Drilling and Blasting Technology
Prof. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur

Lecture – 14
Special Drilling Methods – I

Let me welcome you to the 14th lecture of Drilling and Blasting Technology course. In this lecture we will discuss the Special Drilling Methods, this is the first lecture on that there will be another lecture on this topic.

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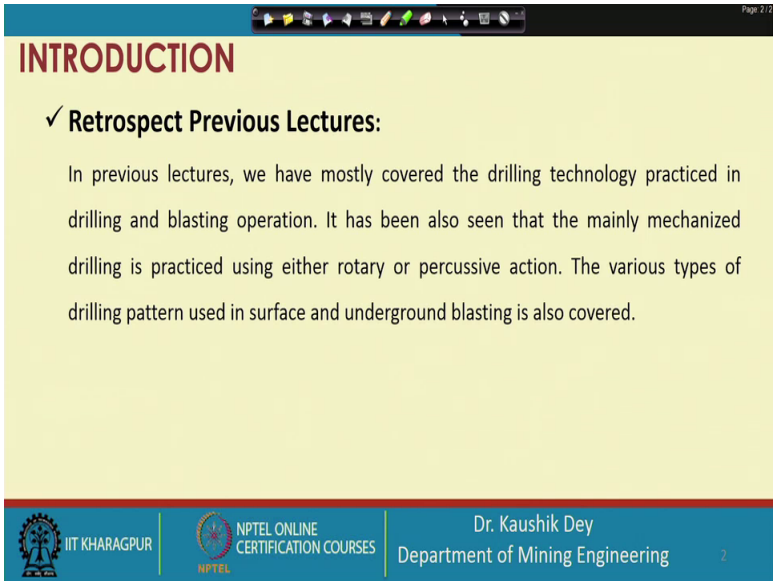

But, before that let us retrospect our previous lectures; in previous lectures we have mostly covered the drilling technology practiced in drilling and blasting operation we have discussed rotary drilling, we have discussed percussive drilling, we have discussed percussive rotary drilling. We have also discussed different types of drill bits, we have discussed the influence of the rock and machines on the drilling this all these are already discussed.

It has been also seen that the mainly mechanized drilling is practiced using either a rotary or a percussive action and various type of drilling patterns used in surface and underground blasting is also covered in our previous lectures.

However, there are few special method of drilling in most of these cases in general what we do, we carry out large dia drilling. So, those are not very commonly carried out for the drilling and blasting purposes, but those large dia drillings are carried out mainly for the excavation purposes or for creating an opening in the in situ rock mass condition.

So, that is basically a special types of drilling technique which is basically practiced apart from that there are two other principles which is carried out one is drilling or you can say a cracking carried out by the flame, another is the cracking carried out by the water jet. So, these are two special thing we will discuss all these things in our coming two lectures.

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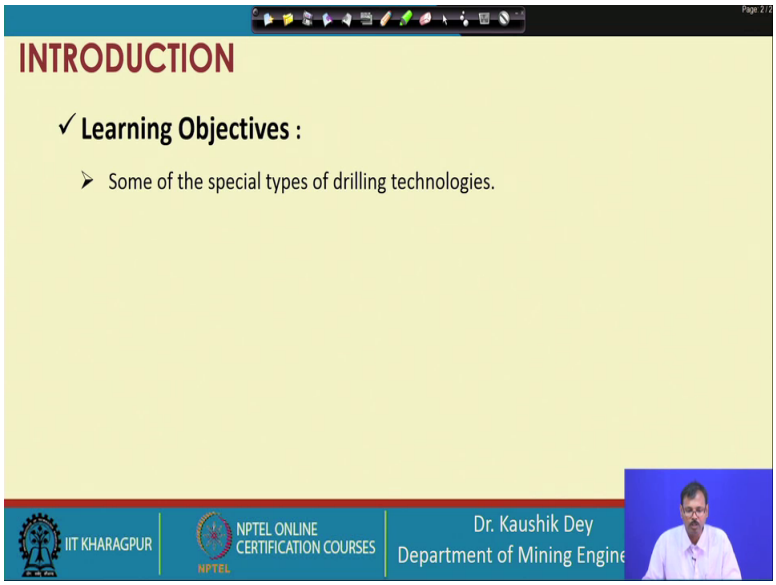

So, our learning objective is some of the special types of drilling technologies will be covered in lecture number 14 and lecture number 15.

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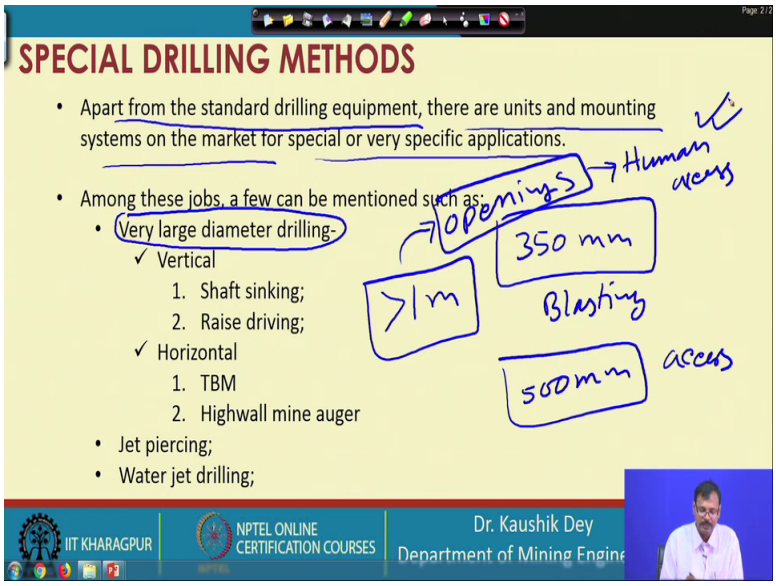

So, let us see what are these special methods; So, apart from the standard drilling equipment there are units and mounting systems on the market for special and very specific applications and what are this very specific application? These are basically very large diameter drilling. This large diameter drilling means normal cases generally we carried out drilling up to 350 millimeter dia which we use for carrying out drilling for blasting purposes and some cases little bit more dia may be around 500 mm dia we carry out for some access or ventilation points also.

But, these very very large diameter drillings are most of the times greater than 1 meter dia which is practiced and these drilling creates basically the openings this openings are used for the human accesses. So, these are carried out for human access and that is why these large diameter drillings are carried out in the in situ condition, so that this can be used as the access.

And, this large dia drilling may be vertical and if we carry out this vertical drilling of large dia this may be either for the shaft sinking purpose or for the raise driving purpose or if we carry out these are for horizontal then it may be for it may be considered as the tunnel boring machine.

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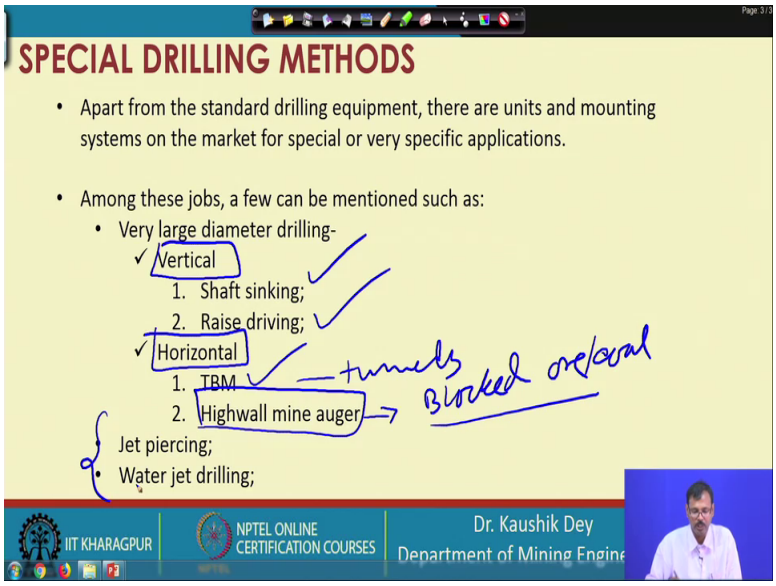

Where tunnels are constructed or it may be high wall miner auger where the blocked rock mass blocked ore which may be coal also are being extracted by this high wall miner and this two are, one is flame, another is water which we have already discussed. So, these are the some special drilling methods can be practiced in different specific conditions.

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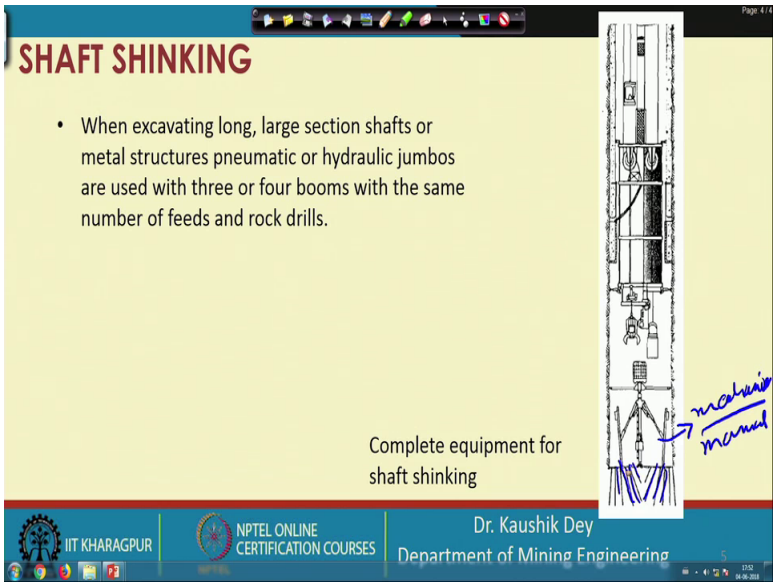

So, let us see the first large dia vertical opening which is created is called shaft sinking in general if we are not carrying out mechanize drilling purpose then shaft sinking is

basically carried out in manual method; where, first the drilling holes are made so, these are the drill holes made using some mechanized or manual drilling machines. So, these holes are created then we blast these holes, then we blast these holes and we create the fragmented rock masses at this position.

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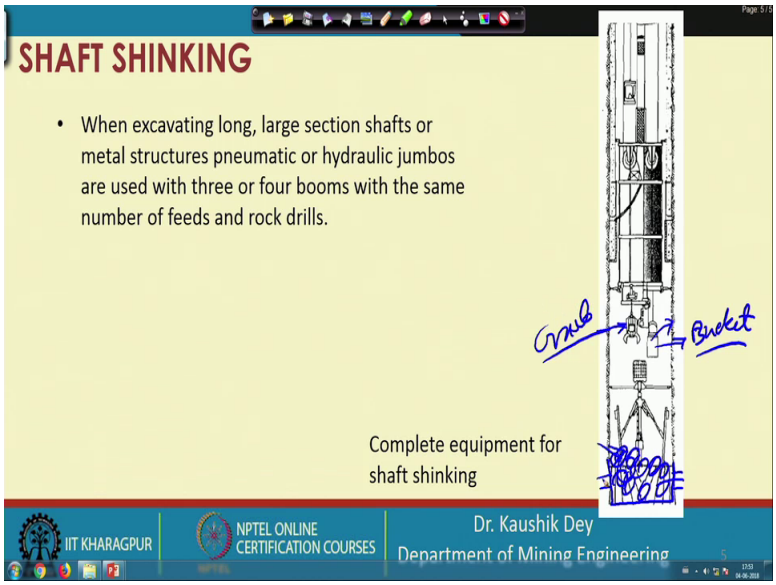

Then, this is the grab cactus grab which is basically the loading machine this cactus grab take this fragmented rock material, load this fragmented rock material on to the top or the bucket, this is the bucket on this bucket then the bucket is lifted in the upward surface or subsurface where the material has to be dumped and as this much of additional length is additional length is excavated then the supporting of that may be carried out either by bolting. And finally, the final support will be made in terms of concreting or short creating. So, that is in general idea about the cyclic of using the cyclic operation shaft sinking may be carried out like this.

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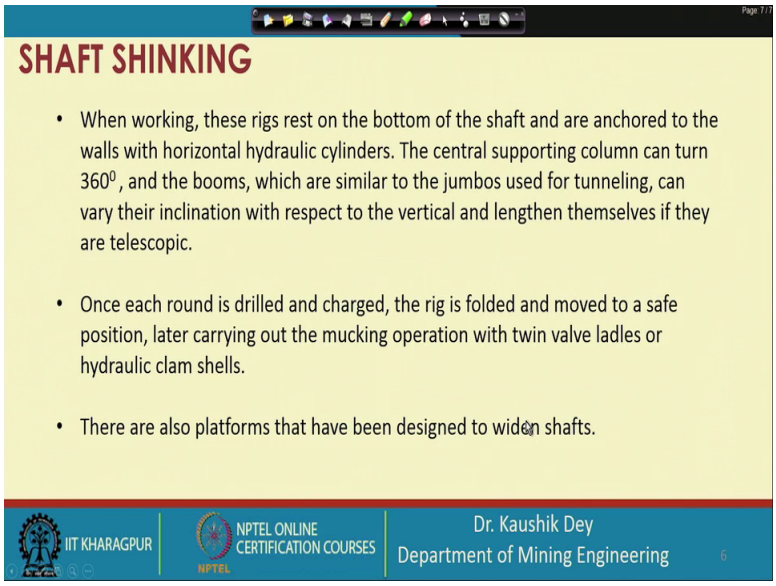

So, when we carried out in this cases we carry out the subs shaft sinking by drilling blasting and the excavation loading unit operations, but in the modern method we are having mechanized drilling system where shafts are being sunk using the drilling machines or often it may be some cutting machines which excavated in a circular manner using a drilling rig.

So, let us observe this video this is a little bit long video and available in YouTube, but I want that you must observe this video completely and then you can easily understand how thus shaft sinking may be carried out by drilling operation.

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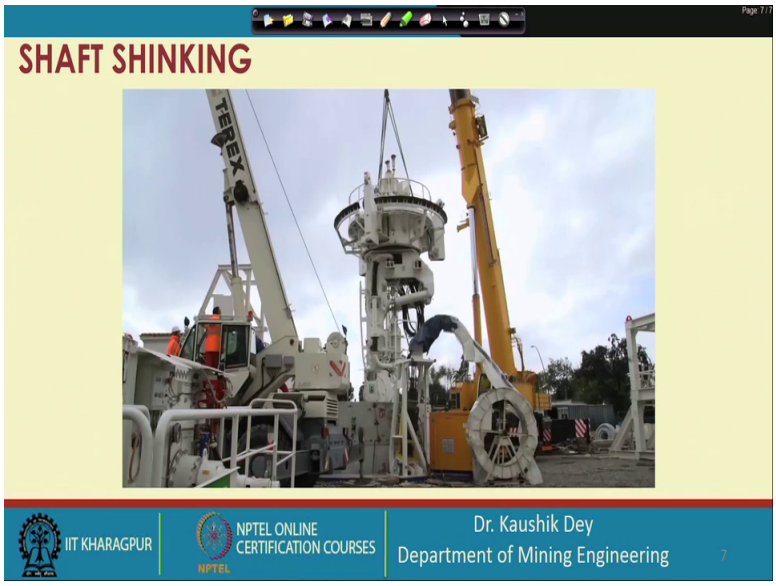

Deep shaft constructors often encounter difficult geological conditions such as high ground water pressure combined with layers of hard and soft material.

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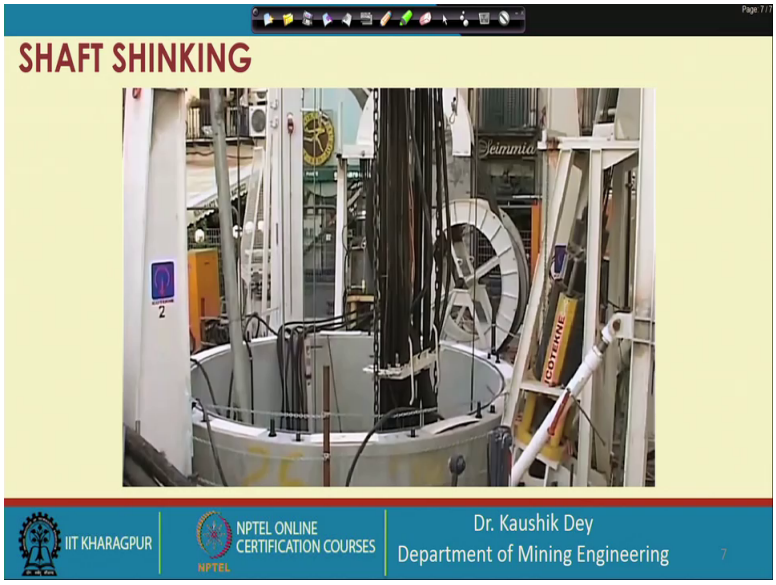

There is an increased requirement to avoid dewatering during construction of shafts in order to avoid the associated settlements which can affect a wide area.

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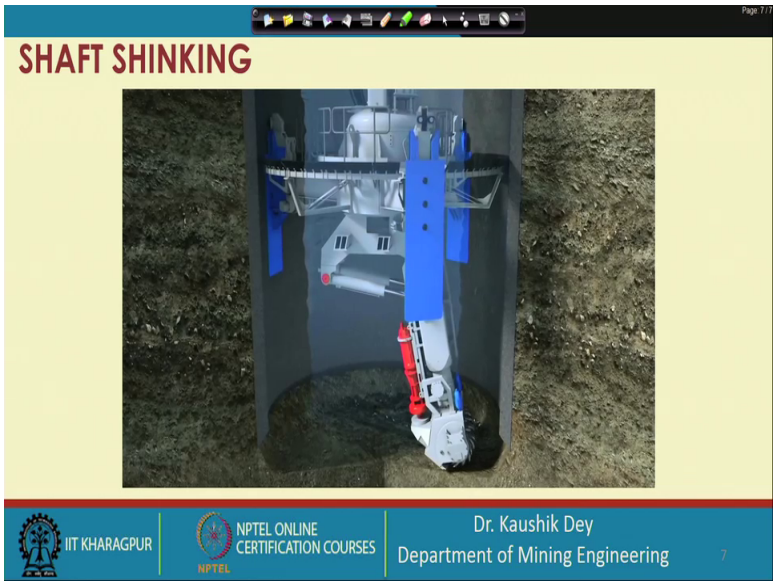

The following animation shows how the Herrenknecht VSM shaft sinking equipment can install shafts quickly, safely and economically.

You can see excavation is being carried out.

In difficult ground conditions and inner-city areas.

While cutting drum.

With limited construction footprint. The initial section is excavated 1 to 2 meters in depth.

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So, first the pile of profaning is created.

And a support concrete ring beam is installed. It acts as a guide way and absorbs the forces from the shafts sinking process.

Then the drilling rig is.

The first set of the.

Placed on the.

Shaft are assembled and lifted in place.

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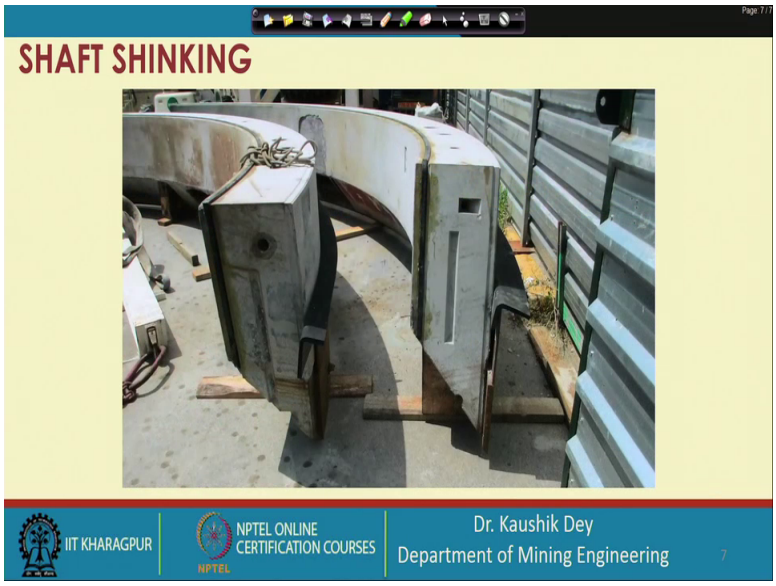

The bottom segment ring has an integrated steel edge.

Opening.

Which acts as a cutting knife.

Size wall supporting maybe treated by the (Refer Time: 08:46).

During the shafts sinking.

Concrete or may be the (Refer Slide Time: 08:47) concrete also.

Strand jacks are installed on the support concrete.

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Strand wires are connected to pockets in the cutting edge. The numbers of strands corresponds to the total weight of the shaft.

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The shaft is now held in position by this compact strand jack system.

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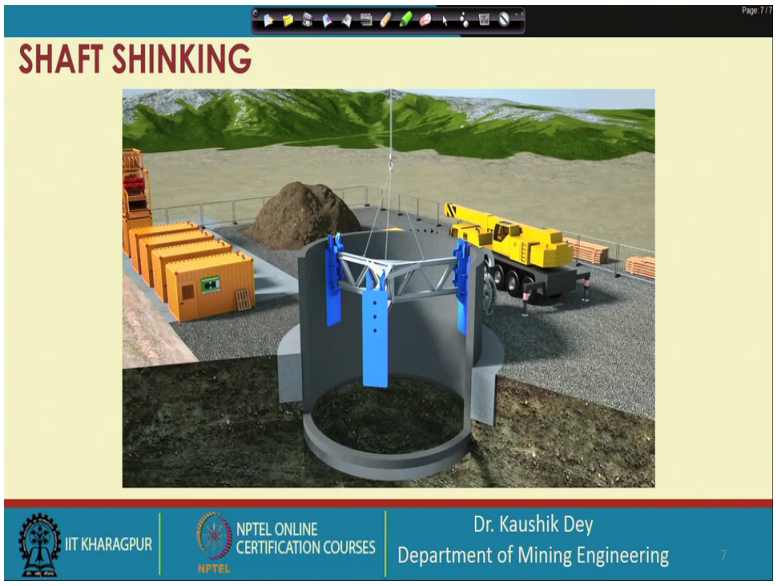

Preparation for the machine installation starts by using a dummy frame to position the brackets for the machine arms which are then welded to the steel plates already cast into the concrete segments.

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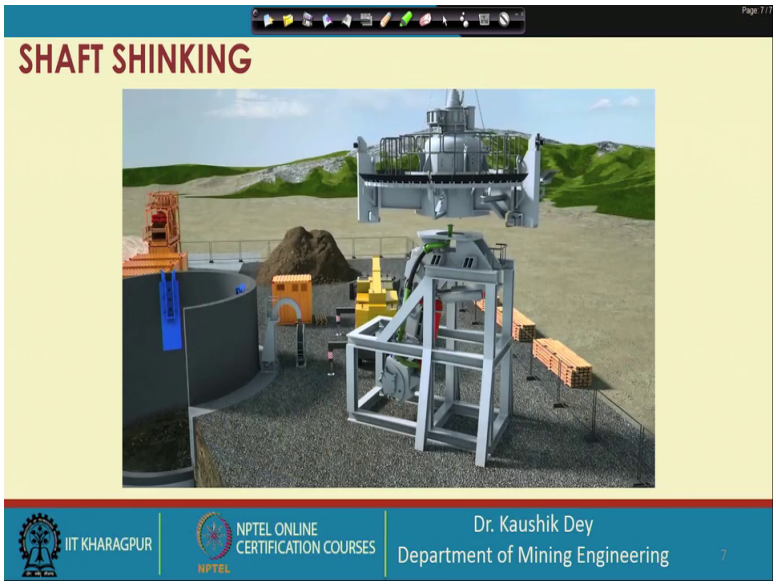

These are the guider plates.

The VSM machine is assembled with the correct arm length to suit the shaft diameter.

And this is the drilling rig.

And then lift it into the shaft via mobile crane.

Which is lift along the.

And mounted onto the bracket.

Guiders provided.

This is in actual.

The rest of the shaft sinking.

This is animation.

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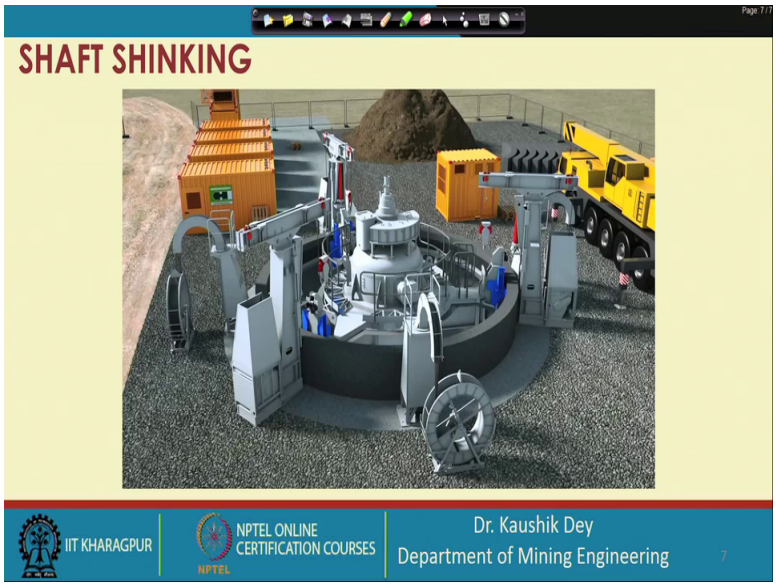

Equipment can now be installed. The three winches are used to lift and lower the machine ie for regular maintenance during shaft sinking.

This are basically different supportive.

As well as to lift it out when the shaft is complete.

Element.

The energy and supply lines provide the machine with all necessary power, fluids and communication.

This is the hydraulic (Refer Time: 10:08) pipelines.

This is an example of complete site setup. All operations are powered and controlled from the container of this process.

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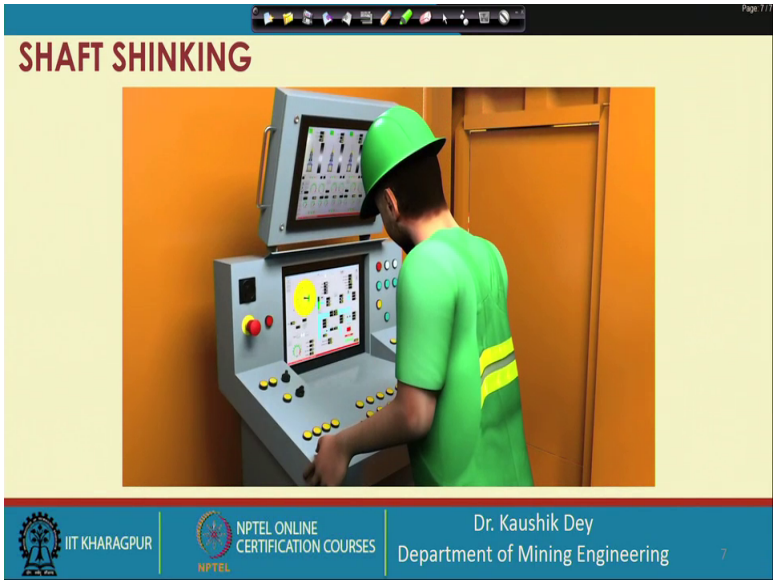

This is control room.

Stored data.

Placed at the surface.

Together with the position of the cutter boom is shown on a graphic display giving the operator full control of the excavation and syncing process.

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The cutter boom can either be controlled manually by the operator.

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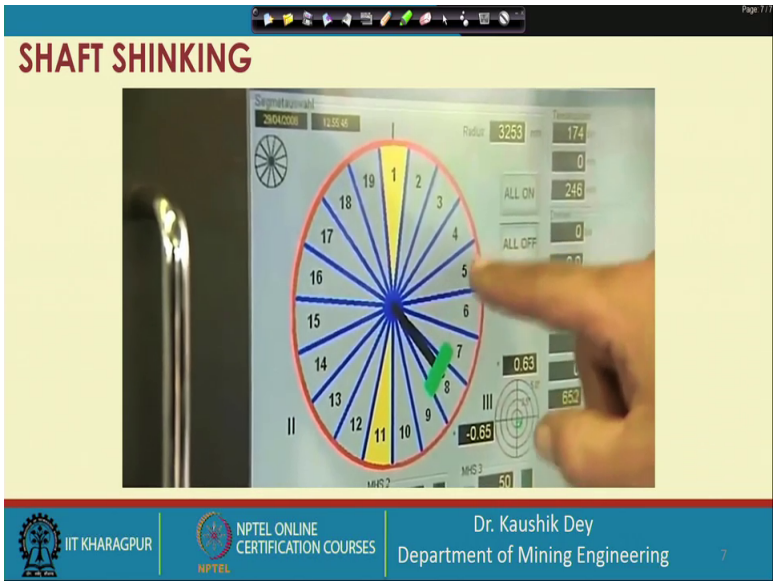

Or setting in automatic mode.

This is for alignments.

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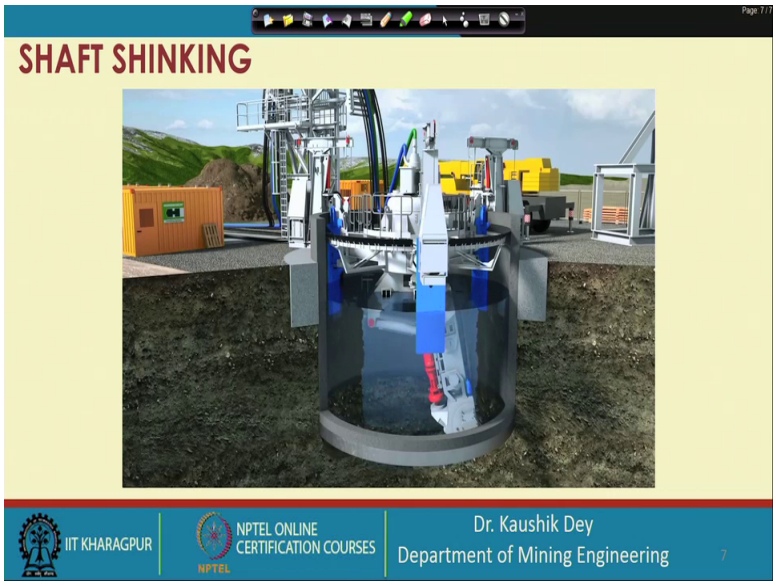

For cutting the set profile in the required section; the shaft is kept full of water during sinking to balance the level of the ground water table in the surrounding geology. In addition.

It is expected that.

Water itself is used as the transport medium.

Generally groundwater may fill the area.

For the excavated ground.

Because, cutting operation is carried out in wet condition.

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Various depths of the groundwater level can be handled.

It is not you can use water jet for that.

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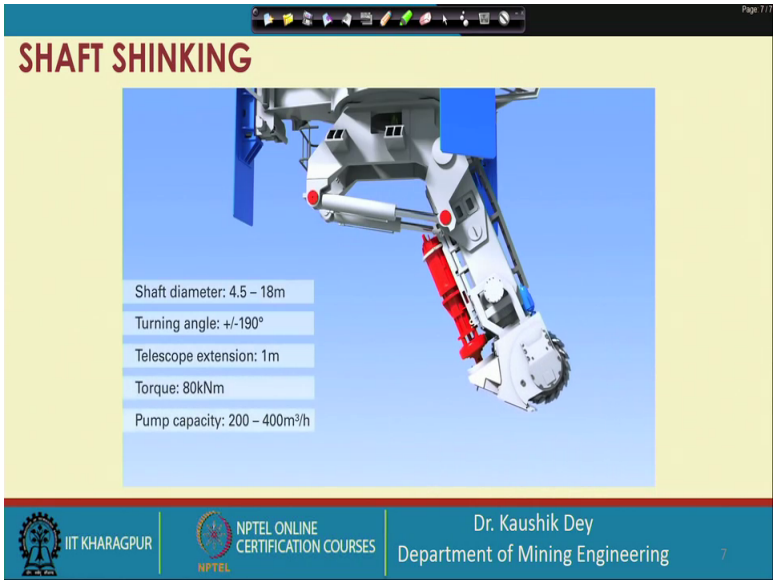

The flexibility of its telescopic arm rotation and slowing movements allows the cutter boom to work in shafts with inner diameters from.

But, in general most of the cases that means it is below ground then it is filled with the groundwater itself.

4.5 meters and outer diameter up to 18 meters.

This is the.

In water depths up to 80 meters.

Specific (Refer Time: 11:08) of this particular.

Shafts shaft borer. However, different specific assumptions are available across the different manufacturer.

The cutting arm moves radially from the centre to the to the outside of the shaft.

So, the cut material is basically cutting the material and cutter cut material.

In soft soil.

Is pumped out.

The cutting edge on the shaft is able to trim.

A slurry form.

The excavation as it sinks into the ground. The cutting speed and the movement of the boom can be varied to achieve the best excavation rate.

It is a slurry form which is pumped out.

When it is necessary to excavate under the cutting edge such as an hard soil.

And the rig is being lowered.

The machine can be moved to a lower position in the bracket.

To the guides.

To the extend the reach of the boom.

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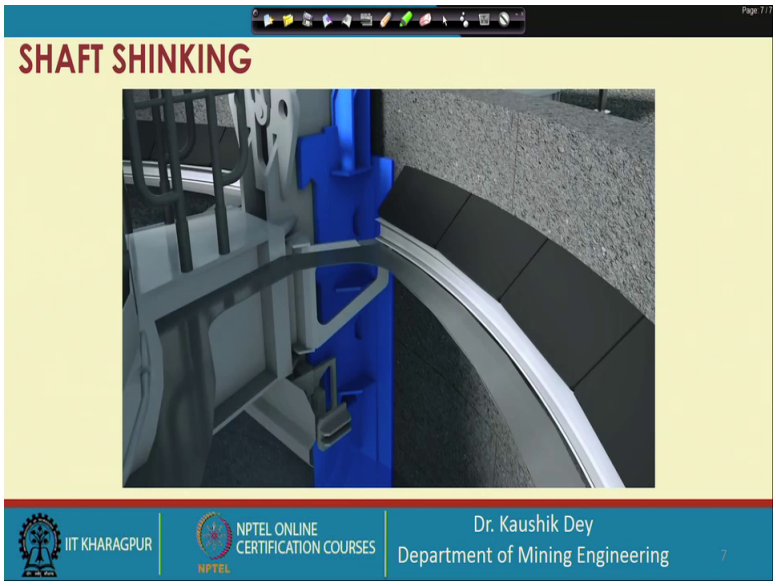

You can see lowering in actual case also.

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Where hard soil is encountered.

This is telescopic.

The machine cuts out to the programmed limit.

The rig is telescopic.

All around the circumference before the shaft is lowered. In rock this controlled descent allows all of the cutting edge to be cleared before lowering. This avoids trapping the cutter boom or deviations in the shaft vertically.

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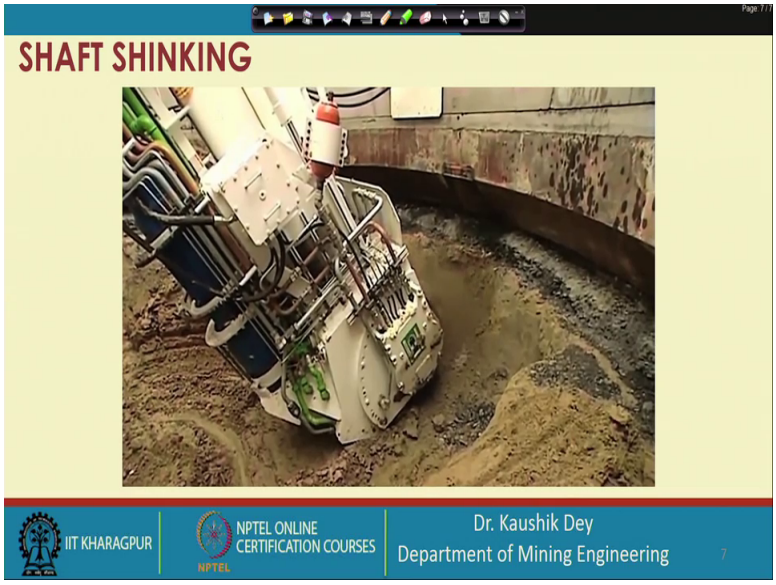

So, after creating and opening up a significant distance a significant depth the lowering of the side wall supports has to be carried out.

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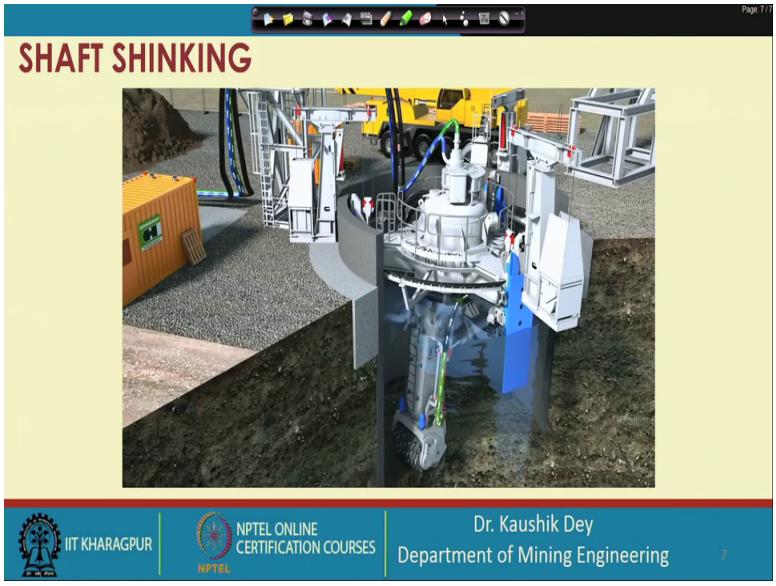

A slurry circuit transports the.

So, this is the.

Excavated material.

Pump pumping out of the slurry.

From a shaft to a separation plant on the surface.

Which basically having the cuts material.

The cutter drum cuts and crushes the material to a granular size.

The cut material is sent to the settling tank.

That can be handled by the integrated centrifugal pump.

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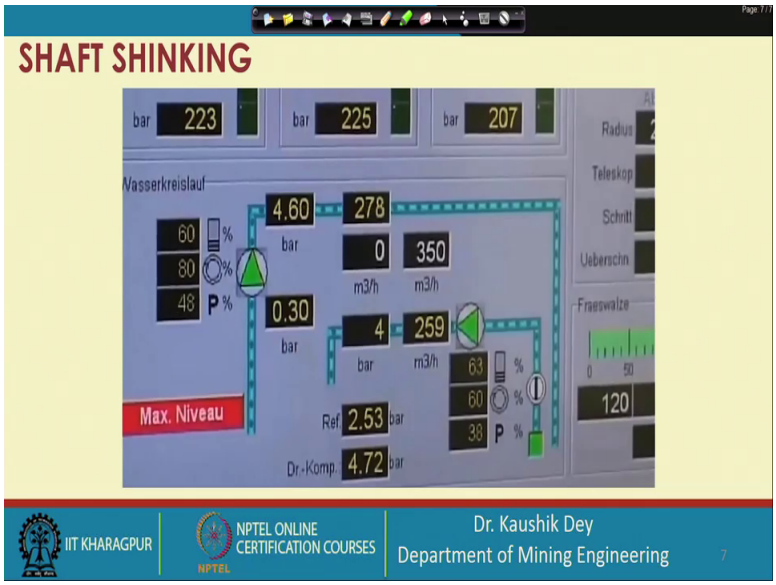

In sticky ground conditions an additional high pressure feed line can be used to clean the cutting drum.

And then.

The separation equipment.

Fresh water may be re-circulated.

Is selected to suit the local soil conditions. As the shaft sinks lower precast concrete segments with rubber gaskets are bolted.

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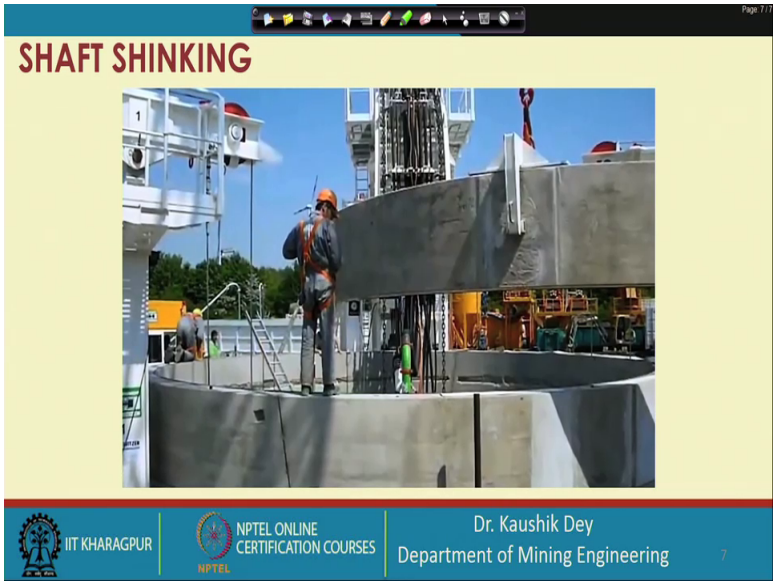

So, after achieving the significant depth.

In place on the top.

The.

Shaft.

Heightening of the.

Excavation shaft sinking and construction of the next ring.

Side walls is carried out either by precast.

Can take place continuously.

Or by the in situ concrete.

The molds for the segments are also supplied.

So, this is precast placement.

As part of the shaft sinking equipment package segment dimensions are designed to suit the shafts purpose.

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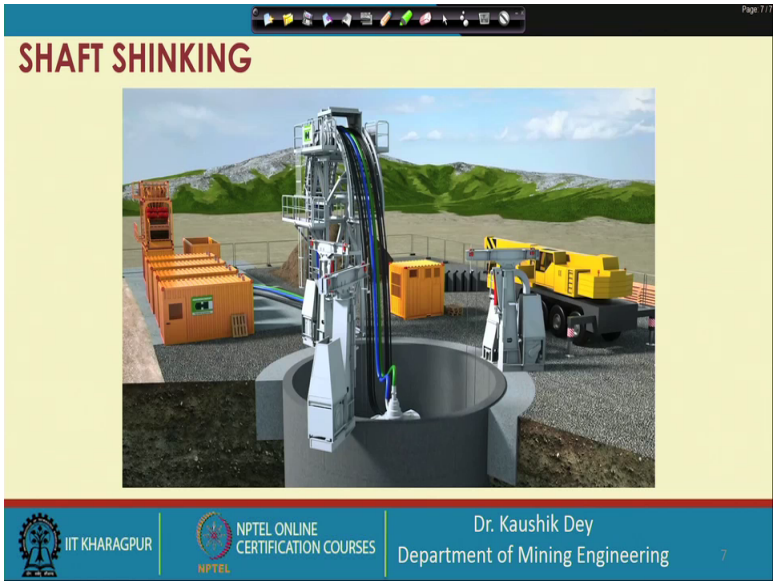

The daily sinking production.

Then it is.

Is in large range from 1 to 5 meters depending on the diameter, geology and working hours.

Forced toward bottom direction hydraulically.

So, (Refer Time: 13:56).

As an alternative to constructing the shaft from individual segment ring in situ.

Is completely lowered; this is in situ concreting.

Can also be used form work designed for the shaft diameter is used to concrete the shaft lining in lifts of about 2 meters in height. The sinking process itself is the same as for shafts constructed with segments.

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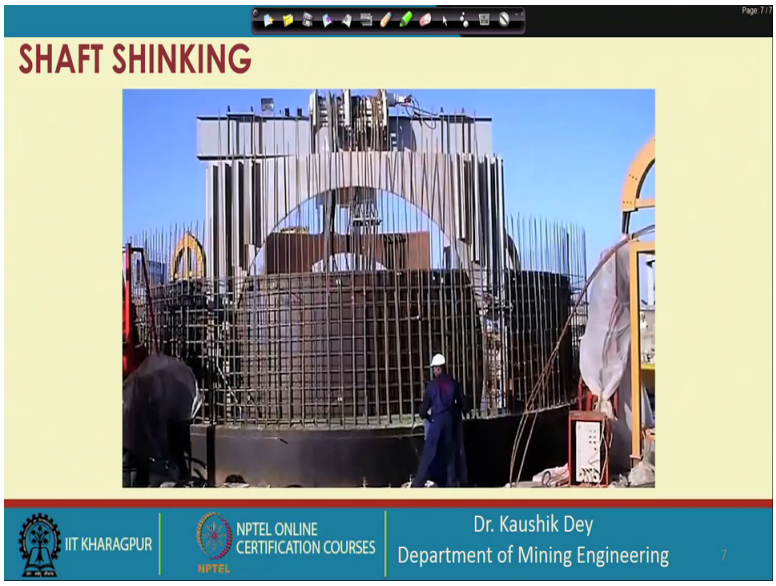

This can be an advantage of the shaft is to be used for launching tunneling machines. The shaft wall can then be prepared with a built in launch I to exactly suit the tunneling equipment.

So, this is in situ concreting here for the (Refer Time: 14:37).

An automatic bentonite lubrication system reduces friction between the shaft exterior and the surrounding ground.

To make.

During.

Easy.

Shaft sinking.

That lowering action.

The total number of nozzles is designed to.

Generally bentonite is has spread.

Suit the soil conditions.

Between the.

When the shaft reaches the final depth.

Casing and the.

The VSM machine is removed and the.

Host rock.

Concrete base block is cast.

And after achieving the desired length drilled rig is withdrawn then the bottom is concreted and the.

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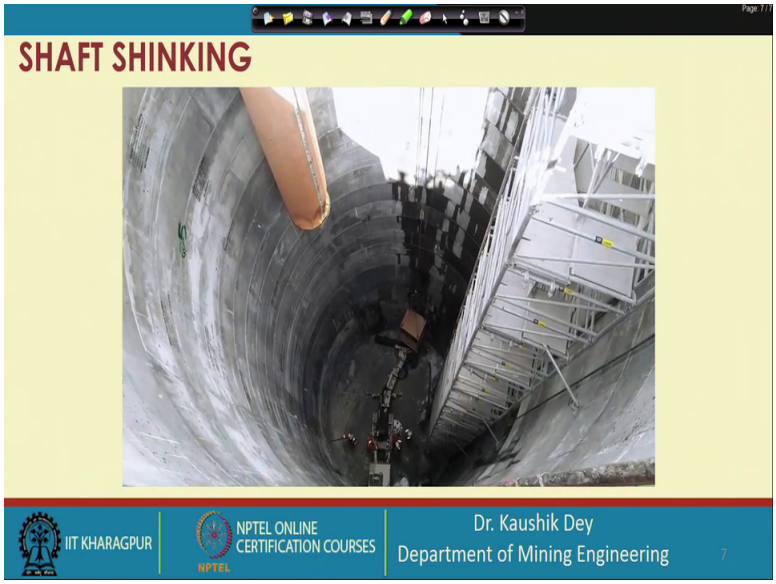

Shaft is completely.

Afterwards the bentonite in the analysts.

Drained out.

Around the shaft is displaced by grout injected through the bentonite nozzles.

The water in the shaft will be.

Once the grout gains.

Completely pumped out.

Sufficient strength.

And.

The water is pumped out.

The shaft sinking may be completed.

The shaft construction has been completed.

And finally, the grouting may be made.

Without effecting the ground water.

Between the.

Or the surrounding soil.

Casing and the.

The shaft is now ready to be used.

Host rock.

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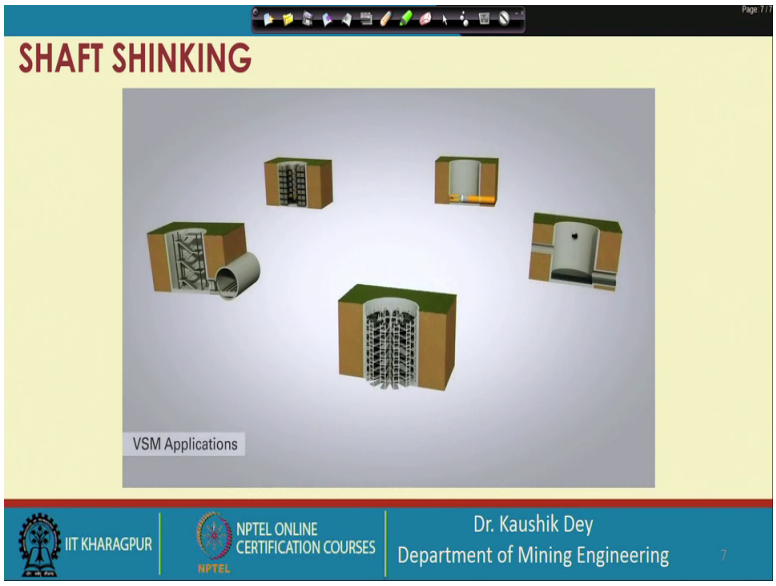

Up to this point in time Herrenknecht VSM technology has been used.

So, these are the different applications of the shaft.

Construct shafts for several.

If it is bore.

different types of applications.

And.

With many more.

Using this type of techniques shaft sinking.

Planned in the future.

May be carried out very fast.

For ventilation and emergency shafts for traffic tunnels.

Only the.

Such as those found in metros and railways.

Initial capital cost requirement is significantly high in these cases. So, these are different applications.

For under.

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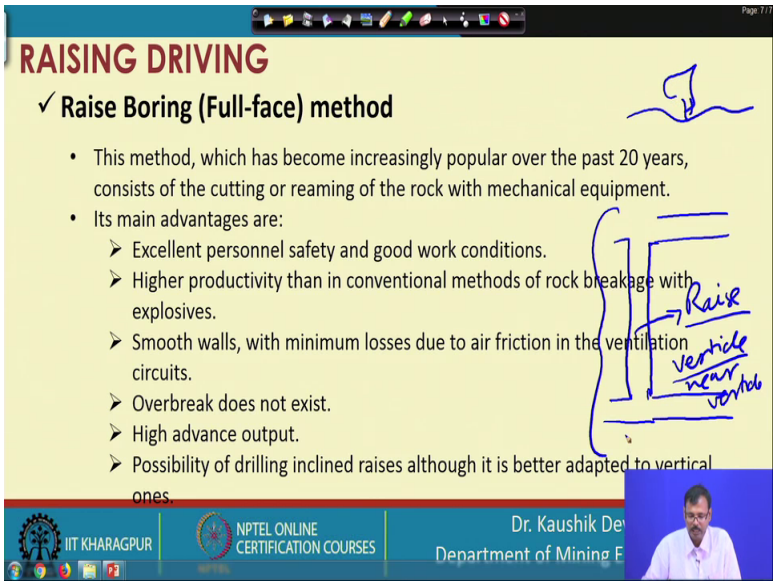

This is shaft sinking in most of the European countries and American countries the best method of shaft sinking is the shaft boring, but often we use similar type of boring for creating the raises also. Before, going into this detail let me first explain you what is raise. Raise is basically an opening where if this is the surface and there are two different underground levels raise is basically the opening which is connecting two underground levels and this is called raise which is either vertical or near vertical.

So, basically raising is the access way between two levels in the underground and raise boring is a very very popular method because, against just like shaft sinking raising raise boring takes a little bit less time. If you are comparing with the manual method or conventional method where drilling, blasting this type of unit operations are being carried out.

So, raise boring is become increasingly popular over the first past 20 years and it is having advantages like personal safety, good working condition, higher productivity, smooth walls that is the damage to the side walls are limited retaining walls are limited; this also gives better less air friction that is why ventilation may be better, over break does not exist high advanced that is again the high productivity is achieved. So, these are basically n number of advantages; you can achieve by raise boring and that is why raise boring is becoming very very popular nowadays.

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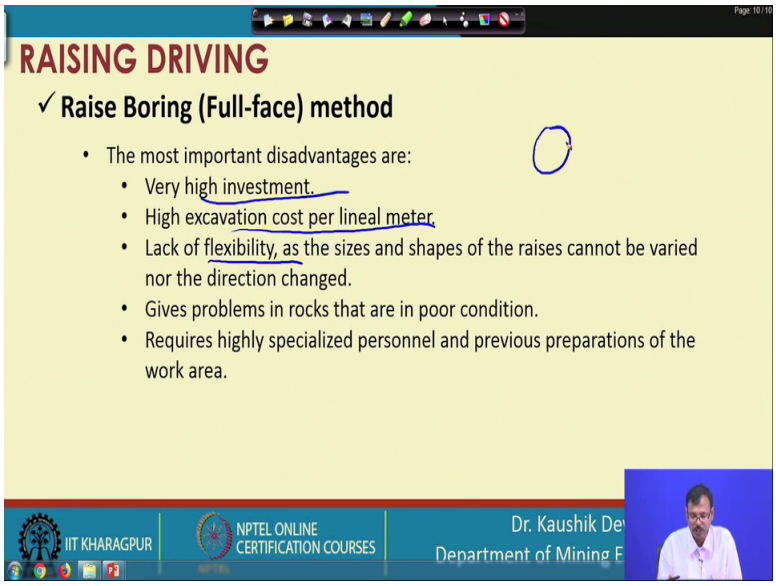

However, there are few disadvantages also say higher in initial investment, cost may be little bit higher, flexibility is very very limited, you cannot have different diameter different dimensions if it is carry carrying out by boarding only then the circular it has to be circular in shape, you cannot have another shaft then the in house accommodation of the different features in the raise may be problematic. So, these are little bit disadvantages are there, but overall the time consumption is less and that is why raise raising method is becoming nowadays very very popular.

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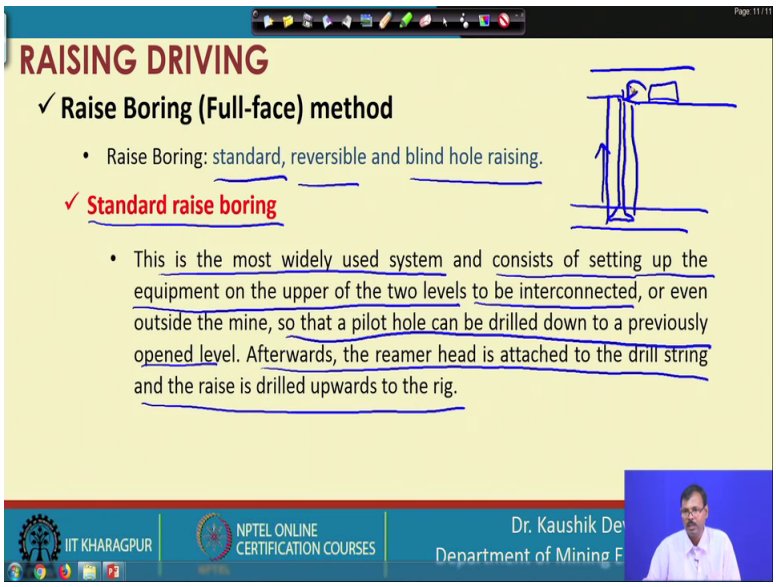

Raise boring maybe method may be classified in three part; one is standard, another is reversible, third one is blind hole raising. What is standard raise boring this is the method widely used system and it consist of setting up the equipment in the upper two levels upper of the two levels to be interconnected or even outside the mine, so that a pilot hole can be drilled down to a previously opened level after what the reamer head is attached to the drilling string and the raise is drilled to the upward direction.

So, what is the feature equipment is placed in the upper level. So, this is the equipment, this is the lower level from upper level to lower level a pilot hole has to be initially connected then through the pilot hole a reamer head is attached. So, that the reamer head is pulled in the upward direction so, that a reamed hole or the large dia hole can be created. So, basically first the pilot hole is created then the it is reamed, but the main machine is placed in the upper level. So, that is the standard raise boring technique.

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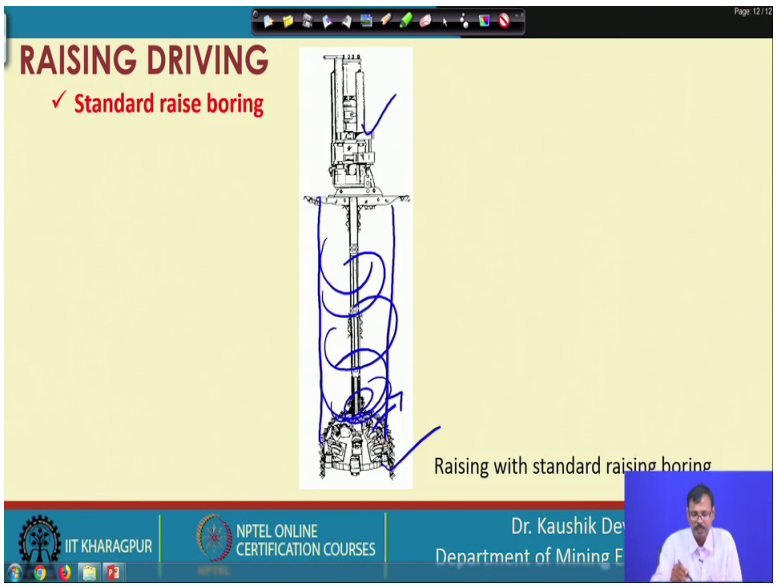
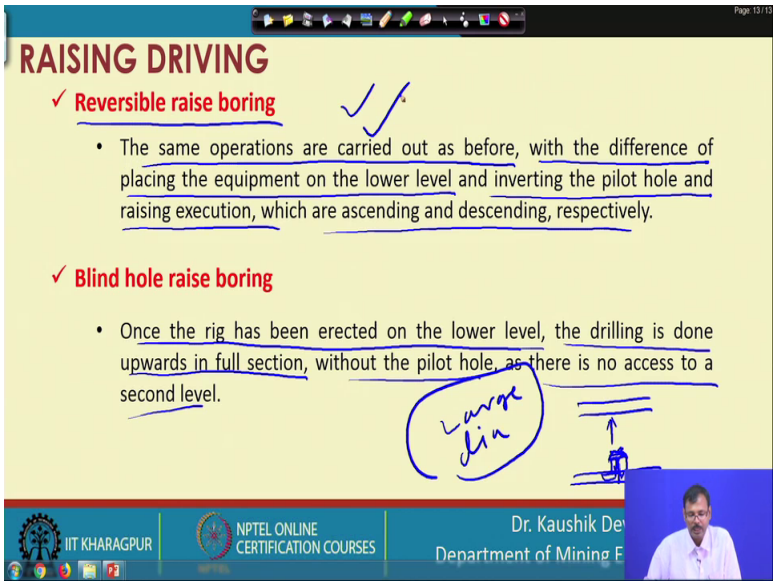


If you look into the next system, so, this is the photograph of that one you can see this is the pilot hole which is created machine is in the upper level this is the lower level and the this is the reaming head and this rimming head is pulled in the upward direction; So, that it reamed and gradually it drilled like this and finally, you can achieve a raise of this dimension.

(Refer Slide Time: 21:14)

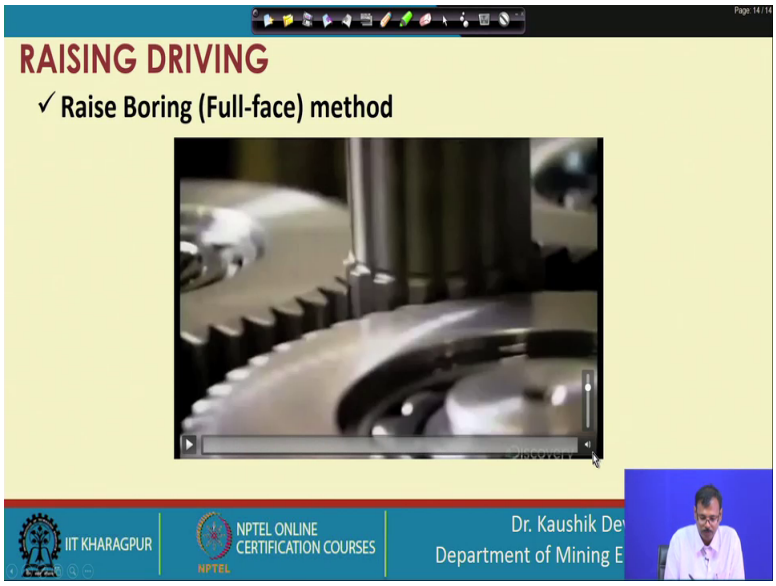


In reversible boring system reversible raise boring system the same operation as are carried out as before only the difference is that the equipment is placed in the lower level inverting the pilot hole and raising execution which are ascending and descending respectively. So, basically if we are reversing this one and place the raise boring machine in the lower level then the method is called reversible raise boring.

Blind hole raise boring once the rig has been erected in on the lower level and the drilling is done upward in full section without a pilot hole is called blind raising. So, that means, here the upper level is this lower level is this and you start carrying out drilling from the lower level to upper level with a drilling head like this which drill the material and go towards upward direction. This enable the dislodgement of the material in the bottom by gravity which later on after few sequences which may be cleared by the LHT.

So, that is blind hole raising which is a truly large dia drilling large dia drilling where these are basically rimming operation from a pilot hole which is created in the raise. So, that is why this is little bit this raising method is little bit different blind hole raising method than the standard raising raise boring and the reversible raise boring techniques.

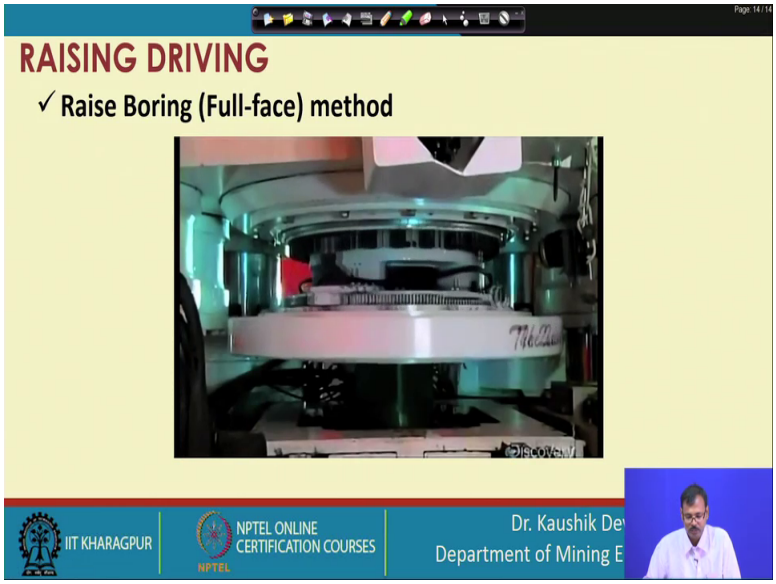
(Refer Slide Time: 23:09)



So, let us observe one such video where you can see the raise boring is carried out.

This is the raise boring.

(Refer Slide Time: 23:16)



This is also available, but.

One of the most powerful (Refer Time: 23:19).

Let.

(Refer Time: 23:21).

I want that you must see so, to the have some idea about the raise boring technique.

(Refer Time: 23:24).

This is.

(Refer Time: 23:28).

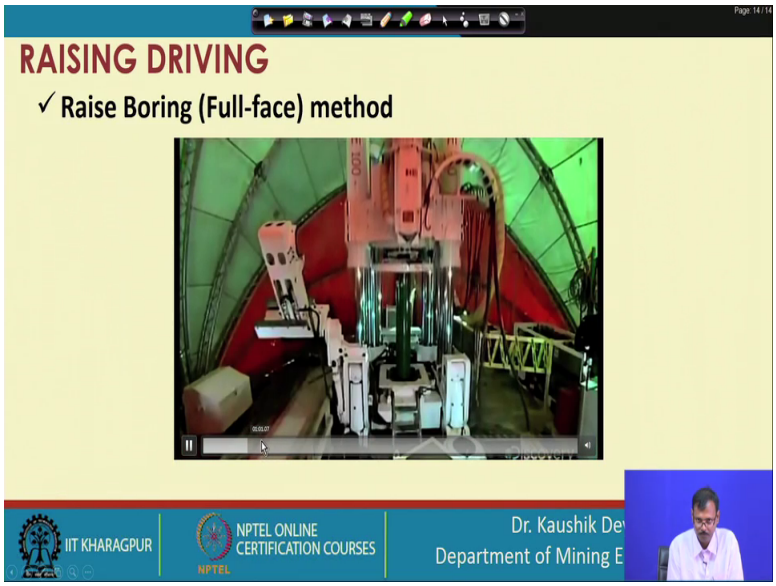
Shown from the surface for the better understand.

This type of drilling is faster, cheaper and cleaner than the old style.

So, this is the (Refer Time: 23:35).

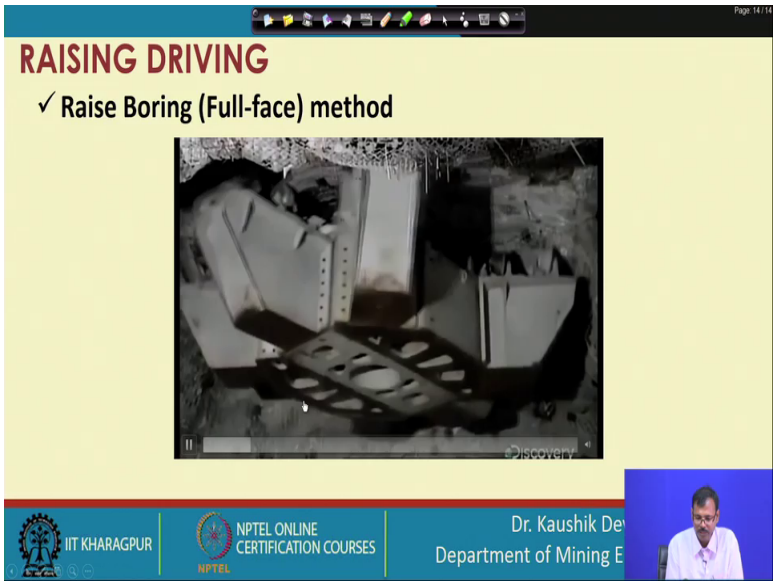
It cuts an 8 meter wide hole, hundreds of meters deep through solid rock, big enough to swallow trucks, what is the trucks.

(Refer Slide Time: 23:58)



They call the one hundred a raise bore drill. Here is why this machine drills up raising its cutter towards the surface.

(Refer Slide Time: 24:01)



So, this is the rimming head.

Its massive cutter (Refer Time: 24:02).

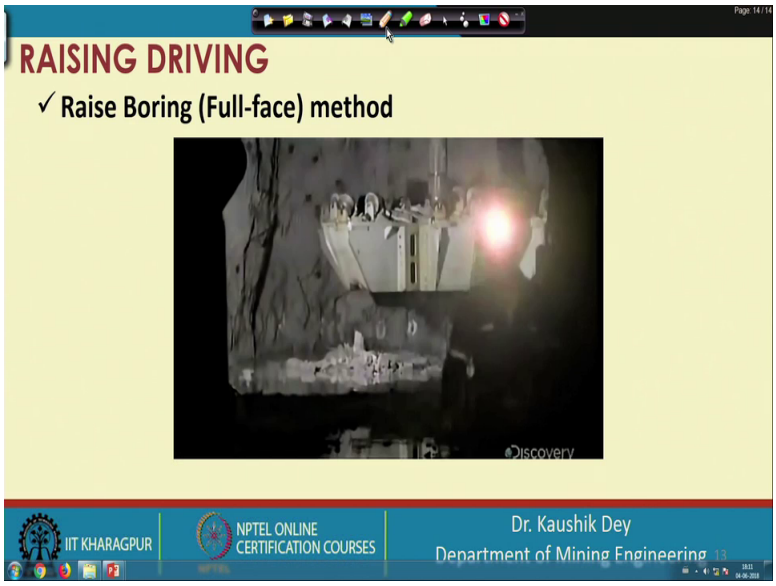
You can see. So, this is the rimming head.

(Refer Time: 24:04).

Which is basically rimming the.

Driven by hydraulic cylinders they crank out a million kilograms of thrust. The same force blasting from NASA's latest rockets, as mines expand they need extra (Refer Time: 24:22).

(Refer Slide Time: 24:25)



So, I want to show you here that this is the first the pilot hole is created and then this shaft is fitted through that pilot hole and the machine drill machine is in the upward portion and this is the reaming head is fitted with this shaft and it is allowed to ream in the upward direction. So, if you little bit show.

Shafts for workers; Let us see how it works. First the reamer is positioned in the target zone of an existing shaft, ready to be attached to this turbine.

You can see this is the rotation of the reamer beam.

The machines top has to launch.

So.

A pilot hole through almost a kilometer of wall.

This is basically.

To hook up with the (Refer Time: 25:13).

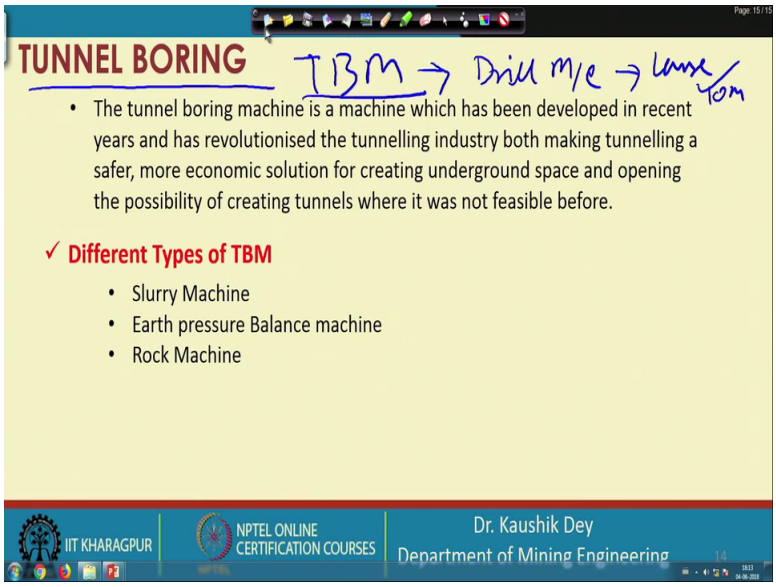
Technique which is carried out that is the pilot hole excavation.

(Refer Time: 25:17) is done.

So, I think you can understand.

Here is the.

(Refer Slide Time: 25:21)

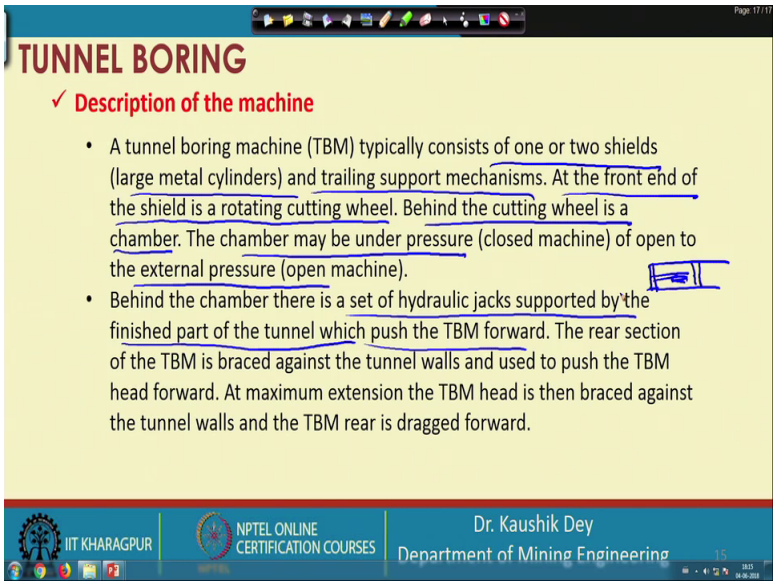


What how the raise boring is carried out. So, this is the second vertical excavation large dia boring is carried out for providing a an excavated opening.

Next we let us look into the horizontal large dia drilling which is basically carried out to create a tunnel and that is why this machine is called tunnel boring machine or in other word TBM. So, basically TBM is nothing, but a drill machine drill machine which carried out drilling of very large dia and often may go up to a 10 meter dia or something like that opening may be created by the TBM. So, large dia drilling may be carried out by TBM which is horizontal or nearly horizontal drilling is carried out here.

And, you can see the TBM is nothing, but a machine which has been developed in recent years that has revolutionized the tunneling industry both making tunneling after economic solution for creating underground space. There are different types of TBM occurs most common for the very soft rock condition is earth pressure balance machine, otherwise different other machines are available for weak rock condition or hard rock conditions machines are also available for different TBMs.

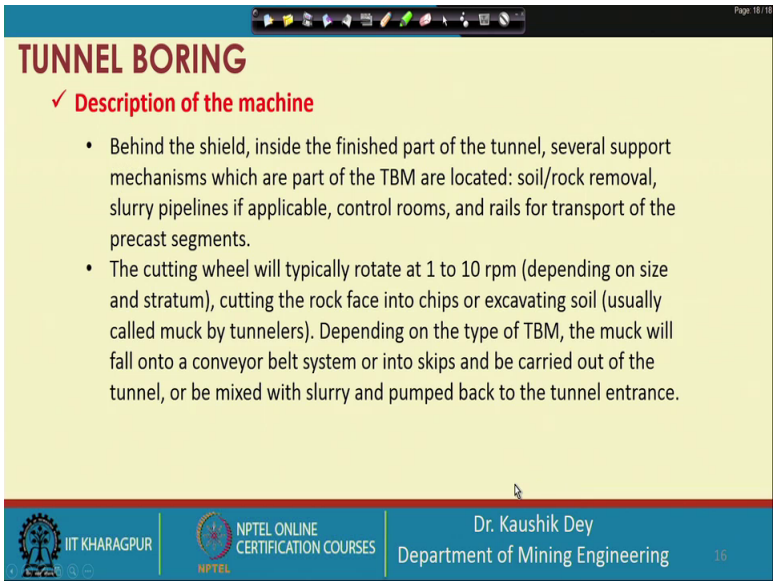
(Refer Slide Time: 26:55)



So, TBM is basically consisting of a shield these are basically large metal cylinders and trailing support mechanism at the front end of the shield there is a cutting wheel which is fitted with the roller cutters and behind the cutting wheel there is a chamber which allow the crossing of the fragmented rocks which are being cut by the cutting wheel. Chamber may be under pressure for the closed test machine where earth pressure balancing technique is followed or it may be open to the external pressure for the open machines.

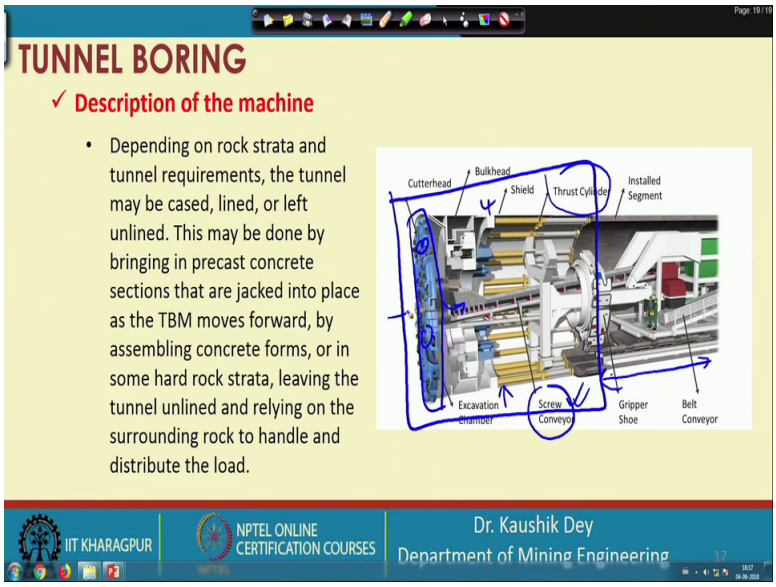
Behind the chamber there is a set of hydraulic jacks which are providing the support to the finished part of the tunnel and TBM is being advanced against this support by the hydraulic push. So, basically the back part if this is the tunnel and in the mouth this is the cutting head this back part is supported this cutting head is being forced hydraulically from this support to the front direction. So, that is the drag force observed in the TBM.

(Refer Slide Time: 28:16)



Behind the shield inside the finished part of the tunnel several support mechanisms which are part of the TBM are located the cutting wheel is typically rotate at a very slow speed, at a very slow speed 1 to 10 rpm depending on the size of the strata cutting of the rock face and the condition of the rock and it also depends on the type of ppm TBM etcetera.

(Refer Slide Time: 28:55)



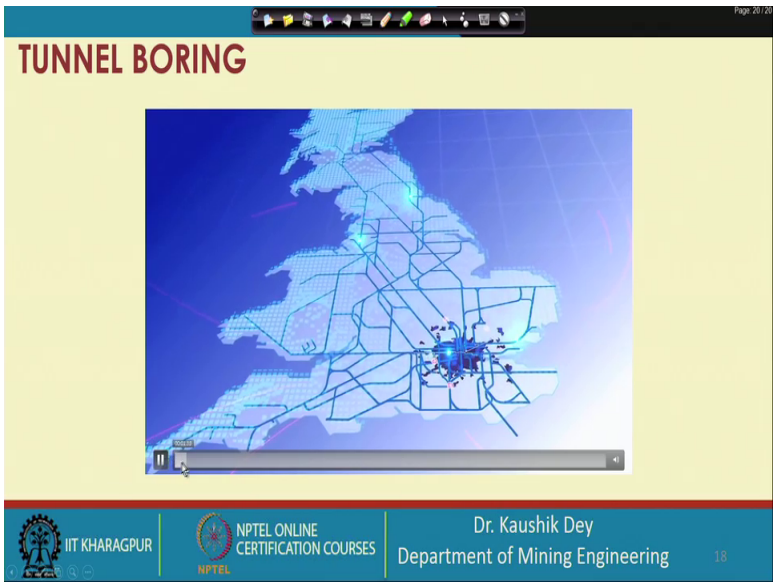
And, if you look into the machine details you can see this is the cutter head these black parts you can see these black parts these are the rollers cutter rollers then this is the

bulkhead which is basically providing a closed chamber you can say this is the excavation chamber bulkhead and cutting head between this excavation chamber is there. So, whichever material is coming here that is crushed and finally, discharged through this openings created in the bulkhead this is the shield up to which this is under support and the machine this is the motive power of the machines which is basically forcing the cutting head through this hydraulic cylinders.

So, this is the screw conveyor this which basically take out the material. Material may be of different there may be a different system in different cases. This is the thrust cylinder which is basically giving the thrust and test these are the gripping shoes and rest part is basically you can consider as the finished tunnel. These are the settling tank etcetera required for the transporting system of the material.

So, these are the main excavation part where drilling is carried out by this cutting head this is the large dia drilling. In fact, you can see the details of this in the next video and that will clear your idea about this one. In fact, we will we will finish after observing this video, but before finishing let me show you this video you keep a little bit patients in this observing this video.

(Refer Slide Time: 30:46)



This is basically.

(Refer Time: 30:46).

Animated video.

(Refer Time: 30:48).

So, that you can understand the.

(Refer Time: 30:48) exist (Refer Time: 30:49).

Complete TBM operation.

(Refer Time: 30:53) central London.

How this is carried out.

(Refer Time: 30:56) tunnel boring machine.

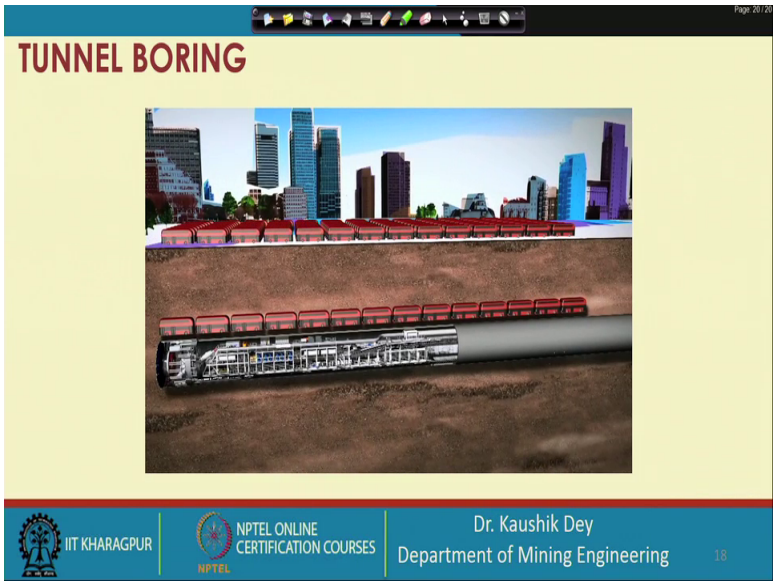
So, you can see this is animated

Through the ground.

The cutting head is being shown to you.

(Refer Time: 30:59) tunnels.

(Refer Slide Time: 31:00)



As the cutting head is rotating the rest part of the TBM is also.

(Refer Time: 31:03).

Shown to you.

(Refer Time: 31:04).

So, this is the shield part.

This is the (Refer Time: 31:06).

After this shield part you can see.

(Refer Time: 31:06) London buses (Refer Time: 31:07).

The rest part is the finished tunnel.

(Refer Time: 31:10) 143 buses in weight it has a rotating cutter.

So, you can see that as the TBM cutter head is rotating.

Behind (Refer Time: 31:20).

The material is being.

(Refer Time: 31:22) and.

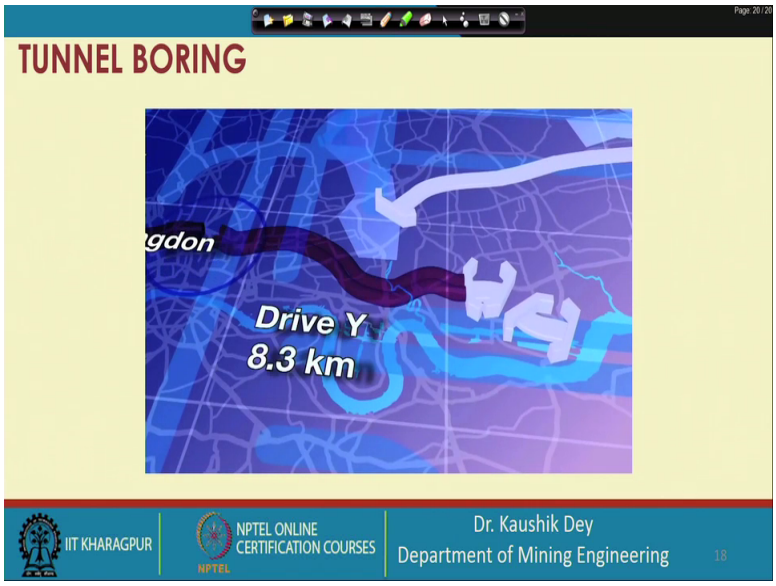
Dislost.

(Refer Time: 31:23) there are two types of TBM being used by (Refer Time: 31:27).

Rock is being dislost fragmented.

(Refer Time: 31:28) balanced TBMs and mix shield TBMs.

(Refer Slide Time: 31:35)



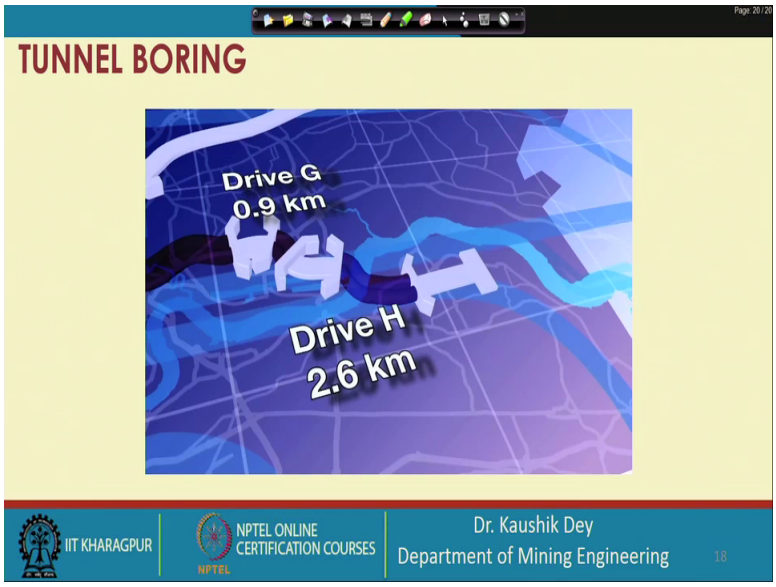
6 earth pressure balance machines will be used for the 18 kilometers of tunnel.

So, this is the.

(Refer Time: 31:37).

Twin tunnel.

(Refer Slide Time: 31:45)



(Refer Time: 31:38) to the west and the riverbed deposits in the east while to mix shield machines will be used to drive the tunnels through the chalk beneath the river Thames. Depending on the geology (Refer Time: 31:50).

So, as the cutter head.

Below in the buildings above ground.

Is being cut we can see these are being forced.

Each TBM will.

Against the.

90.

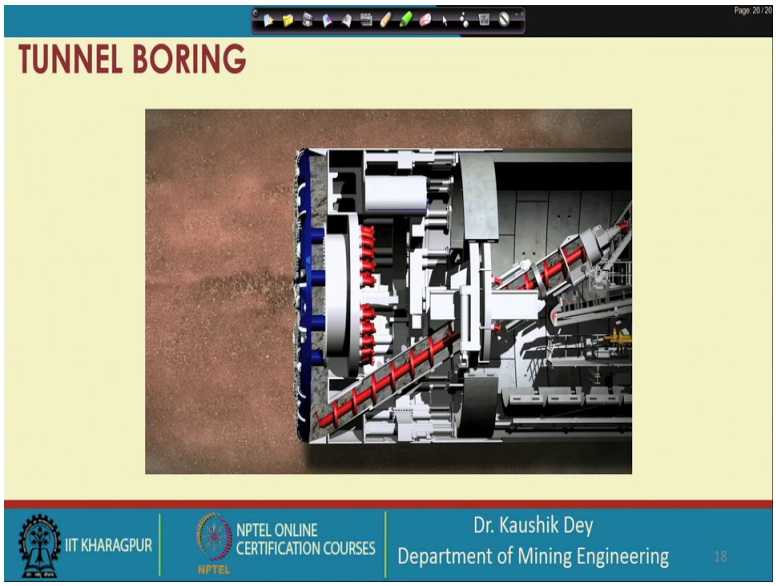
Shield.

150 meters each week.

Then the shields are being advanced.

(Refer Time: 31:58) millimeter where it needs to be. The first part of the TBMs work is the tunneling face.

(Refer Slide Time: 32:15)



So, you can see.

(Refer Time: 32:07).

As it is rotating material is being cut.

Which is pressed against the tunnel face.

The cut material is.

(Refer Time: 32:12).

Is being crushed in the chamber.

Inside the (Refer Time: 32:12).

You can see the material is crushed in the chamber.

(Refer Time: 32:18).

And finally, coming into a screw conveyor.

(Refer Time: 32:20) is unstable and just stop with tunnel face collapsing (Refer Time: 32:23).

So, in this case the transportation system primary transportation system is a screw conveyor.

(Refer Time: 32:28).

Which is discharging the material into a belt conveyor you can see the material is being transported by a.

(Refer Time: 32:34).

Screw conveyor to the belt conveyor.

The tunnel face (Refer Time: 32:36).

And, this belt conveyor is basically placed.

Crushes (Refer Time: 32:39).

In the finished tunnel part.

(Refer Time: 32:42).

And time to time that will be extended.

(Refer Time: 32:45) conveyor and they also (Refer Time: 32:46).

That is telescopic and that will be.

(Refer Time: 32:48).

Extended in time to time.

Material is then (Refer Time: 32:50).

So, you can see as the cut material in a slurry form is being transported.

Once the tunneling phase is done.

Through the belt conveyer.

(Refer Time: 32:58) wheel and screw conveyor are stops in the ring building (Refer Time: 33:00).

(Refer Slide Time: 33:04)

So, support system in this case.

(Refer Time: 33:02).

You can see this is the precast.

(Refer Slide Time: 33:09)

(Refer Time: 33:03) several (Refer Time: 33:04).

This precasts are placed.

Rebuilt reinforced (Refer Time: 33:07).

In the sidewalls.

(Refer Time: 33:08).

As a support system.

(Refer Time: 33:10) special factory above ground.

And.

They must manage (Refer Time: 33:13).

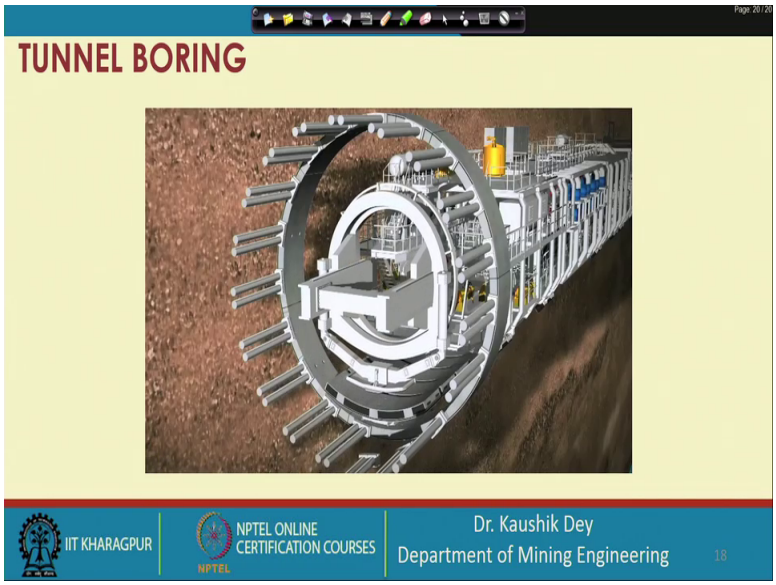
Rubber packers are provided.

(Refer Time: 33:14).

For sealing them.

Into the tunnel on flatbed rail cast. The (Refer Time: 33:19).

(Refer Slide Time: 33:22)



You can see these are also support systems are also being placed it automatically.

(Refer Time: 33:24) placed using a vacuum. The hydraulic cylinders had temporarily retracted in order to (Refer Time: 33:29).

So, that will be placed automatically and it will be fixed by a.

(Refer Time: 33:32).

Bolt or.

The segments are positioned with.

Screw.

Millimeter precision and held in place by cylinder.

You see this packers are fixing that one.

Finally bolted into position. The conical keystone is put in from the front to complete the lining ring.

So, the packers is basically fixing that one.

Each individual tunnel ring is (Refer Time: 33:50).

So.

(Refer Time: 33:51).

Using this horizontal.

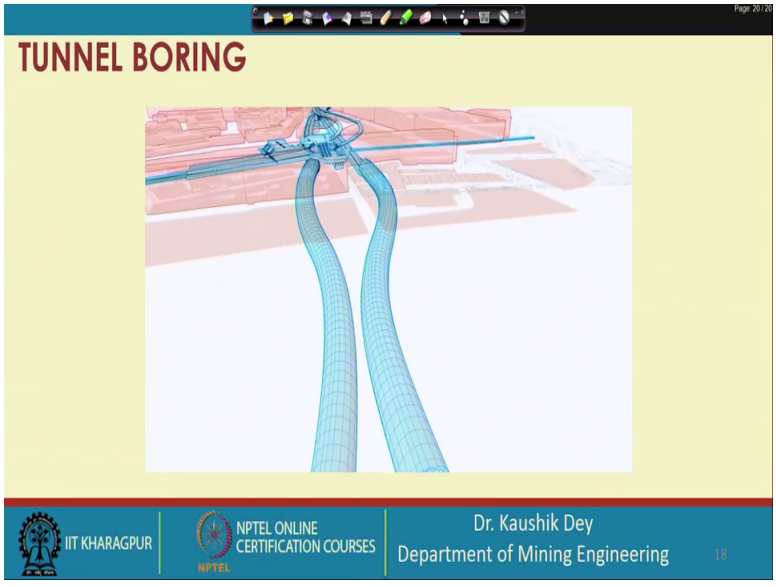
Which means.

Drilling system.

(Refer Time: 33:53) built along with the (Refer Time: 33:54).

(Refer Time: 33:55).

(Refer Slide Time: 33:56)



The advanced rate is very very fast where in conventional.

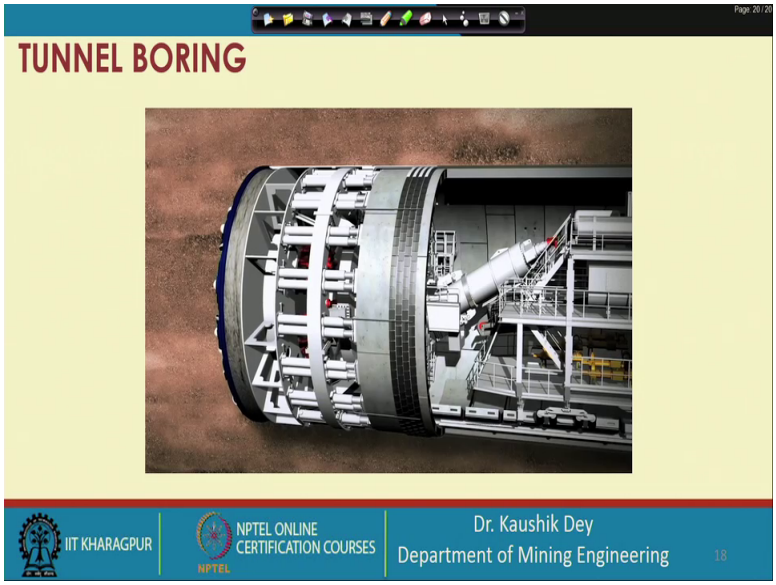
In hydraulic cylinders (Refer Time: 33:58).

And method of excavation.

(Refer Time: 34:00) again (Refer Time: 34:01).

You can achieve around 30 to 40 meter per month progress.

(Refer Slide Time: 34:09)



(Refer Time: 34:01).

You can achieve 100 meter.

(Refer Time: 34:07).

Progress per month in case of using this large dia.

(Refer Time: 34:10) pressure.

Tunnel boring machines.

(Refer Time: 34:12) it is a (Refer Time: 34:13).

However, the problem associated with this.

(Refer Time: 34:16).

Large dia tunnel boring machine is that.

(Refer Time: 34:17).

First of capital requirement is.

(Refer Time: 34:20).

Very very high.

(Refer Time: 34:20) completed (Refer Time: 34:21).

So, a TBM may cost you around 5 50 crore 100 crore something like that. So, capital cost requirement is very high.

(Refer Time: 34:28) in eight different way (Refer Time: 34:29).

And, the next is that.

(Refer Time: 34:31).

The TBM installation.

(Refer Time: 34:33).

Time in the underground is very very high. So, first a pilot tunnel has to be created.

(Refer Time: 34:39).

Which may be of.

(Refer Time: 34:40).

70 meter 80 meter long.

(Refer Time: 34:43) excavation (Refer Time: 34:44).

For installing the TBM is inside that.

(Refer Time: 34:47).

Then only TBM start working.

(Refer Time: 34:48).

So, TBM can be adopted only for those cases.

(Refer Time: 34:53).

Where a long tunnel has to be.

(Refer Time: 34:54) from the working (Refer Time: 34:55).

Constructed. So, in this case.

(Refer Time: 34:56).

You can see the transportation system is a slurry transportation system where material is.

(Refer Time: 35:01).

Cut material is being pumped out.

(Refer Time: 35:03).

Not through the.

Connected in the (Refer Time: 35:04).

Screw conveyor system.

Communicating path (Refer Time: 35:06).

So, basically there are n number of varieties I request you. You can see.

(Refer Time: 35:10).

This large dia horizontal drilling n number of animated videos are available in YouTube you can observe them.

(Refer Time: 35:16).

Then.

Depends upon (Refer Time: 35:17).

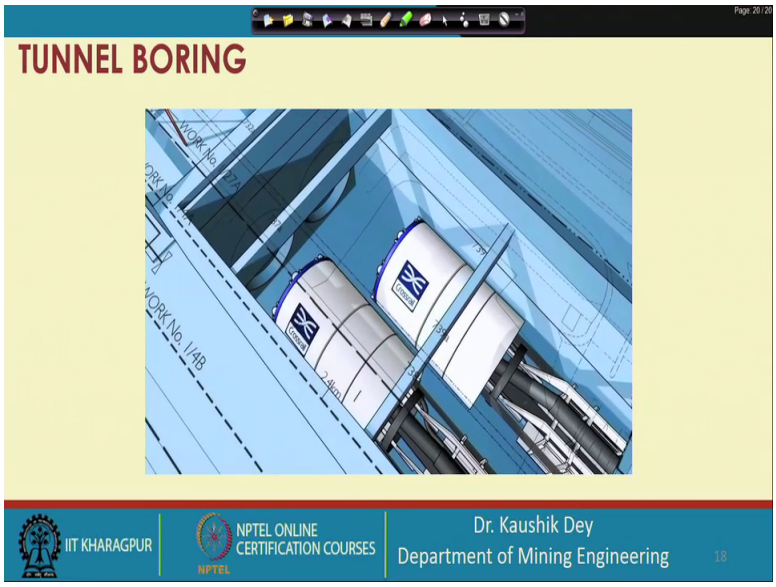
It will be very easy for you to understand.

Membrane which (Refer Time: 35:21).

Those things.

Water changes in the soil can be handled by adjusting the pressurization. It is through the suction line to the separation plane at the surface. Here the soil is separated out and removed from the bentonite suspension through a centrifuge and the clean suspension is transferred back into the slurry circuit. As tunneling advances the flexible extension lines are installed to extend the lines after each thrust phase.

(Refer Slide Time: 35:57)



So, this is the first (Refer Time: 35:54).

(Refer Time: 35:55).

How the pusher is.

TBM.

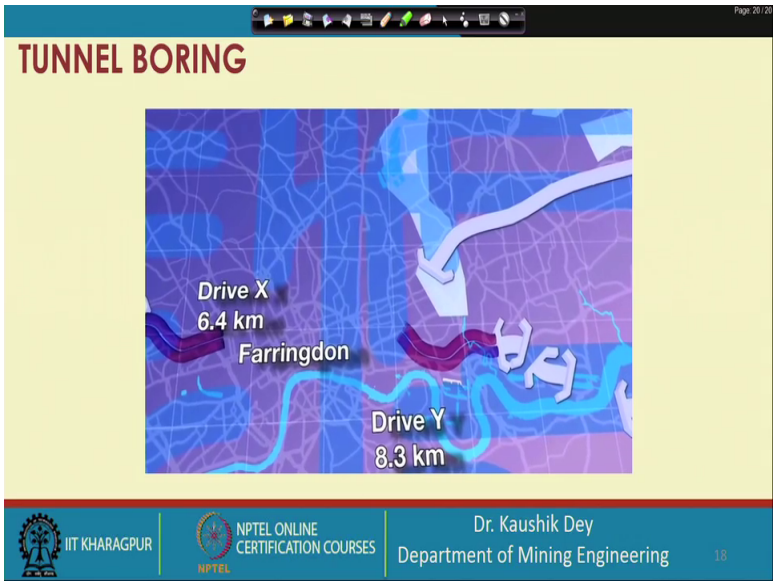
Pushing the TBM.

(Refer Time: 35:57).

In the front direction.

(Refer Time: 35:58) drive at.

(Refer Slide Time: 36:00)



So, that.

(Refer Time: 36:02) a second pair of TBMs Elizabeth and Victoria.

(Refer Time: 36:06).

Will construct drive (Refer Time: 36:07).

It is moving in the front direction.

(Refer Time: 36:09).

There is another.

(Refer Time: 36:11).

A little bit difficulties in TBM.

(Refer Time: 36:12).

The TBM.

(Refer Time: 36:15).

If TBM is being used.

(Refer Time: 36:16).

As the construction of the tunnel.

(Refer Time: 36:18).

Sharp bent cannot be.

(Refer Time: 36:22).

Possible.

(Refer Time: 36:21) follow a (Refer Time: 36:22).

Cannot be a carried out in the designing.

All the time (Refer Time: 36:25).

It is very very difficult to achieve it by TBM because TBM is having a.

(Refer Time: 36:30).

Longer length.

(Refer Time: 36:31) largest (Refer Time: 36:32).

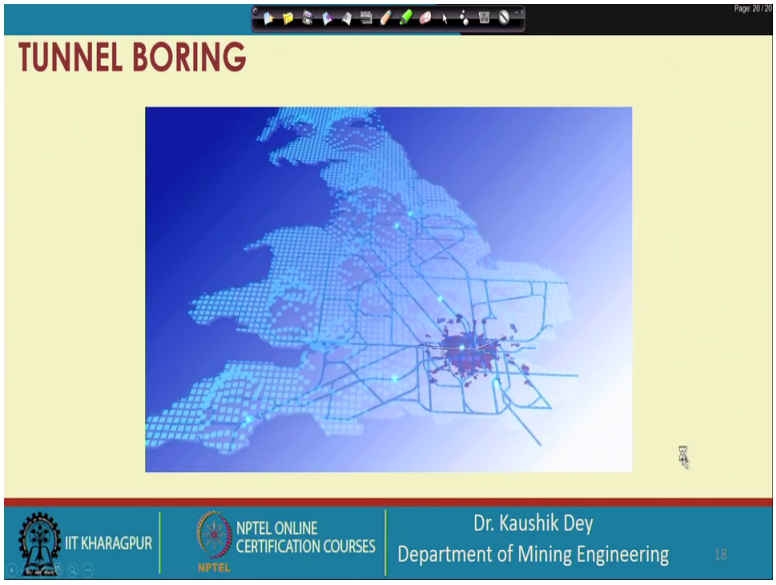
It cannot sustain this sudden.

(Refer Time: 36:34).

Bend.

(Refer Time: 36:37).

(Refer Slide Time: 36:33)



So, let us stop in this class at this position. We will continue the same topic in the next class also with some other horizontal drilling and the frame cutting and water jet cutting.

Thank you.