Piling rigs overturning on construction sites

A guide to loss prevention
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.

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.

   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.

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.
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 1 sq.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.

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

Disclaimer: The guidance in this document refers to industry best practice loss control advice. Adoption of the advice contained within this document does not imply compliance with industry, statutory or HSBEI guidelines, nor does it guarantee that related losses will not occur.

UK Building Research Establishment - BR 470 ‘Working platforms for tracked plant’ ISBN 1 86081 7009
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.
NOT IF, BUT HOW