

BUTE Department of Construction Management and Technology

Construction equipment

20.10.2015

Construction equipment

- Why?
 - Faster
 - To reduce the duration of the process
 - Cheaper
 - To reduce costs (where labour is expensive)
 - Easier
 - To reduce (heavy) manual work
 - A machine makes the work of many workers: excavator (0,5 m³) = 75 persons, tower crane (5 t, 50 m) = 140 persons

Choosing construction equipment

Choosing construction equipment considering:

- The **aim** of the machine – the work to carry out – the planned **technologies**
- The **material / elements** to work with
- The **capacity** needed
- The **quality** to achieve
- The conditions at the **site**
- The **schedule**
- The **budget**

Types of construction equipment

Heavy equipment

- Earthwork/ demolition
- Transportation



- Lifting




- Concrete equipment



Earthwork equipment


Earthwork equipment

Dozers, bulldozers 

- A dozer is a tractor unit that has a **blade** attached to the machine's front.
- Wheel / Crawler dozer;
- Used for:
 - Stripping top soil;
 - Clearing vegetation;
 - Shallow excavation;
 - Spreading and grading soil;
 - Ripping of rock.



Earthwork equipment

Dozers, bulldozers 



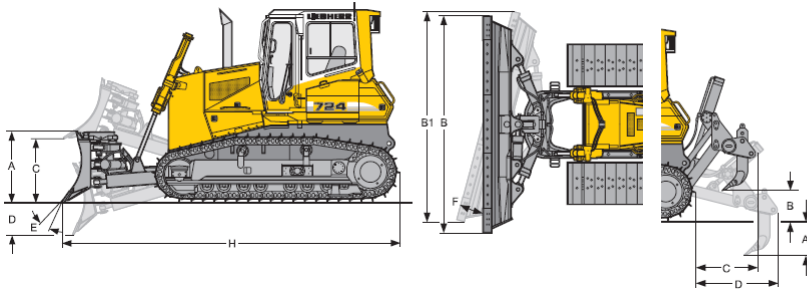
Earthwork equipment

Dozers, bulldozers
ripper



Earthwork equipment

Dozers, bulldozers, ripper



Earthwork equipment

Loaders 

- A loader is one machine in common use to **pick up** excavated material.
- It consists of a crawler or wheeled tractor with a **shovel** or a **bucket** mounted in front.

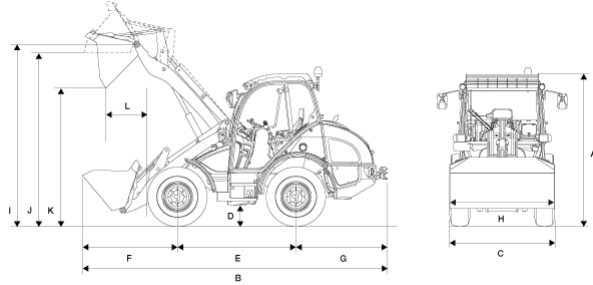


Earthwork equipment

Loaders



- Bucket capacity from less than 1 m³ up to 15m³



Earthwork equipment

Scrapers, graders



- Are self-loading, transporting machines used for general **leveling** of plane surfaces;
- To excavate and haul away **large volumes**;
- Can cut the soil layers from 15-30 cm.
- A scraper is a combination machine, it loads, hauls and discharges material.
- Graders are multipurpose machines used for finishing, bank sloping ,ditching, spreading, leveling and light stripping operations.

Earthwork equipment

Scrapers, graders



Earthwork equipment

Excavators

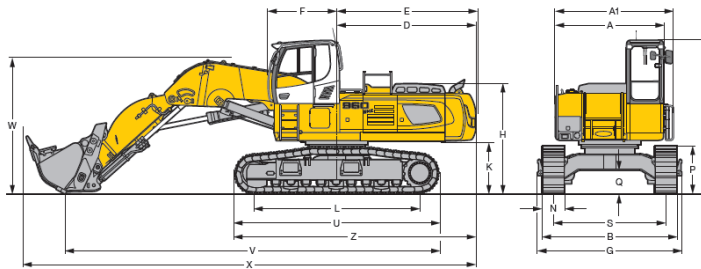


- To **excavate** earth and **load** it into trucks or deposit it;
- Variations:
 - Crawler-mounted: slow, but can operate on soft soil;
 - Wheel-mounted (rubber tires): moves faster and can travel on public roads;
 - Operated by hydraulics;
 - Operated by ropes;
- Several types


Earthwork equipment

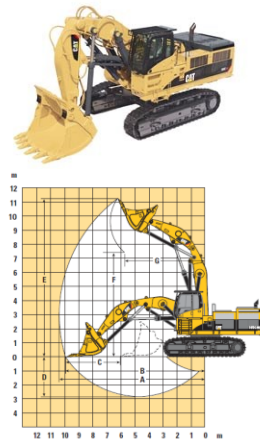
Excavators: Power shovel / face shovel 

- Operates from a flat, prepared surface;
- Works **above the tracks**, against a face or a bank;
- It digs by **pushing** the soil away.



Earthwork equipment

Excavators: Power shovel / face shovel 

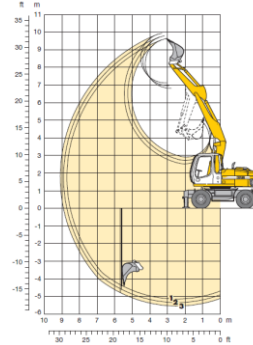


Earthwork equipment

Excavators: Pull shovel / backactor / **backhoe** (hoe)



- The main difference is in the position of the **bucket** (the reverse to that of the power shovel);
- It is designed to dig **below** the level of the machine;
- It digs by **pulling** the load toward the power unit.



Earthwork equipment

Excavators: Pull shovel / backactor / backhoe (hoe)



Bucket capacity: 0,2 m³-1,7m³



Earthwork equipment

Excavators: Pull shovel / backactor / backhoe (hoe)



Earthwork equipment

Excavators: backhoe loader 

- The combination of a backhoe and a loader



Earthwork equipment

Excavators: backhoe loader



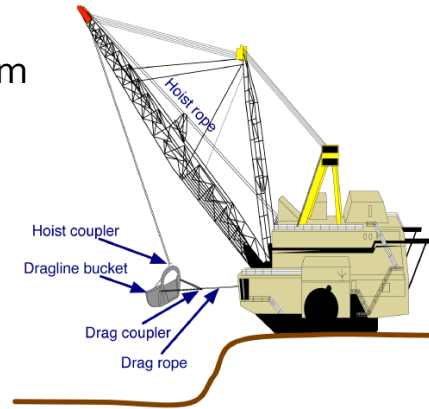
Earthwork equipment

Excavators: Dragline – an attachment used on a crane boom

- It consist of a **dragline bucket** and some **cables**;
- The machine is operated by **pulling** the bucket toward the power unit.
- It does not dig to as accurate as a pull shovel, but it has **larger working range**;
- It is suited to digging below water level and in mud / quicksand;
- It is used in mines.

Earthwork equipment

Excavators: Dragline
Working range: 75-130m



Earthwork equipment

Excavators: Dragline
Bucket capacity up to 24-116m³



Earthwork equipment

Excavators: Clamshell

- A hinged bucket used on a crane boom
- Used for vertical excavating – above and below ground level;
- Hung from a lattice-boom of a crawler crane or hydraulic clamshell buckets on hydraulic hoes;
- Special clamshell buckets for slurry walls.

Earthwork equipment

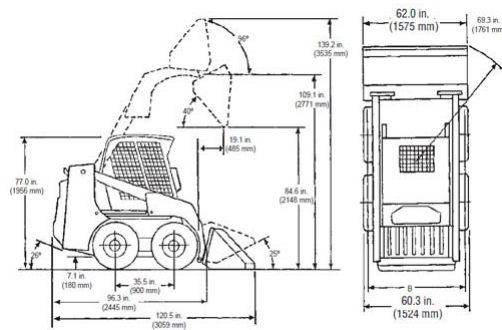
Excavators: Clamshell



Earthwork equipment

Excavators: compact excavators

- Work in narrow places – even in buildings



Earthwork equipment

Excavators: compact excavators

- Work in narrow places – even in buildings



Earthwork equipment

Drills and pile drivers

- Pile drivers may consist of a drop, mechanical or vibratory **hammer**;
 - Drop hammer;
 - Single-acting hammer, double-acting hammer;
 - Diesel-hammer;
 - Hydraulic impact hammers, hydraulic drivers;
 - Vibratory pile drivers.
- Drills – for creating piles and anchors.

Earthwork equipment

Drills and pile drivers



Earthwork equipment

Compacting machines:



- The backfilled soil, gravel is to be compacted to prevent distortion, settlement or softening;
- Backfill and compact always in layers!

Types:

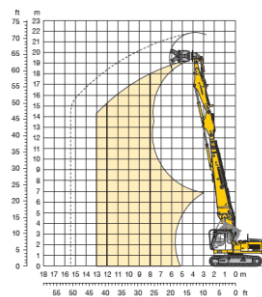
- Static weight roller;
- Vibrating roller;
- Vibrating plate;
- Impact plate;
- Frefall hammer;
- High speed compactor.



Earthwork equipment

Demolition equipment:

- Loaders and excavators;
- Hydraulic operated equipment.



Lifting

Lifting

- The aim is to lift construction material / elements / structures;
- Lift **greater loads** and / or to **greater heights**;
- Types:
 - Pulley and hoisting tackle;
 - Cranes: mobile crane / tower crane / portal crane;
 - Elevators;
 - Other machines, equipment.

Lifting

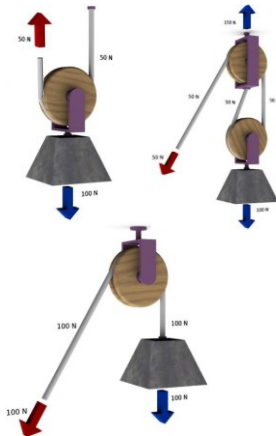
Pulley and hoisting tackle:

- Simplest lifting machines ;
- Operated by hand or an engine (electric motor or diesel engine)
- Material of ropes:
 - Natural – hemp;
 - Plastic fibers;
 - Steel cable.



Lifting

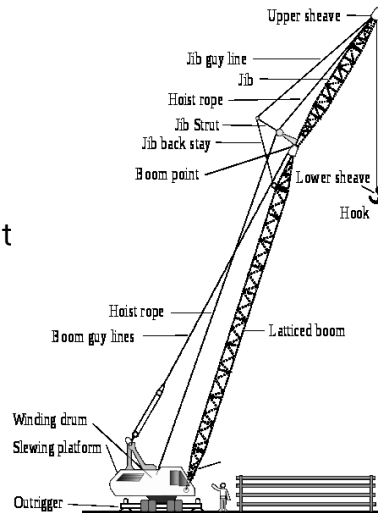
Pulley and hoisting tackle:



Lifting

Mobile cranes:

- Have 3 sections:
 - Base frame mounted on crawler tracks or wheels;
 - Superstructure / power unit
 - Boom.



Lifting

Mobile cranes:

- Base:
 - **Crawler-mounted:** have **greater capacity**, but slow (8-10 km/h) prohibited to use public roads;
 - **Wheeled:** move **faster** (on public roads too), but need outriggers for lifting and have smaller capacity;
- Boom:
 - Lattice-boom: slow to mount / demount;
 - Telescopic-boom: rapid and easily operated by hydraulics.

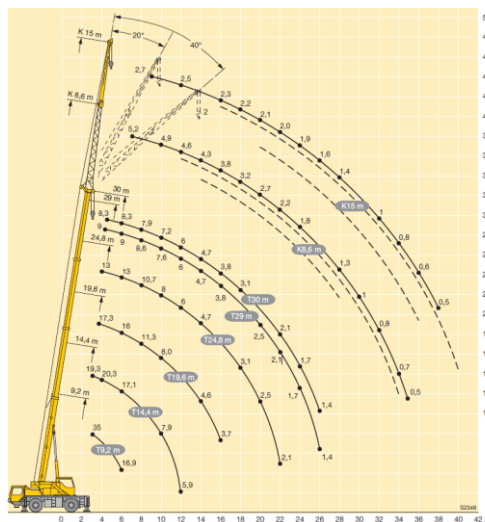
Lifting

Mobile cranes:

- Load **capacity** depends on:
 - The stability of the footing;
 - The strength of the boom (vary with boom length and extensions);
 - The counterweight (the manufacturers specify standard and maximum counterweight).
- The working **range** is limited by the boom length and the length of the hoist cable.

Lifting

Mobile cranes:
Load capacity
diagram



Lifting

Mobile cranes:



Lifting

Mobile cranes:



Lifting

Mobile cranes: accident



Lifting

Tower cranes:

- Provide **high lifting height** and good working radius;
- Takes up a very **limited area on the site**;
- Has a vertical **tower** with a **jib**:
 - Top-slewing (fixed tower) – swing circle mounted at the top of the tower;
 - Bottom-slewing (slewing tower) – swing circle located under the tower.

Lifting

Tower cranes:

- The main differences between top-slewing and bottom slewing cranes are in the setup and dismantling procedures and in lifting height.
 - Bottom-slewing: self-erecting or fast erecting shorter because its revolving base
 - Top-slewing: requires more time (one day or more) and the assistance of other equipment (a mobile crane) to set up.

Lifting

Tower cranes:



Lifting

Tower cranes:



Lifting

Tower cranes:



Lifting

Tower cranes:



Lifting

Tower cranes:

- Generally the crane stands on a **foundation** (mat foundation or piles)
- Other types:
 - Rail-mounted (can travel with a load);
 - Crawler-mounted (has smaller capacity);
 - Tied-in crane (is tied in to the building);
 - Climbing crane (inside a very tall building).

Lifting

Elevators (hoists), other machines:

- Elevators are usually used after the loadbearing structures are ready, for lifting smaller loads and workers.
- Other machines:
 - Truck cranes;
 - Fork-lift trucks;
 - Hydraulic excavators;
 - Etc.

Lifting

Elevators (hoists), other machines:



Lifting

Elevators (hoists), other machines:



Transportation

Transportation

- Transportation **range**:
 - On site – short range;
 - Off site – long range;
- **Material** to be transported:
 - Solid elements (e.g. beams, bricks, doors, etc.);
 - Loose material (e.g. gravel, soil, cement etc.);
 - Fluid material (e.g. water, concrete etc.);

Transportation

Fluids – Pumps

- Water and mud pumps:
 - For dewatering and clearing;
 - In wells.
- Cement pumps:
 - To transfer cement (or plaster etc. in a form of a powder) – using compressed air.

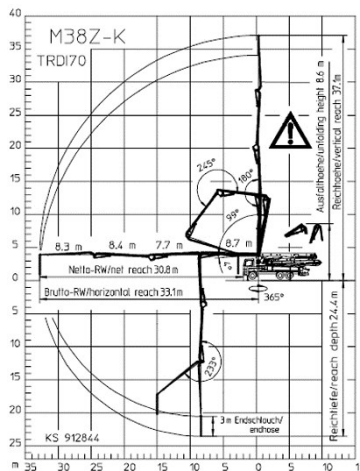
Transportation

Pumps

- Concrete pumps:
 - Only for fluid concrete;
 - Mechanical pump – capacity 40m³/h distance h: 300 m, v: 40 m;
 - Hydraulic pump – capacity 120 m³/h distance h: 600 m, v: 300 m;
 - Squeeze pump – capacity 30 m³/h, distance h: 130m, v: 40 m;
 - Screw pump – capacity 100 m³/h, distance h: 40 m, v: 60 m.

Transportation

Pumps



Transportation

Pumps



Transportation

Trucks: 

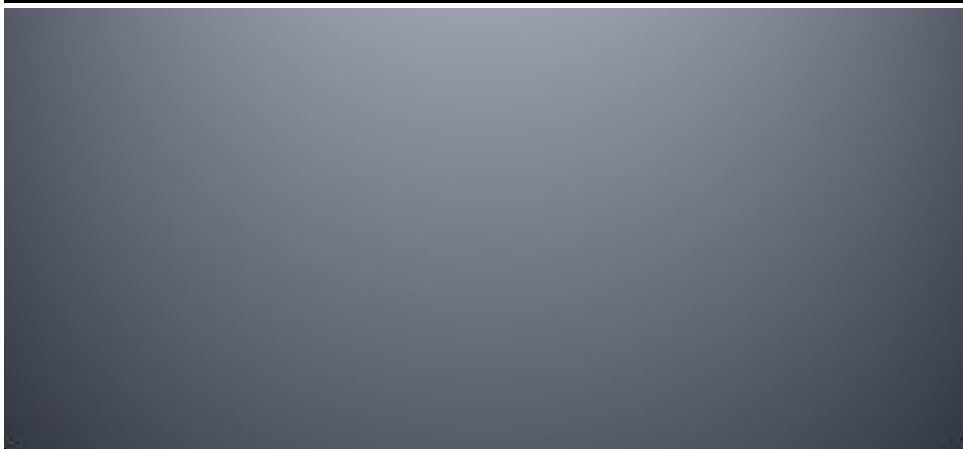
- Trucks are hauling units that provide relatively low hauling costs because of their high travel speeds;
- Trucks are described in terms of:
 - Total number of wheels and driven wheels;
 - Capacity (m³) or payload (t);
 - Net weight empty, maximal weight, axle loads;
 - Engine power (kW/HP), speed;
 - Measures, turn radius.

Transportation

Trucks:



Concrete equipment



Concrete equipment

- Mixing concrete:
 - Ready-mixed concrete (off site);
 - On-site mixing.
- Placing concrete:
 - Buckets;
 - Hand / power buggies, wheelbarrows;
 - Chutes and drop pipes;
 - Belt conveyors;
 - Concrete pumps.
- Consolidating and finishing:
 - Vibrators (internal, surface and form vibrators);

Concrete equipment

Placing concrete:

- Bucket
- Wheelbarrow
- Chute
- Pump



Concrete equipment

Ready-mixed concrete

- Concrete is mixed in a central batch plant and transported to the site;



Concrete equipment

Ready-mixed concrete

- Transit-mix trucks / mix trucks



Concrete equipment

On-site mixing

- Only in cases when ready-mixed concrete is not available or the quality of the concrete is irrelevant;
- Using a smaller mixer or a mixing plant.

