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 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

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

- 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 15 m³

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

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
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.
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)

Earthwork equipment

Excavators: backhoe loader
- The combination of a backhoe and a loader
Excavators: Dragline – an attachment used on a crane boom

- It consists 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.
Excavators: Dragline
Working range: 75-130m

Excavators: Dragline
Bucket capacity up to 24-116m³
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: compact excavators

- Work in narrow places – even in buildings
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.
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;
  - Freefall hammer;
  - High speed compactor.

Demolition equipment:
- Loaders and excavators;
- Hydraulic operated equipment.
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.
Mobile cranes:
- Have 3 sections:
  - Base frame mounted on crawler tracks or wheels;
  - Superstructure / power unit
  - Boom.

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.
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:

Lifting

Mobile cranes:
Mobile cranes: accident

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.
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:

- 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

Tower cranes:

- It is associated with stockyard e.g. for precast concrete elements, where lifting facilities are required.
- The portal legs are mounted on rail tracks;
- The bridge is lattice frame construction;
- The portal beam supports an electric hoist travelling on wheels.

Portal cranes:

- It is associated with stockyard e.g. for precast concrete elements, where lifting facilities are required.
- The portal legs are mounted on rail tracks;
- The bridge is lattice frame construction;
- The portal beam supports an electric hoist travelling on wheels.
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
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 40 m$^3$/h distance h: 300 m, v: 40 m;
  - Hydraulic pump – capacity 120 m$^3$/h distance h: 600 m, v: 300 m;
  - Squeeze pump – capacity 30 m$^3$/h, distance h: 130m, v: 40 m;
  - Screw pump – capacity 100 m$^3$/h, distance h: 40 m, v: 60 m.
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.