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Introduction

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For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD

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Drilling and foundation machinery — Soil or soil and rock mixture drilling and foundation machines — Commercial specifications

ICS: 53.100

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 195, *Building construction machinery and equipment*, Subcommittee SC 3, *Drilling and foundation machinery and equipment*.

This second edition cancels and replaces the first edition (ISO 11886:2002 and ISO 11886:2002/COR 1:2006) which has been technically revised.

The main changes compared to the previous edition are as follows:

- extension of the scope to drilling and foundation machines, except HDDs.

Introduction

This document has been prepared to provide recognized industry terms and their definitions and give commercial specifications for soil drilling machines, and soil or soil and rock mixture drilling machines, and foundation machines.

This document is meant to assist designers, producers, dealers and users of these machines.

Drilling and foundation machinery — Soil or soil and rock mixture drilling and foundation machines — Commercial specifications

1 Scope

This document defines terms for drilling machines and foundation machines including those terms related to their applications, working methods, machine types, and main components of the machines.

This document also provides commercial specification information for these machines.

This document is applicable to:

- mobile drill rigs for civil and geotechnical engineering
- foundation equipment including piling machines
- diaphragm walling equipment
- jetting, grouting and injection equipment
- interchangeable auxiliary equipment.

This document does not apply to:

- machines specifically designed for mining application (e.g. rock drilling, raise boring, jumbo machines)
- horizontal directional drilling (HDD) machines (covered by ISO 21467:2023^[1]).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6014, *Earth-moving machinery — Determination of ground speed*

ISO 6016:2008, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 6707-1:2020, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 6746-1, *Earth-moving machinery — Definitions of dimensions and codes — Part 1: Base machine*

ISO 6746-1:2003, *Earth-moving machinery — Definitions of dimensions and codes — Part 1: Base machine*

ISO 6746-2:2003, *Earth-moving machinery — Definitions of dimensions and codes — Part 2: Equipment and attachments*

ISO 6746-2, *Earth-moving machinery — Definitions of dimensions and codes — Part 2: Equipment and attachments*

ISO 6746-2:2003/Cor 1:2004, *Earth-moving machinery — Definitions of dimensions and codes — Part 2: Equipment and attachments — Technical Corrigendum 1*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 6016:2008, ISO 6707-1:2020, ISO 6746-1:2003, ISO 6746-2:2003, ISO 6746-2:2003/Cor 1:2004 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>.

3.1 General

3.1.1

machine family

group of machines designed for the same type of operation

Note 1 to entry: *Drilling and foundation equipment* (3.4.1) comprises the following machine families:

- Soil or soil and rock drill rigs [*drill rig* (3.4.2)];
- horizontal directional drilling (HDD) (covered in ISO 21467:2023^[1]);
- equipment [*diaphragm walling rig* (3.4.4)];
- *Injection grouting* (3.3.7) equipment;
- Interchangeable equipment [*Interchangeable auxiliary equipment* (3.4.8)].

3.2 Drilling and foundation components/elements

3.2.1

pile element

foundation element installed in the soil made of concrete (precast or cast in situ), or steel (tubes, beams or sheet piles), wood or plastic material

Note 1 to entry: Piles can have an interlocking feature to enable pile section to be joined together.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.23]

3.2.2

sheet pile

flat vertical structural member with restricted width compared to its depth, intended to be driven into the soil in a continuous row, usually to resist lateral pressure

3.2.3

borehole

narrow shaft bored in the ground by a *drilling tool* (3.2.4)

Note 1 to entry: A borehole can be constructed for many different purposes, e.g. the extraction of water, geotechnical investigation, environmental site assessment, foundation works, for geothermal installations.

3.2.4

drilling tool

device attached to, or forming an integral part of, the *drill string* (3.2.6), designed as a tool for penetrating the geological formation

3.2.5**drill bit**

consumable device attached to the *drill string* (3.2.6), designed as a tool to penetrate the formation being drilled by the drilling method employed

3.2.6**drill string**

all components, (for example, drill rods, drill bit, rod stabilisers) that are coupled together for transforming the rotation, percussion energy, vibration energy, separately or in combination, from the drill or rotation unit and are inserted into the hole when drilling

3.2.7**carriage**

trolley

sledge

mechanical transmission between the mast and the drilling head which guides the tool in the drilling direction

3.2.8**injection plant**

assembly of units to produce and inject products into ground

Note 1 to entry: Examples of units include pumps, mixers, agitators, silos, screw conveyors.

3.2.9**high-pressure pump**

pump for pumping water, mud, or cement grout to a high-pressure jetting system (jet grouting)

Note 1 to entry: Typically, the pressure borne by the pump is over 40 MPa.

3.2.10**agitator tank**

buffer container for mud, grout or concrete to keep the mixture fluid

3.2.11**silos and screw conveyors****3.2.11.1****silo**

buffer tank used, during a certain period of time, to contain bulk material(s), e.g. aggregates, cement or bentonite, or liquids, e.g. water, mud

Note 1 to entry: The silo is usually charged from the top and discharged from one or more outlets at the bottom or side.

3.2.11.2**screw conveyor**

conveyor for loose bulk materials with a trough or tube as the carrying medium, with the material being moved by the action of a rotating screw

Note 1 to entry: This rotating screw can be rigid or flexible to take curves.

3.3 Methods and processes

3.3.1

vibration drilling

resonance drilling

sonic drilling

method with or without rotation by which the hole is formed by transmission of high frequency continuous compression waves through the drill rods which fluidise the ground immediately adjacent to the drill bit

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.33]

3.3.2

percussive drilling

method by which the hole is produced by crushing the ground or rock at the bottom of the *borehole* (3.2.3) while also striking it with the *drilling tool* (3.2.4) and then removing the cuttings out of the *borehole* (3.2.3)

Note 1 to entry: Percussive drilling is either *top percussive drilling* (3.3.2.1) or *down the hole percussive drilling* (3.3.2.2).

Note 2 to entry: The cuttings can be continuously removed out of the borehole by a flushing medium which is carried to the drilling tool.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.34 - modified editorially]

3.3.2.1

top percussive drilling

method where a piston strikes the top of the *drill string* (3.2.6) which then transmits the percussive energy to the *drill bit* (3.2.5)

3.3.2.2

down the hole percussive drilling

method where a piston strikes directly on the *drill bit* (3.2.5) at the bottom of the *drill string* (3.2.6)

Note 1 to entry: The piston is typically powered by either hydraulic fluid, water or compressed air. At the same time the drill bit is rotated either continuously or intermittently.

3.3.3

rotary drilling

method where the drilling tool at the bottom of the *borehole* (3.2.3) rotates while a feed force is applied by a feed system or weight of *drill string* (3.2.6)

Note 1 to entry: The ground or rock at the bottom of the borehole is crushed or cut by pressure, shear or tensile stress produced by the different drilling tools. The cuttings are periodically or continuously removed out of the bore hole.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.35 - modified editorially]

3.3.4

rotary percussive drilling

method that combines the *percussive drilling* (3.3.2) and *rotary drilling* (3.3.3)

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.36]

3.3.5

double-head drilling

method in which the inner rods and outer casing are driven independently by two rotation heads

3.3.6**soil mixing**

method where the soil material is disaggregated and mixed with binder, filler or both to produce a concrete part in soil

Note 1 to entry: Soil mixing is possibly done mechanically or hydraulically.

3.3.7**injection grouting****3.3.7.1****grouting**

method for filling borehole void

Note 1 to entry: The pressure of the grout pump is up to 0,3 Mpa.

[SOURCE: EN 16228-6:2014+A1:2021:2022^[3], 3.1]

3.3.7.2**injection**

method for either grouting liquid mixtures or resins into voids/pores or for injecting of ground anchors or micro piles

Note 1 to entry: Two different methods can be distinguished: the injection of solid matter in a liquid mixture, e.g., cement, bentonite; and the injection of chemicals, e.g., water, waterglass, hardener.

Note 2 to entry: The pressure of the injection pump is up to 11 Mpa.

[SOURCE: EN 16228-6:2014+A1:2021:2022^[3], 3.2 - note 1 modified editorially]

3.3.8**jet-grouting****jetting**

process where the soil or weak rock is disaggregated by means of high-pressure jet of fluid(s), then mixed with, and partially replaced by a cementing agent

Note 1 to entry: The pressure of the jetting or high pressure pump is up to 60 MPa, which creates an exit velocity of the jet from the nozzle of more than 100 m/s.

Note 2 to entry: Typical applications are underpinning of foundations of existing buildings, produce a dense pit or densify the pit floor, stabilize the soil while tunnelling or erect a dense screen for dams.

3.3.9**vibrofloatation**

method by which the soil is being compacted by putting a vibrating *vibrofloat* (3.4.6) vertical in the ground

3.3.10**stone columning**

process where the tool is advanced to create a hole either for soil displacement into the ground or for soil removal, then feeding the hole with materials, e.g. stones

3.3.11**soil displacement**

process consisting of advancing the tool for soil displacement into the ground with a rotary drilling rig using both torque and crowd force

3.4 Machines and equipment**3.4.1****drilling and foundation equipment**

integrated machine, *interchangeable auxiliary equipment* (3.4.8) or machine equipped with *interchangeable auxiliary equipment* (3.4.8) designed for one or more of the following applications

- preparing holes into soil or soil and rock mixture, for construction, exploration, water wells, soil and soil and rock mixture investigation, or
- preparing, installing or retracting of longitudinal elements for foundations (e.g. sheet piles), retaining-walls, slurry-walls, soil improvement, or
- preparing and installing contiguous panels for retaining-walls and cut-off walls, or
- installing elements for ground improvement as drainage or injection, or
- installing elements for soil or soil and rock mixture nailing

Note 1 to entry: If drilling and foundation equipment is designed for different applications, it may consist of an assembly of machines and components.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.1 – internal references to EN 16228 replaced]

3.4.2

drill rig

machine for drilling in soil and soil and rock mixture utilising either percussive, rotary or vibration principles (or a combination of principles) which can involve the addition of drill rods, tubes, casings or augers etc., normally threaded, as the hole extends

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.2]

3.4.3

pile installation and extraction equipment

Note 1 to entry: The machines for pile installation and extraction can be divided into two groups: dynamic type (e.g. impacting and vibration) [*impact extractor* (3.4.3.4)] and static type [e.g. *hydraulic pile press-in and extraction machinery* (3.4.3.7)].

3.4.3.1

piling equipment

assembly of machines and components designed for installation or extraction of pile elements

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.8]

3.4.3.2

piling rig

carrier machine (3.4.10) complete with *leader interface* (3.5.3) and *leader* (3.5.1), but without pile installation attachment and other equipment

3.4.3.3

impact hammer

equipment that drives piles or longitudinal elements into the soil

Note 1 to entry: Impact hammer can be:

- winch operated: The striking mass is raised by a wire rope on a winch or similar means (see [Figure 18](#)).
- steam/air operated : The striking mass is raised by air or steam pressure (see [5.4.4.2](#)).
- diesel powered: The striking mass is raised by the expansion of gases resulting from the combustion of fuel and air. Normally power source is diesel, but can also be kerosene, methanol or other fluid (see [Figure 17](#)).
- hydraulically powered: The striking mass is raised by hydraulic pressure (see [Figure 18](#)).

Note 2 to entry: Raising the striking mass produces the striking energy of a hammer. At the end of the subsequent downward motion, the ram impacts directly or indirectly on the pile, transferring its energy in a relative short time.

Note 3 to entry: In the case of indirect impact on the pile there are interface assemblies between the striking mass and the pile, which may comprise an anvil together with any form of pile cap assembly described in this standard.

3.4.3.4**impact extractor**

equipment that withdraws, by backward impacts, piles or longitudinal elements from the soil

Note 1 to entry: The striking energy of an extractor is derived from the upward or backward kinetic energy of a rising mass being transferred to the head of a pile by means of a linkage, wire rope connection or other mechanical means.

3.4.3.5**impact hammer/extractor**

equipment that combines functions of *impact hammer* (3.4.3.3) and *impact extractor* (3.4.3.4)

3.4.3.6**vibratory driver and extractor**

machine that generates unidirectional vibrations, in most instances vertical vibrations, designed to install or extract piles or longitudinal elements

Note 1 to entry: For an example, see [Figure 21](#), [Figure 23](#) and [Figure 24](#).

Note 2 to entry: Vibration can be produced by eccentric masses or other means, while a device, placed above the vibratory body dampens the vibrations for the protection of the *carrier machine* (3.4.10).

Note 3 to entry: The element to be installed into or extracted from the ground is rigidly held under the vibratory gearbox by means of one or several clamps. However, for units designed for annular grip, the clamping device might be located on the side(s) of the vibratory gearbox(es).

3.4.3.7**hydraulic pile press-in and extraction machinery**

machinery or movable device designed for installing or extracting piles or longitudinal elements by applying a static force to them using several vertical hydraulic jacks, implying a reaction force

Note 1 to entry: The reaction force can be taken by the weight of the machinery or by clamping on a number of sheet piles that have previously been installed into the ground.

Note 2 to entry: For an example, see [Figure 25](#) to [Figure 27](#).

3.4.4**diaphragm walling rig**

carrier machine (3.4.10) and cutting tools to cut panels for diaphragm walls

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.9]

3.4.4.1**foundation grab**

rope operated or hydraulic excavating device composed of *clamshell* (3.4.4.2) and a guiding device for cutting a diaphragm wall

Note 1 to entry: For an example, see Figure C.21.

[SOURCE: EN 16228-5:2014+A1:2021:2022^[4], 3.5 – modified]

3.4.4.2**clamshell**

bucket attached to the bottom end of the grab frame that digs or grabs in a generally vertical direction, discharging below and above the ground reference plane (GRP)

[SOURCE: ISO 7135:2009^[5], 3.4.5 - modified]

3.4.4.3

diaphragm wall cutter

assembly of counter-rotating wheels hydraulically or electrically driven within a guide body designed to break up soil or rock for cutting a diaphragm wall, comprising a mud pump or air-lift system to remove the cuttings

[SOURCE: EN 16228-5:2014+A1:2021:2022^[4], 3.6 – modified: notes removed]

3.4.5

jetting, grouting and injection equipment

machine for mixing, pumping or injecting grout, cement, concrete and drilling fluids

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.10]

3.4.5.1

jet grouting pump unit

grout pump unit

power-driven displacement pump with necessary power-source, transmission and structural supporting elements for jet grouting

Note 1 to entry: A pump unit itself, which terminates at the inlet and outlet connections, can include ancillary equipment, such as relief valves or pulsation suppression devices, when furnished by the supplier and mounted on the pump or pump unit.

3.4.5.2

pumping system

system consisting of a pump or pumps and those interacting or interrelating elements, which together accomplish the specified performance work

Note 1 to entry: The pumping system generally includes (but is not necessarily limited to) the *pump driver* (3.6.6), drives, cabling, control and monitoring devices and those piping elements that transfer liquid from and to the pump.

[SOURCE: ISO 17769-2:2012^[6], 2.1.8]

3.4.5.3

rotary positive displacement pump

pump in which liquid is trapped in confined volumes and transported from an inlet port to an outlet port by a rotational movement of the pumping element or elements

[SOURCE: ISO 14847:1999^[7], 3.1]

3.4.5.4

centrifugal pump

non-volumetric pump in which the flow of the liquid is achieved by means of one or more impellers

[SOURCE: ISO 12809:2020^[8], 3.2]

3.4.5.5

roller rotary pump

hose pump

peristaltic pump that discharges liquid material by squeezing an elastic tube by one or several rotating rollers

3.4.6

vibrofloat

deep vibrator

probe generating radial vibration for soil compaction

3.4.7**cutter soil mixing equipment**

assembly of counter-rotating wheels hydraulically or electrically driven within a guide body designed to cut and mix soil or rock with cement and water mixture simultaneously injected

3.4.8**interchangeable auxiliary equipment**

separate equipment that can be attached to a *carrier machine* (3.4.10) to allow it to be used for drilling and foundation operations

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.11]

3.4.9**stone columning rig**

machine for performing *stone columning* (3.3.10) process by using *stone columning* (3.3.10) equipment

Note 1 to entry: Examples of *stone columning rig* (3.4.9) are, according to the wet top feed / dry bottom feed technics.

3.4.10**carrier machine**

machine providing mobility for and supporting the weight of the *drilling and foundation equipment* (3.4.1), together with the accessories and the load (e.g. pile, excavated soil)

Note 1 to entry: The carrier is part of the *drilling and foundation equipment* (3.4.1) in integrated machines.

Note 2 to entry: A carrier machine may also accommodate the necessary power source and controls of the *drilling and foundation equipment* (3.4.1).

Note 3 to entry: It may be an adapted lifting crane or earth moving machine or other machine specifically designed or adapted for this purpose.

[SOURCE: EN 16228:2014+A1:2021, 3.5 modified – Last sentence of Note 2 to entry is withdrawn. Note 3 to entry is added.]

3.5 General components and systems**3.5.1****leader**

mast

structure mounted to the *carrier machine* (3.4.10) guiding the installation and extracting equipment

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.13]

3.5.1.1**direct mounted leader**

direct mounted mast

leader (3.5.1) directly coupled to the *carrier machine* (3.4.10)

Note 1 to entry: The major weight of leader, pile etc. is taken by the *leader interface* (3.5.3) near the bottom of the leader.

3.5.1.2**boom supported leader**

boom supported mast

leader (3.5.1) connected to and extending above the boom head of the *carrier machine* (3.4.10)

Note 1 to entry: The major weight of leader, pile etc. is taken by the *leader interface* (3.5.3) at its fixing with the boom head. A further steadying connection is made by another part of the *leader interface* (3.5.3) at the lower leader structure.

3.5.1.3

suspended leader

suspended mast

leader (3.5.1) with free hanging structure from the *carrier machine* (3.4.10) boom head

Note 1 to entry: The *carrier machine* (3.4.10) can be a mobile crane or a cable excavator.

3.5.2

boom

structure for positioning of the *mast/leader* (3.5.1), feed beam or working platform, or for directly supporting an excavating tool

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.14]

3.5.3

leader interface

optional component (e.g., universal joints, sliding or telescopic elements), that ensures connection between the *carrier machine* (3.4.10) and the *leader* (3.5.1)

Note 1 to entry: It may be attached to the *carrier machine* (3.4.10) for mobility in a number of ways, depending upon *leader* (3.5.1) type.

3.5.4

attachment

assembly of components that can be mounted onto the *carrier machine* (3.4.10) or equipment for specific use

[SOURCE: ISO 6165:2012^[9], 3.10, modified : base machine replaced by *carrier machine* (3.4.10)]

3.5.5

movable platform

platform attached to leader guided parts (e.g., drill head) of *drilling and foundation equipment* (3.4.1) to enable operational work or maintenance to be carried out

Note 1 to entry: The platform can be a temporary or permanent *attachment* (3.5.4).

Note 2 to entry: Persons may enter and stay on the platform only when it is stationary.

Note 3 to entry: A separate means of access may be needed to access to the *movable platform* (3.5.5) (e.g. ladder).

3.5.6

working platform for lifting personnel

platform designed for raising or lowering personnel and materials, independently guided by the *mast/leader* (3.5.1) to enable operational work or maintenance to be carried out

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.15]

3.5.7

stabilising device

any device and system designed to stabilise the machine by supporting and/or levelling of the complete structure

EXAMPLE Outrigger, jacks, suspension locking devices, extending axles.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.37 - modified: term completed, "any" added and "outrigger" added to the example]

3.5.8**clamping device**

hydraulically or mechanically actuated assemblies which can grip the sheet piles, steel beams or tubes and allow the transmission of vibrations from a vibrator, extraction forces from an *impact extractor* (3.4.3.4), or forces from a *hydraulic pile press-in and extraction machinery* (3.4.3.7)

Note 1 to entry: These assemblies can also be integral with the construction of the pile installation or extraction equipment.

3.5.9**pile threader**

pile handling device designed to insert sheet piles into one another to form a structure (e.g. a curtain wall)

Note 1 to entry: The pile threader dispenses with the need to post an operator near the lifted *sheet pile* (3.2.2) or at height.

3.5.10**pile guide**

device either fixed to, or guided by the *leader* (3.5.1) to provide location and support to the pile when at forward or backward inclinations

3.5.11**acoustic shroud**

means enclosing part or all of the *piling equipment* (3.4.3.1) and pile to reduce the emission of noise during pile operations

3.5.12**shock/vibration absorber**

device to isolate the supporting structure from the forces being transmitted from the *drilling and foundation equipment* (3.4.1)

Note 1 to entry: It is commonly associated with vibrators and *impact extractors* (3.4.3.4).

Note 2 to entry: It is often integral with the construction of the pile installation or extraction equipment.

3.5.13**kelly bar**

transmission part constituted with a specific steel bar or tube designed for transferring torques and forces onto the drilling tool

Note 1 to entry: A kelly bar may be telescopic with friction transmission between element or with an interlockable function. Tools are attached to the lower end of the Kelly.

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.12]

3.5.14**feed system**

arrangement of drive elements, which force the rotary head / pile hammer / vibrator to move the tool/ pile element into the ground or out of the ground in the forward or backward direction

Note 1 to entry: Drive elements can be a rope on a winch, a motor- and chain-arrangement, a cylinder- and chain-arrangement, a rack and pinion, a cylinder- and rope-arrangement or combination of these.

Note 2 to entry: Feed system is possibly a pull-up/pull-down system in vertical operation.

3.6 Tools and accessories**3.6.1****spindle**

part of drill head that transmits the drilling rotation speed and torque to the *drill string* (3.2.6)

3.6.2

drive cap

accessory located between the striking mass and the pile which is guided from a *leader* ([3.5.1](#)) or contained within the structure of the *piling equipment* ([3.4.3.1](#))

Note 1 to entry: Accessories may incorporate cap filling or cushion material between the striking mass and the cap or other mechanical features, which influence the shape of the impact stress wave in the pile.

Note 2 to entry: Drive caps can be attached to a plate to enable larger profile piles to be driven.

3.6.3

helmet

drive cap ([3.6.2](#)) provided with a recess on its underside to locate a pile and accommodate additional cushioning material to protect pile heads from damage

3.6.4

follower

interfacing parts between the underside of the *drive cap* ([3.6.2](#)), *helmet* ([3.6.3](#)), or plate and the pile head, to enable the pile to be installed deeper into the ground or a larger diameter of pile to be accommodated

3.6.5

remote release shackles

pile handling device connected to steel piles, designed to lift the steel piles and to be released from the connection remotely

Note 1 to entry: The remote release shackles dispenses with the need to post an operator near the lifted *sheet pile* ([3.2.2](#)) or at height.

3.6.6

pump driver

machine supplying mechanical energy to power the pump

Note 1 to entry: This can include, but is not limited to, electric motors, hydraulic motors, and internal combustion engines.

[SOURCE: ISO 17769-1:2012^[10], 2.1.17.23, modified]

3.6.7

variable speed drive

any device that can be utilized to vary the speed of the pump, either mechanically or electrically

Note 1 to entry: ISO 17769-2:2012^[6], 2.2.3, modified – "magnetic drives" and "steam turbines and gas turbines" deleted

3.7 Undercarriage types

3.7.1

crawler mounted

carrier machine ([3.4.10](#)) mounted on a tracked undercarriage

Note 1 to entry: For an example, see [Figure 1](#), [Figure 2](#) and [Figure 3](#).

3.7.2

wheel mounted

carrier machine ([3.4.10](#)) mounted on a wheeled undercarriage

Note 1 to entry: For an example, see [Figure 4](#) and [Figure 8](#).

3.7.3**rail mounted**

carrier machine (3.4.10) whose wheeled undercarriage runs on rails

Note 1 to entry: For an example, [Figure 13](#).

3.8 Mobility methods**3.8.1****tramming**

moving of drilling and foundation equipment (3.4.1) in operating condition on site

[SOURCE: EN 16228-1:2014+A1:2021:2022^[2], 3.31]

3.8.2**travelling**

moving of *drilling and foundation equipment* (3.4.1) in non-operating condition specified by the manufacturer

[SOURCE: EN 16228-1:2014+A1:2021, 3.32]

3.9 Design and/or performance characteristics**3.9.1****required stability angle**

minimum required value for stability angle (α_{sr})

Note 1 to entry: Different values may be required for different load cases (e.g. travelling, working) and types of machine.

3.9.2**rope/chain safety factor**

ratio between the guaranteed minimum breaking and maximum pulling load

3.9.3**slewing**

rotation of the upper structure of drilling and foundation equipment in relation to a fixed reference frame on the ground

3.9.4**stability angle**

minimum among tipping angles relative to all tipping lines within a load case and position, to be found for all load cases, positions and all foreseen combinations of loads

3.9.5**tipping angle**

angle a machine can be tilted before it becomes unstable while the machine is subjected to a system of loads (own weight, wind, accelerations, working loads)

Note 1 to entry: In case travelling and operating on slopes is allowed, tilting starts from the maximum allowed operating slope.

3.9.6**tipping line**

line about which *drilling and foundation equipment* (3.4.1) on various mountings can tip and which are designed to calculate the stability

Note 1 to entry: Tipping lines for drilling and foundation equipment, crawler and *wheel mounted* (3.7.2):

- a) in the direction of travel, the lines connecting the lowest support points of contact of the idlers, rollers or the drives of the tracks or the front wheels;

- b) in sideward direction (perpendicular to the direction of travel), the lines passing through the centres of the support contact areas on each side of the chassis. Tipping lines for drilling and foundation equipment on support legs:
- c) the lines passing through the outer edges of the support contact areas on each side of the chassis.

3.9.7

hook load

load carried by the hook of the bottom block

[SOURCE: EN 16228-1:2014+A1:2021, 3.24 - modified]

3.9.8

ground travel speed

speed of the *carrier machine* (3.4.10) in both forward and reverse directions at operating mass

3.9.9

rotary spindle power

rotational power at the *spindle* (3.6.1) output

3.9.10

maximum feed speed

maximum speed of movement of the tool / *carriage* (3.2.7) at no load in the advancing direction

3.9.11

maximum retracting speed

maximum speed of movement of the tool / *carriage* (3.2.7) at no load in the reverse direction

3.9.12

maximum forward feed force

maximum force measured to stall movement of the *carriage* (3.2.7) in the advancing direction

3.9.13

maximum pullback force

maximum force measured to stall movement of the *carriage* (3.2.7) in the retracting direction

3.9.14

maximum drilling fluid power

maximum power calculated from measured values of pressure of the drilling fluid and its flow simultaneously available at the fluid pump outlet

3.9.15

maximum drilling fluid pressure

maximum pressure measured at the fluid pump outlet

[SOURCE: ISO 21467:2023^[1], 3.7.1 modified: "spindle" changed by "fluid pump outlet"]

3.9.16

maximum drilling fluid flow

maximum flow measured at the fluid pump outlet

[SOURCE: ISO 21467:2023^[1], 3.7.2 modified: "spindle" changed by "fluid pump outlet"]

3.9.17

Drill pipe performance

3.9.17.1

torque capacity

maximum torque the pipe can withstand without permanent deformation with the moment applied and resisted through the end connections

Note 1 to entry: For an example, see [Figure 13](#).

3.9.17.2**push/pull capacity**

maximum compressive and tensile loads the pipe can withstand without permanent deformation, when testing the pipe with axial opposite loads applied at both ends of the pipe

Note 1 to entry: For an example, see [Figure 15](#).

3.9.17.3**make-up torque**

manufacturer's recommended tightening torque when two joints of drill pipe are screwed together

3.9.18**injection, grouting****3.9.18.1****rotating speed**

number of revolutions of the pump shaft in the considered time interval

3.9.18.2**flow-rate**

volume of liquid that flows through the pump per unit of time

3.9.18.3**pump power consumption**

power given to the pump by the power source, measured at the inlet shaft of the pump

3.9.18.4**maximum theoretical pumping flow**

theoretical delivery flow which is obtained by the maximum displacement volume per unit of time of a volumetric pump

Note 1 to entry: For a piston pump, the maximum theoretical pumping flow is calculated

$$Q_{th} = \left(\frac{\pi \cdot d^2}{4} \right) \cdot s \cdot n \cdot r \cdot 10^{-6}$$

where

- Q_{th} is the theoretical delivery volume (l/min);
- d is the diameter of the cylinder piston (mm);
- s is the stroke (mm);
- n is the number of crankshaft revolutions per minute;
- r is the number of plungers.

Note 2 to entry: The displacement volume is obtained, e.g. by linear piston or rotating screw of the pump.

3.9.19**measurement of performance characteristics**

measurement carried out with the machine in *steady state* ([3.9.20](#)) under specified conditions (e.g. temperature, wind, moisture) that makes it repeatable and consistent

Note 1 to entry: In this standard, the *measurement of performance characteristics* ([3.9.1](#)) is considered when defining the following performance characteristics.

3.9.20**steady state**

condition in which all relevant operational parameters are not significantly changing with time

[SOURCE: IWA 28:2018^[1], 3.2.3]

3.9.21

slewing speed

rotation speed of the upper structure of *drilling and foundation equipment* (3.4.1) in relation to a fixed reference frame on the ground

3.9.22

engine net power

net power of the engine according to ISO 9249

3.9.23

maximum ground travel speed

ground travel speed of the *carrier machine* (3.4.10) in both forward and reverse directions at *operating mass* (3.10.1.1) at maximum engine rotational speed

[SOURCE: ISO 21467:2023^[1], 3.6.1 modified — "carrier machine" replaces "HDD machine"]

3.9.24

maximum spindle torque

maximum torque transmitted by the spindle (3.6.1) before stalling

3.9.25

maximum spindle speed

maximum measured revolutions per minute of the spindle (3.6.1) under no load

[SOURCE: ISO 21467:2023^[1], 3.6.2]

3.10 Main characteristics of drilling and foundation equipment

3.10.1

General characteristics

3.10.1.1

operating mass

mass of the base machine, with equipment and empty *attachment* (3.5.4) in the most usual configuration as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems (i.e. hydraulic oil, transmission oil, engine oil, engine coolant) at the levels specified by the manufacturer and, when applicable, with sprinkler water tank(s) half full

Note 1 to entry: The mass of an operator is not included for non-riding machines.

Note 2 to entry: Ballast mass at delivery can be included if specified by the manufacturer.

[SOURCE: ISO 6016:2008, 3.2.1]

3.10.1.2

shipping mass

transport mass

mass of the base machine without an operator, with the fuel level at 10 % of tank capacity or with the minimum fuel level needed for machine shipping purposes as specified by the manufacturer, whichever is higher, with all fluid systems at the levels specified by the manufacturer and with empty sprinkler tank(s), when applicable, and with or without equipment, ballast, *attachment* (3.5.4), cab, canopy, operator-protective structures, wheels and counterweights as stated by the manufacturer

Note 1 to entry: If the manufacturer intends that the machine be partially disassembled for shipping purposes, the masses of the disassembled items will also be stated.

[SOURCE: ISO 6016:2008, 3.2.6]

3.10.1.3

average ground-contact pressure

drilling machine operating mass divided by ground contact area

3.10.2**dimensions**

definitions and codes of dimensions strictly related to *drilling and foundation equipment* ([3.4.1](#)), are defined in [3.10.2.1](#) to 3.10.2.3

3.10.2.1**overall width without counterweight**

W1

overall width of the machine with the *boom* ([3.5.2](#)), counterweight, and counterweight support removed (if removable)

Note 1 to entry: Dimension *W1* is illustrated in [Table A.1](#).

3.10.2.2**shipping height**

transport height

H2

height from the ground reference plane (GRP) to the highest point on the machine without easily removable or foldable components (e.g. the *boom* ([3.5.2](#)), counterweight, exhaust pipe, air cleaner inlet pipe)

Note 1 to entry: Dimension *H2* is illustrated in [Table A.1](#).

[SOURCE: ISO 7136:2006^[12], 3.3.9 - modified.]

3.10.3**Drilling characteristics****3.10.3.1****drill pipe mass**

measured mass of an empty drill pipe

[SOURCE: ISO 21467:2023^[1], 3.5.2]

3.10.4**Diaphragm wall characteristics****3.10.4.1****diaphragm walling**

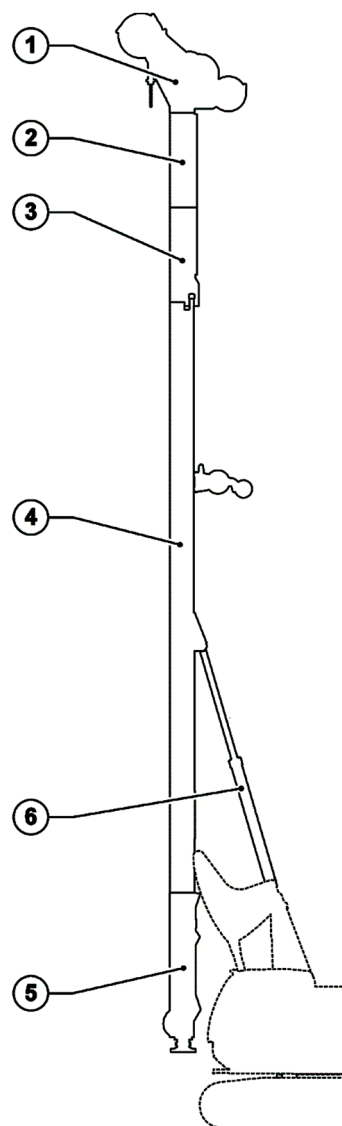
method to process a wall made of cast *in situ* concrete or precast concrete panels constructed in a trench mainly temporarily supported by bentonite or polymer suspension

3.10.5**Piling characteristics****3.10.5.1****sheet piling**

process of driving *sheet piles* ([3.2.2](#)) into the soil in a continuous row, usually to resist lateral pressure

4 Nomenclature**4.1 General components and systems**

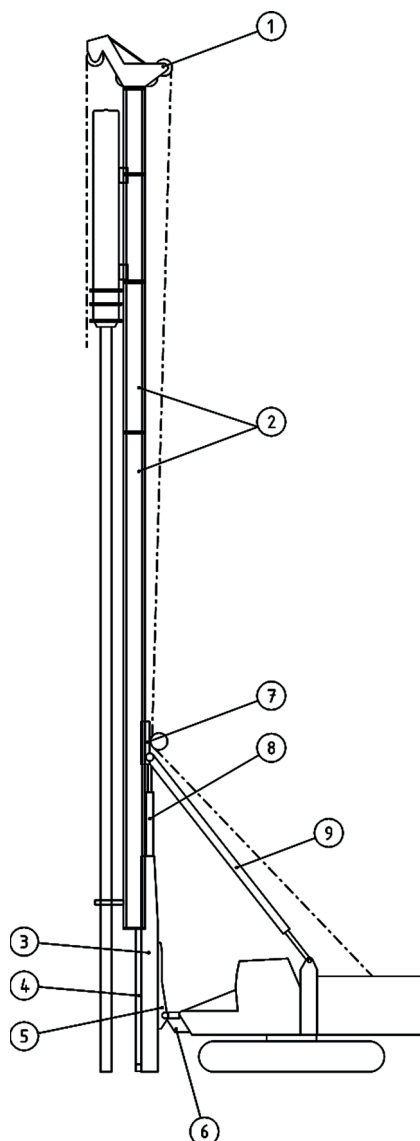
[Figure 1](#) to [Figure 7](#) show examples of general components and systems.



Key

- | | | | |
|---|--------------------------------|---|-------------------------------------|
| 1 | cathead | 4 | mast central section |
| 2 | mast extension upper section | 5 | mast extension lower section |
| 3 | mast extension central section | 6 | mast erecting and tilting cylinders |

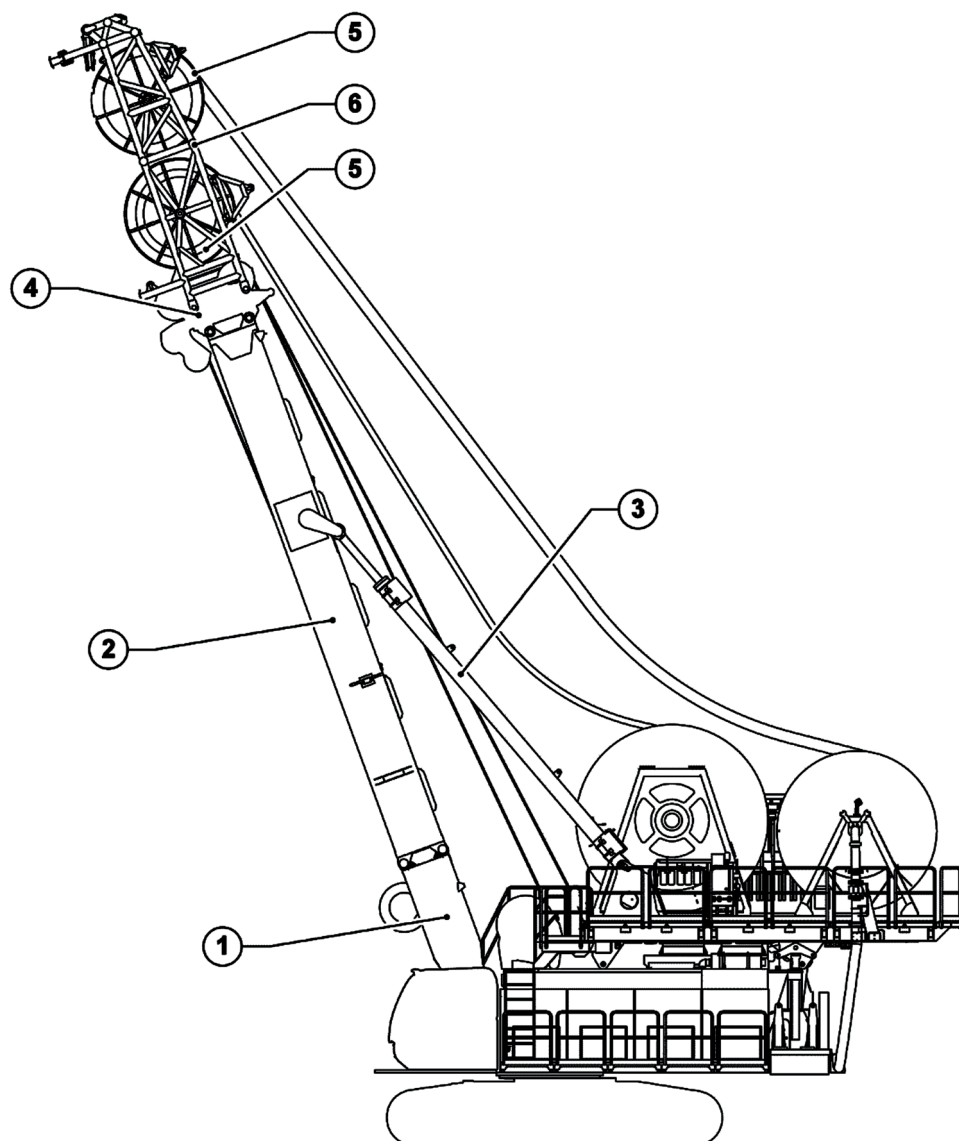
Figure 1 — Example 1 of a mast



Key

- | | | | |
|---|--------------------|---|-------------------------------|
| 1 | cathead | 6 | horizontal slide |
| 2 | mast sections | 7 | upper slide |
| 3 | base leader | 8 | forward inclination cylinder |
| 4 | telescope cylinder | 9 | lateral inclination cylinders |
| 5 | lower slide | | |

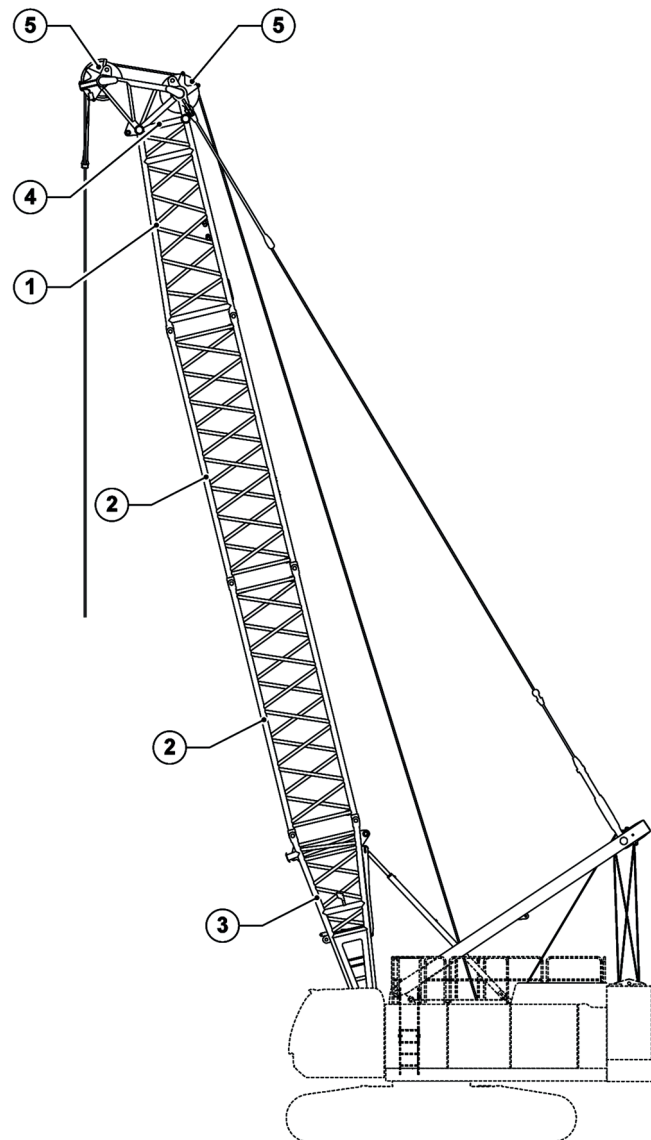
Figure 2 — Example 2 of a mast



Key

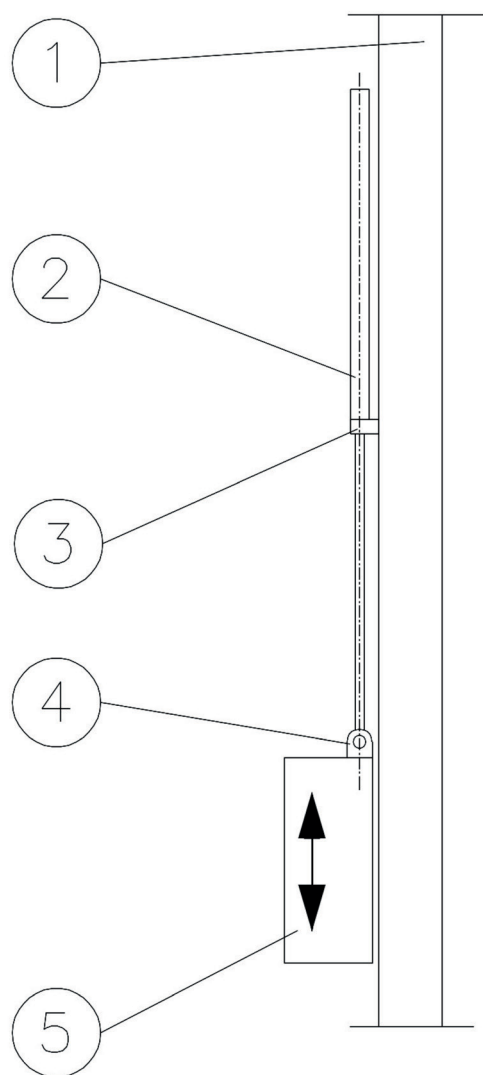
- | | |
|---------------------------------------|-------------|
| 1 boom lower section | 4 boom head |
| 2 boom intermediate section | 5 pulley |
| 3 boom erecting and tilting cylinders | 6 boom tip |

Figure 3 — Example of boom


Key

- | | | | |
|---|---------------------------|---|-----------|
| 1 | boom end section | 4 | boom head |
| 2 | boom intermediate section | 5 | pulley |
| 3 | boom foot (boom base) | | |

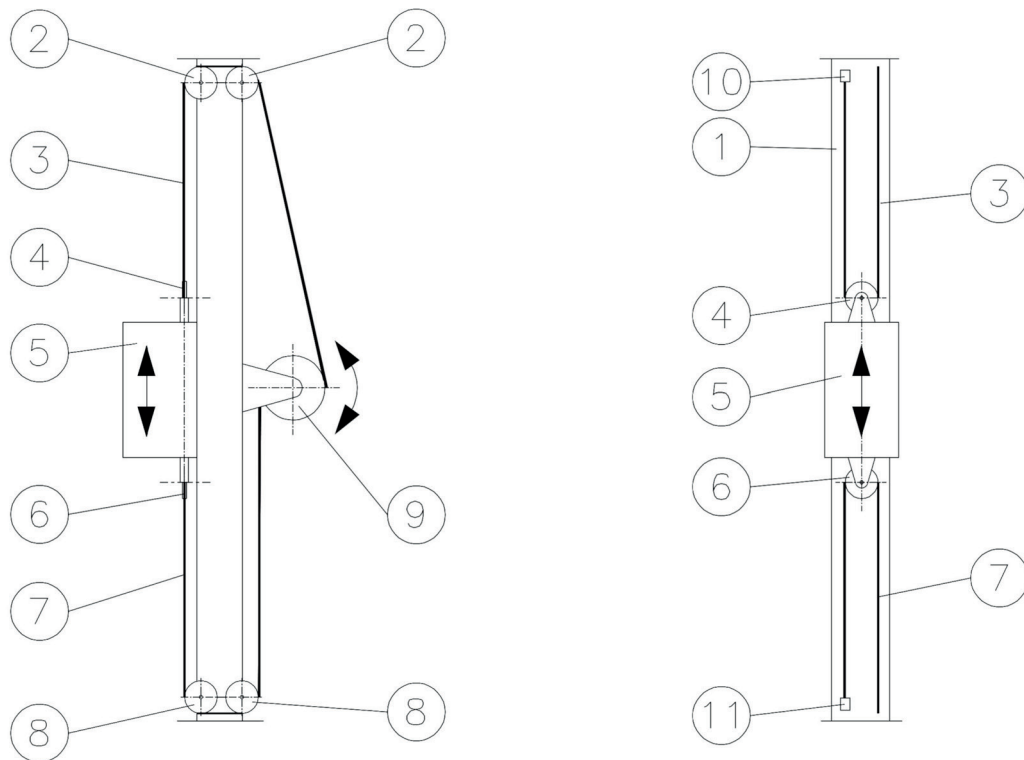
Figure 4 — Example of lattice Boom



Key

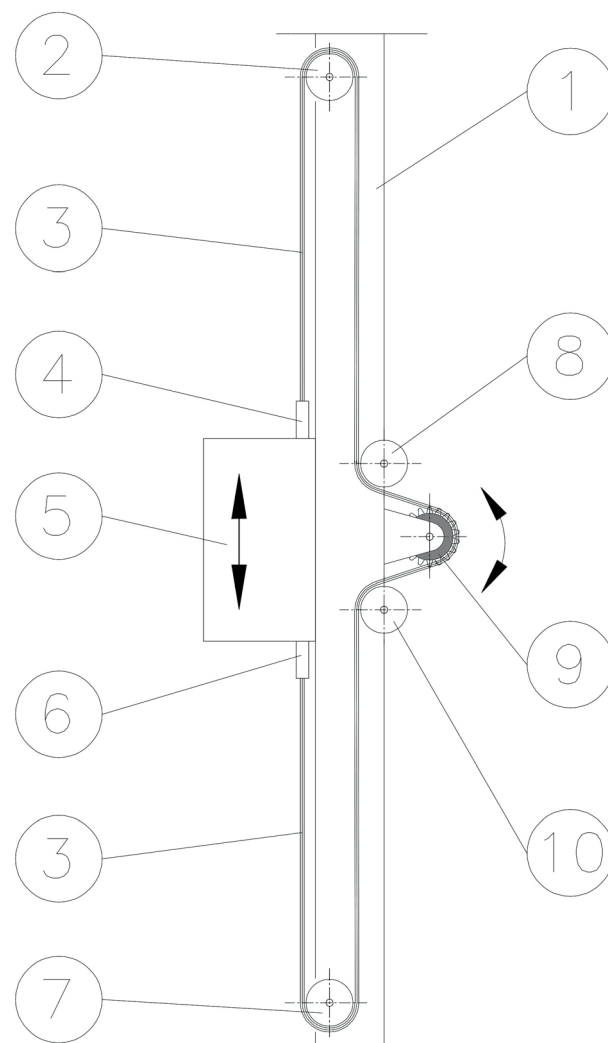
- 1 mast
- 2 hydraulic cylinder
- 3 hydraulic cylinder fixture on mast
- 4 hydraulic cylinder fixture on drill head carriage
- 5 drill head carriage

Figure 5 — Feed system - Cylinder

**Key**

- 1 mast
- 2 upward return sheave
- 3 upward pull rope
- 4 upward return sheave
- 5 drill head carriage
- 6 downward return sheave
- 7 downward pull rope
- 8 downward return sheave
- 9 rope-winch
- 10 upward pull rope fixture
- 11 downward pull rope fixture

Figure 6 — Feed system - Rope-winch



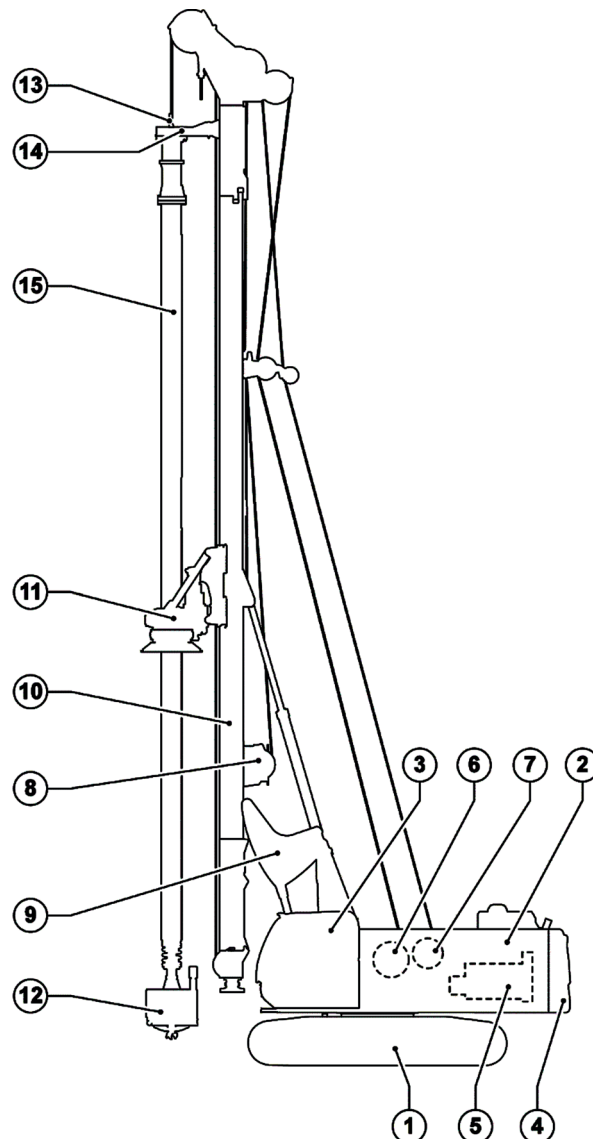
Key

- 1 mast
- 2 upward return roller
- 3 chain
- 4 upward chain fixture
- 5 drill head carriage
- 6 downward chain fixture
- 7 downward return roller
- 8 upward deflexion roller
- 9 chain drive system
- 10 downward deflexion roller

Figure 7 — Feed system - Chain-feed system

4.2 Mobile drill rigs for civil and geotechnical engineering

[Figure 8](#) to [Figure 10](#) show examples of mobile drill rigs for civil and geotechnical engineering.

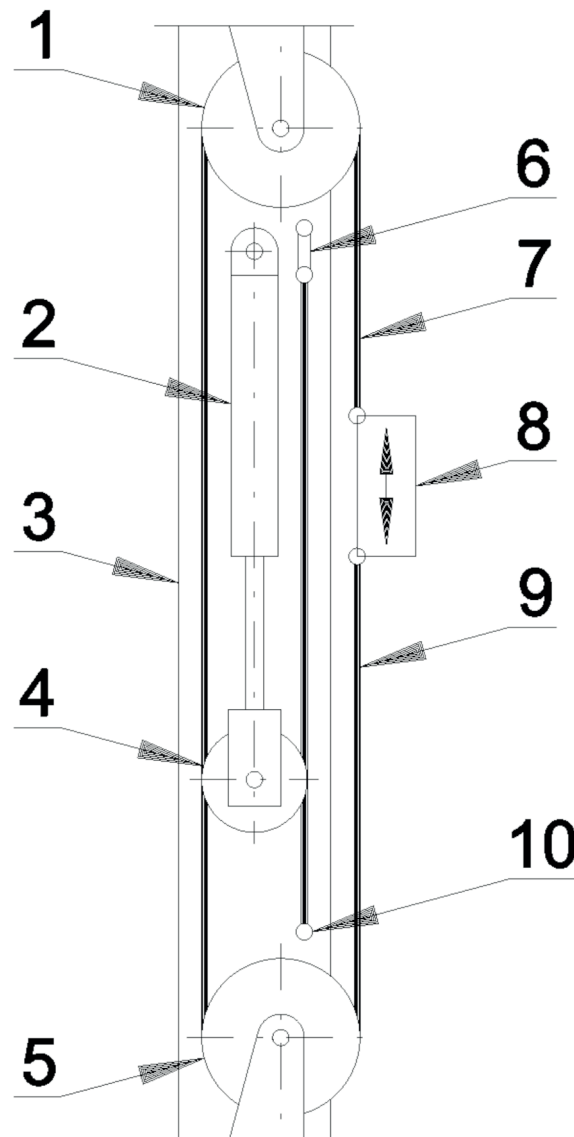


Key

- | | |
|---------------------------------|-------------------------|
| 1 carrier-crawler undercarriage | 9 kinematics |
| 2 slewing turret | 10 mast |
| 3 driving cab | 11 rotary table |
| 4 counterweight | 12 tool |
| 5 engine/motor | 13 swivel |
| 6 main winch | 14 kelly upper guide |
| 7 service winch | 15 kelly telescopic bar |
| 8 pull-up and pull-down system | |

NOTE The pull-up and pull-down system is possibly a winch as shown in this picture or cylinder.

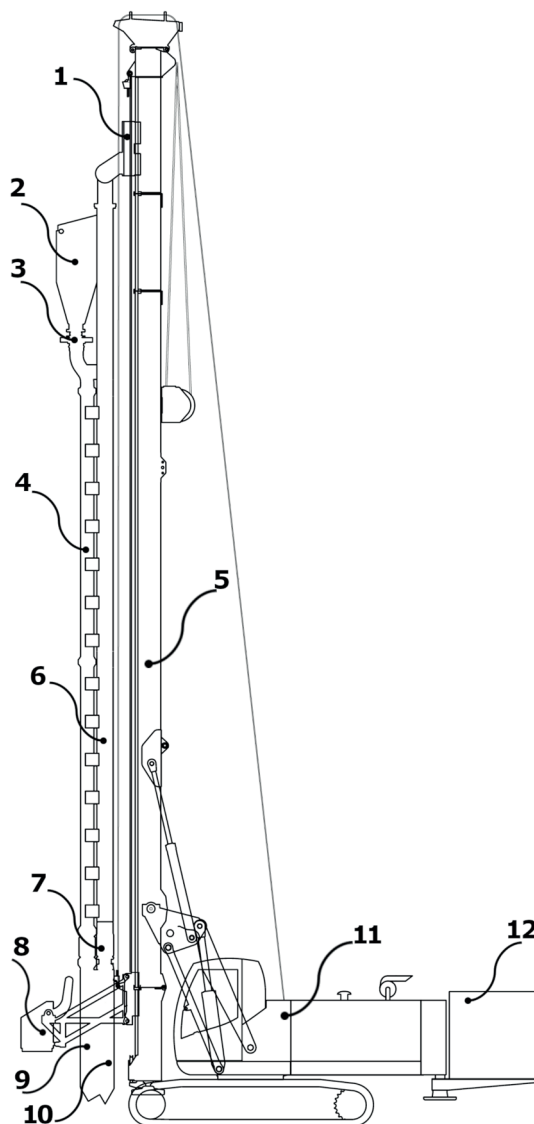
Figure 8 — Mobile drill rigs for civil and geotechnical engineering



Key

- 1 pull-up chain deflection sheave
- 2 hydraulic cylinder
- 3 mast
- 4 tackle with sheaves
- 5 pull-down chain deflection sheave
- 6 pull-up chain fixture
- 7 pull-up chain
- 8 drill head carriage
- 9 pull-down chain
- 10 pull-down chain fixture

Figure 9 — Chain and cylinder driven pull-up/pull-down system (3.5.14)



Key

- 1 sled for the vibro-compaction tool
- 2 stone tank
- 3 stone gate
- 4 stone tube
- 5 mast
- 6 main tube of vibro-compaction tool
- 7 vibration isolator
- 8 stone conveyor (skip)
- 9 bottom feed stone tube
- 10 vibrating cell
- 11 rig
- 12 air compressor for stone injection assistance

Figure 10 — Stone columning rig