

## UNIT 3 – OTHER CONSTRUCTION EQUIPMENTS

### 3.1 Equipment for dredging, trenching, drag line and clamshell, tunneling

#### 3.1.1 Equipment for dredging

Dredging involves the use of specialized equipment known as dredges to remove unwanted sediments. It creates a vacuum to help suck up and pump out dredging material from the bottom of a water body. So how exactly does the dredge work?

Here are the steps of the dredging process.

1. The operator lowers the dredge boom to the bottom or side of a body of water.
2. A rotating cutter-bar will then use its teeth to loosen the debris or sediments.
3. The submersible pump will remove the sediment from the waterway's bottom.
4. The dredge will then transport away the sediment and debris for final processing.

#### TYPES OF EQUIPMENT USED FOR DREDGING

There are two main types of dredging equipment used:

- Hydraulic dredging
- Mechanical dredging

## **HYDRAULIC DREDGING VS MECHANICAL DREDGING**

Hydraulic dredgers act as a giant, underwater vacuum cleaner to clean and remove sediments, while mechanical dredging uses heavy equipment to dig up the bottom of a water source, and move it. Let's dig a little deeper into each.

### **HYDRAULIC DREDGING**

This is widely considered the most effective method of dredging when the environment and the ecosystem of the dredging site is of major concern. It is preferred because it prevents most of the contaminated sediments from being dispersed or released into the nearby water source. While this is a major advantage to hydraulic dredgers, they do have their limitations. Because of their design, hydraulic dredgers are excellent for moving loose soils, sands, silt, gravel, or rocks.

### **MECHANICAL DREDGING**

While mechanical dredging is the most commonly rented form of dredging machinery, that does not mean it is always the most effective. Because this form of dredging requires a bucket or digger to impact and shovel away the sediment, there is a higher chance of contaminated materials within the sediment to be dispersed into the water surrounding it. The contaminated soil can fall out of, or through the bucket, and spread further into the water.

### **OTHER TYPES OF DREDGING EQUIPMENT**

In addition, there are two other common types of dredging equipment you will find: mechanical/hydraulic dredgers that use a combination of both hydraulic and mechanical methods to get the job done. Cutter suction dredgers are an example of these. Hydrodynamic dredgers are the other type of dredging equipment you will find in the industry today.

### **3.1.2 Trenching**

A trencher is a piece of construction equipment used to dig trenches, especially for laying pipes or electrical cables, for installing drainage, or in preparation for trench warfare. Trenchers may range in size from walk-behind models, to attachments for a skid loader or tractor, to very heavy tracked heavy equipment.

#### **What Is Trenching?**

Trenching is a simple excavation technique that involves removing dirt, rock and other organic matter to create a hole in the ground. Trenches are usually dug from aboveground in a path that's deeper than it is wide. Trenches can vary greatly in depth, but OSHA only considers an excavation to be a trench if it's less than 15 feet wide at the very bottom of the trench. Anything larger and it's considered an excavation, which can be any depression or opening in the earth's surface.

#### **Different Types of Trenches**

Trenching may be used to create new ditches for installing drainage, retaining walls, electrical or fiber conduit, sprinkler systems and gas, sewer and water lines. It can also be used to create replacement trenches to replace old sewer, water and drain lines with new materials. There are several different types of trenches, with trench type determined by its shape and the shape determined by the purpose of the trench. Issues that affect the type of trench you can use include:

- Type of soil being dug in
- Availability of shoring or shielding
- Size of pipe or conduit being installed in the trench
- Location of the trench, i.e., roadway versus open field
- Proximity to any existing utilities, buildings or other structures

Four commonly used trench types include:

- **Straight Trenches:** Have parallel sides that are at right angles to the base. These trenches are usually utilized in areas where there's limited surface area, such as near buildings or roadways. Shoring or trench boxes are required protective systems.
- **Sloped Trenches:** Have angled sides to prevent cave-ins, with the slope's angle determined by trench depth, soil type and how long the trench must remain open. These trenches are used for placing large culverts or pipes and are also common for new construction sites where there's a wider path of soil and other protective systems aren't available. Sloping and shielding are employed as protective systems.
- **Benched Trenches:** Have sides that have been cut away to create steps, with the height of the steps determined by soil type and shallower angles required in less stable soils. Single or multiple bench systems may be used to stabilize a trench that needs to be up to 20 feet deep. Shielding or trench boxes are used as protective systems.
- **Bell-Bottom Pier Hole Trenches:** Have tops that are usually narrower than the bottom of the hole, giving it a bell shape. These trenches are typically used for installing footings to support a structure's foundation. Additional protective systems are required because there's a higher potential for collapse due to the sides sloping inward over the floor of the excavation.

### 3.1.3 DRAGLINE AND CLAMSHELL

#### DRAGLINES

Dragline excavators, known simply as draglines, are large excavating machines used for surface mining and terrain development. Draglines operate by lowering a bucket onto the terrain from a boom and then reeling the bucket in with a winch located in front of the machine. A blade on the bucket scrapes and collects surface

material until the bucket is full, where it is then raised and emptied into a dump truck or designated location. Draglines used for the construction of roads, ports, or other infrastructure projects are typically smaller than draglines used for mining, and can be disassembled and relocated. These types of draglines are typically mounted on caterpillar treads, and many cranes can be implemented as draglines. Most of these draglines are diesel-powered. Draglines meant for the removal of overburden above coal or for tar-sand mining are amongst the largest vehicles ever constructed. These machines are purpose-built and rarely leave the excavation site. Draglines of this magnitude are mobilized by 'walking feet' which pick-up and replace the dragline a couple yards at a time; caterpillar tracks would sink or collapse in loose soil below the machine. Furthermore, mining draglines are often hardwired into a high-voltage grid due to its immense power requirements. Despite the sizeable cost of draglines, they remain popular due to their reliability and ease of waste removal.

### **Types of Draglines**

- Crawler mounted
- Wheel-mounted
- Truck-mounted

A crawler-mounted dragline can operate on surfaces that are too soft for the wheel and truck-mounted dragline. The speed of crawler mounted dragline is as low as 2 kmph. Whereas the wheel or truck-mounted dragline has the advantages of mobility. The wheel or truck-mounted dragline can travel as high as 50 kmph.

### **Basic Part of Dragline**

Boom

Drag cable

Hoist

cable Drag

chain

bucket

Operation of dragline

By releasing both the hoist and drag cable the bucket is lowered down in a fully dumped position till it rests on the ground with the sharp digging teeth into the earth. The hoist cable becomes active slightly and then the dragging pull is applied.

This action fills in the earth and the bucket take a horizontal position. Then the bucket is filled. The boom is swung to the position of dumping when the needed dumping height is achieved, and then the drag brake is released. This process will dump the load off the bucket.

Then, the boom is swung back to the digging position and the same cycle of operations is repeated.

### **Application of Dragline**

- For digging softer material and below the track level, the dragline machine is the most suitable machine.
- Dragline is a very useful machine for excavating trenches when the sides are allowed to establish their angle of repose without shoring.
- The dragline machine has long reached.
- In the excavation of canals and depositing the excavated earth on the embankment without hauling units, a dragline machine is mostly used.

### **Principle of Dragline**

Dragline drops the bucket on the source and then drag it horizontally bucket start tilting as it come closer to the machine.

### Uses of Dragline

Deep down pile driving, Surface mining, deep down excavation, Underwater excavation, Road excavation.

### CLAMSHELLS

The clamshell is a bucket with two hinged jaws carried by a crane suspended from the boom by two lines: one raises and lowers the bucket, and the other pulls the jaws together against gravity for digging action. It is used chiefly for deep, narrow excavations.

### TYPES OF CLAMSHELLS

1. Hydraulic clam shell bucket
2. single rope cable clam shell bucket
3. electro hydraulic clam shell bucket

1. **Hydraulic Clam Shell Bucket** - These types of buckets typically come in a wide range of sizes and capacities, making them amenable to many aggregates' applications. Such flexibility also makes this particular kind suitable for an array of material handling functions. Because of their center rotation mechanism, hydraulic buckets require fewer parts. At the same time, each of these limited number of parts tends to be exposed to the same wear and tear. Parts made of wear steel can mitigate the damage wrought from such exposure.

2. **Single Rope Cable Clam Shell Bucket** - Cranes in which the holding and closing lines are shared (e.g., naval gear cranes and overhead bridge cranes) often make use of an anvil attachment single rope cable clam shell bucket. This type of functionality maximizes the bucket's production capabilities, but such heavy usage can quickly result in bucket erosion. High-quality wear steel like Ten's alloy AR400

is one of the best ways to eliminate these erosive tendencies and extend wear.

3. **Electro Hydraulic Clam Shell Bucket** - In some cranes, electric is supplied to the clam shell. These types of buckets are frequently found in ship gears and overhead gantry cranes where barge unloading and heavy handling are encountered. Wear steel can maximize the life span of this type of bucket.

### 3.1.4 TUNNELING

Tunnels are structures that creates an underground passage that may pass through a hill, under buildings or roads, under water or even under entire cities. They might be required to traverse an obstacle, create a mass transit systems, provide connections beneath sea, accommodate pipelines, provide sewage systems and so on. There are wide range of methods that can used for the design and construction of tunnels, depending on the scale of the tunnel required, the specific ground and groundwater conditions, the depth, the availability of space and so on. The main considerations include:

- **The purpose of the tunnelling:** This will influence the size and cross-section of the tunnel.
- **The type of ground:** This will influence the selection of the route for the tunnel and whether it is economical or feasible to construct where there may be poor conditions or defects in strata.
- **The construction method:** This will alter depending on the type of tunnel, the ground conditions, the tunnel length required and the project time pressures.
- **Removal of debris:** The size and length of the tunnel will determine the equipment required for 'mucking out' debris.
- **Control of water:** Pumping is the most common technique for dealing with the presence of water whilst tunnelling.



## TYPES OF TUNNELLING:

**Cut-and-cover tunnels:** In this type of tunnels, the tunnel structure is cast- in-situ or precast in an excavation. After construction, the structure is back- filled with new or excavated soil. Cut and cover construction is adopted when the depth of tunnel is shallow and the safe excavation is possible from the surface without collapsing the walls of excavation and when it is economical and acceptable. This methodology is usually used for the construction of underpasses, approach sections of other tunnels & tunnels in flat terrain or shallow depth.

**Bored or Mined Tunnels:** These tunnels are built without excavating the ground surface. These tunnels are named according to the type of material through which the tunnel is being excavated. When a tunnel passes through different types of material it is known as mixed face construction. In bored tunnelling, the excavation takes place at the portal or at a shaft, thus there is a minimum impact on usual traffic, air & noise quality, and utilities.

**Rock Tunnels:** Rock tunnels are excavated through the rocks either by drilling or by blasting. The tunnelling method utilizes mechanized excavators in case of soft rocks or rock tunnel boring machines (TBM). Sequential Excavation Method (SEM) is also used in some cases. The behaviour of rocks can change place to place and type to type so depending on this stabilization measures ranging from no support at all to anchor bolts to steel sets to even heavily reinforced concrete lining and combination of all these are used. It is one of the most challenging tunnelling geologies.

**Soft Ground Tunnels:** When tunnels are excavated in soil using a shield or pressurized face TBM, or by mining methods commonly known as sequential excavation method (SEM) are used they are called soft ground tunnels. Soft ground includes cohesive soils as well as cohesion less soils and silty sands. Very soft ground tunnels when excavated sequentially by small drifts and

openings, it is known as New Austrian Tunnelling Method (NATM).

**Immersed Tunnels:** Immersed tunnels usually consist of very large pre- cast concrete or concrete filled steel tunnel elements which are fabricated in the land and later installed under water. After installation, these tunnels are backfilled. There are lot of immersed tunnels around the world used for road or rail connections. Immersed tunnels are fabricated in required lengths in dry docks or in improvised floodable basins or on shipways.

**Jacked Box Tunnels:** In these types of tunnels, prefabricated box structures are jacked horizontally through the soil against a thrust wall using methods to reduce surface friction, like bentonite slurry. These are often used for construction beneath runways or railroads embankments where surfaces are shallow but the must not be disturbed since it can disrupt the normal services. The method was developed from pipe jacking technology. The Jacked box tunnelling is used in soft ground and for short lengths of tunnels.