
# Summer Training report on **Dragline Excavators** at NCL (KHADIA PROJECT)

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# ACKNOWLEDGEMENT

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# Introduction

The Report gives a brief profile of Northern CoalFields Limited, Singrauli.
It further elaborates about dragline excavators , their types , and about various components of a dragline with their corresponding figures.
Furthermore, working parameters and mechanisms are discussed .

# Northern Coalfields Limited (NCL)

Northern Coalfields Limited (NCL), Singrauli is a major contributor towards fulfilling energy requirement of the nation. NCL is a wholly owned subsidiary of Coal India Limited, under the Ministry of Coal, Government of India and Mini Ratna (Category-I) company since 2007.

NCL operates primarily with the objective of producing coal with due regard to social up-liftment, sustainable development and environmental up gradation. It is an ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 certified company.
Organization's main products include non-coking coal in the range of grades G5 to G13 besides 'De-shale Coal' and the 'Coal Rejects'.
About 86% of the coal produced is dispatched to Power Sector. NCL has share of about 15% in nation's total coal production i.e. a contribution of about 10% in total power generation.
NCL was formed in November, 1985 encompassing Singrauli Coalfield, carved out of Central Coalfields Ltd., with its Headquarter at Singrauli, Madhya Pradesh.The area of Singrauli Coalfield is about 2202 sq.km.

## Dragline Excavators

Dragline excavators are large, heavy-duty machines used in mining and civil engineering projects for excavating and moving large amounts of earth, rock, and other materials.
A dragline consists of a long boom and a bucket suspended from a hoist rope, which is operated by a system of cables and motors . The

bucket is typically shaped like a large scoop or shovel, capable of holding several cubic meters of material. The machine is called a "dragline" because it drags the bucket towards itself to excavate material.

They can remove large amounts of overburden (the top layer of soil and rock covering the mineral deposit) efficiently and economically.

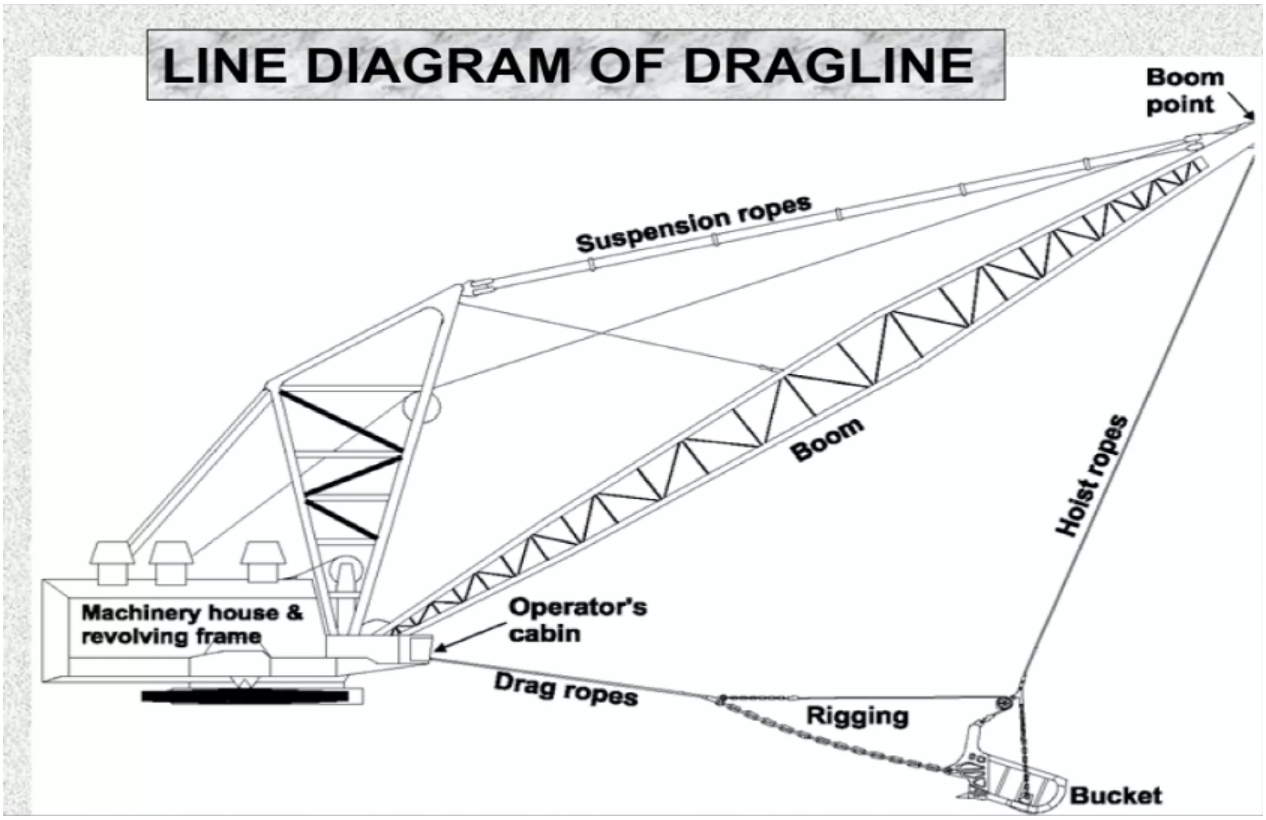
There are five main operations on which a dragline works:

1. The empty bucket is positioned, ready to be filled.
2. **Dragging:** The bucket is dragged toward the dragline to fill it.
3. **Hoisting and Swinging** : Filled bucket is simultaneously hoisted and swung over to the spoil pile. If the swing motion must be slowed to permit hoisting, the dragline is said to be hoist critical. When hoisting to the dump position is completed before the boom is in position to dump, the dragline is said to be swing critical.
4. **Dumping** The material is dumped on the spoil and then bucket is swung back to the cut while simultaneously being lowered and retrieved to the digging position.
5. **Marching** operation is performed at last in which machine

In Khadia project three dragline excavators are there, Baidyanath and Vishwanath draglines both having bucket capacity of 20 cubic meters and boom length of 90m while Somenath dragline have

relatively large bucket capacity of 33 cubic meters and boom length of 72 metres.

Somenath dragline  varies from other two is mainly due to its gear based marching mechanism and boom structure.



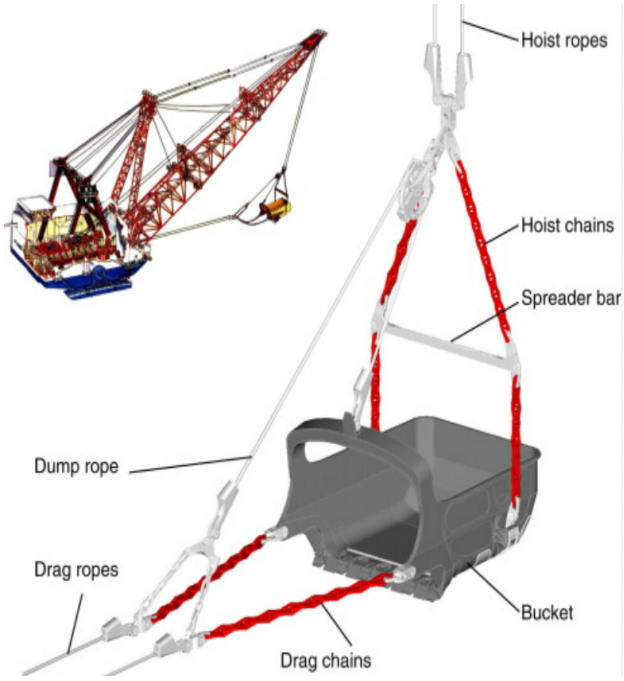

# Various Components of a Dragline Excavator

## Boom:

It is also known as Mast . It is a metal structure which rises from the body of machine and on this pulleys are attached which hangs the hoist wire.

To support the boom, boom support cables or suspension rope is present.

## Bucket:



Above figure shows all the components of a bucket system

A dragline bucket system consists of a large bucket which is suspended from a boom with hoist ropes. The bucket is controlled collectively by hoist , drag , dump ropes and chains. The hoist and drag ropes are powered by large motors.
Hoist ropes are longer than drag rope( in Baidyanath and Vishwanath draglines hoist rope is 240 meter long while drag rope is 140 meter long).

- Dump ropes :it is used to serve the purpose of controlling the dumping the material from the bucket.By pulling or releasing the dump rope, the operator can tilt or rotate the bucket, causing the material to be discharged.
- socket:Ropes are connected to other parts of bucket through socket
- cross members:-These are triangular in shape ,acts a junction for connecting different chains and sockets(which are connected to ropes)
- Balancing bar (spreader bar) is used to balance the bucket

## Motors and Generators

To control the hoisting and dragging processes , there are several motors present in the machine. For controlling the hoisting process two hoist motors are present and two drag motors are there for the Dragging process. These motors are connected in series so that their shafts have same direction of rotation. These motors are powered by Generators i.e Hoist and Drag generators

<u>Controlling hoist and drag ropes :</u>

Drag ropes are wrapped on two large drums(6 meter radius).these drums are rotated at lower rpms with the help of gearing arrangement.
Drag motor's shaft is connected to pinion shaft with help of gear meshing and the pinion (double helical gear) is in mesh with bull gear which is mounted on the intermediate shaft. To provide stability to intermediate shaft thrust bearing is used.
This shaft has gear mounted on it which is in mesh with bif=g gear of drum.
This way when the motor starts and break is removed drum starts to rotate .

In similar way hoisting is also done.

## Swinging Mechanism:

There are four(three in Somenath) swing motors in series which are powered by a Swing Generator . These motors are placed at different locations. Shaft of these motors are coupled with gear and to further reduce the rpm gearbox is there (at base of motors) and finally lower rpm is provided to the pinion shaft.
The base(tub) of the machine have rack gear which is in mesh with the pinions and To reduce the friction, there are hundreds of rollers. This way when the swing motors starts causes the swinging motion of the excavator.

# Marching Mechanism:

Dragline excavator marches on two different types of mechanism

1. Hydraulic marching mechanism:

The hydraulic marching mechanism of a dragline excavator typically involves a set of large hydraulic cylinders and a large foot on both sides . The foot is located near the base of the machine and supports the entire weight of the excavator while marching.
The hydraulic cylinders are attached to the foot and are responsible for generating the walking motion. These cylinders are connected to the machine's hydraulic system, which supplies pressurized hydraulic fluid.
One of the cylinder having more thickness is known as Main cylinder while less thicker one is called Auxiliary cylinder.

To initiate movement, the operator controls the hydraulic system(it consists of 6 valves) to extend the hydraulic cylinders. This action pushes the walking beam forward, causing the front end of the dragline excavator to lift slightly off the ground. As the cylinders continue to extend, the rear end of the machine is lowered onto the ground.

Once the rear end is resting on the ground, the operator retracts the hydraulic cylinders, pulling the walking beam towards the rear. This action pushes the front end of the excavator down, allowing it to move forward. The process is repeated in a cyclical manner, creating a walking motion

2. <u>Gear based marching mechanism:</u>
   The gear-based marching mechanism typically consists of a set of large gears, driven by a motor or an engine, and interconnected to form a closed-loop system. These gears are designed with teeth that mesh and transmit power to create movement.

To initiate the walking motion, the operator engages the motor or engine, which drives the gears. As the gears rotate, they interact with each other, causing the entire walking mechanism to move. The gears are designed with a specific ratio, determining the speed and direction of the walking motion.

## Compressor ( air brake system)

Compressors are mechanical devices used to increase the pressure of compressible fluids, or gases, the most common of these being air. Most common applications of compressors are :- paint sprayers; air conditioning and refrigeration; to propel gas through pipeline ; air brake system.

Based on the method of compressing air , various types of compressors are available

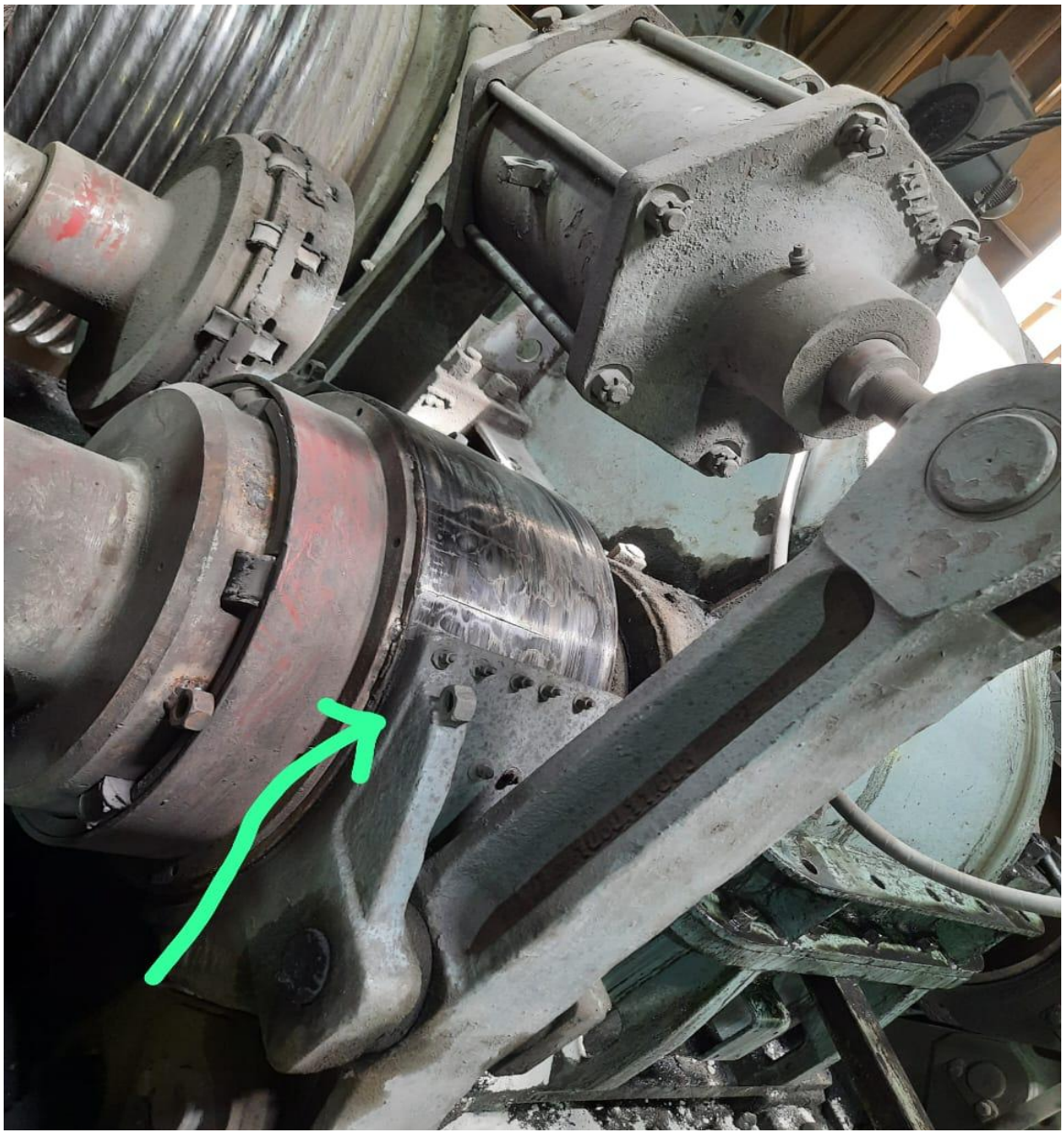
**Reciprocating compressors**: - It has cylinder piston arrangement to compress the atmospheric air.
A typical plant-air system provides compressed air in the 90-110 psi range.Generally two stage compressing is done .It has low discharge.
Working- A motor is

In an excavator, compressed high pressure air is used in braking applications. The compressed air from storage tanks are supplied to release the brakes.
In an excavator's air brake system, compressed air is stored in a reservoir or air tank. When the operator wants to release the brakes and enable movement, they activate a control valve that allows the compressed air to flow into the brake system.

Air Braking system:

- Cylinder-piston braking system:

  The compressed air from air tank reaches to the distributor which is then transferred into the cylinder .Due to this hig pressure air  piston starts to expand and brakeliners expand from both sides results into the free rotation of intermediate shaft.



**Above figure shows the brakeliners and cylinder-piston arrangement**

- Disc brake system:

The disc brake assembly in an excavator consists of a rotor, caliper, and brake pads. The rotor is attached to the wheel or axle, and the caliper houses the brake pads. When the compressed air is supplied to the brake system, it exerts force on the caliper, causing it to release the brake pads from the rotor. This creates a small air gap between the brake pads and the rotor, allowing the wheel to rotate freely.

Conversely, when the operator wants to apply the brakes and stop the machine, they release the control valve, which cuts off the supply of compressed air. Without the air pressure, the caliper is pushed back onto the rotor by springs or other mechanisms, causing the brake pads to grip the rotor tightly and create friction. This friction slows down or stops the rotation of the wheel, bringing the excavator to a halt.

## EUT Cranes:

EUT cranes are used to lift heavy machinery (like Damaged motors) from one place to another inside the machine. It has a pulley rope system which can go up and down and at the end there is a hook to lift the objects .
It stands on wheels and rails which are used to change its position.