FEDERATION OF PILING SPECIALISTS

GUIDANCE FOR THE MECHANISED HANDLING OF DRILLING TOOLS

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MECHANISED HANDLING OF DRILLING TOOLS

FPS WORKING NOTES

AIM

To establish an FPS guidance note on the implementation of the Statement of Intent agreed upon by the FPS members:

> *"Wherever reasonably practical, handling of augers, casings and rods during mini-piling and other specialist geotechnical operations shall be achieved by either of the following methods: a mechanised tool-handling system be fitted to the rig, for example a carousel, magazine; or a mechanised tool-handling device that can be attached to supporting equipment, such as an excavator's quick-hitch."*

The Group will review and present the options currently available in the market to achieve the agreed aims stated above along with an assessment of their advantages and disadvantages, identify areas where currently it is not reasonably practical to adopt mechanised handling for example where we do not have technical solutions and identify potential solutions engaging with Associate Members and other third parties if required to find potential solutions.

For many years handling the tooling for restricted access drilling – whether it be rods & casings or sectional augers, has been undertaken manually or at best manually assisted by the winch (if fitted).

This in turn has exposed our employees to hazards and injury associated with manual handling as well as trapping as limbs find themselves between tooling and rig parts.

Whilst some tools are in short lengths and very small diameters where the risks maybe less, increasingly, sizes and lengths have grown – and consequently the weights have increased quite significantly.

Sectional Flight Auger in particular has developed up to larger pile diameters with some 1m long auger sections weighing up to 300kgs – which to manually handle would need at least 12 men that in turn would need as much room as a mechanical handler. Many of the components in 1m lengths that make up a drill string will weigh in excess of 25kg.

Some of the aides we use such as auger "forks" "plates" or "spoons" have developed to match the increase in size of tools we use, handling some of these manually and safely would now need 2 or 3 men – combined with spoil arisings from the drilling activity can increase the exposure of employees to trapping and crushing injuries generated through slips and trips when handling heavy weights.

Continuing to develop mechanical means to handle our tooling is key to reducing incidents and accidents to our workforce.

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SCOPE

Machines covered by EN16228 Part 2: Mobile Drill Rigs for Civil and Geotechnical Engineering, Quarrying & Mining. We should note that increasingly the lines are blurring between larger Sectional Flight Auger and smaller CFA activity.

TECHNIQUE DEFINITIONS

SECTIONAL FLIGHT AUGER – SFA (with or without casing)

- Construction of bore using sectional augers with a hollow stem

SOLID STEM AUGER (with or without casing)

- Construction of bore using sectional augers with a solid stem

OVERBURDEN DRILL SYSTEM (rods & casings)

- Simultaneous advancing of casing & rods with or without down the hole hammer (DTHH)

ROTARY OPEN HOLE

- Construction of bore using single drill string with flushing medium with our without down the hole hammer (DTHH)

ROTARY PERCUSSIVE

- Rotary driven using a top hammer / Sonic / Vibrating Head Techniques

SELF-DRILLING

- Installation of hollow bar as reinforcement with flushing medium

JET GROUTING

- Drilling using high pressure grout / water / air fed through hollow rods (single / double triple)

HANDLING OF INSTALLATIONS

- Vertical or inclined and including anchors and placing of reinforcement

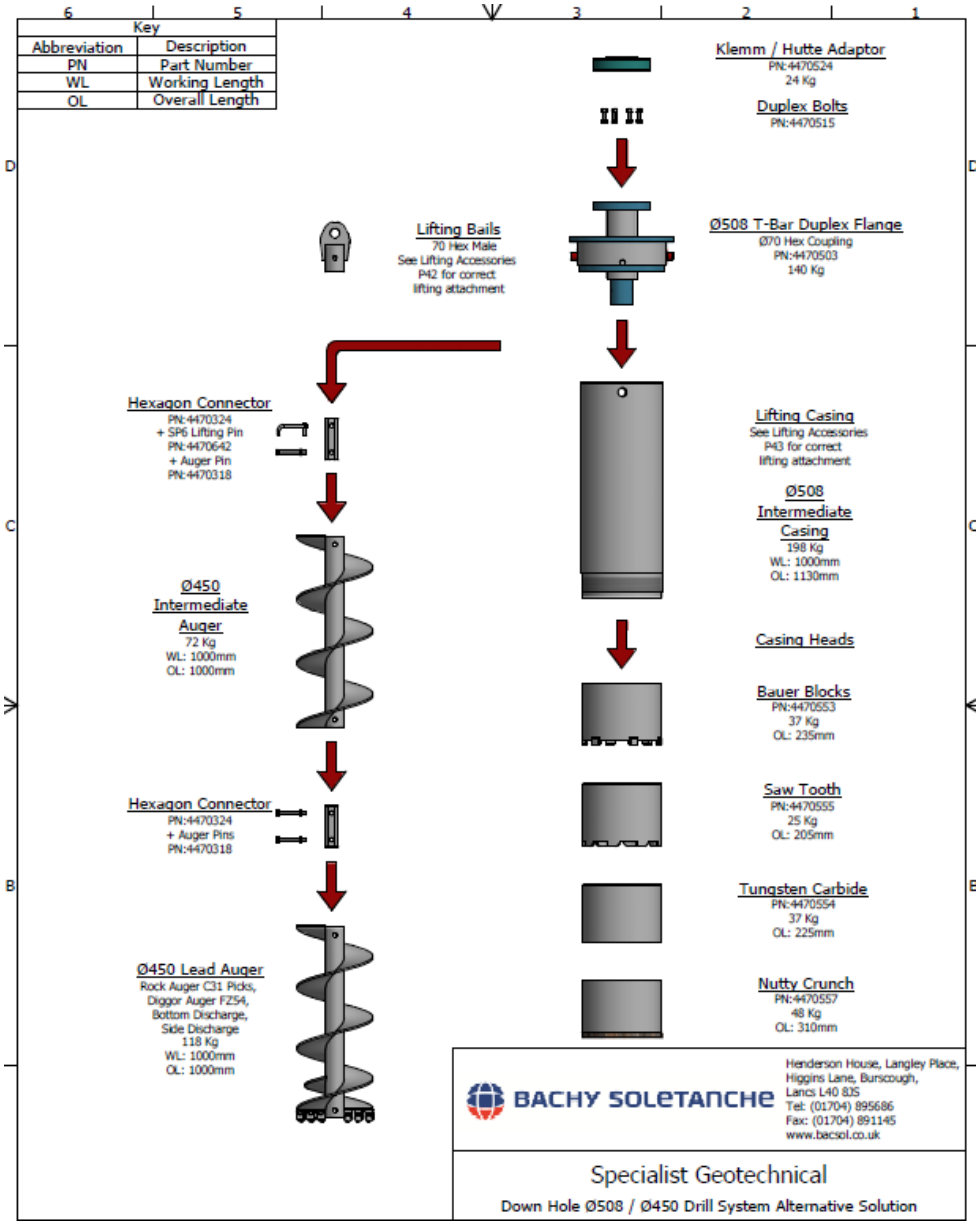
CABLE PERCUSSIVE

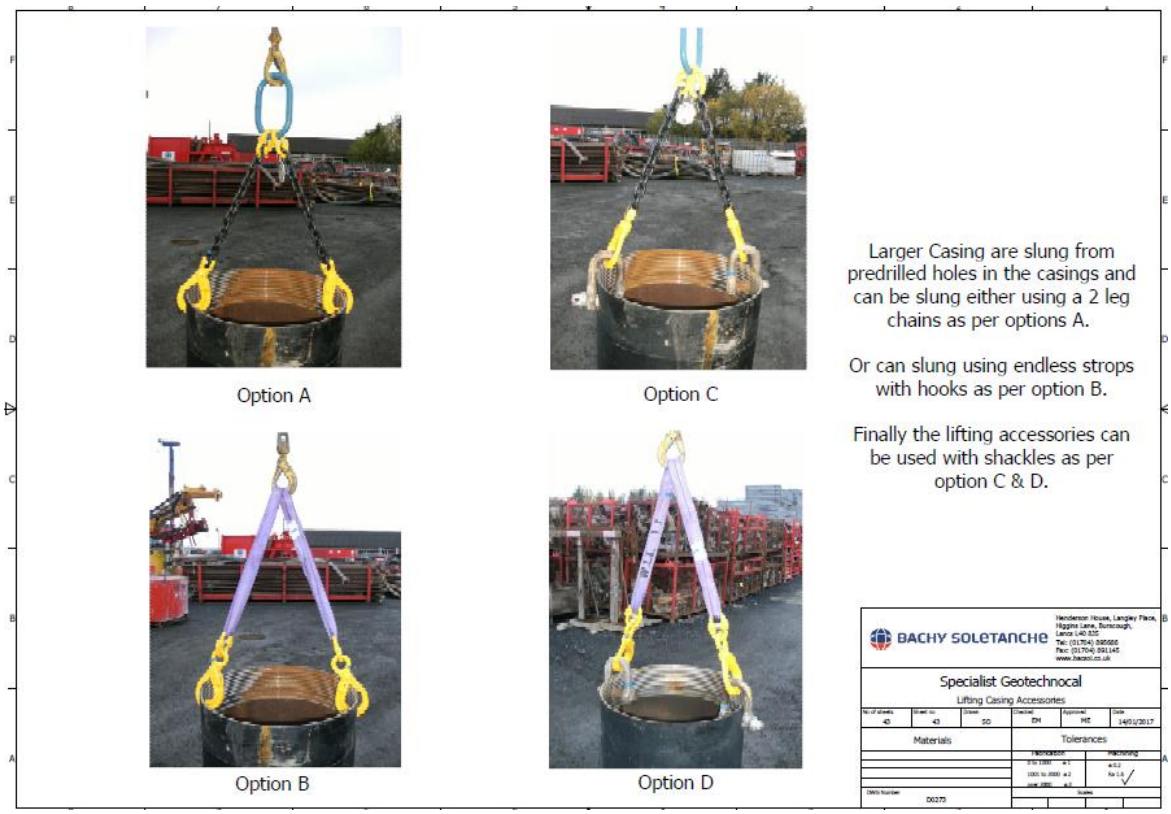
- Construction of bore using single wire winch using percussive techniques

PLANNING CONSIDERATIONS

Prior to mobilisation of any project the following must be considered -

- What is the method of construction / technique to be adopted?
- What are the site constraints?
- Quantity of tooling required together with component weight (example attached)
- Handling of tooling to work area.
- Handling (and frequency) of tooling to and from the rig.
- Having mechanical means of splitting rods and casings without the need for spanners etc (correct breakers)
- Communication of lift plan, method and risk reduction measures to the site team





RISK REDUCTION MEASURES AVAILABLE

There are several means of mechanically handling drill tools readily available today that can be used for each of the techniques considered. Often the selection of handling aide to be used will be driven by physical constraints of the construction site rather than the availability of solution.

These aides when used correctly, all offer reduction of interface of human operative and the drilling activity. They can be arranged in a hierarchy of precedence from a preferred mechanical aide to manual handling where site constraints preclude any mechanical solution being used. That said, our clients have a responsibility to ensure that during the planning stages of a project due consideration is given to the construction process and that risk is designed out.

Preferred and readily available mechanised tool handling devices include –

ROD (& CASING) CAROUSEL

Readily available and are not new to the market. Fit directly to the rig and are controlled by the rig operator. Some OEM's can now supply carousel to handle both rods and casings.

- Advantages are that they are integral with the machine and require no human intervention in placing and removing tooling from the rig. Will work vertically or with inclined drilling. Tools are stored and handled with the rig.
- Disadvantages are that they hold limited tooling (size; quantity; weight). Increase the footprint and ground loadings of the rig

EXCAVATOR MOUNTED ROD HANDLER

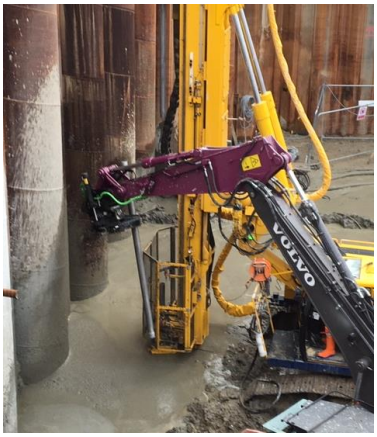
Increasingly more readily available. Only suitable for drilling with rods and / or casings at this time. Excavator and Handler must be specified to match tooling (ie; rods or rods and casings; diameters, weights and working radius). Additional equipment over and above that required for drilling operation therefore must be adequate safe working area for all equipment. Can be suspended by either chain or swivel tilt rotator. To be versatile, must be fitted with swivel tilt rotator

- Advantages are that it eliminates physical contact with tooling when placing / removing into the rig. Allows use of longer and heavier tooling. No working at height concerns attaching / detaching tools. Will work vertically or with inclined drilling.
- Disadvantages are that machine must be correctly configured with jaws to avoid need for human intervention in splitting tooling. Operator experience with the handler is critical to the safe and efficient operation.

EXCAVATOR MOUNTED STEEL WRIST

Only suitable for handling rods or casings. Excavator and "wrist" must be specified to match tooling (ie; rods or rods and casings; diameters, weights and working radius). Additional equipment over and above that required for drilling operation therefore must be adequate safe working area for all equipment. Attached via swivel tilt rotator.

- Advantages are that it eliminates physical contact with tooling when placing / removing into the rig. Allows use of longer and heavier tooling. No working at height concerns attaching / detaching tools. Will work vertically or with inclined drilling.
- Disadvantages are that machine must be correctly configured with jaws to avoid need for human intervention in splitting tooling. Operator experience with the handler is critical to the safe and efficient operation.



RIG MOUNTED HIAB / CRANE

Hiab arms can be fitted to the rig. The hiab arm / crane is a practical means of handling tooling into the rig. Can be used with a hook – or could be developed further to include a manipulator.

- Advantages are that the hiab / crane is integral with the rig and there is no additional equipment.
- Disadvantages are that the hiab / crane arm must not be operated outside of its lifting radius and must not be used for dragging tools to the machine. Adding a manipulator will reduce its operating capacity. Operator will require further appropriate training. Ground bearing pressures will increase.

EXCAVATOR (WITH LIFTING HEAD)

Commonly adopted today. Must be used with a designed and approved lifting attachment. Not suitable for inclined drilling (greater than 10 deg). Must be adequate safe working area for all operations.

- Advantages are that the excavator will handle the tool from storage area to the rig. It can be used with a rig not equipped with a service winch or a sliding rotary head.
- Disadvantages are that the operatives are still in physical contact with the tool risk that lifting head would not be used; risk that tools can be dragged. Removal of lifting head can be hazardous due to height and constraints of jaws and spoil. Additional plant in working area.

WINCH (WITH LIFTING HEAD)

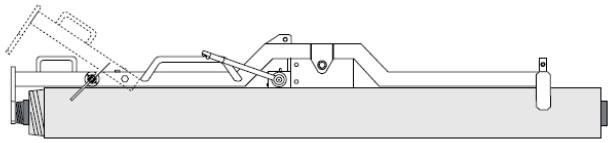
Commonly adopted today. Must be used with a designed and approved lifting attachment. Allows handling in confined working areas. Tools supplied to lifting zone using mechanical means such as excavator or FLT. Winch must be operated in accordance with OEM instruction. Not suitable for inclined drilling (greater than 10 Deg).

- Advantages are that most rigs are equipped with service winch; allows for operation in confined working areas; tool can easily be manuipulated
- Disadvantages are that operatives are still in physical contact with tool; risk that lifting head would not be used; risk that tools can be dragged; hazardous if rig is not fitted with sliding rotary head (will not lift in alignment with drill string). Removal of lifting head can be hazardous due to height and constraints of jaws and spoil.

WINCH WITH MAGNET

Allows handling of rods and casings with winch. Allows handling in confined working areas. Tools will be supplied to lifting zone using mechanical means such as excavator or FLT. Winch must be operated in accordance with OEM instruction.

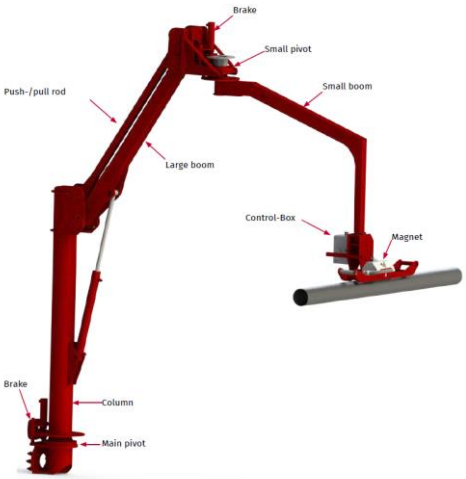
- Advantages are that most rigs are equipped with service winch; allows for operation in confined working areas; tool can easily be manuipulated
- Disadvantages are that operatives are still in physical contact with tool; risk that lifting head would not be used; risk that tools can be dragged; hazardous if rig is not fitted with sliding rotary head (will not lift in alignment with drill string).



MANIPAL & MAGNET

Suitable for use with rods and casings. Is a system that aides manual handling – tool handling is aided by a magnet and assisted lifting. Not all manipal systems can work both vertical and inclined.

- Advantages of this system are that it reduces the exposure of operatives to the hazards of manual handling. Eliminates the need for additional equipment in the working area.
- Disadvantage is that operatives are still in the working area and in contact with equipment. Limitations on weights.



TILTING ROTARY / JAW

Concept allows the rotary to connect to rods in the horizontal – effectively picking them up from a tray or trestle.

- Advantages are that the unit is integrated in the rig and the tools are lifted into position mechanically.
- Disadvantages are that this needs a much larger working area around the front of the rig so not suitable for confined areas. Still a degree of handling of the rod to the jaw / rotary

MANUAL HANDLING

Manual handling will inevitably be required in certain circumstances. Communication of component weight to those involved in the process is critical.

- Advantages are that where it is not reasonably practical to use mechanical means, tools may need to be handled. Light tools can be handled quickly.
- Disadvantages are that tool size and weight will be limited and the hazard exposure for operatives in the process is significantly greater. Additional operatives may be required.

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The following table details the different techniques commonly used together with suggested hierarchical control measures -

Handling Aide	Heirarchy Of Control	Drilling Technique								
		Sectional Flight Auger (with or without casing)	Solid Stem Auger (with or without casing)	Overburden Drill System (rods & casings)	Rotary Open Hole	Rotary Percussive	Self Drilling	Jet Grouting	Handlings of Installations (cages / bars etc)	Cable Percussive
		300mm up to 900mm dia sectional lengths up to 6m	76mm up to 600mm dia sectional lengths up to 3m	88.9mm up to 763mm dia lengths up to 9m	75mm up to 600mm dia lengths up to 3m	R32 up to 178mm dia lengths up to 3m	R32 up to T168 lengths up to 6m	88.9mm up to 140mm dia lengths up to 3m	Various	100mm up to 600mm dia lengths up to 1m
Rod Carousel	Most Preferred	×	×	✓*	✓	✓	✓	✓	×	×
Excavator Mounted Handler		Future ?	Future ?	✓	✓	✓	✓	✓	✓	✓
Excavator Mounted Steel Wrist		×	×	✓	✓	✓	✓	✓	×	✓
Mounted Hiab / Crane		✓	✓	✓	✓	✓	✓	✓	✓	✓
Excavator With Lifting Head		✓	✓	✓	✓	✓	✓	✓	✓	✓
Winch With Lifting Head		✓	✓	✓	✓	✓	✓	✓	✓	✓
Winch with Magnet		×	×	✓	✓	✓	✓	✓	×	✓
Rotary / Jaw Tilt / tray		×	×	✓	✓	✓	✓	✓	×	✓
Manipal		×	×	✓	✓	✓	✓	✓	×	✓
Manual Handling	Least Preferred	✓	✓	✓	✓	✓	✓	✓	✓	✓

* = Not all carousels are suitable

AREAS FOR FURTHER DEVELOPMENT

There are a number of well-established solutions for handling rods and casings but less so for sectional flight augers where we are still reliant on a degree of human interface whilst adding and removing augers.

Manufacturers such as Klemm and Casagrande both have solutions that are being developed that will in time offer greater risk reduction to this process.

As an industry we should encourage our suppliers to continue to develop innovative solutions and aspire to further reduce human interface in our activity.

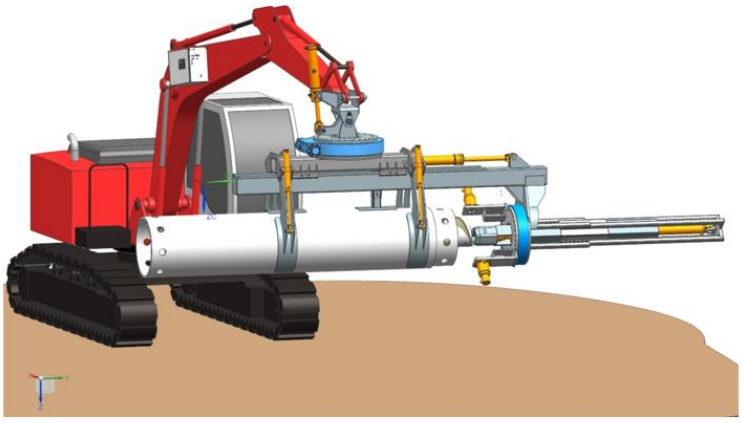
CASAGRANDE

Have a concept for handling section flight augers and casings looks promising as it places and removes the tools mechanically to and from the rig. It demonstrates that it is feasible to further remove human activity in this process

CASAGRANDE

Excavator mounted handling system

Complete handler for both **casing and auger**



TECHNICAL DATA

Casing - Auger length: 3000 – 4500 mm

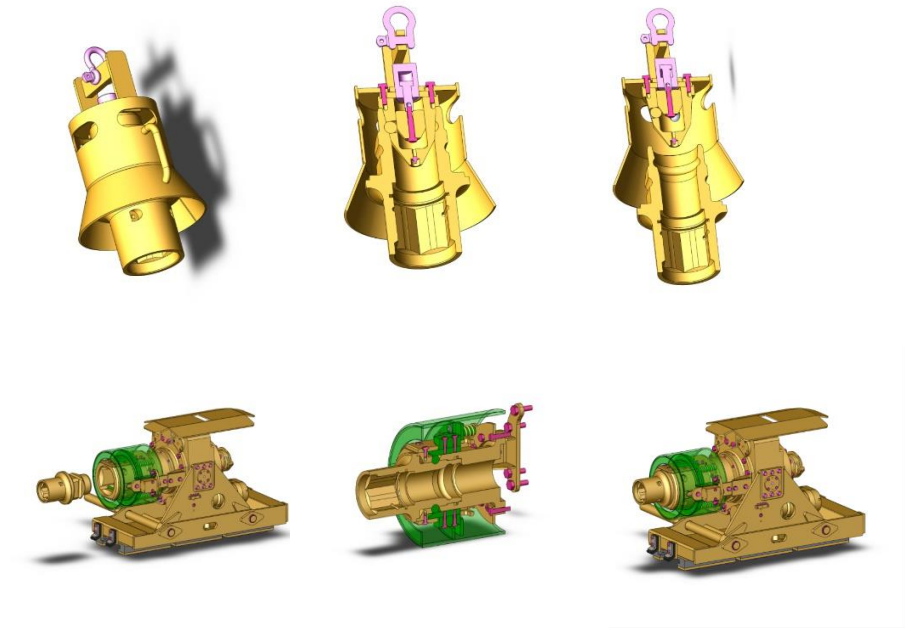
	from (mm)	to (mm)
Casing – Auger diameter	300	600

KLEMM

The hydraulic lifting bail will be attached to the excavator using small drop chain, the hydraulic drive chuck will be attached to the underside of the rig drive head, so it can move up and down the mast. 2no hex adaptors will be required, one to insert into the hydraulic bail and one to insert into the drive chuck these are needed to allow attachment of the Hex Auger. These are hydraulically locked in position.

The Excavator will lift the augers up to drill string already on rig, manually pinning at the bottom auger, the excavator operator will then release the insert and move away the lifting bail leaving the Hex adaptor.

The rig driver will then lower the chuck drive onto the hex adaptor and engage to lock it in place, once to depth the rig operator can disengage the chuck and lift the head. The process will be repeated.



SOILMEC

Have developed further the concept of rod handling where a larger quantity of rods and/or casings can be transported and handled from a dedicated unit –