**Surface Mining Technology**
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**Indian Institute of Technology, Kharagpur**
**Lecture Number 36**
**Excavation with Dragline-1**

Let me welcome you to the 36th lecture of NPTEL online certification course: Surface Mining Technology. Before this lecture, we have covered the excavation using surface miner. So, from this class we will start excavation with dragline, this excavation with dragline; there will be three lectures on this. This is the first lecture on this series but as we do in every class let us see once again.

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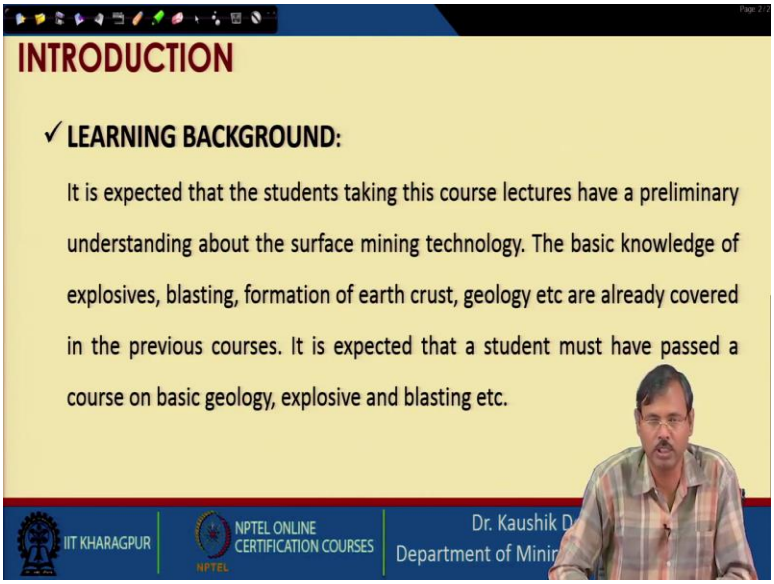


The learning background required for Surface Mining Technology course.

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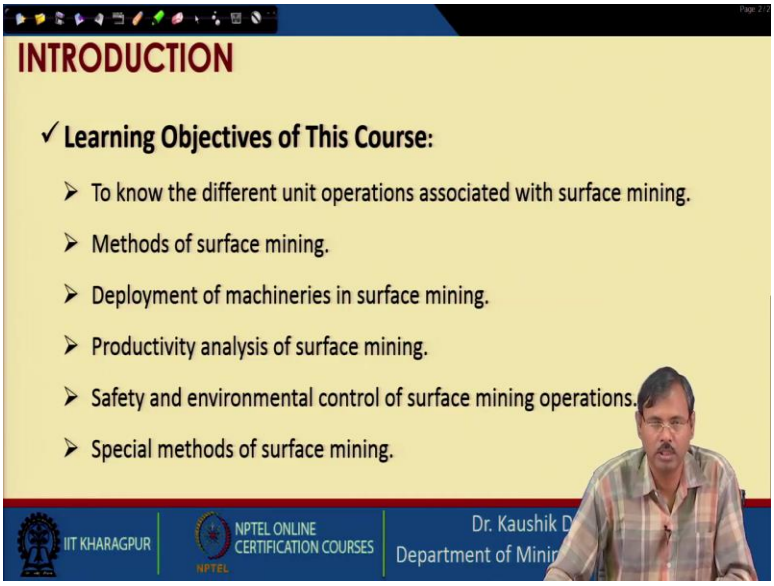


And these are the learning objectives for Surface Mining technology course.

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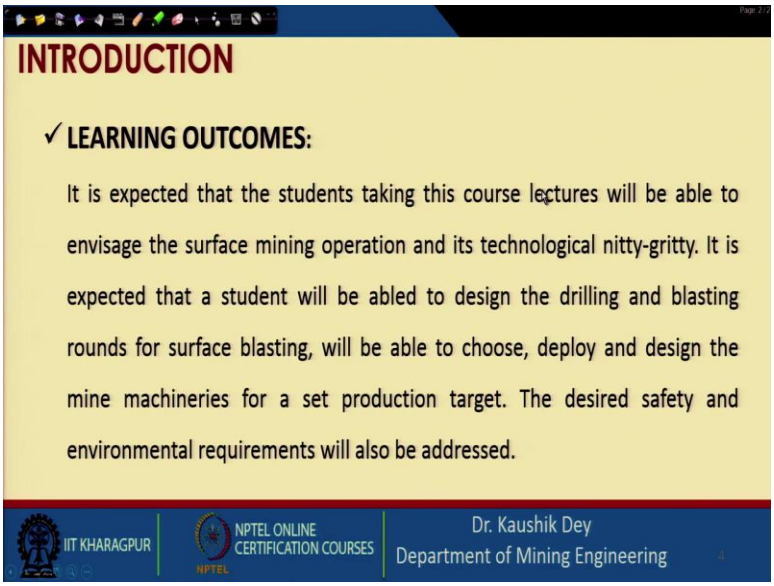

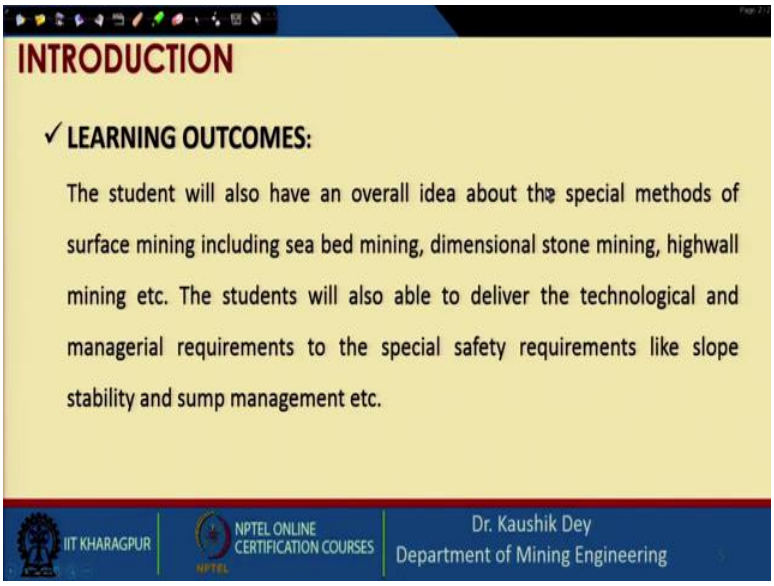


And these are the expected learning outcomes from the participant of surface mining technology course.

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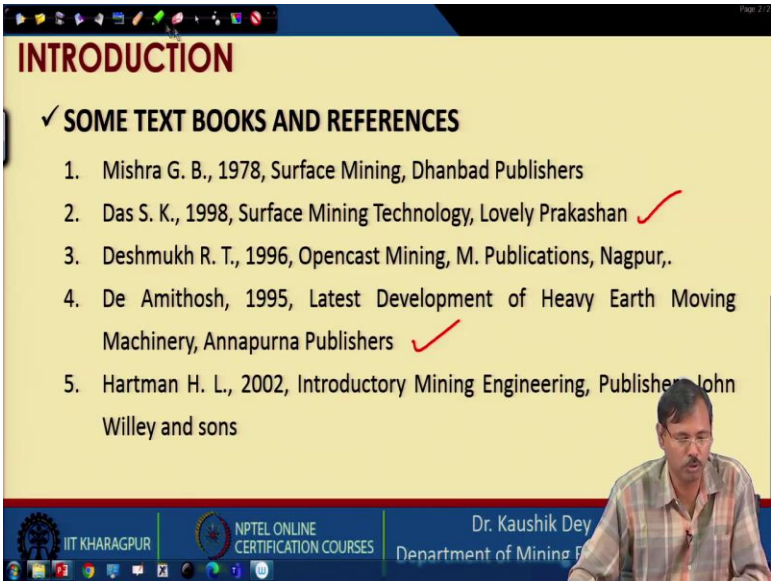

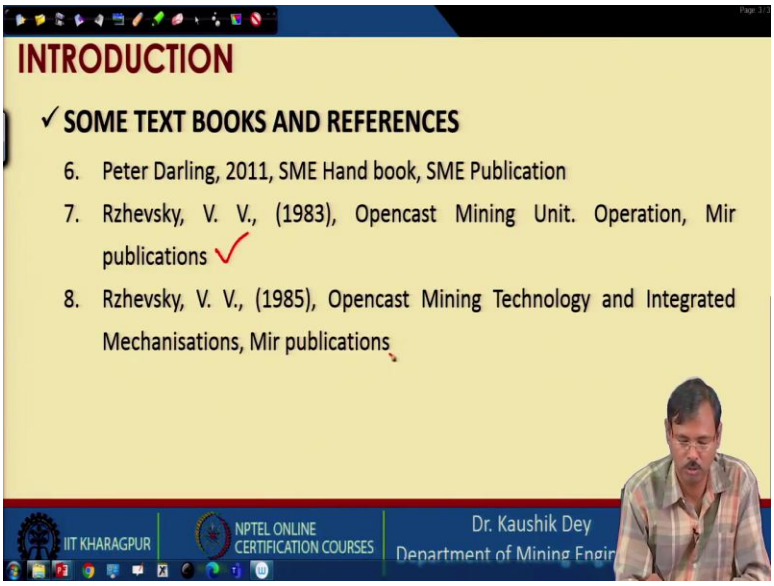


And some of the textbook and references, these are available here, I would like to draw your attention related to the work of dragline in this book as well as this book, also you will get some good inputs. And these are two important books. These two books are important book particularly for the excavation of dragline. However, a number of web source are already available from which you can get good inputs pertaining to dragline.

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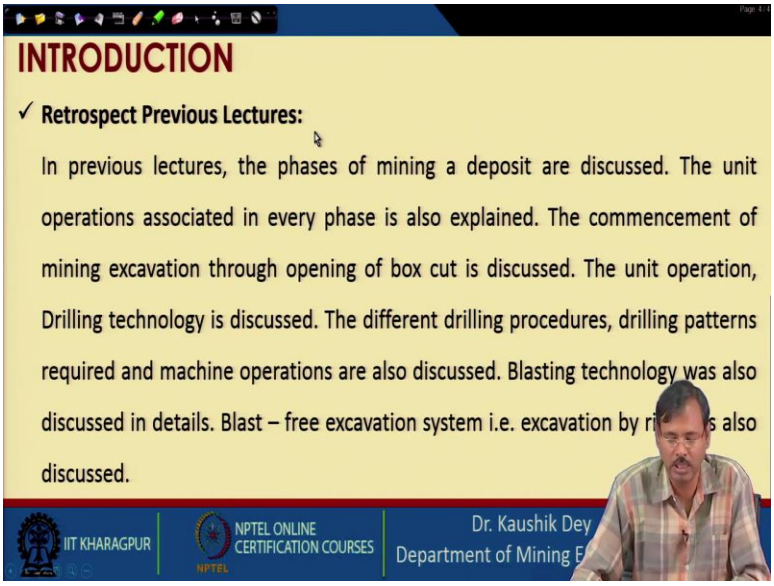

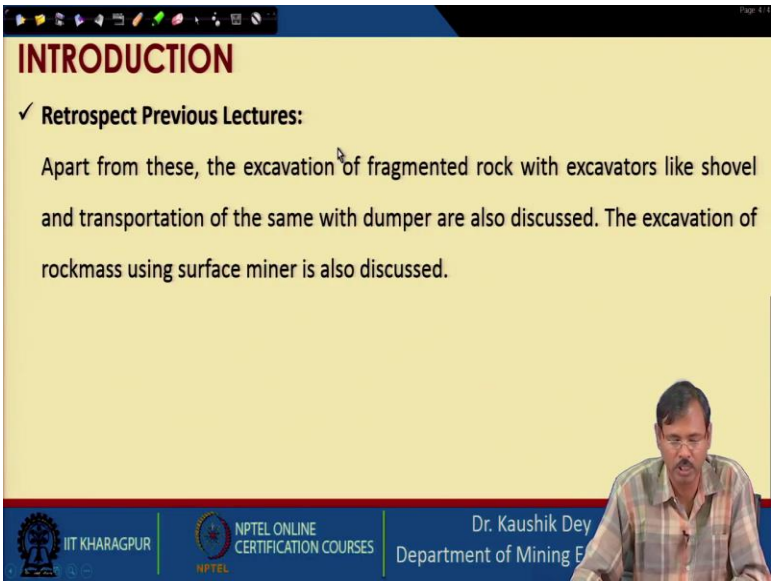


Let us retrospect so far whatever we have covered in this surface mining technology course. In this course we have started with the phases of mining a deposit, then we have seen what are the basic unit operations required in every phases. And we have also seen the commencement of surface mining through opening the box cut. Then different unit operations like drilling, in which we use the drill machine to drill the hole in the rock mass.

Then blasting is carried out utilizing the drill holes in which the explosives are placed and blasted. Then the fragmented rock mass is taken out by the shovel and transported through the different transporting system like dumper. And we have seen the blast free excavation systems like ripper and surface miner also. So, these are the main topics so far we have covered.

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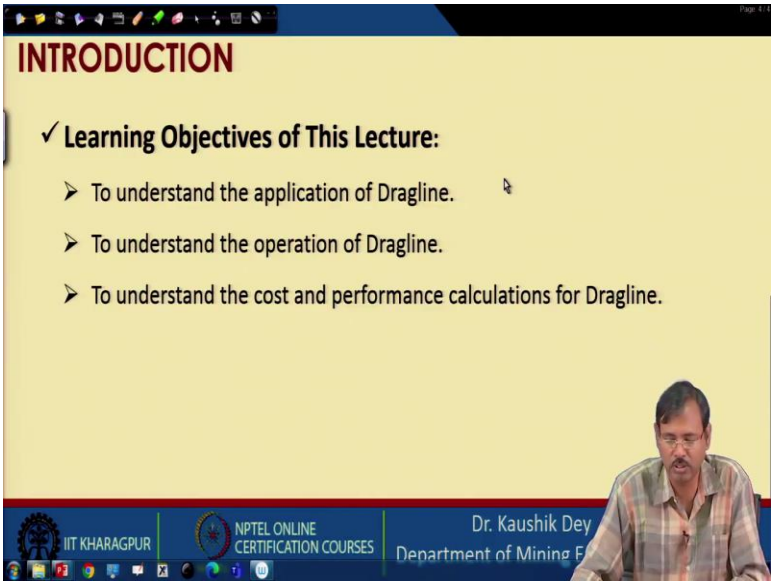


And we have set our learning objectives from the lectures related to this excavation by dragline, our objectives are to understand the application of dragline, to understand the operation of dragline and to understand the cost and performance calculation for dragline. So, these are the basic objectives we have set. So, this is the first lecture on the introduction to dragline in which you will understand the dragline operation and applications.

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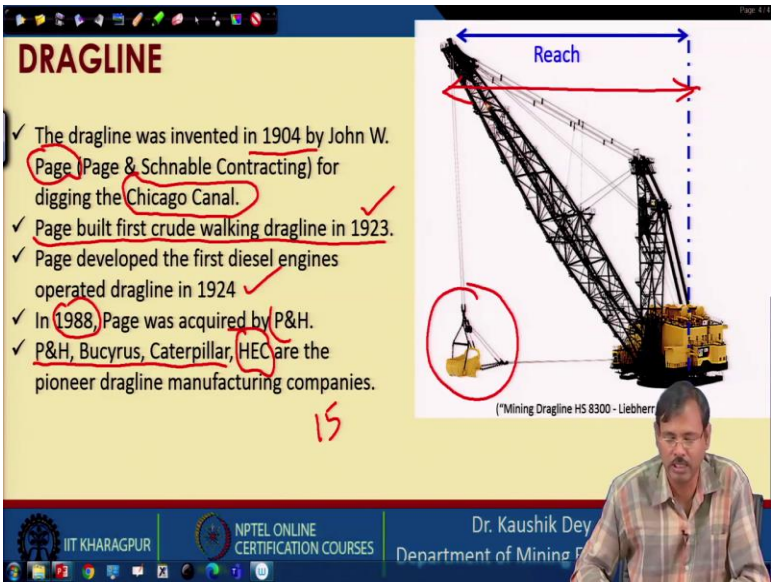


So, at the very beginning, let us have some historical knowledge, dragline was invented in the year 1904 while Chicago Canal was carried out in that place for the first time, it was developed

by Page in 1904. And initially all the developments were carried out by the same company. Walking type dragline was introduced in 1923 and diesel engine operated dragline was also started in 1924.

And in 1988 the company was acquired by P & H and currently these are the major companies which are producing the dragline among which HEC is the Indian company who was also a prominent manufacturer of the dragline and around 15 draglines were manufactured by HEC. This company is the Indian company. This is one view of dragline in which basically mining engineers; they define a dragline in terms of its bucket capacity.

And bridge up the boom up to which the material can be transferred. So that is why it is dragline if it is called say 36 cubic meter and 90 meter means the bucket capacity is 36-meter cube and reach of the dragline means up to 90 meters that dragline can dump the material. So, that is the in general way we define a dragline in our process.

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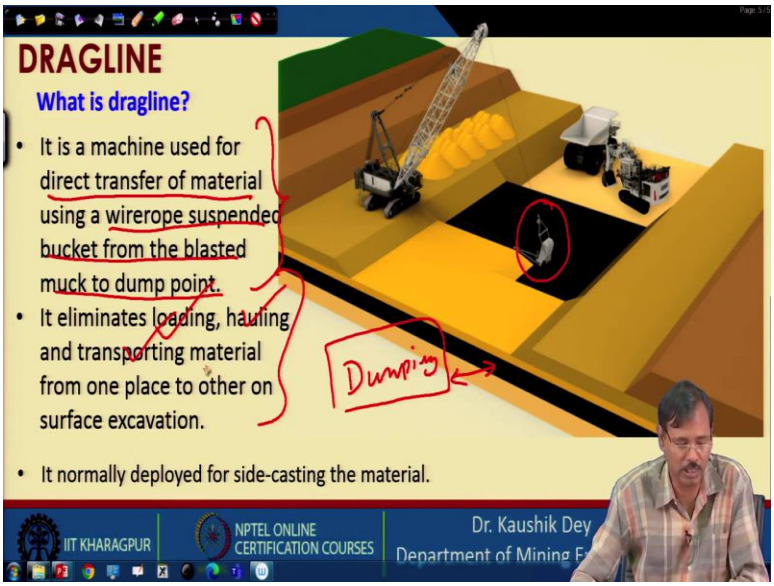


Now, what is the dragline? Dragline is basically a machine which directly transfer the material using a wire rope suspended bucket from the blasted muck to the dump point. So, dragline is essentially utilized to take the blasted muck and transfer the material or dump the material at a height. One point must be remembered in this case the dragline bucket is suspended with the wire.

So, this bucket cannot be used for loading purpose because it is always oscillating with the wire just like pendulums. So that is why it is not judicial to use that as a loading machine. So, this can be only used in dumping and in dumping it is basically spreading the material over an area and it is not basically dumping at a particular point. So that is why this machine is eliminating, loading, hauling and transporting of the material from one place to the dump site. And this can be directly carried out by the dragline.

So, that is why dragline is very popular and very  cost effective excavation technique that can be utilized for the overburden material which can be dumped especially in the backfilling condition.

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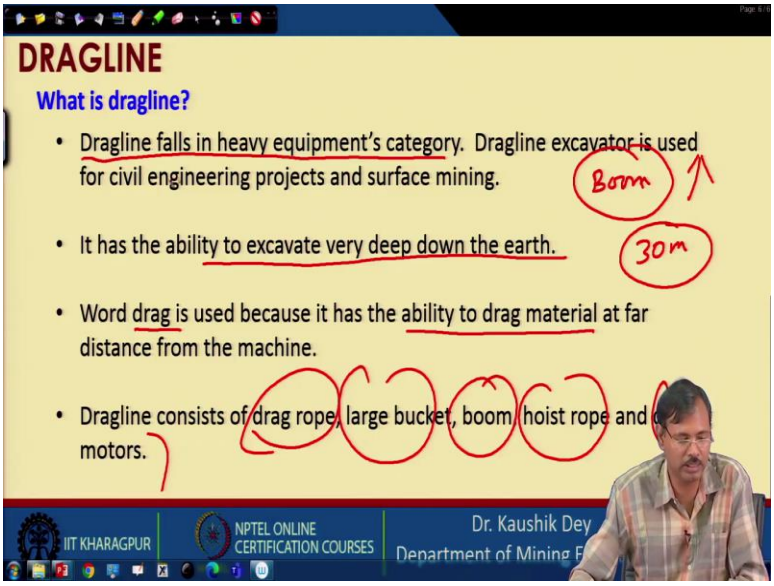


Dragline itself is a very heavy equipment because to having a long boom essentially the machine weight, self-weight has to be increased significantly. So that is why dragline is a heavy equipment and this can have the ability to deep down the earth and that can take the material from a very high bench, so dragline can operate a bench height of 30 meter also. And that is allowing the keeping the bench height is significantly more and that is why the number of benches requirement can be reduced if we are using dragline.

The word drag is used. So that its ability to drag the material from a distance towards the machine and it is costing a drag rope, a large bucket, boom, hoisting rope, and driving motors, those arrangements are the essential components of a dragline.

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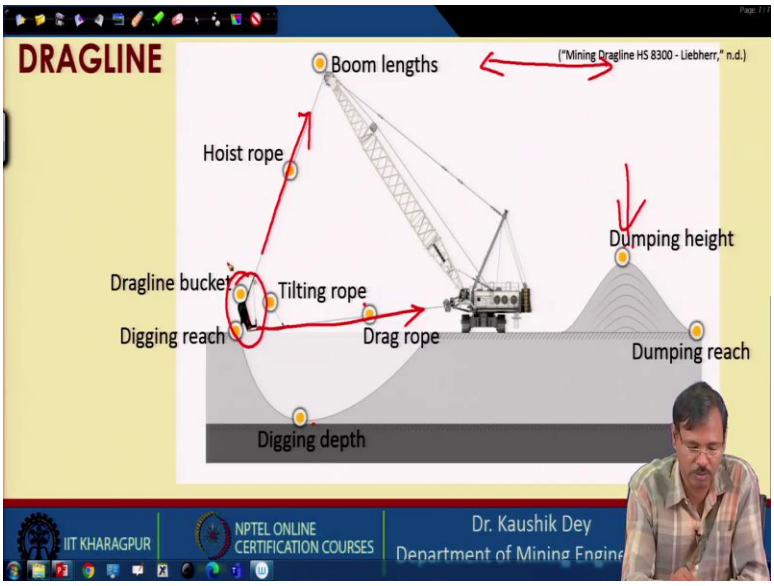


Now, a dragline can be specified like this, it is having this rope is called drag rope. This rope is called hoisting rope. So, the bucket is basically suspended with this hoist rope and it is dragged towards the machine by the drag rope. So that the bucket can be filled and after filling the bucket the boom is rotating and moving towards this direction and this is the reach because of this boom height. This up to this the material can be dumped at this position.

So, this is the digging depth up to which this drag rope can work efficiently and this is the dump height from up to this the dumping can be carried out depending on the stability purpose et cetera. And by the way, the dragline is basically defined with the bucket capacity and the boom reach of the dragline.

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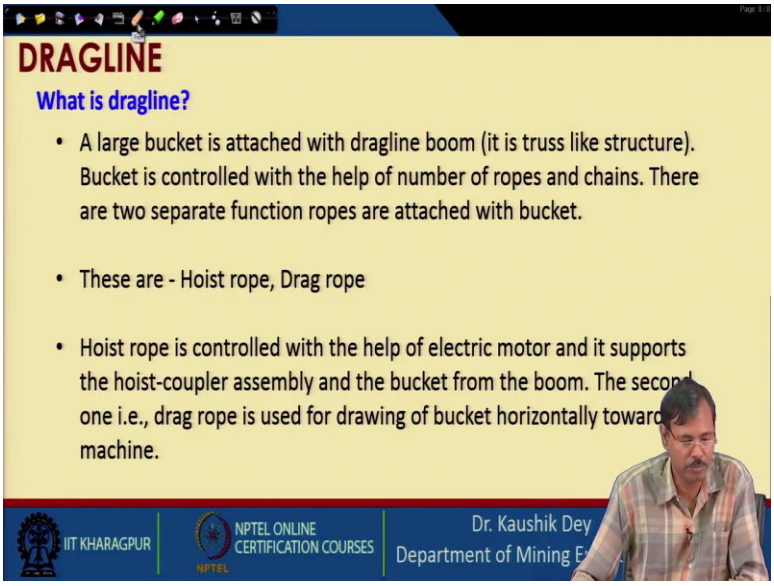


So, these are the basic components of the dragline.

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Now, let us look how the dragline is working, this is a video from the NCL. This is also available in YouTube. So, this is the hoist rope, the drag rope is now dragging the bucket towards the machine and the way the bucket is being filled with the blasted muck. Now the bucket is filled and now the hoisting rope is taking the material, lifting the bucket, and along with that the dragline is rotating and simultaneously the bucket is being hoisted and rotation of this one now, the bucket is basically released. Now, we can see basically the dumping is carried out over an area and that is why the material is dumped in the dump pile only; it cannot be used for filling of the machines.

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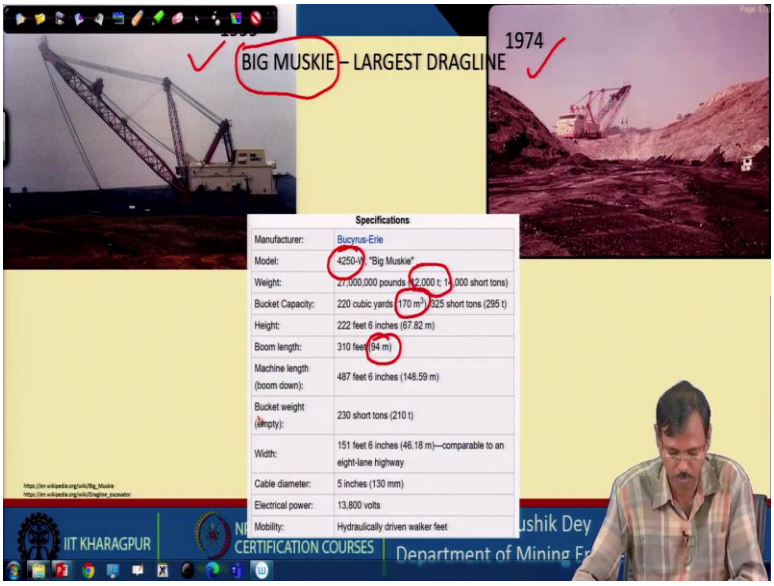


This is the world largest dragline Big Muskie; it was commissioned in the year 1969 and work up to 2004. This is a photograph of 1974, this is a photograph of 1999, and you can see the bucket capacity is 170-meter cube and its boom length is 94 meters. So, this is a huge machine its self-weight is 12,000 ton. So, 12,000 ton is the machine and its power requirement is 4200, 4000 I think this is, let me see, yeah 4250-watt machine.

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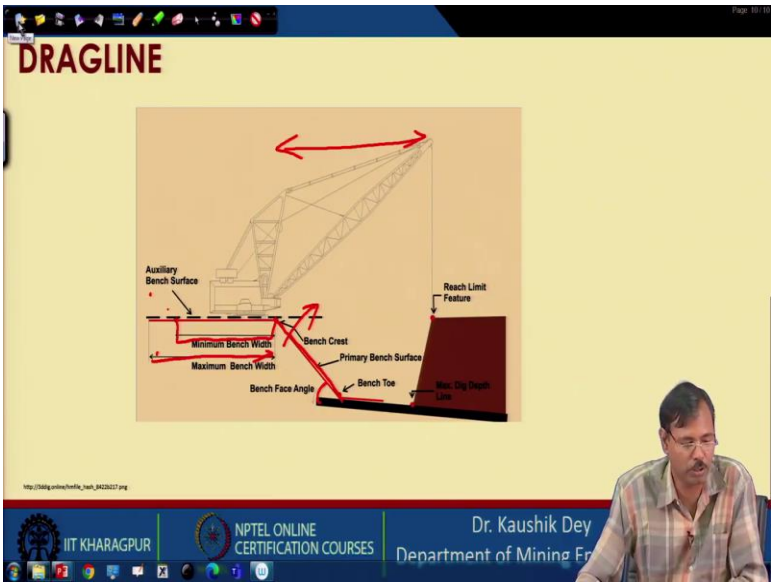


Now, you can see the specification of a dragline bench. This is the coal seam and this is the overburden rock material and this is already blasted and dragline is working standing on the

blasted muck pile. And it is shifting the material from this point to this point. And this is the minimum bench width required for the operation of the dragline. This is the maximum bench width from this point, the material can be transferred up to this otherwise it cannot be transferred.

And this is the bridge and the bucket capacity is not shown here. It must be remembered that every time as a blasted muck pile is there, slope angle must be there for the bench in the bench face for the stability of this bench that is mandatory requirement whereas in the operating bench, we can have a steeper slope but in a dragline bench we should have a significant slope for this there is a problem in this actually the dump has to be made not on the coal. That is a little mistake in this one but this is taken from this photograph. Otherwise, this one is good.

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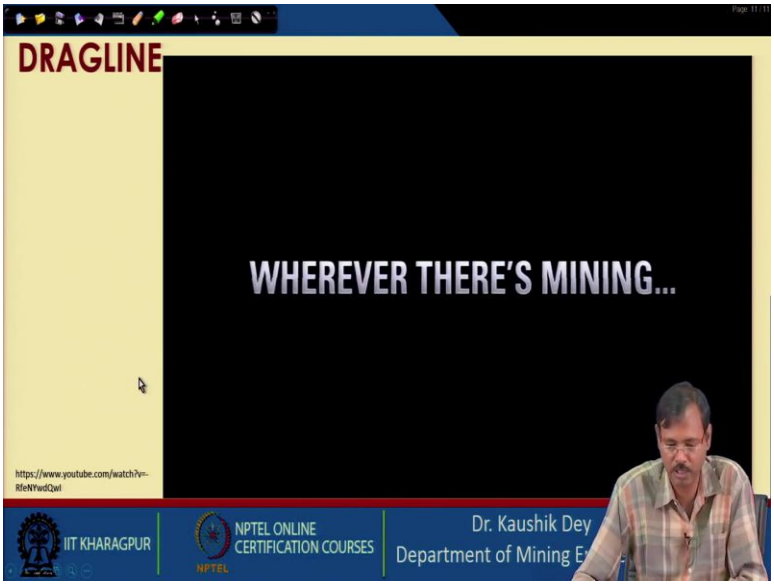

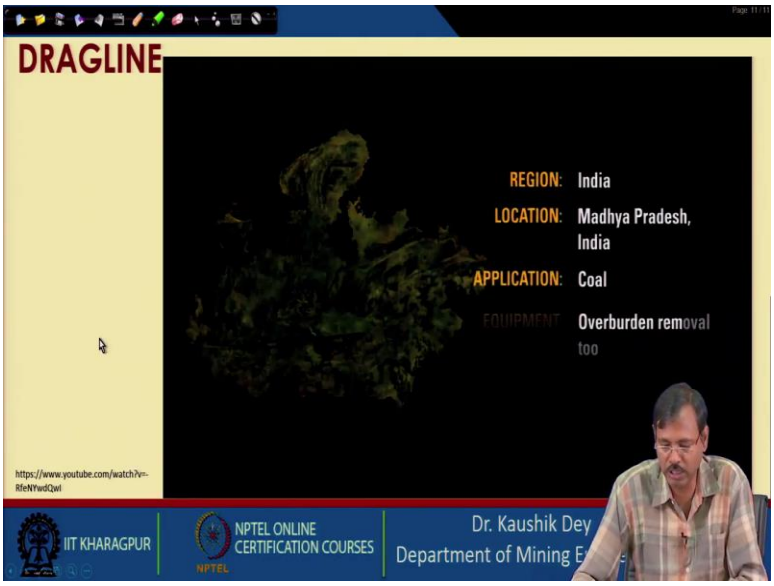


Now this is a caterpillar video. Available in this. This is showing the different parts of a dragline, this is also for the Northern coal field of Coal India.

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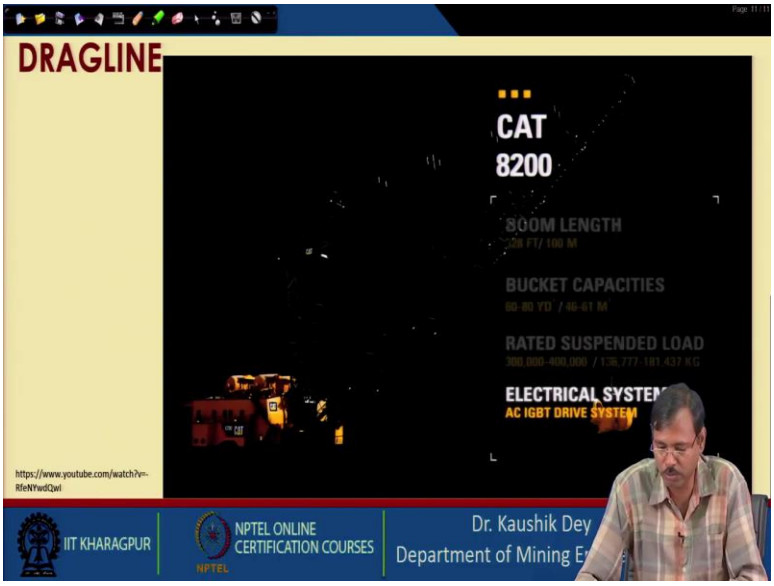

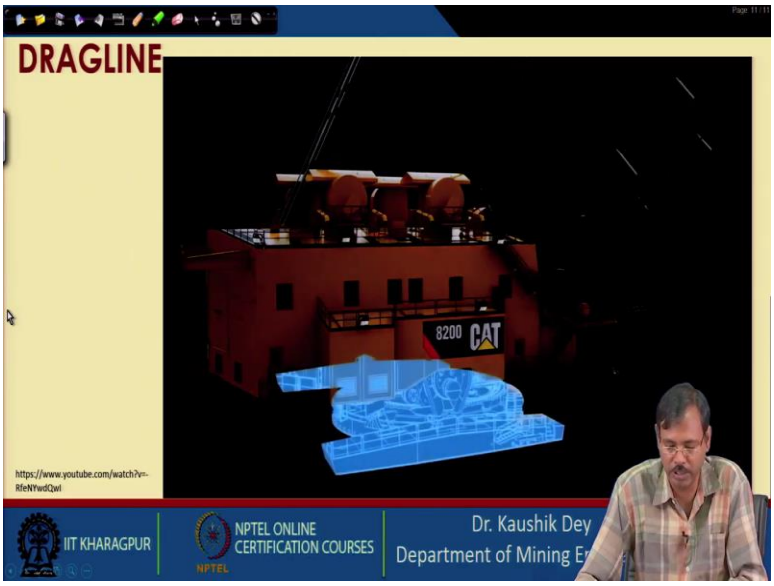


So, this is the dragline CAT 8200 dragline of boom length 100-meter, bucket capacity is 46-to-61-meter cube. So, it is eliminating the most of the diesel operated equipment like shovel, dumpers, so that is why it is better environment friendly, this is skid mounted walking dragline we will see the walking principle in the next slide. So, these are the skid and this is having the revolving frame. So, skid is moving the machine in general stands on a circular base.

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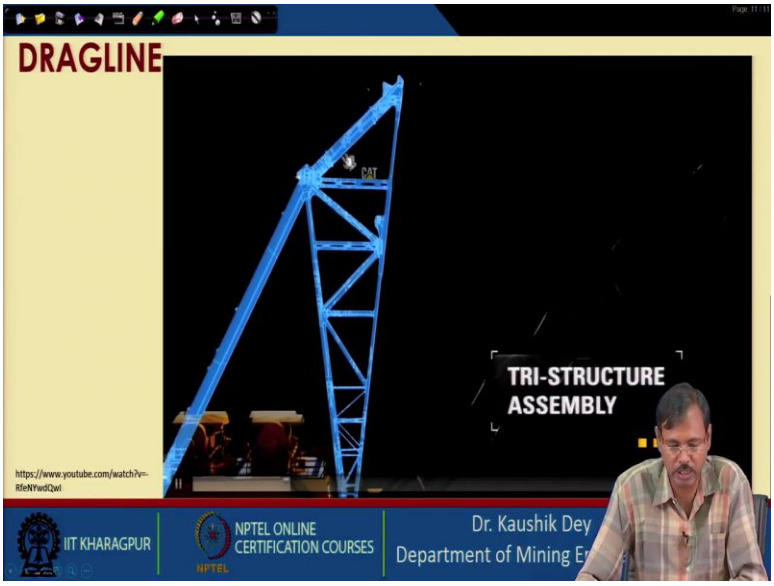

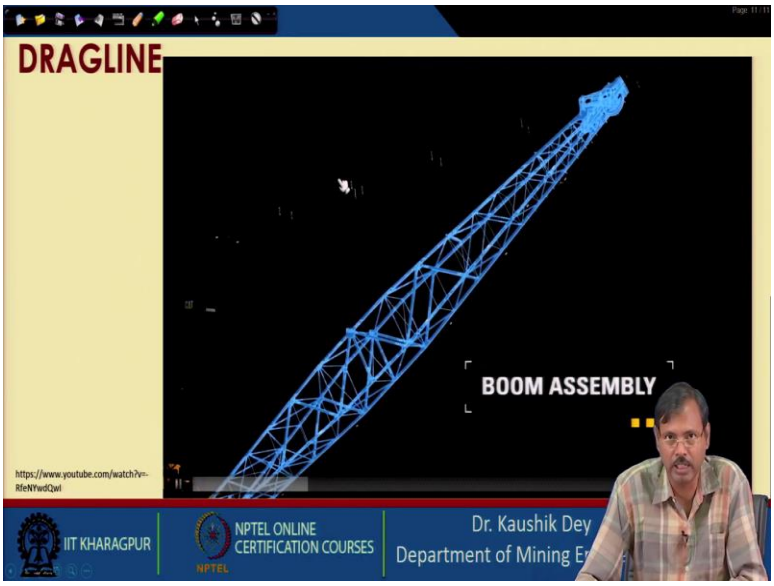


So, this is the tri-structure assemble, basically, these are inspected time to time, this frame is taking the load of this boom, nondestructive tests are carried out to find out any cracks in the structure as well as in the wires of the dragline. And for inspection, these are accessible for detection of cracks, often the pressurized gases are used.

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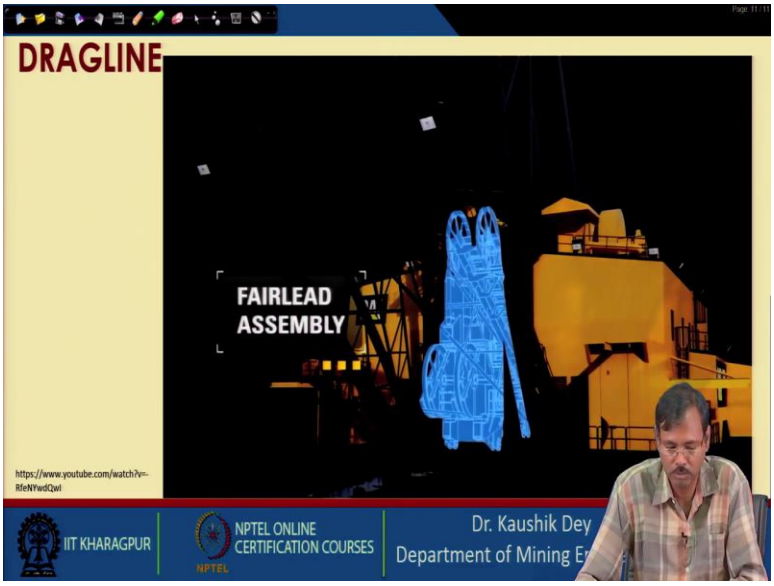

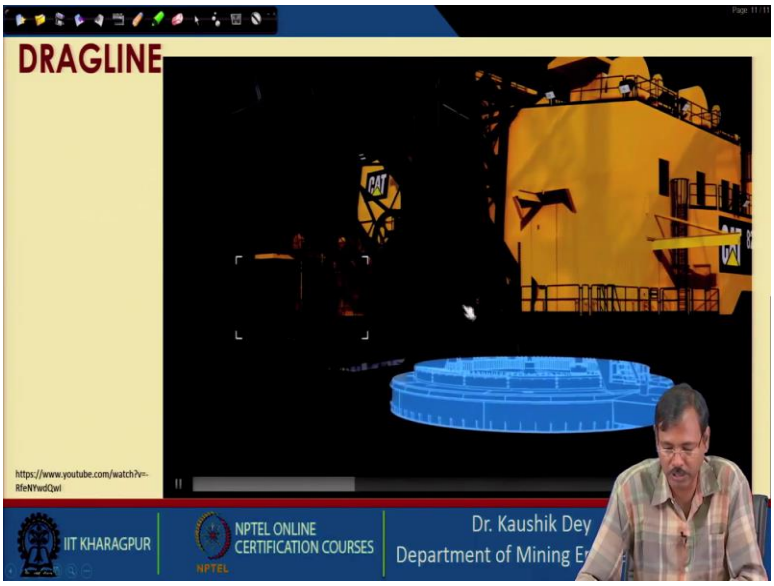


These are the, how the wire ropes are being basically carried out here, this is the best frame on which the dragline in general stands. And dragline can rotate on these also in 360 degrees.

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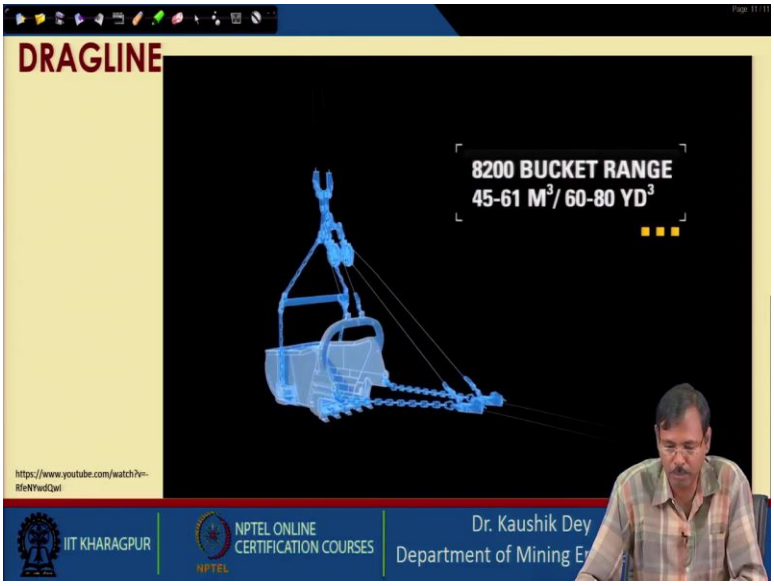


This is the bucket and this is the hoist rope, this is the drag rope and these are the attachment of the bucket. And generally, as this bucket is allowed to fill on dragging it towards the dragline over a slope. So basically, drag filling factor of the bucket is in general low for the dragline. So, the wear and tear onto the rope is also required to be inspected, swinging is carried out in the planetary system.

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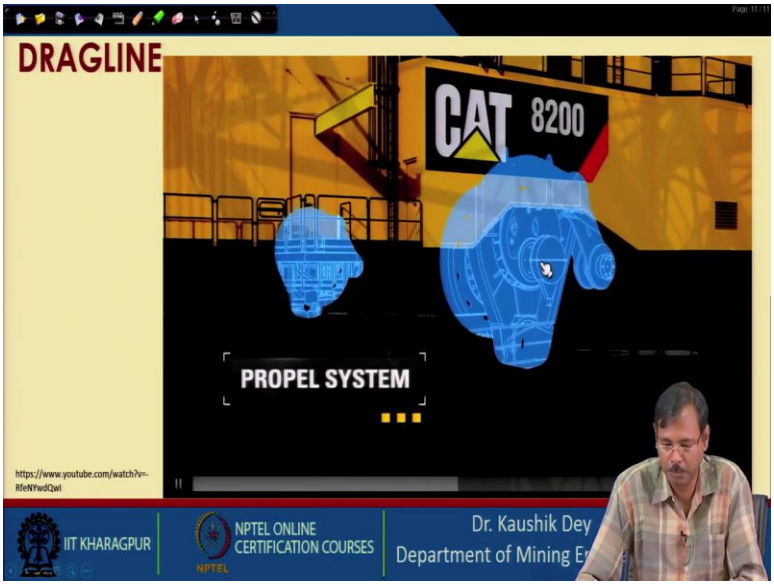


And this is the walking arrangements for the walking draglines.

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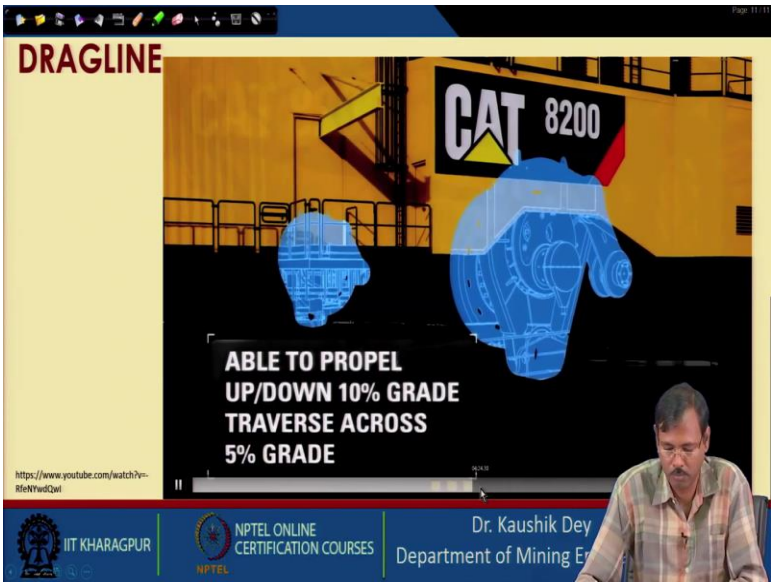

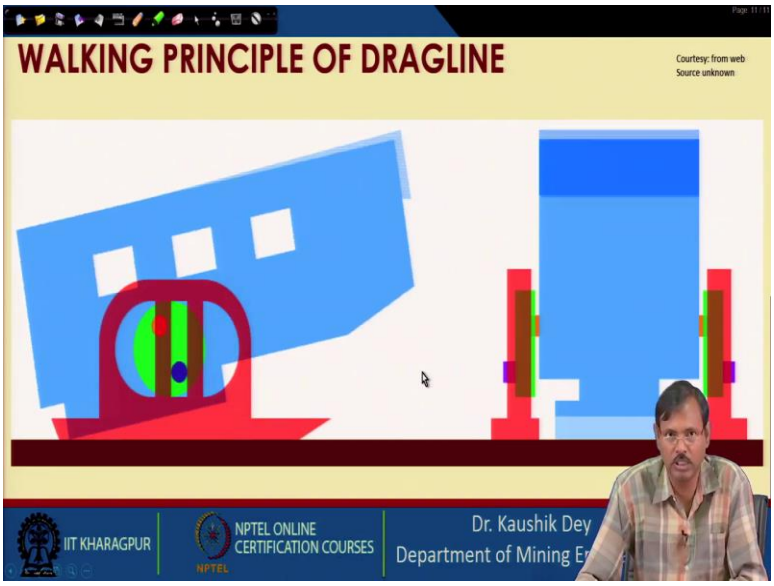


So, this is the walking principle, say this walking pads come down, then this one is rotated and machine is moved in the front side. Again, the machine is allowed to stand on base platform then the walking pads are allowed to move in front and then again it is taking the load, lifting the base and then it is rotating moving the base in the front direction. So as the walking pads are also rotating when the machine is swinging with the base.

So, that is why the turning is very easy, it can turn in any direction from any point, from where the circular base is placed. From there it can turn to any direction by rotating the machine on the platform itself. So that is the way basically a dragline can walk.

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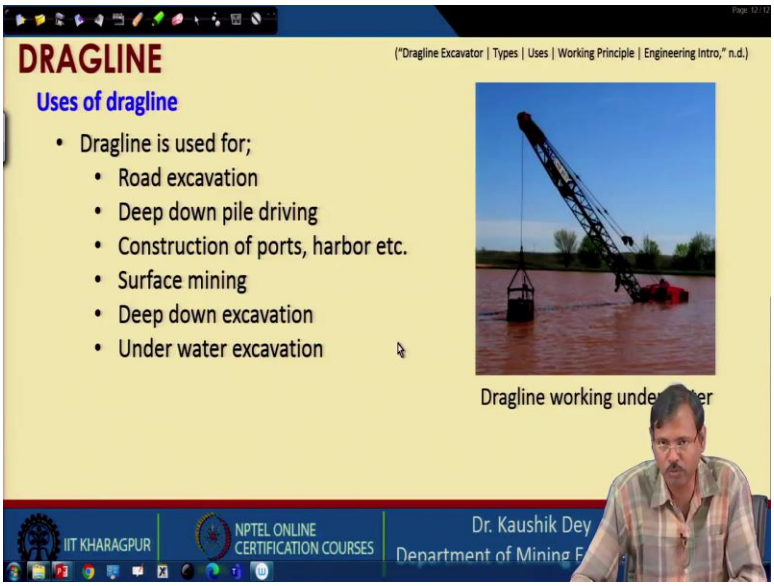

The dragline can be deployed for road excavation, surface mining excavation, deep down pile driving, construction of ports harbors, surface mining we are talking about, deep down excavation, underwater excavations also for dredging purpose etcetera for different places we can use dragline. This is one photograph where the dragline is being deployed for underwater excavation.

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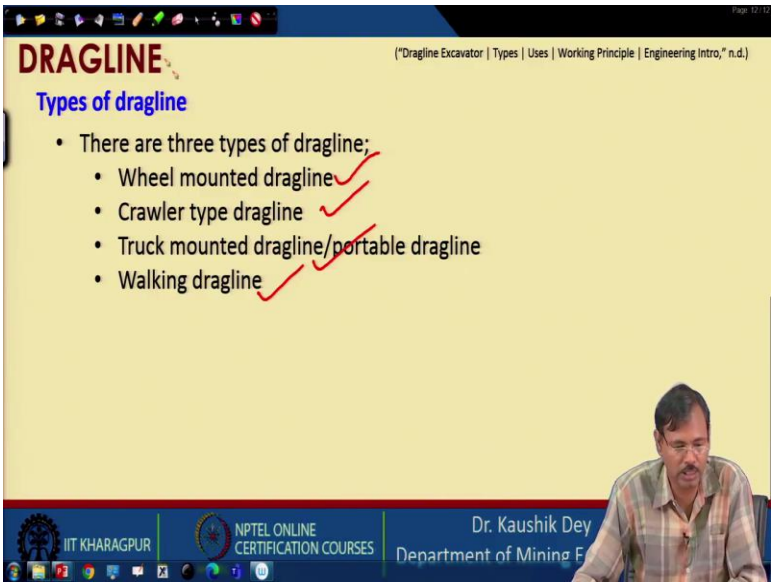


In general, dragline can be classified as wheel mounted dragline, crawler type dragline, or truck mounted dragline, and walking dragline. So, these are the different types of draglines, in many places truck mounted draglines are used as it can give more mobility but these are having small applications like digging ponds, et cetera.

Crawler type dragline are often used in the surface mine also, even up to 1950s, 1960s it was very popular equipment. And currently the walking dragline is very popular and most of the bedded deposit walking dragline is found to be uncommon equipment to be deployed for direct crusting of the material.

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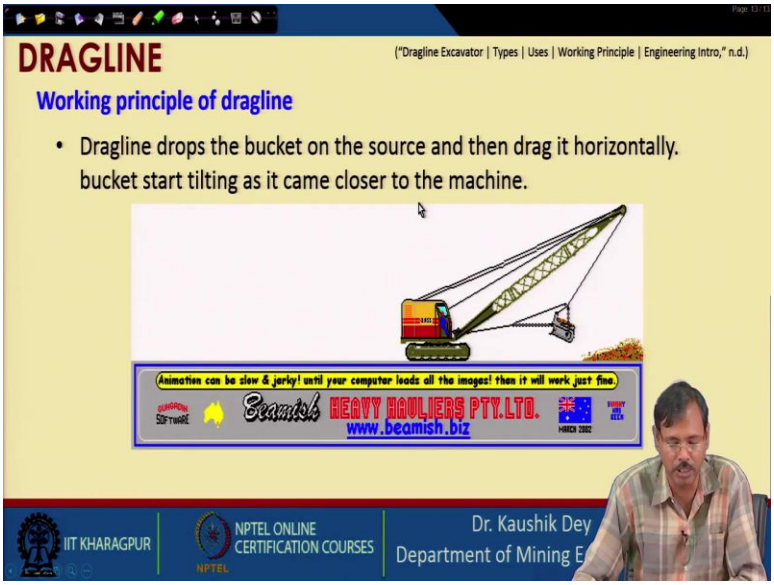


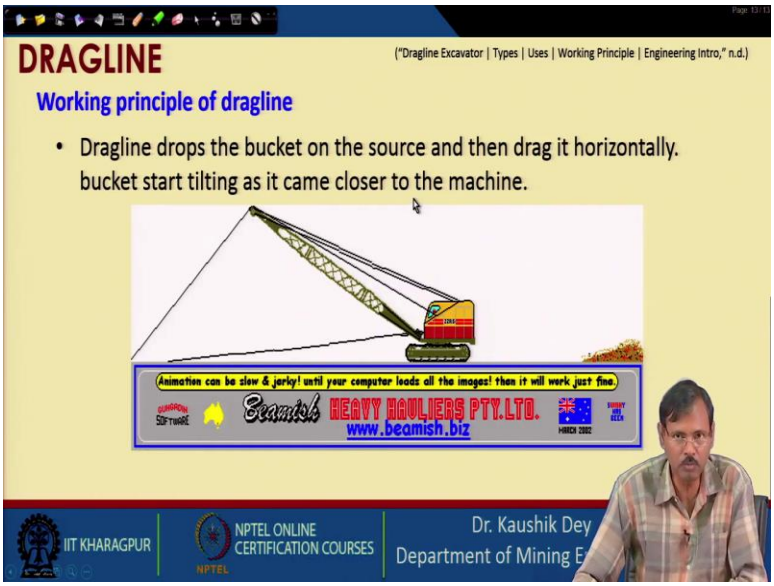

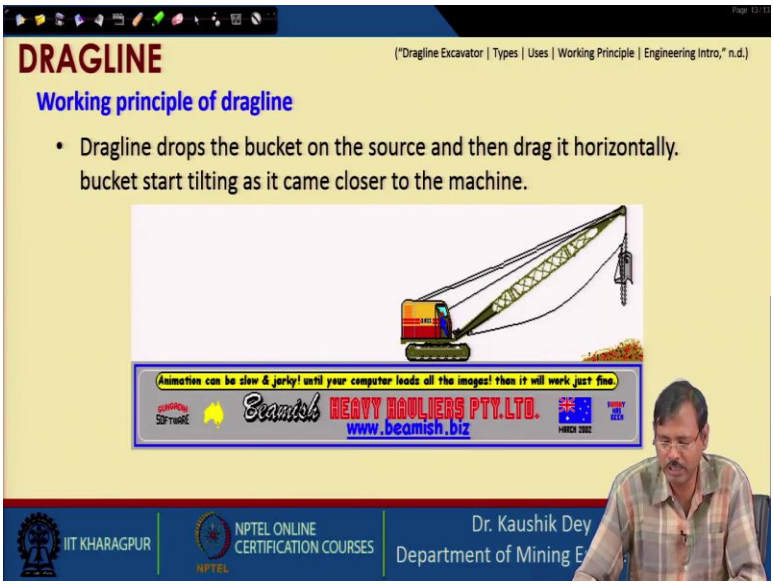


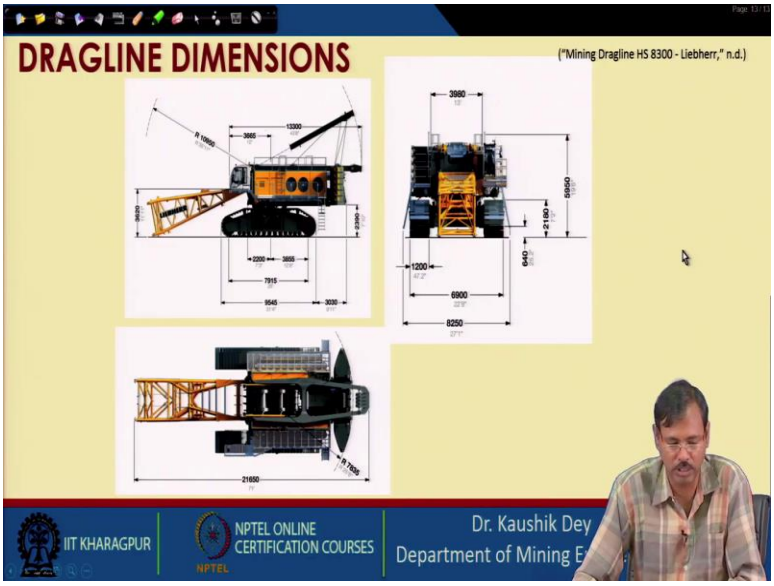


This is the way how a dragline operates. So, it is basically filling the bucket then discharge the bucket and again return back and again drag the material in the drag wire towards it, these are the different components of the dragline you see, in this case dragline is mounted on a crawler.

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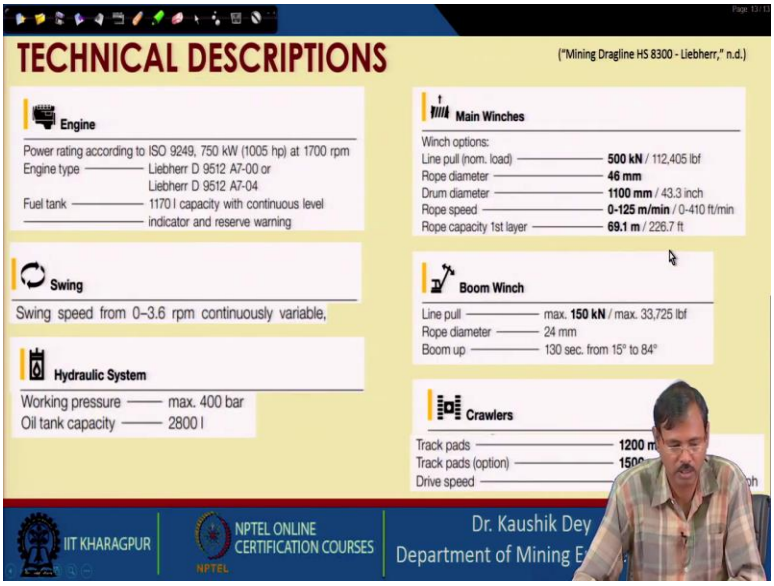
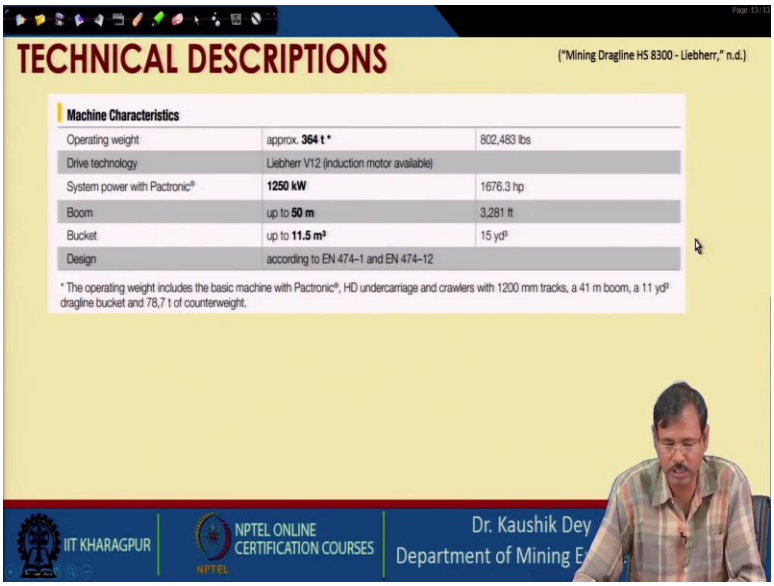
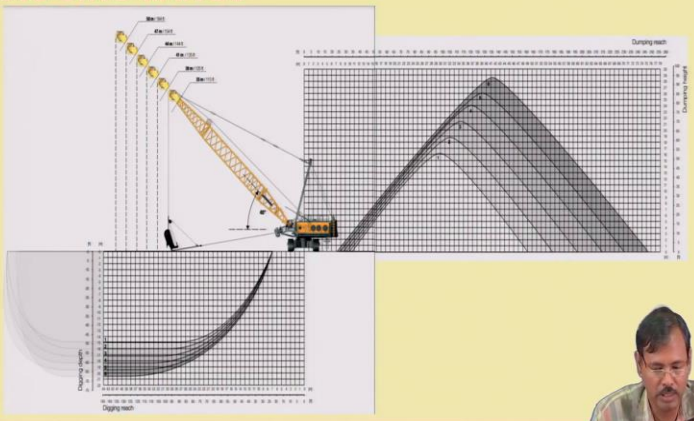


# DIGGING RANGE

("Mining Dragline HS 8300 - Liebherr," n.d.)

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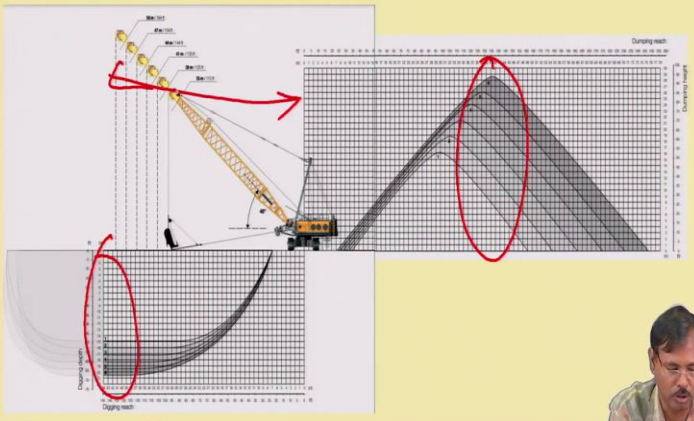
("Mining Dragline HS 8300 - Liebherr," n.d.)



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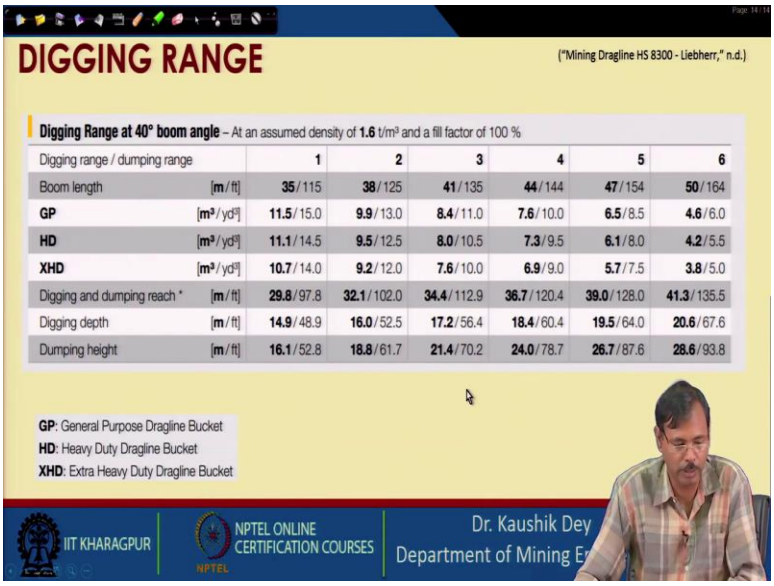


These are engines, etcetera. And this is the general performance curve provided in most of the cases by the manufacturer which can show the digging depth, reach and the allowable dump height. So, these are the dumping height, these are the digging height and these are the reach. So, these are in general given and based on that the performance can be observed in the dragline. So, these are the charts in general, the dragline manufacturers used to provide.

And these are some of the specifications of the same, where the boom length, then the volume, then digging reach, digging depth or dumping height all these are specified. This is for assuming the density of this one and fill factor: they have considered 100 percent but in general as the bucket is filled by dragging it with the drag wire and by that way the bucket is basically rubbed with the face of the crushed face of the face.

So, that is why the bucket is filled but obviously 100 percent filling is not observed because it is not guided by a solid boom. In case of shovel where the bucket is basically guided or the more digging forces applied, here the natural digging force by the drag force given by the wire that is coming but in case of a boom mounted shovel that digging force is much higher.

So, the bucket fill factor with 100 percent is very difficult in case of dragline, in fact filling factors are in general very poor for dragline operations. So, that has to be considered and based on that this performance are considered in this case.

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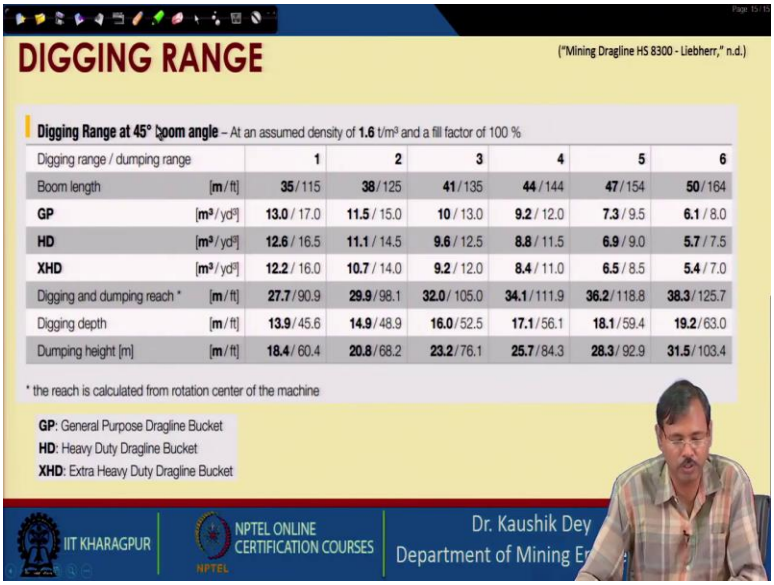


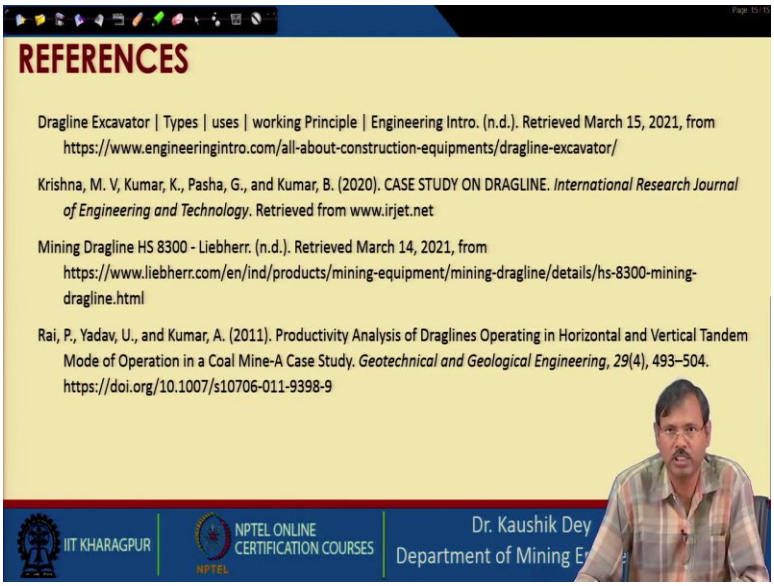


These are some more chapters where the 45-degree angle is considered and that is more or less about the introduction of the dragline, it has been found that the dragline is basically a wire suspended bucket which is allowed to operate at a digging depth. So, the dragline bucket is allowed to dig from the level below to the level at which the dragline is standing. And then the bucket is hoisted using the hoisting rope and it is discharged over a dump.

So, in dragline the main advantage is that it can operate at a greater depth, the depth is significantly high almost 30-meter 40 meters depth can be well adjusted with the dragline digging. And it is very fast movement of the material so only as because it is having a very long

boom range. It can take the material and dump the material at a distance. So direct casting is very easy with the dragline. So, this gives the very high productivity of the dragline and that is why it is very popular. Thank you.