaring these general terms and conditions applicable, the Principles of European Law on Service Contracts (PELSC) also apply, whereby the contracted party shall be deemed to be the constructor in accordance with and in the meaning of art. 2:101 PELSC and the work contracted by the contractor as the construction / structure in accordance with and in the meaning of art. 2:101 and 2:102 PELSC.

1.2 In the event of a conflict between these general terms and conditions and the PELSC, these general terms and conditions prevail.

Clause 2. Formation and content of the agreement

2.1 The agreement is formed by the acceptance of the offer of the contractor or by a written agreement. If the exactness of a written confirmation of a verbal assignment has not been disputed in writing within eight working days after receipt by the client, the parties are bound to it.

2.2 Unless otherwise agreed, the drawings, technical specifications and conditions of the principal of the client do not apply.

2.3 All work not specifically referred to in the agreement, does not form part of the agreement.

2.4 Unless otherwise agreed, the following activities and costs are in any event for the account of the client;

- value added tax (VAT) or similar national tax.
- taking all necessary traffic control measures, obtaining any permits and payment of sufferance rights on encroachments in, on or above public land;
- insurance premiums;
- connection costs, disconnection costs and usage costs of gas, water and electricity;
- inspection of building material, equipment and tools at the request of the client (the costs of these inspections are for the account of the client);
- carrying out soil-related surveys including, but not limited to, geotechnical surveys and environmental surveys;
- making calculations and drawings;
- (height) measurements, measuring work as well as the monitoring and maintenance of such during execution;
- required excavation, demolition, cutting, shoring and repair work to constructions;
- welding and burning work;
- levelling of pile heads, walls, barriers and massifs with soil improvement;
- carrying out all soil and drainage works and the installation of auxiliary structures required for the stabilisation of other construction and the surrounding area;

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- the removal of all obstacles in, on and above the ground which could impede the execution of the work or cause damage;
- making the proper choices in the design phase in accordance with the occupational hygiene strategy when determining the foundation engineering option;
- the arrangements made or measures taken to prevent noise nuisance, nuisance or damage to the environment, adjacent premises, installations, information carriers, cables, ducts and road surfaces;
- client fees;
- pile-driving supervision, calendaring, test-loading, taking acoustic measurements and making/testing drilling cores;
- fencing and surveillance of the building site;
- providing (waste) containers and the landfill costs;
- a Permit to Dig or similar authorisation on a daily basis or as otherwise agreed marking the exact location of remaining overhead or underground of all live or disused pipes, cables or the like to prevent the entry of concrete, grout, slurry or drilling fluids during construction.
- making available site huts for breaks and sanitation in accordance with working conditions legislation
- drawing up quality, safety and inspection plans.
- control or diversion of footpaths, road, rail or water borne traffic, including all necessary arrangements and payment of charges in connection with any road closures, lane rental and/or suspension of parking bays, rail possessions and the like.
- provision of site security to safeguard plant, equipment, materials and the contractor works.
- provision of internet access (Wifi) and designated areas for mobile phones.
- manned wheel-cleaning facilities and/or road-cleaning, as necessary.

Clause 3 Risk regulation, prices

3.1 The prices referred to in the offer are based on the taxes, levies, wages, social insurance costs, material and raw material prices and other costs in force on the day of the offer. If, after the date of the offer, one or more of these cost categories undergo or have undergone a change, the contractor is entitled to change the agreed price as a result.

3.2 If the contractor has stated unit prices, these prices only apply insofar as the work is completed unchanged and the activities can be carried out unchanged. If the manner of execution changes, the unit prices will be reconsidered.

Clause 4. Obligations of the client

4.1 The client shall adequately inform the contractor of the specification elements, pile plans and other documents and knowledge the client possesses which are relevant for the execution of the work, whether or not originating from the principal. If said documents are fully or partially part of the agreement, in case of any conflict between these general terms and conditions and said documents, these general terms and conditions prevail. The client guarantees the accuracy and completeness of the information it has provided.

4.2 The client ensures that the contractor has timely access to geotechnical and hydrological information, information on soil contamination, old building materials emerging from the work and the building material made available by the client, information on the structural condition of adjacent premises as well as changes of work and/or site circumstances which the client was, or should have been aware of, in advance, the above information being relevant to or affecting the price of the work. The client guarantees the accuracy and completeness of the information it has provided.

4.3 The client guarantees the orders and directions which the principal gives directly to the contractor in the context of pile-driving supervision conducted by it.

4.4 If construction meetings are held between the principal and the client without the contractor being present, the client must inform the contractor regarding the issues discussed in the meeting insofar as they relate to the work assigned to the contractor. In that event, the client shall provide the contractor with a copy of the relevant passages from the construction meeting minutes.

4.5 The client ensures that the contractor has the approvals and permits required for the work in good time before the commencement of the activities. The client makes the required payments of levies and fees which may be due for the use of the site or for the execution of the foundation work.

4.6 The client makes health and safety facilities available in order to meet the applicable legislation and regulations.

4.7 The client shall take all the required provisions to prevent nuisance to the surrounding area, damage to adjacent premises and the environment.

4.8 The client is responsible for the order of the activities to be carried out prescribed by or on behalf of the client, prescribed pile systems or sheet piling profiles and foundation engineering, including the influence on such which may be exerted by the soil condition or due to hydrological causes, the condition and the location of cables, ducts and constructions or obstacles in the subsoil, omitted or incorrectly provided information which the client was obliged to provide pursuant to the agreement as well as the orders and directions given by or on its behalf.

4.9 The client guarantees the complete suitability of the building material it has prescribed and for building material which must be purchased from a supplier it has nominated, unless the contractor had the freedom of choice in relation to this building material.

Clause 5. Working Platform and area

5.1 The client is responsible for the proper practicability and access of the building site, or in the event of water works, for the navigability to and from the working area, for the transport of equipment, materials and personnel. The costs of any required facilities to make the site reachable and suitable for execution of the activities by the contractor are for the account of the client.

5.2 Design, installation, maintenance, regular inspection, repair and subsequent removal and exclusive use of free draining Working Platform, safe for pedestrian access and in accordance with the requirements of the attached Guidance, Regular Inspection Log and Working Platform Certificate. A signed copy of which must be provided to the contractor prior to the contractor's commencement. The design(s) shall include for all piling rigs, ancillary plant and equipment and wheeled transport including articulated and ready mixed concrete lorries and the checking of any retained structures which support the Working Platform. Where it is not possible for the contractor to have exclusive use of the Working Platform, the contractor's agreement to any other activities to be carried out concurrently must be obtained before they are commenced.

5.3 The client is responsible for the removal, in advance, of obstacles located above ground on the surface area which negatively affect the work of the contractor or the quality of the work or may cause damage to such.

5.4 The client ensures that there is sufficient space around the location of the activities by the contractor and its equipment, including sufficient space for the protection of adjacent works and the property of third parties. If necessary, a minimum required clearance is agreed.

5.5 The client is responsible for providing adequate parking facilities for the contractor, its subcontractor and employees, free of charge for the contractor.

5.6 The client is responsible for the construction and maintenance of suitable access routes from the public road to the building site and the storage area.

5.7 The client is responsible for adequate overall lighting and direct lighting of the building site to enable safe working conditions and safe entry and exit, and to facilitate the execution of the work of the contractor.

5.8 The client is responsible for the supply of sufficient electricity and water at the work and at the site where the activities are carried out.

5.9 The client is responsible for the control or rerouting of any road, train or shipping traffic and for placing, maintaining and removing all necessary traffic signs and for other traffic control measures.

5.10 The client is responsible for site huts for breaks and sanitation (also) on behalf of the contractor in accordance with the Working Conditions Act.

5.11 The client must make appropriate and efficient rescue equipment permanently available and maintain this equipment, including lifeboats and navigators where required.

5.12 The contractor is entitled to fence off its work by means of fencing. Where the work is fenced off, only the contractor is authorised to have access.

5.13 The contractor is entitled to reimbursement of costs and/or a term extension if the execution of the work by the contractor is delayed or the contractor suffers loss in any other way because the client fails to comply with its obligations pursuant to this clause, unless the costs and/or delay are due to a circumstance which can be attributed to the contractor.

5.14 Protection of the works where taken over by other trades or contractors or where the contractor has left site, whichever occurs first. Backfilling of an empty bore/panel excavation with a suitable material which will not obstruct or be deleterious to the works but which will ensure the stability of the contractor works and will maintain compliance with items 5.1, 5.2 and 5.4.

Clause 6. Soil

6.1 The client is responsible for the advance removal of underground obstacles that may negatively affect or damage the work of the contractor or the quality of the work. The client is responsible for the removal of obstacles (whether or not created by people) - including archaeological objects - that are discovered during the execution of the work.

6.2 The client is responsible for an adequate facility for the removal of, the packaging of, or the protection against poisonous or harmful materials found in the soil. If during the execution of the work, the contractor has to take safety measures in connection with the discovery of items or substances, the obligations or costs arising as a result are reimbursed to the contractor as additional work.

6.3 Clear and substantive setting out, marking or exposing on site the exact location of existing underground and overhead works and services and providing a drawing on which their positions in line and level are accurately plotted relative to the contractor's works. Adequate protection, diversion or removal of such works or services in order to prevent damage from the contractor's operations. The location and plugging off of all disused pipes or ducts in order to prevent the entry of concrete, grout or drilling fluids during construction.

6.4 Prior removal of overhead, surface or underground obstructions which may affect or impede the contractor's operations or quality of the works and backfilling of excavations and voids with a suitable material which will not obstruct or be deleterious to the works but will ensure the stability of the contractor's plant. Also removal of unexpected man made obstructions, including archaeological items and reimbursement of additional costs, including delays, to the contractor works.

6.5 The contractor is entitled to reimbursement of costs and/or a term extension if the execution of the work by the contractor is delayed or the contractor suffers loss in any other way because the client fails to comply with its obligations pursuant to this clause, unless the costs and/or delay are due to a circumstance which can be attributed to the contractor.

Clause 7. Commencement of the work; duration of the execution

7.1 The client shall prepare a realistic schedule in consultation with the contractor.

7.2 The client must, in consultation with the contractor, make the construction site available on the first day of the agreed week. It is determined in consultation between the parties on which day in the agreed week the work commences.

7.3 If it is not possible for the contractor to commence its work in the agreed week, the client shall notify the contractor as soon as possible, but at the latest two weeks before commencement, or so many days as agreed by the parties, before the agreed commencement date.

7.4 If the work cannot commence in the agreed week due to the actions of the client, a new commencement week must be agreed with the contractor which fits in with the schedule of the contractor.

7.5 If the commencement or progress of the work assigned to the contractor is delayed by force majeure, by circumstances attributable to the client or by an amendment in the agreement or the conditions of the execution, the loss arising from this for the contractor shall be compensated by the client.

7.6 The client shall compensate the contractor for the business interruption costs, trading loss and consequential loss suffered by the contractor as a result of the client, or a third party, failing to carry out the work and/or deliveries properly, in full and on time, or other circumstances which are for the account of the client.

7.7 Force majeure includes: any independent cause beyond the will and/or control of the contractor which is not at its risk and as a result of which the contractor is prevented from complying with its obligations. Force majeure includes in any event: abnormally high or low water levels, floating ice, unworkable weather, industrial action, riot, wilful damage and delay in the work and deliveries to by carried out by the client and/or third parties, outside the responsibility of the contractor.

7.8 If due to changed circumstances, force majeure or suspension of the work the contractor is impeded in the performance, or full performance, of the agreement, it is entitled to amend the performance of the agreement. The contractor shall then take the justified interests of the client into account.

7.9 An amended performance as a result of circumstances referred to in clause 7.8 shall be settled as contract variations.

Clause 8. Insurance

8.1 The client insures the work from the start of the work up to and including the end of the maintenance term, if agreed, or at any rate up to and including the delivery, by means of a CAR insurance, against all material damage, loss or destruction, due to whatever cause, replacing Article 951 and insofar as necessary Article 932 Book 7 of the Dutch Civil Code, for such an amount that the costs of clearing up, repair or replacement of all that is damaged or lost can be paid. This CAR insurance must be primary, meaning that it prevails over other insurances.

8.2 The CAR policy shall state that in any case of damage, the pay-out of the insurance money shall be made to the party who owns the goods. Deductions relating to excess can never be more than 1% of the contract sum per event for the contractor. The client shall not offset any claims against the contract price of the contractor.

8.3 The insurance covers in any event:

- the loss which arises as a result of the loss and/or material damage of (part of) the work, as well as all accompanying work, additional work, changes, all materials and building materials, structures and parts destined for the work, and in addition all temporary and/or auxiliary works, auxiliary materials and other objects to be used for the benefit of the work.
- liability for loss which is the result of, or relates to, the execution of the work on the building site and/or its direct environment, including damage caused by work equipment subject to the Motor liability insurance.
- material damage to and/or loss of property of the principal, caused by the work;

8.4 The client shall ensure that the CAR insurance does not include in an in-the-ground-formed-piles and/or sheet piling clause.

8.5 The client shall stipulate that in the policy all the parties involved in the work and their employees shall be considered to be third parties towards each other.

8.6 Without prejudice to the responsibility of the client to comply with the obligations of this clause, the client is obliged to submit the policy, the general policy conditions and the clauses before the commencement of the work. At the request of the contractor, the client is also obliged to demonstrate that there is actual cover.

8.7 Without prejudice to the provisions in clause 8.1, the client, in whatever capacity, and/or its employees shall never be deemed to be co-insured under the insurance policies of the contractor.

8.8 The client indemnifies the contractor against claims for compensation for which the CAR insurance does not entitle to an insurance benefit as a result of the failures by the client in the obligations on the basis of this clause.

Clause 9. Liability of the parties

9.1 If the contractor does not comply with its obligations and the client therefore declares the contractor to be in default, the notice of default shall be in writing and the client shall give the contractor a reasonable term to as yet comply with its obligations.

9.2 The contractor does not accept liability for:

a. misplacement of piles and (sheet) piling, unless demonstrably caused by gross negligence and this has been notified by the client in writing on time;
b. damage caused to underground cables, pipes or ducts, culverts, sewers and such like, unless the client has sufficiently informed the contractor by means of drawings of their location and this location corresponds with the provided information;
c. loss as a result of errors in the design, unless the agreement expressly shows that the contractor is liable for the design of the complete works or for that part in which the error has occurred.

9.3 The obligation of the contractor to pay compensation, on whatever basis, is at all times limited to the amount of the contract price.

9.4 Without prejudice to the provisions in clause 9.3, the obligation of the contractor to pay compensation is limited to the amount to which it is entitled on the basis of the Construction All Risk (CAR) insurance, Motor liability insurance or public liability insurance taken out by or (partly) for the benefit of the contractor.

9.5 If, for whatever reason, the insurances as referred to in clause 9.4 in respect of loss for which the contractor is held liable, do not entitle to a benefit, the total liability of the contractor for losses, damages or costs of any kind shall be finally limited to 10% of the contract value or € 225,000.00 whichever is the lower and our total liability in respect of delay shall be limited to 5% of the contract value or € 25,000.00 whichever is the lower.

9.6 If the circumstances as referred to in clause 9.5 occur, the damage to the work, which at least includes the equipment, temporarily constructions, building materials, is deemed to come for the account of the client, unless the damage can be attributed to the contractor.

9.7 If the circumstances as referred to in clause 9.5 occur, the contractor does not accept liability for damage to the works of the client connected to the work or to other works and property of the client or third parties, unless the damage has been caused by the execution of the work and is due to an intentional act or gross negligence of the contractor, its personnel, its subcontractors or its suppliers.

9.8 The client indemnifies the contractor against all claims by third parties for loss for which the contractor pursuant to the agreement between the client and the contractor is not liable.

Clause 10. Delivery

10.1 The contractor shall notify the client if it considers the work to be ready. A submitted final instalment or a final invoice are considered to be a notice of completion for the work carried out.

10.2 Following the notice of completion, the client shall inspect the work and subsequently notify the contractor whether or not the work is approved, possibly stating the items on the delivery points still to be remedied.

10.3 The work is deemed delivered if is approved by the client or if the client has failed to make known in writing that it disapproves the work within fourteen days after the day on which the work in accordance with the completion notice of the contractor was ready. The work is also deemed delivered if it is taken into use by the client, which also includes the carrying out of further works to the work by the client.

10.4 The day of delivery is the day on which the work was ready according to the contractor's completion notice, provided that the work can subsequently be deemed as delivered in accordance with clause 10.3.

Clause 11. Retention of title

11.1 As long as the client has not made full payment in respect of the agreement, the delivered materials remain for the account and at the risk of the client and, either processed or unprocessed, the property of the contractor.

11.2 This retention of title also covers the materials already paid for by the client if and, insofar other materials, also those later delivered, remain unpaid by the client.

Clause 12. Disputes

12.1 Unless otherwise stipulated by the parties in the agreement, all disputes - including those only considered to be such by one of the parties - as a result of the agreement or of agreements resulting from such between the client and the contractor are resolved by arbitration in accordance with the Regulations of the Court of Arbitration for the Building Industry in the Netherlands or an International Chamber of Commerce as applicable on the day of the contract award or contract confirmation.

12.2 Instead of relying on the dispute resolution as set out in clause 12.1, the contractor is entitled submit a dispute to the competent court in the district of the contractor.

12.3 If a clause in these conditions is declared void or unreasonably onerous, either wholly or in part, by any court or arbiter, it is deemed to have been converted into a clause which, whilst maintaining the content and purport of such as far as possible, cannot be classified as such.

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Safety on Working Platforms 2016: https://youtu.be/KkUn90iqG2U

Appendix 14

U.S. Department of Labor

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the attention of

OCT 2 2012

Richard Marshall
Safety Director
Richard Goettle, Inc.
12071 Hamilton Avenue
Cincinnati, OH 45231

Dear Mr. Marshall:

Thank you for your January 7, 2011 letter to the Occupational Safety and Health Administration (OSHA) in which you ask for clarification of a requirement of the Construction Cranes and Derricks Standard (Subpart CC of 29 CFR Part 1926). We have paraphrased your questions as follows:

Question #1: If the site is uneven, wet, soft, and generally unsuited for safe crane operation, is the general contractor required to improve the site?

A: Yes, assuming that the general contractor is the controlling entity or employer described in §1402(d), which would normally be the case.[1] It is ultimately the controlling entity's responsibility to make sure sufficient improvements to ground conditions are made for the crane to be assembled or used within the requirements of section 1926.1402(b). Section 1926.1402(c)(1) requires that the controlling entity must ensure that ground preparations necessary to meet the requirements in paragraph (b) of this section are provided. OSHA requires the controlling entity to be responsible for ground conditions because the controlling entity has the authority to improve ground conditions and is more likely to be able to have the necessary equipment provided. For more discussion of this provision, see the explanation of the final rule at 75 Fed. Reg. 47,931, 47,933 (Aug. 9, 2010).

OSHA's standard provides flexibility to the controlling entity regarding the means by which it assesses ground conditions and remedies deficiencies. The standard defines the controlling entity's responsibility in terms of "ensure" and "are provided" to make clear that the controlling entity does not have to personally determine and prepare the necessary ground conditions. 75 Fed. Reg. 47934. However, the standard makes clear that the ultimate responsibility for ground conditions remains with the controlling entity, and the standard sets up a system of communication to facilitate the fulfillment of that responsibility. For example, section 1926.1402(e) requires employers of crane operators to "have a discussion" with the controlling entity if ground conditions are inadequate under paragraph (b)(1). See 75 Fed. Reg. 47,933-35.

[1] Subpart CC defines a controlling entity as an employer that is a prime contractor, general contractor, construction manager, or any other legal entity which has overall responsibility for the construction of the project—its planning, quality, and completion. Paragraph §1402(d) provides that in the absence of any controlling entity at a worksite, the "employer that has authority at the site to make or arrange for ground preparations needed to meet paragraph (b) of this section" is responsible for the controlling entity ground preparation duties specified in § 1402.

Question #2: How long in duration is the controlling entity required to ensure that adequate ground conditions are provided in accordance with the requirements of 29 CFR 1926.1402(b)?

A: The crane standard does not include any durational limit on this duty. Thus, the controlling entity must meet this obligation whenever the crane is set-up or used, and that duty continues for the duration of the construction activity, including set-up needed for assembly and disassembly, as well as for hoisting operations and movement of the crane around the site.[1] Because construction worksite conditions are always subject to change, section 1926.1417(d)(1)(x) requires a competent person to inspect the ground conditions each shift to ensure proper support of the crane. In addition, section 1926.1402(e) requires that the operator or assembly/disassembly director notify the controlling entity of inadequate ground conditions. Therefore, the controlling entity must provide for preparations whenever they are needed to address changes in ground conditions that would make its support of the crane inadequate, even if the crane has not moved on the site.

Thank you for your interest in occupational safety and health. We hope you find this information helpful. This letter constitutes OSHA's interpretation of the requirements discussed. OSHA requirements are set by statute, standards, and regulations. The Occupational Safety and Health Act requires employers to comply with safety and health standards promulgated by OSHA or by a state with an OSHA-approved state plan. However, this interpretation is not itself a standard or regulation, and it creates no new legal obligations. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov. If you have any further questions, please feel free to contact the Directorate of Construction at (202) 693-2020.

Sincerely,

James G. Maddux, Director
Directorate of Construction

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[1] See Cranes and Derricks in Construction Final Rule: Frequently Asked Questions, #31 (delivery of crane to a worksite may not constitute "construction activity" in certain situations), available at http://www.osha.gov/cranes-derricks/faq.html

Appendix 15

Occupational Health and Safety Act
Loi sur la santé et la sécurité au travail

ONTARIO REGULATION 213/91

CONSTRUCTION PROJECTS

Note: On July 1, 2016, the Regulation is amended by adding the following sections: (See: O. Reg. 345/15, s. 19)

ROTARY FOUNDATION DRILL RIGS

156.1 (1) Before the start of any drilling operation on a project with a rotary foundation drill rig,

(a) an inspection of the work area shall be conducted to identify,

(i) potential hazards, including utilities, services, obstructions, structures and soil conditions that may endanger a worker engaged in, or in the vicinity of, the drilling operation, and

(ii) buildings and structures adjacent to, or in the vicinity of, the drilling operation that may be affected by it;

(b) any hazards identified under subclause (a) (i) shall be removed if practicable;

(c) if it is not practicable to remove the hazards identified under subclause (a) (i),

(i) if practicable, they shall be disconnected or inactivated so as not to endanger workers engaged in, or in the vicinity of, the drilling operation, and

(ii) they shall be located and marked by signs; and

(d) a written report shall be prepared that indicates,

(i) all of the hazards identified under subclause (a) (i),

(ii) which hazards have not been removed, and

(iii) which hazards have been disconnected or inactivated. O. Reg. 345/15, s. 19.

(2) The constructor shall keep a copy of the report mentioned under clause (1) (d) at the project until the drilling operation is completed, and make the report available, upon

request, to an inspector and an employer responsible for the drilling operation. O. Reg. 345/15, s. 19.

156.2 (1) Before a drilling operation begins, the employer responsible for it shall,

(a) develop written measures and procedures in accordance with subsection (2) to protect the health and safety of workers engaged in, or in the vicinity of, the drilling operation; and

(b) have a copy of these written measures and procedures provided to, and reviewed with, the workers engaged in the drilling operation. O. Reg. 345/15, s. 19.

(2) The written measures and procedures required under subsection (1) shall include, at a minimum, details of,

(a) the measures and procedures to be implemented to protect workers from all unremoved hazards;

(b) the procedures to be implemented for the assembly, erection, disassembly, alteration and operation of the drilling equipment;

(c) the safe work areas that have been designated for,

(i) the drilling operation,

(ii) the staging, disassembly and alteration of the drilling equipment, and

(iii) the storage of any excavated soil and material;

(d) the procedures to be implemented for removing excavated soil and material;

(e) the restricted access zone that has been designated around the drilling operation to restrict or prevent access by persons or equipment;

(f) the fall protection measures, in addition to those required under sections 26.1 to 26.9, to be implemented to prevent workers from falling into a drill hole or being engulfed by collapsing soil around a drill hole, while or after the hole is drilled; and

(g) the communications system to be used among the drill rig operator, the drill rig front-end worker and other workers in the restricted access zone, or a system of

prearranged visual signals to be used among them if those signals are clearly visible and understood by them. O. Reg. 345/15, s. 19.

(3) Workers shall follow the written measures and procedures. O. Reg. 345/15, s. 19.

156.3 Sections 156.4 and 156.5 apply when a drilling operation at a project uses a rotary foundation drill rig that can exert a ground pressure of 200 kiloPascals or more under its tires, crawlers or outrigger pads in any configuration, including during its operational activities. O. Reg. 345/15, s. 19.

156.4 (1) Before a drilling operation described in section 156.3 begins, a professional engineer shall,

(a) design a supporting surface for the drill rig in accordance with good engineering practice to adequately support the drill rig during all drilling and drill rig set-up activities;

(b) designate and design a path of travel for the drill rig to use on the project to ensure the path of travel safely supports the drill rig; and

(c) prepare a written report described in subsection (2). O. Reg. 345/15, s. 19.

(2) The written report required under clause (1) (c) shall include, at a minimum, details of,

(a) the project and its location;

(b) the designs and specifications for the supporting surface and path of travel;

(c) any operating restrictions imposed by the drill rig manufacturer's instructions, including the maximum safe ground slope for the drilling operation;

(d) the existing soil conditions, all associated hazards to workers' health and safety and the precautions to be taken to protect workers from the hazards associated with the soil conditions;

(e) the minimum load-bearing capacity of the supporting surface required for each activity to be undertaken by the drill rig;

(f) the surface preparation required for the supporting surface and path of travel to safely support the drill rig during its operation and travel;

(g) the parts of the drill rig and the attachments of the drill rig that are permitted on the supporting surface;

(h) the precautions to be taken to ensure that the drilling operation and movement of the drill rig on the path of travel,

(i) do not damage or affect the stability of any building, structure, property or public way adjacent to, or in the vicinity of, the drilling operation, and

(ii) do not endanger a person using any building, structure, property or public way adjacent to, or in the vicinity of, the drilling operation;

(i) the frequency of inspections of the supporting surface and the path of travel of the drill rig, and the type of inspection required, to ensure they remain stable, do not deteriorate and continue to function as designed by the professional engineer, and any specific weather or other conditions that could affect the supporting surface or path of travel that would require additional inspections to be conducted; and

(j) the qualifications of the person who conducts the inspections of the supporting surface and path of travel and whether the person needs to be a professional engineer, a person under the direction of a professional engineer, a competent worker or another person with specified qualifications. O. Reg. 345/15, s. 19.

(3) The supporting surface and path of travel for the drill rig shall be prepared or constructed in accordance with the professional engineer's written report. O. Reg. 345/15, s. 19.

(4) No deviation from the written report is permitted unless the deviation is approved, in advance and in a written report, by a professional engineer. O. Reg. 345/15, s. 19.

(5) The supporting surface and path of travel for the drill rig shall be inspected by a professional engineer after they are prepared or constructed and before the drill rig is assembled and erected on the supporting surface or uses the path of travel to confirm that they were prepared or constructed in accordance with the professional engineer's report. O. Reg. 345/15, s. 19.

(6) The professional engineer shall prepare a written report of the results of the inspection under subsection (5). O. Reg. 345/15, s. 19.

(7) While a rotary foundation drill rig is in service at a drilling operation described in section 156.3, the employer responsible for the drilling operation shall ensure that,

(a) the supporting surface and path of travel are regularly inspected in accordance with, and by the person identified by, the report described in subsection (2); and

(b) a written report of the inspections and results are kept at the project and made available to an inspector upon request. O. Reg. 345/15, s. 19.

(8) The constructor and employer responsible for the drilling operation shall keep at the project a copy of all reports described in this section and make them available to an inspector upon request until the drilling operation is completed. O. Reg. 345/15, s. 19.

156.5 (1) Before a drilling operation described in section 156.3 begins, the employer responsible for it shall,

(a) develop a drilling procedure for the drill rig in accordance with subsection (2) and have it approved by a professional engineer; and

(b) have a copy of the drilling procedure provided to, and reviewed with, the workers engaged in the drilling operation. O. Reg. 345/15, s. 19.

(2) The drilling procedure shall be in writing and shall include, at a minimum, details of,

(a) the sequence of activities of the drilling operation to be followed including, if applicable, the delivery of concrete, rebar, steel piles and other materials related to the drilling operation;

(b) the procedures to be implemented for removing excavated soil and material from an auger or drilling tool and away from the supporting surface of the drill rig;

(c) the location to be used for storing excavated soil and material so that it does not endanger workers;

(d) the working area and designated path of travel to be used for any machinery or equipment used in the vicinity of the drilling operation so that the machinery or equipment does not affect the stability and integrity of the supporting surface of the drill rig;

(e) the measures and procedures to be implemented during the drilling operation to ensure that unremoved hazards do not endanger workers; and

(f) the areas that have been designated at, or in the vicinity of, the drilling operation where,

(i) only persons authorized by the employer are allowed to enter, and

(ii) no persons or equipment are allowed to enter. O. Reg. 345/15, s. 19.

(3) While a rotary foundation drill rig is in service at a drilling operation described in section 156.3, the employer responsible for the drilling operation shall ensure that,

(a) the drilling procedure described in subsection (2) is implemented; and

(b) the drilling procedure is followed by the workers engaged in, and in the vicinity of, the drilling operation. O. Reg. 345/15, s. 19.

156.6 (1) An employer shall ensure that a worker who operates a rotary foundation drill rig,

(a) is qualified in accordance with section 156.7;

(b) has completed a training program that meets the requirements of section 156.9, or is participating in a training program that meets such requirements and is being instructed on the operation of the drill rig;

(c) has demonstrated to the employer that the worker has adequate knowledge and proficiency in operating the drill rig to be used at the project; and

(d) is authorized by the employer to operate the drill rig at the project. O. Reg. 345/15, s. 19.

(2) The employer shall maintain a record of the training program described in section 156.9 provided to the worker that includes,

(a) the worker's name and the training dates; and

(b) the name and signature of the training provider. O. Reg. 345/15, s. 19.

(3) The employer shall make the training record available to an inspector upon request. O. Reg. 345/15, s. 19.

156.7 (1) No worker shall operate a rotary foundation drill rig except in accordance with this section. O. Reg. 345/15, s. 19.

(2) The worker shall,

(a) have completed a training program that meets the requirements of section 156.9 and have written proof of training available at the project to an inspector upon request; or

(b) be participating in a training program that meets the requirements of section 156.9 and is being instructed on the operation of the drill rig. O. Reg. 345/15, s. 19.

(3) If a worker is operating a drill rig with an effective torque equal to or greater than 50 kilonewton metres, the worker shall have a certificate of qualification or written proof of training as required by section 156.8 available at the project to an inspector upon request. O. Reg. 345/15, s. 19.

156.8 (1) No worker shall operate a rotary foundation drill rig with an effective torque greater than 270 kilonewton metres unless the worker,

(a) holds a certificate of qualification issued under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1; or

(b) is an apprentice who is working pursuant to a training agreement registered under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1. O. Reg. 345/15, s. 19.

(2) No worker shall operate a rotary foundation drill rig with an effective torque greater than 190 kilonewton metres but less than or equal to 270 kilonewton metres unless the worker,

(a) holds a certificate of qualification issued under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1, or hoisting engineer – mobile crane operator 2; or

(b) is an apprentice who is working pursuant to a training agreement registered under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1, or hoisting engineer – mobile crane operator 2. O. Reg. 345/15, s. 19.

(3) No worker shall operate a rotary foundation drill rig with an effective torque equal to or greater than 50 kilonewton metres but less than or equal to 190 kilonewton metres unless the worker,

(a) holds a certificate of qualification issued under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1, or hoisting engineer – mobile crane operator 2;

(b) is an apprentice who is working pursuant to a training agreement registered under the *Ontario College of Trades and Apprenticeship Act, 2009*, that is not suspended, in the trade of hoisting engineer – mobile crane operator 1, or hoisting engineer – mobile crane operator 2; or

(c) has written proof that the worker has completed a training program on the operation of a 0-8 ton mobile crane that included instruction on,

(i) the relevant requirements of this Regulation,

(ii) how to use the manufacturer's operating manuals,

(iii) minimum distances when approaching an overhead electrical conductor,

(iv) communications and signals,

(v) types of mobile cranes and their components, including wire and synthetic rope, hydraulics, rigging and rigging hardware,

(vi) pre-operational inspections and checks, and

(vii) safe work practices related to mobile cranes, including crane set-up, load charts, assembly and disassembly of manual boom extensions, basic crane operation and maintenance. O. Reg. 345/15, s. 19.

156.9 A training program for the operation of a rotary foundation drill rig shall include instruction on,

(a) the relevant requirements of this Regulation and the drill rig manufacturer's operating manual;

(b) safe work practices;

(c) communications and signals;

(d) pre-operational inspections and checks;

(e) site assessment;

(f) drill rig set-up, securing and operation; and

(g) equipment maintenance. O. Reg. 345/15, s. 19.

Appendix 16

STRATEGIC FORUM FOR CONSTRUCTION

PLANT SAFETY GROUP

GOOD PRACTICE GUIDE

Ground Conditions for Construction Plant

SAFETY PUBLICATION SERIES
SAFETY PUBLICATION SERIES
SAFETY PUBLICATION SERIES
SAFETY PUBLICATION SERIES

CPA

Appendix 1

Ground Conditions for Construction Plant

Strategic Forum for Construction Good Practice Guide

Reference No. CPA 1402

First Published: October 2014

Published by:

Construction Plant-hire Association
27/28 Newbury St
London
EC1A 7HU
Telephone: 020 7796 3366

Email: enquiries@cpa.uk.net

Appendix 1

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Appendix 1

Foreword

Construction plant is a vital part of the construction process. Plant stability often depends on the integrity of the ground on which it stands. If the ground fails, plant can overturn or collapse. In the past such incidents have led to a significant number of serious accidents, some tragically fatal. Not only do these accidents have a terrible cost in terms of human suffering, they also have a significant financial cost for all concerned. Consequently there is a very strong business case for improving safety performance.

Effective assessment of ground conditions is essential to assist with safe installation, setting up and operation of construction plant.

The purpose of this guidance is to help those involved with planning and carrying out plant operations to achieve a better awareness of ground conditions and how plant selection and use can affect the ground.

This guidance will also help those carrying out ground assessment to be aware of their own limitations - ground engineering can be a complex topic. It will help with planning simple operations and help site staff to work more effectively with experts. It is essential that all involved in planning plant operations know when to stop and seek advice from a structural or geotechnical engineer.

This guidance has been developed by a working group representing all parts of the industry. It provides clarity on the assessment of ground conditions and will help construction plant suppliers and users improve health and safety standards. The guidance addresses planning, ground assessment, plant selection and measures to ensure ground stability. The advice in this document is straightforward, comprehensive and easy to adopt. This guidance may go further than the minimum you need to do to comply with the law.

I thank those who have been involved in its preparation and commend the guidance to anyone who owns, supplies or controls the operation of construction plant. Please read the publication and turn the advice into action.

Philip White
HM Chief Inspector of Construction
Chair of the Health and Safety Executive's Construction Industry Advisory Committee (CONIAC).

Appendix 1

Appendix 17

AMERICAN NATIONAL STANDARD

ANSI/ASSE A10.23 – 2014
Safety Requirements for the Installation of Drilled Shafts

American National Standard for Construction and Demolition Operations

ANSI/ASSE A10.23 – 2014

Appendix 17

AMERICAN SOCIETY OF SAFETY ENGINEERS

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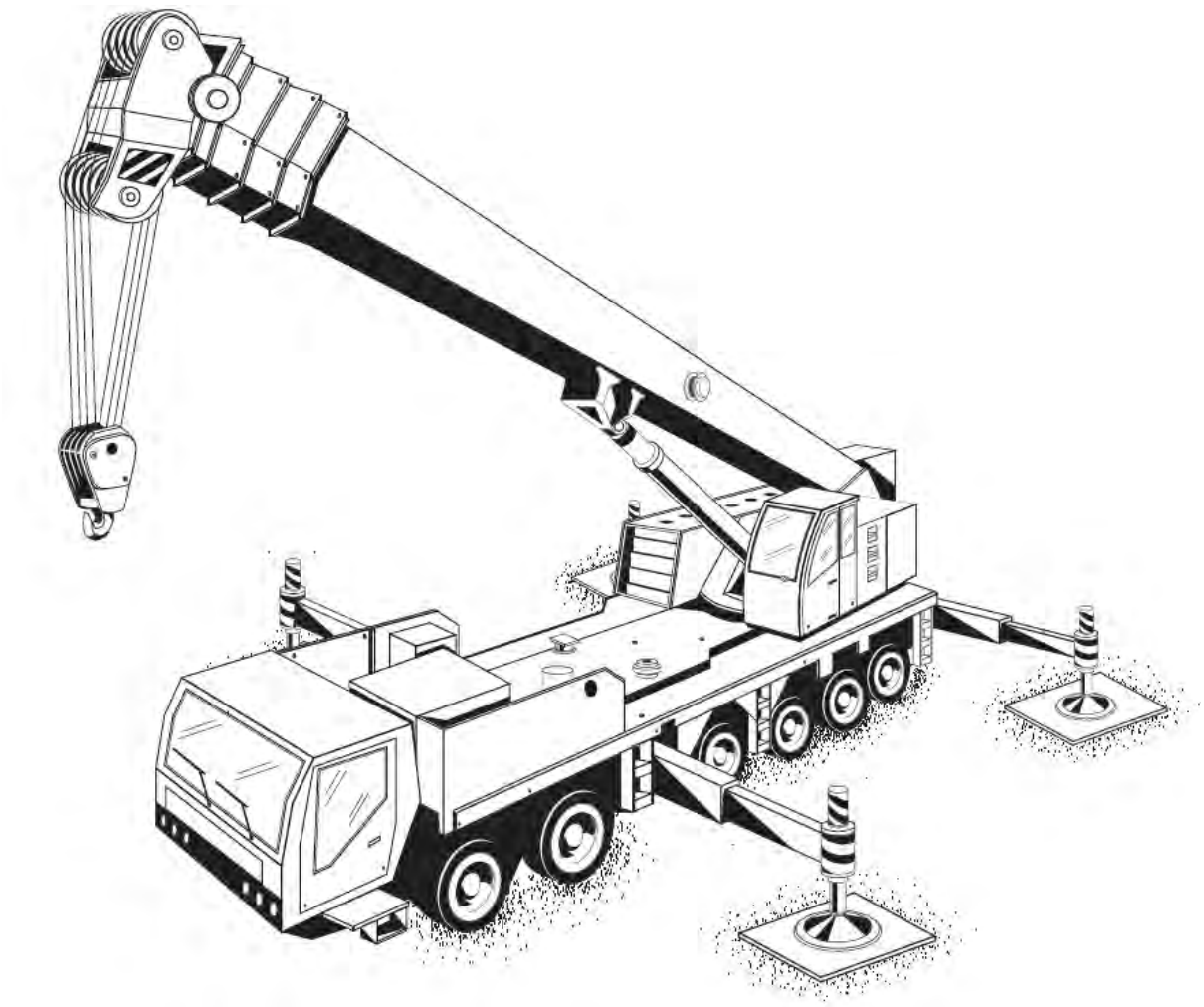
Appendix 18



CICA & CANZ Guidance Note

Crane Stability and Ground Pressure

Author: The Crane Industry Council of Australia

CICA-GN-0013-A

Date: 30/01/2017

Lifting Industry Standards

Appendix 1

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1. Introduction

Many factors need to be considered when safely setting-up mobile cranes on site. Crane stability often depends on the integrity of the ground on which it stands. Effective assessment of ground conditions is essential to assist with safe set up and operation of cranes. To reduce the risk of crane accidents as a result of improper crane set-up, planning activities shall be carried out by a competent person(s) to assess the capability of the ground to withstand the loads and pressures imposed by the lifting equipment.

All parties who are involved in the planning, set up and use of cranes on site must be aware of the fundamental criteria, planning issues and risk assessments that are needed to ensure lifting operations proceed in a safe and stable manner.

This Guidance Note provides general guidance to assist on:

- determining the load exerted by mobile crane outriggers or crawler crane tracks
- determining the suitability of the crane mats, and
- bearing capacity of different types of soil.

2. Responsibility

As with all activities on construction sites, the effective management of the safety of lifting operations can only succeed if all parties involved are clear about their roles and responsibilities. It is essential for all persons undertaking these roles to be competent, having relevant up-to-date training and the qualifications and experience appropriate to the operations for which they are responsible.

The responsibilities for undertaking the various activities involved in ground assessment are set out below:

- A person conducting a business or undertaking (PCBU) that includes the carrying out of construction work (i.e. the principle contractor in control of the project site) has overall responsibility for the safety of all personnel on site. They should ensure that where a crane is being used to carry out a task, adequate steps have been taken to ensure the stability of the crane during transport onto site, set up, use, movement, maintenance, dismantling and removal from the site. PCBU should provide accurate geotechnical report for the site ground condition or other relevant information for crane stability to the worker responsible for the lifting operations if this is necessary for the safe operation of the lifting activity. It is usually the PCBU's responsibility to make sure the ground is safe to work on.
- A worker who carries out work for a PCBU (i.e. the person or company in control of a lifting operation) is responsible for all aspects of planning, supervision and execution of the lifting operation, including ensuring that the ground or structure on which equipment stands will take the loads imposed by the plant. This does not mean that the worker has to be an expert in ground assessment, they must however take reasonable steps to satisfy themselves that the information provided by the person in control of the site is relevant and appropriate. The worker should have the necessary confidence and authority to carry out their duties effectively and safely.

Where doubt exists as to the accuracy or sufficiency of the information provided it is the responsibility of the worker to ensure that the lifting operation does not proceed until the doubt has been satisfactorily resolved.

Appendix 19

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September 11, 2017

ANSI/ASSE Voluntary National Consensus Standards
Recognition by Governmental Agencies

One of the main questions we continue to receive addresses the issue of where/how the ANSI/ASSE Voluntary National Consensus Standards are recognized by governmental agencies.

To answer this question, we have several sources of information we can point to:

#1. A spreadsheet of voluntary national consensus standards created by OSHA. While the spreadsheet is somewhat dated, it still provides a good snapshot for recognized standards:

Copy of ANSI
Standards Used by (

#2. During this past summer ASSE put together an additional spreadsheet addressing recognition specific to the ANSI/ASSE Standards. Our goal is to keep this information updated and include new references as we discover them:

Appendix 19

List of ANSIASSE Standards (Summer

#3. Some background materials addressing the overall issue of government recognition and use of voluntary national consensus standards, which does include the ANSI/ASSE Standards:

- Safeguarding: Are ANSI Standards Really Voluntary? https://www.ansi.org/news_publications/other_documents/safeguarding?menuid=7

- What's the Difference Between an OSHA Rule and an ANSI Standard? http://www.asse.org/assets/1/7/Glen_Demby_Article_-_Use_of_Standards_in_the_Public_Sector1.pdf

- ASSE Position Statement on The Role of Consensus Standards and Governmental Regulations in Occupational Safety and Health http://www.asse.org/assets/1/7/PositionStatementonConsensusStandards.pdf

The Society is interested in additional references addressing recognition of our standards. If you should identify a reference please submit to the attention of ASSE at TFisher@ASSE.Org and we can include in the spreadsheets.

Appendix 20

Bearing capacity of a geogrid-stabilised granular layer on clay

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ABSTRACT

Granular layers are often placed over weaker clay soils to improve the bearing capacity of working platforms and spread foundations. The installation of geogrid within the granular layer can improve the bearing capacity significantly, allowing thinner granular layers to be installed and bringing cost savings associated with the smaller volumes of material and excavation. Existing bearing capacity calculation methods often incorporate the geogrid benefit in terms of a tensile strength obtained from testing in air but this is not suited to multi-axial stabilising geogrid. By testing the shear strength of stabilised granular materials as one composite material it has been possible to derive a bearing capacity calculation method incorporating the full benefits of stabilising geogrid for a range of geometries and clay strengths. This has been based on the recently-developed "T-Value method" that defines the dependency of two-layer bearing capacity on the shear strengths of the two layers. This paper describes the derivation of the *T*-value to subgrade strength relationship for one stabilised material validated by full-scale testing. A working platform design example is also presented.

NOTATION

B Foundation width or diameter

D	Foundation embedment depth
H	Granular layer thickness between foundation base and clay
L	Foundation length
T	Granular layer load transfer efficiency
p'_0	Effective vertical stress at base of granular layer
q_g	Net bearing capacity of granular layer of infinite depth
q_s	Surface bearing capacity of clay
q_u	Net bearing capacity of granular layer on clay
s_u	Undrained shear strength of clay
α	Load spread angle
γ	Weight density of granular layer
φ'	Internal friction angle of granular layer

INTRODUCTION

Granular layers are often used in working platforms and beneath foundations to improve load spread and bearing capacity on weaker clay soils. The installation of a stiff polymer mesh (geogrid) within the granular layer can improve the bearing capacity significantly, allowing thinner granular layers to be installed and bringing cost savings associated with the smaller volumes of material.

Bearing capacity failure involves punching shear through the granular layer and a bearing capacity mechanism in the underlying clay (as illustrated in Figure 1), unless the granular layer exceeds a critical thickness above which shear failure occurs entirely within the upper layer. Existing design methods (without geogrid) include the semi-empirical Meyerhof (1974) or Hannah and Meyerhof (1980) method and the load spread or projected area method. The former is generally more accurate and is recommended by BRE (2004) for the routine design of piling platforms but suffers from the drawback that punching shear coefficients were derived empirically from model footing tests at 1g and not in a non-dimensional form so are appropriate only for the granular layer density and thickness used in the derivation (Burd & Frydman, 1997).

In the load spread method, the granular layer is assumed to spread load uniformly to the underlying clay and the shear strength contribution of the granular layer is ignored (Terzaghi and Peck 1948; Yamaguchi 1963). The angle α of load spread to the vertical is assumed the same as the angle of the straight shear planes in the granular layer. Many values have been proposed, as summarised by

Craig and Chua (1990), and the main drawback of this method is the difficulty of determining α. Brocklehurst (1993) and Ballard et al (2011) showed that α is also influenced by the shear strength of both the granular layer and the underlying clay.

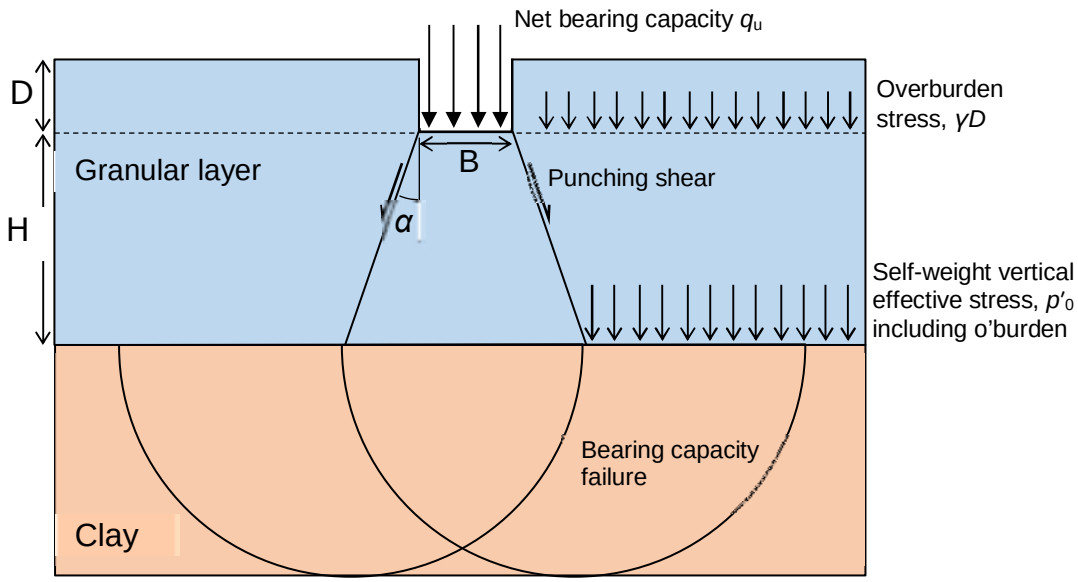

Figure 1: Geometry and terminology of problem

Lees (2019) derived a non-dimensional relationship (Equations 1 and 2) between bearing capacity ratio q_u/q_s and the load transfer efficiency of the granular layer expressed as a dimensionless T value. The T value depends on the shear strengths of the two layers and are derived by numerical analysis (e.g. FEA) parametric study and physical testing, the results of which are shown as the lower non-stabilised curves in Figure 2. In design, this allows a simple calculation to be made of the bearing capacity directly from the shear strengths of the individual soil layers without the need for empirical-based charts. It can be applied to both surface and shallow embedded foundations, circular and rectangular and with dry or saturated granular layers. The bearing capacity of foundations with B/L ratios between 0 and 1 can be determined by linear interpolation. The inequalities in Equations 1 and 2 are needed to check for cases where shear failure entirely within the granular layer is critical.

EQUATION 1: $\frac{q_u}{q_s} = 1 + T\frac{H}{B} \leq \frac{q_g}{q_s}$ (strip footing)

EQUATION 2: $\frac{q_u}{q_s} = \left(1 + T\frac{H}{B}\right)^2 \leq \frac{q_g}{q_s}$ (square or circular footing)

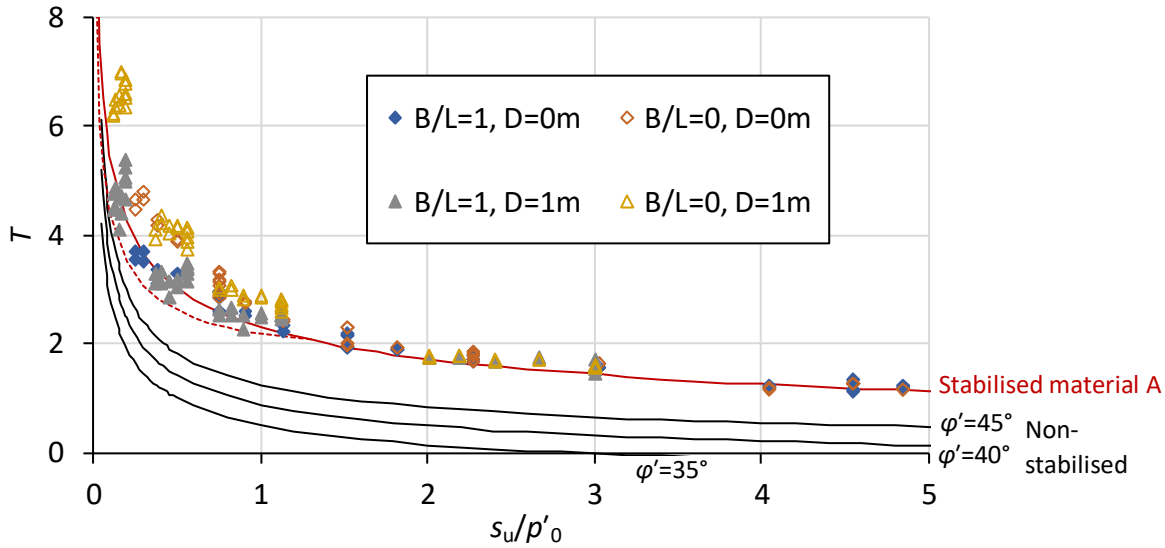

Figure 2: Variation of *T* with s_u for specific geogrid product and aggregate

The Meyerhof (1974) and load spread methods have both been modified to include the benefit of installing geogrid within the granular layer. A simple modification to the former was proposed in BRE (2004) involving the addition of a factored geogrid tensile strength to the design equation while Milligan et al (1989a and b) added the geogrid benefit to the load spread method by taking account of additional shear stresses generated at the interface between the granular layer and clay, limited by the tensile strength of the geogrid. These methods are intended for reinforcing geogrid where geogrid performance is defined in terms of a tensile strength obtained by testing in air. They are not suited to multi-axial geogrid that is designed primarily to stabilise the aggregate rather than provide tensile reinforcement. BRE (2011) recognised that alternative design methods may be used for geosynthetics in situations for which they have been validated. The benefit of stabilising geogrid on bearing capacity has been defined for proprietary design methods in terms of an enhanced load spread angle validated by field experience and laboratory and full-scale testing. The drawback with this method has been the inability to demonstrate analytically the benefit of geogrid stabilisation.

This paper addresses this drawback by presenting a modification to the new "T-Value Method" (Lees, 2019) to include the benefit of installing multi-axial stabilising geogrid in a granular layer overlying clay on its bearing capacity. The dependency of the stabilisation benefit on geometrical parameters and s_u will be determined by finite element analysis (FEA) validated by full-scale testing.

STABILISED SOIL BEHAVIOUR

Stiff, punched and drawn multi-axial (triangular aperture) polypropylene (PP) geogrid was designed primarily to restrict the movement of soil particles in and around its apertures – a function defined as stabilisation in the International Geosynthetic Society's latest guide (IGS, 2018) – and there is evidence (e.g. Bussert and Cavanaugh (2010)) that the stabilising effect of geogrid extends a significant distance from the geogrid plane, typically 30 cm or more.

Lees and Clausen (2019) performed large triaxial compression tests (specimen size 0.5 m dia. x 1.0 m height) with vacuum-applied confining stress on a dry, crushed diabase rock with and without a stiff, punched and drawn multi-axial PP geogrid placed at mid-height. The crushed rock had a coefficient of uniformity C_U of 23 with D_{60} = 8 mm and D_{100} = 40mm. It was compacted to at least 95% maximum dry density. The plots of averaged deviatoric stress q against averaged axial strain ε_a at three different confining stresses with and without the geogrid in Figure 3 show an enhanced peak shear strength in the geogrid-stabilised soil at all three confining stresses. These formed a markedly non-linear failure envelope in the stabilised case due to restraint on particle translation and rotation, significantly increasing the work done required to shear and dilate the specimen. Also of note is the larger strains required to cause significant softening of the stabilised granular soil compared with the non-stabilised. Peak failure occurred at axial strains of about 4 to 5% in the non-stabilised case after which dilation-induced softening occurred whereas the stabilised specimens experienced significant softening at more than about 10% axial strain. Strain levels at the onset of bearing capacity failure in clays are generally up to about 10% depending on the clay stiffness, meaning that lower post-peak shear strengths are appropriate for overlying non-stabilised granular layers when calculating bearing capacity for design but, in many more cases, it would be appropriate to adopt the peak strength of stabilised granular layers due to the higher strain level at which significant strength softening occurs.

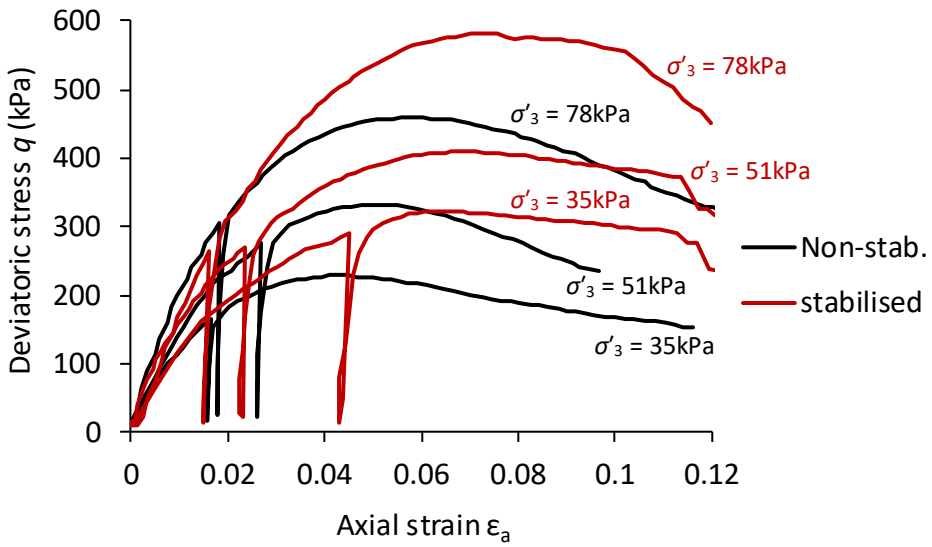

Figure 3: *q* v. εa plots from triaxial compression tests on stabilised and non-stabilised crushed rock aggregate

Since the restraint on soil particles would be at a maximum at the geogrid plane and reduce with distance from the plane, the failure envelope was considered to vary (assumed linearly) from a maximum at the geogrid plane to the non-stabilised failure envelope at a perpendicular distance Δ*y*, beyond which the non-stabilised failure envelope prevailed, as illustrated in Figure 4. The non-stabilised failure envelope can be obtained straightforwardly from shear strength tests on the granular material without geogrid and the maximum failure envelope and Δ*y* determined from the back analysis of shear strength tests with one or more layers of the specific geogrid product being tested.

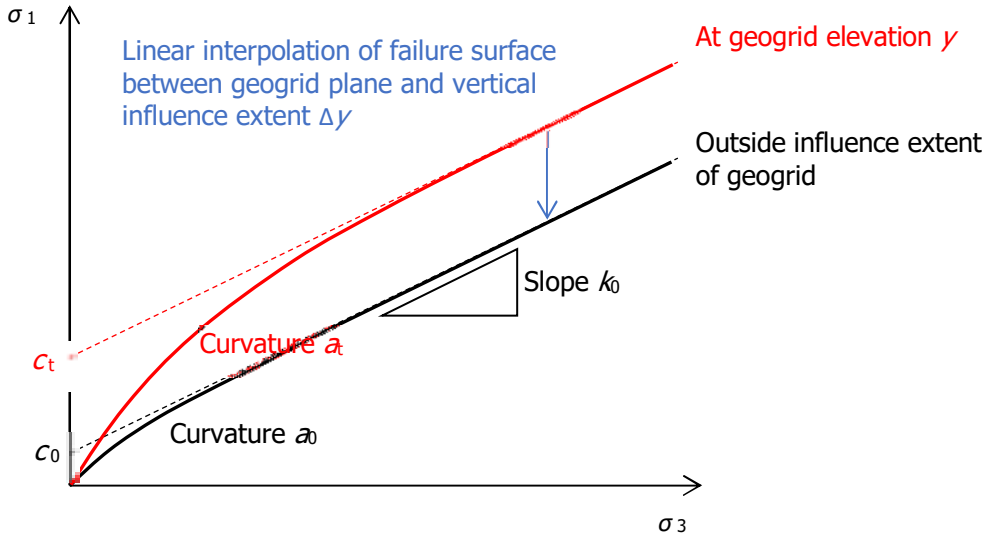

FIGURE 4: Geogrid-stabilised soil failure envelope (Lees and Clausen, 2019).

A linear elastic perfectly-plastic (LEPP) constitutive model called the Tensar Stabilised Soil Model (TSSM) with the non-linear failure envelope was implemented into the Plaxis 2D 2018 (Brinkgreve et al, 2018) FEA software and found to provide accurate predictions of failure stress in back-analyses of the triaxial compression tests (Lees and Clausen, 2019).

FEA PARAMETRIC STUDY

The parametric study of bearing capacity was performed by two-dimensional FEA using Plaxis 2D 2018 in plane strain for strip loads and axisymmetry for equivalent square loads. The TSSM was used for the granular material described in the previous section with a specific stabilising punched and drawn PP multi-axial geogrid denoted together as "Stabilised Material A" with the input parameters shown in Table 1. The clay was modelled with an LEPP model with Tresca failure criterion with undrained Young's modulus E_u taken as $800s_u$ and Poisson's ratio v_u as 0.495. Geometrical and clay shear strength parameters were varied as shown in Table 2 (the square footing *B* values give the same foundation area as the circular footing simulated in FEA). In all cases, one geogrid plane was placed at the base of the granular layer. When *H* was 0.45 and 0.6 m, an additional geogrid plane was placed 0.3 m above the base of the granular layer, and when *H* was 0.75 and 0.9 m, a third geogrid plane was placed at 0.6 m above the base of the granular layer. A rigid, rough footing was assumed in all cases and displacement control was used to increase the load to failure.

Parameter	Value
k	5.7
c_0	56kPa
a_0	2.0
m	5.7
b	2.0
Δy	0.30m
c_t	350kPa
a_t	14
E	50MPa
v	0.25
γ	21kN/m^3

Table 1: TSSM input parameters for Stabilised Material *A*.

s_u (kPa)	5, 15, 30, 80
B/L	0 (plane strain), 1 (axisymmetric)
B (m)	0.3, 0.6, 0.9, 1.2, 1.8, 2.4
H (m)	0.3, 0.45, 0.6, 0.75, 0.9
γD (kPa)	0, 20

Table 2. Input parameters varied in the FEA parametric study.

The output from the parametric study is presented in Figure 2 in terms of the *T* value back-calculated using Equations 1 and 2 from output of q_u and adopting N_c = 5.14 and 6.2 for q_s in the plane strain and axisymmetric cases respectively. All cases, including with overburden stress (γD>0), are shown to follow a similar trend when s_u is normalised by p'_0. The line shown is considered a best fit line for the plane strain (B/L=0) cases and a lower bound for the axisymmetric cases (B/L=1) and follows Equation 3 and can be applied for granular materials of similar characteristics with the specific geogrid product tested. The interactions between aggregates and geogrid are highly complex so similar products may not follow this relationship and should be derived specifically for each product following the same procedure with full-scale validation.

EQUATION 3: $$T = 2.9\left(\frac{s_u}{p'_0}\right)^{-0.32} - 0.6$$

The line follows a similar trend to those derived for non-stabilised granular layers with different φ' angles shown where the *T* value increases with the φ' value. The higher *T* value obtained with a stabilised granular layer is consistent with the higher shear strength imparted to the soil by the stabilising geogrid. The higher ductility of the stabilised granular layer also allows the peak strength to be used in design whereas for non-stabilised soil the strain levels at bearing capacity failure

typically exceed peak failure strains in dense granular materials and post-peak shear strengths should be used in design.

The outputs of *T* value become increasingly sensitive to s_u/p'_0 as s_u/p'_0 values fall below about 1.25 since stress changes have a proportionally bigger effect on bearing capacity as shear strength becomes very low. At s_u/p'_0 values below 1.25, it is recommended to apply the correction shown in Equation 4 to the T value to take account of this uncertainty. This correction plots as the dashed line in Figure 2 which forms a lower bound to all the values obtained in the FEA parametric study. Alternatively, more advanced analysis (e.g. FEA) than the *T*-value method could be undertaken for bearing capacity calculations in very soft clays.

EQUATION 4: $T_{corr} = \frac{T}{1+0.2\left(1.25-s_u/p'_0\right)}$ when $s_u/p'_0 < 1.25$

VALIDATION

The stabilisation function of geogrid and enhanced shear strength are heavily dependent on the interactions between geogrid components and the aggregate particles that are being restrained. As such, the *T*-value to subgrade strength relationship should be derived for specific geogrid products and aggregate types and then validated by full-scale testing appropriate for the foundation or track width to be supported. An example of an appropriate full-scale validation test is presented in this section.

A 0.4 m thick platform of the same characteristics as “Stabilised Material A” including one layer of the multi-axial stabilising geogrid at its base was laid and compacted over the existing ground during construction of the Kingsway Business Park in Rochdale, Greater Manchester in December 2018. The existing ground was a reworked Made Ground comprised of a firm gravelly clay to about 4 m depth.

Five plate load tests (PLT) on the platform surface were undertaken in accordance with BS 1377-4 Clause 4.1 (BSI, 1990). A large 600 mm diameter plate was used for the tests to match the expected loaded width on the platform and to ensure that the critical failure mechanism was punching shear through to the subgrade rather than shear failure entirely within the granular layer. Dynamic cone penetrometer (DCP) testing was also undertaken in accordance with Jones (2004) at each PLT location to confirm the platform thickness and to determine the s_u value of the subgrade. Since s_u is related to moisture content and varies, it is important to take measurements on the same day as the

PLTs and the simple, lightweight nature of the DCP allows this on a live construction site. However, correlations between blow count and s_u are approximate, especially for soft, fine-grained materials and results are subject to rod alignment and skin friction as well as operator error. The results of the DCP testing are presented in Figure 5 as blows per 100 mm penetration where the 0.4 m thick platform is apparent. An average value for the subgrade is shown for which an s_u value of 20 kPa was derived using Look (2014).

The bearing capacity of a 600 mm diameter plate on a 0.4 m thick platform of Stabilised Material A on a subgrade of s_u = 20 kPa was calculated as 585 kPa using the method presented in this paper. The PLT results are plotted in Figure 6 where it is shown that the bearing pressure reached the approximate calculated bearing capacity on all 5 occasions without any indication of bearing failure visible on site or apparent in the load-deflection data. The load could not be increased further in an attempt to measure the fully mobilised bearing capacity because the safe capacity of the test equipment had been reached. Nevertheless, the actual bearing capacity exceeded the calculated value which provided useful validation of the proposed design method.

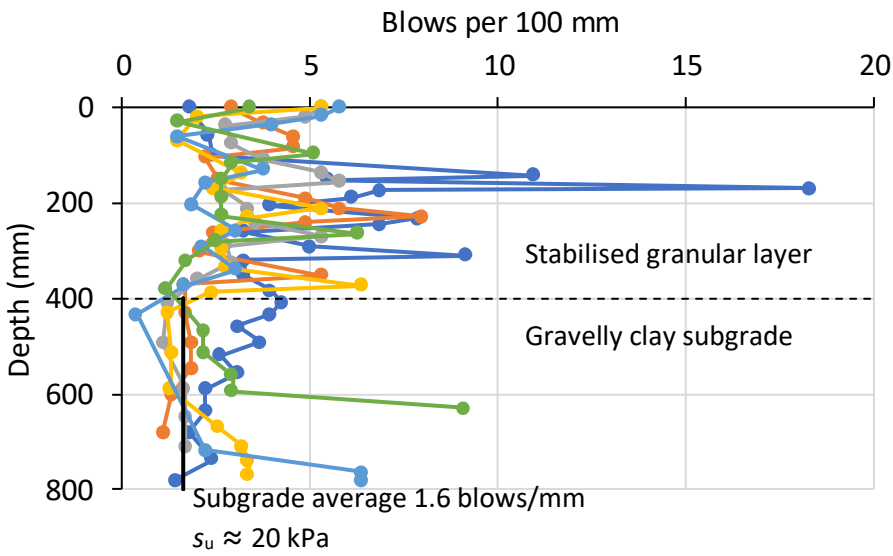

Figure 5: Dynamic cone penetrometer data from Kingsway, Rochdale site

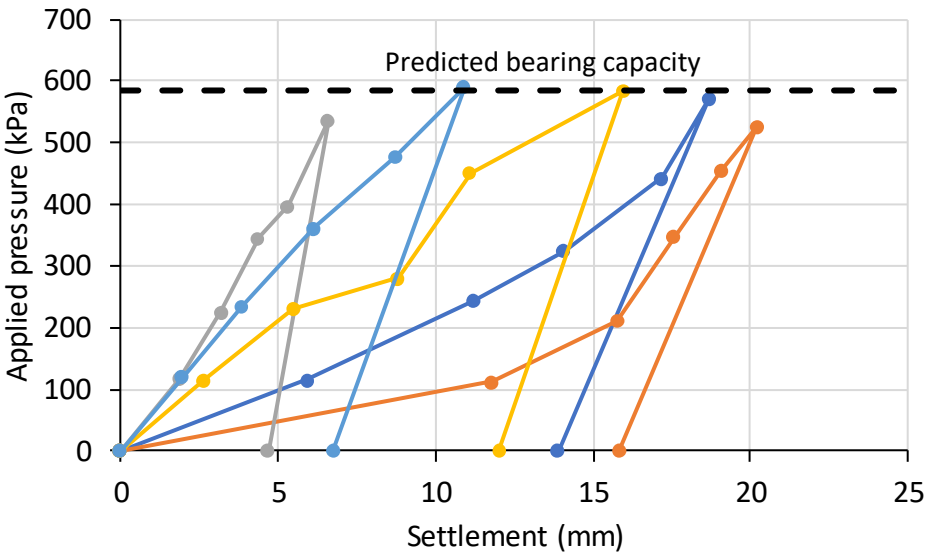

Figure 6: Plate load test data from Kingsway, Rochdale site

EXAMPLE

A worked example is presented in this section as shown in Table 3 for a working platform with track loading. Note that the parameters are appropriate only for a working platform composed of a granular material and stabilising geogrid product of the same characteristics tested in triaxial compression to obtain the parametric study outputs and which have subsequently been validated by full-scale testing as described earlier in this paper.

Example: Track loading on stabilised working platform with the same characteristics as those in the parametric study described earlier in this paper.	
Input data: B = 0.6 m, L = 3.0 m, s_u = 40 kPa, γ = 18 kN/m^3, H = 0.3 m	
p'_0 = 0.3 x 18 = 5.4 kPa s_u/p'_0 = 40/5.4 = 7.4 T = 0.93 (from Equation 3)	
B/L = 1: $q_s = s_c N_c s_u$ = 1.2 x 5.14 x 40 = 246.7 kPa Equation 2: $q_u/q_s = (1 + TH/B)^2 = (1 + 0.93(0.3/0.6))^2$ = 2.15. q_u = 246.7 x 2.15 = 529.5 kPa	B/L = 0: $q_s = s_c N_c s_u$ = 1.0 x 5.14 x 40 = 205.6 kPa Equation 1: $q_u/q_s = (1 + TH/B) = (1 + 0.93(0.3/0.6))$ = 1.46. q_u = 205.6 x 1.46 = 301.2 kPa
B/L = 0.6/3.0 = 0.2 Interpolation between B/L = 1 and 0: q_u = 346.9 kPa $q_g = \gamma D N_q s_q + ½ B \gamma N_\gamma s_\gamma$ = 0 + 0.5 x 0.6 x 18 x 241 x 0.94 = 1223 kPa (taking φ'=45° for stabilised material) $q_u \leq q_g$? YES. **q_u taken as 347 kPa**	

Table 3: Calculation example for working platform

CONCLUSIONS

A parametric study using FEA of strip and circular foundations was used to derive the load transfer efficiency *T* of a granular layer stabilised by a multi-axial PP geogrid product overlying a clay soil of a range of s_u values. This relationship between *T* and s_u can be used to calculate the bearing capacity of granular layers of similar characteristics stabilised with the specific geogrid product for a wide range of geometries and clay strengths. This has been demonstrated by a worked example and validated by comparison with an example full-scale field test.

The relationship between *T* and s_u can be determined for other granular materials and stabilising geogrid products by 2D axisymmetric and plane strain FEA parametric studies covering the range of s_u and *H*/*B* values that will be encountered, validated by full-scale testing with the same geogrid product and aggregate characteristics. FEA input parameters should be derived from large triaxial compression tests on the granular material at the appropriate density with the specific geogrid product.

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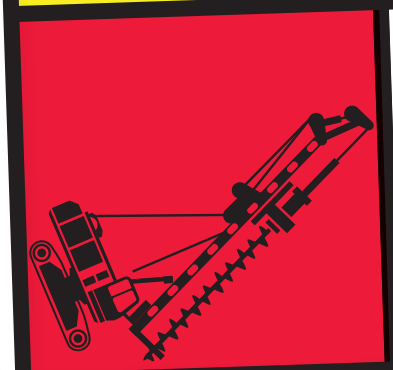
Appendix 21

CLIENT / PRINCIPAL

PLANNER / PROJECT CONTROLLER

BUILDING CONTRACTOR

STOPP



MACHINE TIPPING OVER

LEAFLET FOR THE PREVENTION OF MACHINE TIPPING OVER IN SPECIAL FOUNDATION ENGINEERING

STOPP MASCHINEN UMSTÜRZE

Appendix 21

CONTENTS

STOPP MASCHINEN UMSTÜRZE

CLIENT / PRINCIPAL
PLANNER / PROJECT CONTROLLER
BUILDING CONTRACTOR

Appendix 21

MOTIVATION AND PROBLEM

It is normally the case that equipment that is used in special civil engineering has a high dead weight and a system centre of gravity that is also high. Their travel and working movements also result in cyclical and dynamic loads being transferred into the ground. They are therefore susceptible to a risk of tipping over when in use on the construction site. Outmost importance is to be given to the prevention of large pieces of equipment from tipping over both from an occupational safety and an economical point of view as the tipping over of large pieces of equipment is the cause of the most serious accidents of construction activities. Not only are employees at risk of suffering severe or fatal injuries, a great risk is also posed to uninvolved third parties. Accidents and "near misses" also place the construction site personnel under a heavy burden, possibly resulting in a temporary or permanent incapacity to work. This often goes hand in hand with massive production losses and additional costs as a result of project delays. Last but not least, this can cause a considerable loss of image for those participating in the construction and the construction project as a whole.

Practical experience has also shown that the installation of professional working platforms results in an improved working performance, as the implementation and work processes are accelerated, etc. The consequence is that economical working is possible so that the client is provided with a direct benefit.

An analysis of more than 75 cases of equipment tipping over on special civil engineering construction sites in Germany and abroad has concluded that the majority of the tipping over occurred as a result of an inadequate working platform. Additional fundamental aspects are the qualification of the equipment operator and the construction site personnel in addition to the coordination, controlling and communication on the construction site. A defective equipment technology was only responsible for the tipping over in a few cases.

The editors have intensively researches this subject in recent years in addition to having worked in cooperation with experts, research facilities, training facilities, subject experts and legal experts on specific recommendations of actions for those involved in the construction process.

Appendix 21

Appendix 22

The content of this Excel file is:

One calculation sheet for cohesive soil, named "cohesive".

One calculation sheet for granular soil, named "granular".

The present sheet named "README".

* A more sophisticated method may be used.

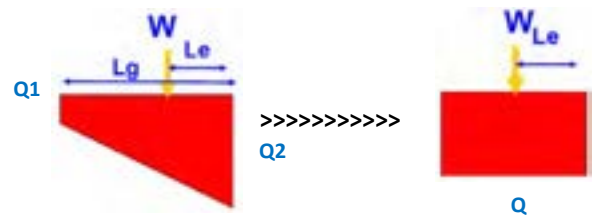
* There is no deformation criteria in the method.

* For cohesive soil where cu < 20 kPa or cu > 80 kPa, an alternative method is to be considered.
The Federation of Piling Specialists has issued a technical note on use of BR 470 in case of cu < 20 kPa.
Please refer to SB-DSG-NoPLATF-NDC-001-B or use link below.
http://www.fps.org.uk/fps/guidance/technical/otherguidance/otherguidance_BR470softclay.php

Reference documents are :
BR 470 - Working platforms for tracked plant.
Working platforms for tracked plant. SB-DSG-NoPLATF-NDC-001-B.

Revision	Date	Prepared	Rewieved	Approved	Issue
A	2016 - november -16	JMJ	TJE	PSC	First edition
B	2017 - february -13	JMJ			Granular. Formulas F/ and G/
					~~loadind~~ loading in B17

Routine design calculations. COHESIVE subgrade.
BRE-BR 470 (2004).



Total track load	W = (Q1 + Q2).Lg/2
Eccentricity of load centroid	Le = Lg.(Q1 + 2.Q2)/(3.(Q1 + Q2))
Equivalent uniform bearing pressure for design	Q = W/(2.Le)
Equivalent track bearing length for use in design	L = 2.Le

For details on calculation of track bearing pressures, please refer to the following link:
http://www.fps.org.uk/fps/guidance/platforms/platforms_trackpressurecalc.php

A - Track plant data.

Case 1 loading --> q1k =Q1
Rig or crane operator is unlikely to be able to aid recovery from an imminent platform failure.

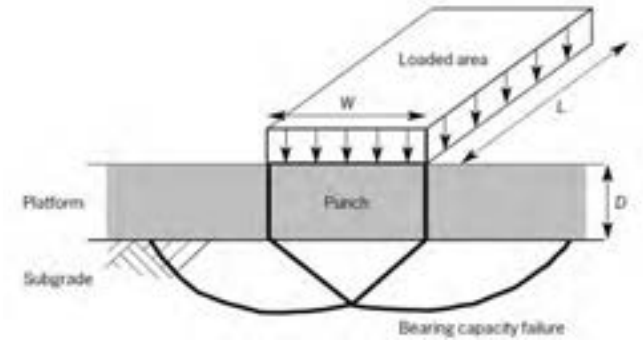
Case 2 loading --> q2k =Q2
Rig or crane operator can control the load safely, for example by releasing the line load,
or by reducing the powerto aid recovery from an imminent failure.
This type of loadind could include:extracting an auger or casing.

Nota. EN996 superseeded ---> EN16228-1. Annex F. Normative reference.

qd i = γq i qk i

γq i	without platform	with platform	qk i (kPa)
Case 1	2.0	1.6	140
Case 2	1.5	1.5	190

	case	1	2
Track width	wi	0.70	0.70
Track length	Li	3.60	3.10
	sc i = 1+0.2 wi/Li	1.04	1.05
	sγ i = 1-0.3 wi/Li	0.94	0.93
	sp i = 1+ wi/Li	1.19	1.23



B - Material properties.

		cu (kPa)	ϕ'i (°)	γi (kN/m3)	kp tanδ	Nq	Nγ
	Platform	-	40	20	5.54	64.2	109.4
Case of cohesive subgrade	**COHESIVE** Subgrade	25	-				

cu d = cu k
γ = γp d = γp k
ϕ d = ϕ k
δ = 2/3 ϕ'

! In case of shallow watertable, use γ'.
Note. 20 kPa < cu < 80, elsewhere consider an alternative method.

C - Establish wether platform is required. BR 470 - A2(d).

Rd1 > qd1 and Rd2 > qd2 => Working platform not required => Requirements for running platform to define.

Rd1 < qd1 or Rd2 < qd2 => Working platform required. Refer to point D and following.

case	1	2	
Rd i subg	134	134	
qd i	280	285	w/o platform
conclusion	PF required	PF required	

Rd i subg = cu i (π+2) sc i

D - Check that the platform is stronger than the subgrade. BR 470 - A2(e).

Rd i platform = 0.5 γp wi Nγp sγ > Rd i subgrade = cu Ncs sic

case	1	2
Rd i plat	721	714
Rd i subg	134	134
conclusion	PF stronger than subgrade	PF stronger than subgrade

γq i : case with platform from D to G.

E - Check that the platform material will provide sufficient bearing resistance. BR 470 - A2(e).

qd i < Rd i platform = 0.5 γp wi Nγp sγ i

case	1	2	
Rd i plat	721	714	
qd i	224	285	w platform
conclusion	PF ok	PF ok	

F - Estimate platform thickness. BR 470 - A2(f).

At equilibrium: Rd i platform = cu Nc sc i + γ Di² kp tanδ sp i /wi = qd i

=> Di = [wi (qd i - cu Nc sc i) / (γp kp tanδ sp i)]$^{0.5}$

case	1	2
Di²	0.48	0.78
Di	0.69	0.88
Dmin	0.3	0.3

Required platform thickness is : 0.88 m
without geotextile

Note. Minimum thickness Dmin is the lesser of 0.5 w and 0.30 m.

G - In case of use of geosynthetic. BR 470 - A2(g).

In case of big platform thickness (say > ~0.8 m), use stronger platform material or structural geosynthetic reinforcement.

At equilibrium: Rd i platform = cu Nc sc i + γp Di² kp tanδ sp i /wi + 2 Td/wi = qd i

Td tensile strength of the reinforcement : Td = Tult /2. Tult (kN/m)= 30

=> Di ² = wi (qd i - cu Nc sc i - 2Td /wi) / (γp kp tanδ sp i)

case	1	2
Di²	0.25	0.56
Di	0.50	0.75
Dmin	0.3	0.3

Required geoT reinforced platform thickness is : 0.75 m
Check additional condition below.

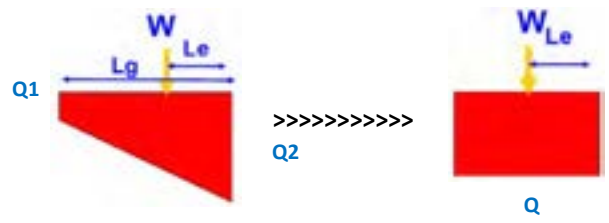
Additional condition: Unreinforced platform of same thickness satisfy: Rd i > qk i γq i

case	1		2		
γiq	1.25		1.05		
Di calculated	*0.50*		*0.75*		
Final Di retained		***0.53***		***0.10***	< --- with geoT
Rd i	187		136		
qd i	175		200		
conclusion	PF ok		Increase D !		

Rd i = cu Nc sc i + γp Di² kp tanδ sp i /wi

Final thickness required = 0.53 m
with geotextile

Routine design calculations. GRANULAR subgrade.
BRE-BR 470 (2004).



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Equivalent uniform bearing pressure for design	Q = W/(2.Le)
Equivalent track bearing length for use in design	L = 2.Le

For details on calculation of track bearing pressures, please refer to the following link:
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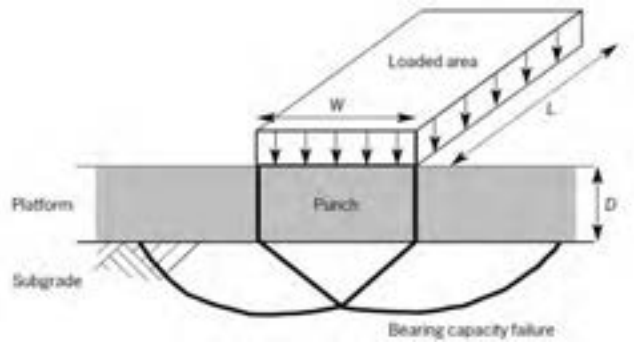
A - Track plant data.

Case 1 loading --> q1k =Q1
Rig or crane operator is unlikely to be able to aid recovery from an imminent platform failure.

Case 2 loading --> q2k =Q2
Rig or crane operator can control the load safely, for example by releasing the line load, or by reducing the powerto aid recovery from an imminent failure.
This type of loading could include:extracting an auger or casing.

Nota. EN996 superseeded ---> EN16228-1. Annex F. Normative reference.



qd i = γq i qk i

γq i	w/o platform	w platform	qk i (kPa)
1	2.0	1.6	140
2	1.5	1.5	220

case	1	2
wi	0.50	0.50
Li	3.00	2.50
sγ i = 1-0.3 wi/Li =	0.95	0.94
sp i = 1+ wi/Li =	1.17	1.20

B - Material properties.

		cu (kPa)	ϕ'i (°)	γi (kN/m3)	kp tanδ	Nq	Nγ
	Platform	-	45	20	10.40	134.9	271.7
Case of granular subgrade	**GRANULAR** Subgrade	0	35	20		33.3	48.0

! In case of shallow watertable, use γ'.

γ = γp d = γp k
ϕ d = ϕ k
δ = 2/3 ϕ'

C - Establish wether platform is required. BR 470 - A2(d).

Rd1 > qd1 and Rd2 > qd2 => Working platform not required => Requirements for running platform to define.

Rd1 < qd1 or Rd2 < qd2 => Working platform required. Refer to point D and following.

case	1	2	
Rd i s	228	226	
qd i	280	330	w/o platform
conclusion	PF required	PF required	

D - Check that the platform is stronger than the subgrade. BR 470 - A2(e).

ϕ'k p > ϕ'k s means platform is stronger as subgrade.

OK platform is stronger than subgrade

E - Check that the platform material will provide sufficient bearing resistance. BR 470 - A2(e).

qd i < Rd i platform = 0.5 γp wi Nγp sγi

case	1	2	
Rd i plat	1291	1277	
qd i	224	330	w platform
conclusion	PF ok	PF ok	

F - Estimate platform thickness. BR 470 - A2(f).

At equilibrium: Rd i platform = 0.5 γs wi Nγs sγi + γp Di² kp tanδ sp i /wi = qd i

=> Di = [wi (qd i - 0.5 γs wi Nγs sγi) / (γp kp tanδ sp i)]$^{0.5}$

case	1	2
Di²	-0.01	0.21
Di	undefined	0.46
Dmin	0.25	0.25

Required platform thickness is : 0.46 m
without geotextile

Note. Minimum thickness Dmin is the lesser of 0.5 w and 0.30 m.

G - In case of use of geosynthetic. BR 470 - A2(g).

In case of big platform thickness (say > ~0.8 m), use stronger platform material or structural geosynthetic reinforcement.

At equilibrium: Rd i platform = 0.5 γs wi Nγs sγi + γp Di² kp tanδ sp i /wi + 2 Td/wi = qd i

Td tensile strength of the reinforcement : Td = Tult /2. Tult (kN/m)= 0

=> Di ² = wi (qd i - 0.5 γs wi Nγs sγi - 2Td /w) / (γp kp tanδ sp i)

case	1	2
Di²	-0.01	0.21
Di	undefined	0.46
Dmin	0.25	0.25

Required platform thickness is : 0.46 m
Check additional condition below.

Additional condition: Unreinforced platform of same thickness satisfy: Rd i > qk i γq i

case	1	2	
γiq	1.25	1.05	
Di calculated	*undefined*	*0.46*	
Final Di retained	***1.30***	***1.10***	< --- with geoT
Rd i	undefined	830	
qd i	175	231	
conclusion	undefined	PF ok	

Rd i = 0.5 γs wi Nγs sγi + γp Di² kp tanδ sp i /wi

Final thickness required = undefined m
with geotextile

Appendix 23

Platform safety for large plant and equipment

Standard

KELLER

Appendix 23

Purpose

This platform safety standard ensures that adequate controls are in place for the risks related to working platforms for large plant and equipment. It specifically addresses the controls necessary for silos, tracked cranes, piling and vibratory rigs, excavators and wheel loaders. It does not address the use of forklifts, skid steers and vehicles designed for road use.

This standard was released to the organisation in November 2018. Not all business units will be immediately compliant and a period of implementation is necessary. Each business unit should begin implementation and progressively apply the requirements. It is expected that Keller Group in its entirety will be compliant by 1 January 2020.

All business units must integrate the requirements of the standard into their management system and do periodically verify progress, supported by the HSEQ and E&O functions.

Scope

These requirements apply to all locations and operations under Keller control. This includes all companies that Keller wholly owns, has a majority stake in or has overall operational control.

The diverse structures and job titles used in our organisation mean that, where job titles are used below, business units will need to identify the individuals who perform these roles, or the roles closest to them.

Requirements

1. BU competent person for platform safety

Each business unit must nominate at least one competent person who has the necessary skills and experience to provide advice on platform safety, issues, specifications and requirements during any phase of a project, including tendering, design, installation and maintenance.

Each business unit is responsible for ensuring that the competent person is known to all project managers and site superintendents.

2. Tenders and contracts

The person(s) in a business unit accountable for signing off tenders and/or contracts, in line with established project management procedures, must ensure the documentation specifies who is responsible for the installation, maintenance and repair of the working platform.

3. Project Planning

The project manager must ensure that the platform design and/or assessment is documented and integrated into project planning.

Appendix 23

4. Platform design and assessment

The project manager must assess if a formal platform design is needed. Where one is needed, assistance is to be sought from the BU competent person for the preparation of the design.

If no formal platform design is needed, the working platform must be assessed for suitability based on past experience of the project manager and/or supervisor. This assessment will include a review of the available soil information, the equipment to be used, working platform materials used, visual observation of the work site, and testing (eg controlled proof rolling, plate load tests or test pits).

Platform design or assessment must be suitable for the plant, equipment and silos to be used. If the equipment or configuration of the equipment changes, the platform design or assessment must be reviewed.

The project manager must communicate to the site management any limitations and conditions of use including inspection and maintenance requirements, platform delineation, proximity to services and geotechnical features such as embankments, ramps and any other factors that may impact a safe working platform.

5. Installation

The site superintendent together with the project manager must ensure that the platform is installed according to the design, and that all adjacent works and areas of interaction (rig and de-rig location, areas of travel, access routes, repair and maintenance) are compatible with the platform assessment.

If required, a competent earth works contractor must be used to install the working platform. They must demonstrate compliance with the testing and quality controls specified by the platform designer to the satisfaction of the design authority or competent person.

6. Demarcation

The platform must be clearly identified to ensure operators are aware of the extent of the safe working platform and edges marked or clearly recognizable to make visible any variance in height or stability.

7. Inspection and testing

The site superintendent is responsible for ensuring that the working platform is inspected thoroughly and tested as applicable, and that a record of the inspection is maintained.

8. Maintenance

The site superintendent is responsible for ensuring the maintenance of the working platform. Business units must ensure a documented process is in place.

Appendix 23

9. Managing changes

The project manager must authorise any changes to the platform design. Bearing track pressures applicable to the item of plant and proposed technique must be assessed. This must include any modification or change in configuration that substantially impacts the stability of the rig or crane.

The project manager must use a formal management of change process and document authorisations accordingly.

10. Operator competence and responsibility

Site superintendents must ensure that operators provide evidence of competency (training and experience) before they are authorised to start work. This applies to all Keller and subcontracted workers.

Operators and the site management team are responsible for ensuring that all plant is operated safely and that due care and attention is given to those working nearby.

11. Stop Work Authority

Site superintendents must regularly reinforce every individual's right to stop work whenever conditions become unsafe. This right applies to all personnel on site.

If someone chooses to exercise this right, they should not be reprimanded, or suffer any form of reprisal, under any circumstances

Where conditions are found to be hazardous, you must take the necessary corrective action to control the situation before work restarts.

More information

Please contact your divisional HSE lead.

Appendix 23

Appendix 24

Example - Working platform safety checklist

KELLER	**Working platform safety checklist**
Project name	
Work area covered (describe, or add sketch)	
Date and time	
Project manager	
Site manager	
Superintendent/supervisor	
Main equipment 1	
Main equipment 2	
Main equipment 3	

Activities	
Lifting/handling	
Small diameter drilling	
Soil improvement	
Piling (bored/driven)	
Other:	

Renew this daily checklist after any repair or change of working platform, change of work area, or equipment configuration.

		Checked and OK	**Checked, not OK**
Design, assessment and work preparation			
1	Working platform designed to recognised standard, or assessed for suitability		
2	Access ramps designed of sufficient gradient and width to allow equipment to be moved safely		
3	Method Statement for works available		
Installation			
4	Subgrade inspected prior to working platform installation (pre-work platform inspection)		
5	Working platform installed according to design, or assessment		
6	Extent of platform clearly marked (should extend at least 2m beyond outer pile position)		
7	Working platform free draining and clean		
8	If Working platform installed by others, installation works		

	supervised or documented (spot check)		
Testing and inspection			
9	Proof testing of working platform done (eg plate load test, trial pit), eg at edges of working platform, or to detect ‘soft spots’		
Maintenance and repair			
10	Working platform monitored for abnormalities daily (visual checks)		
11	Any excavation made in working platform is properly backfilled and compacted to original state		
12	Working platform is maintained (housekeeping, spoil control)		
Competence			
13	Operator competent and trained for equipment and product line		
14	Operator carrying valid driving license, or equivalent		
Additional remarks			
Safety of working platform			

Distribution	
Date and time	
Name of person coordinating platform safety	
Signature of person coordinating platform safety	

Appendix 24

Appendix 25

Appendix 25

Photographs of Good Practice

The photographs below show a selection of images gathered from the members of the DFI / EFFC that show best practice when executing geotechnical works on well designed, well installed and well maintained working platforms.

Fig A1. Good demarcation of piling activities

Fig A2. Well compacted granular platform

Fig A3. Example of a concreted platform

Fig A4. Platform overlaid by steel plates
(beware of creating a slippery surface)

Fig A5. Example of a platform with dewatering

Fig A6. Example of a cement bound platform
(level smooth surface – beware of ponding)

Fig A7. Example of a reinforced concrete platform
(with drainage in centre)

Fig A8. Example of edge protection around the platform
to protect the environment

Fig A9. Use of timber mats to form a working platform