

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

**Lecture – 11**  
**Drilling Machines - 2**

Let me welcome all of you to the 11th lecture of Drilling and Blasting Technology course. This is in this lecture we will continue our drilling machine from the last class.

(Refer Slide Time: 00:30)

**INTRODUCTION**

✓ **Retrospect Previous Lectures:**

In previous lecture, we got to know the different drilling machines, their operation process and applications. We have covered up to top hammer drill and we will continue the session with other types of drills.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey  
Department of Mining Engineering

In let us see what we have carried out in the last class. In last class we have learned about the drilling machines. And we have covered up to the percussive drilling machine of top hammer drill type. So, this is up to this we have covered. In this class we will cover down the whole hammer drill and other rotary drilling also we will covering this class. But before starting this class let me clear it to you that as our today's learning objective is again the same drilling machines and classification their operations understanding their operations.

(Refer Slide Time: 01:01)

**INTRODUCTION**

✓ **Learning Objectives :**

- To know the different drilling machines.
- To understand its classifications, applications at various situations.

Motor  
Drill Rig  
Drill

4" - 6" Shank  
4" - 8"

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

But here I would like to aware you that invariably all the drill machine should have start with; this is the drill rig, and the top part of the drill rig, this is where the actions to be provided on to the drill rod. So, in this drill rig at this position, there is a motor or rotor whichever it is required that has to be provided at this or the hammer the motive power that has to be required to be provided to the drill steel, that must be placed here. Then from this there is a shank adapter. In this shank adapter, this basically fit that or the connecting this power plot part with the steel and this steel is basically transmit the power to the bit.

So, basically this portion is very, very important. If we want to change anything on our drilling systems say, we would like to change our diameter of the drill, then we have to change this part; that means, we have to change the shank. From the shank a say this part may be of 4 inch so, this 4 inch and our drill since a 6 inch. So, the shank should accommodate a 4 inch by 6 inch coupling so that this can be converted from 4 inch to 6 6-inch drill rod.

If we replace our 6-inch drill rod with the 8-inch drill rod, then we have to use a 4 inch by 8-inch shank. So, this shank adapter is essentially required for accommodating this drill steel size with the motive power size. So, this part is very, very important, you must know this shank adopter then drill steel then drill bit this is available for all type of drilling machine.

(Refer Slide Time: 03:51)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Rotary percussive - Down-the-Hole (DTH) Drilling**

- It is also known as in-the-hole (ITH) drilling, is a method in which the percussive hammer works in the hole during drilling.
- In this system, the hammer (piston) strikes directly on the bit, and no energy is lost through joints in the drill string.
- The piston strikes the drill bit directly, while the hammer casing gives straight and stable guidance of the drill bit. This results in minimal deviation and great hole wall stability, even in fissured or otherwise demanding rock.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

Now, let us start with the rotary percussive drilling of down the hole drill machine. Down the hole hammer actually this is down the hole hammer drilling.

(Refer Slide Time: 04:01)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Rotary percussive - Down-the-Hole (DTH) Drilling**

Working methods of DTH

Legend:  
■ PNEUMATIC ENERGY  
■ HYDRAULIC ENERGY

Labels in diagram:  
FEED MOTOR, ROTATION MOTOR, DIESEL ENGINE, STEEL ROD, CENTRALIZER AND CLAMP, DRILL-HOLE, PROPELSION MOTORS, DOWN THE HOLE HAMMER, BIT

Handwritten notes:  
Hammer  
1) Pneumatic  
2) Hydraulic

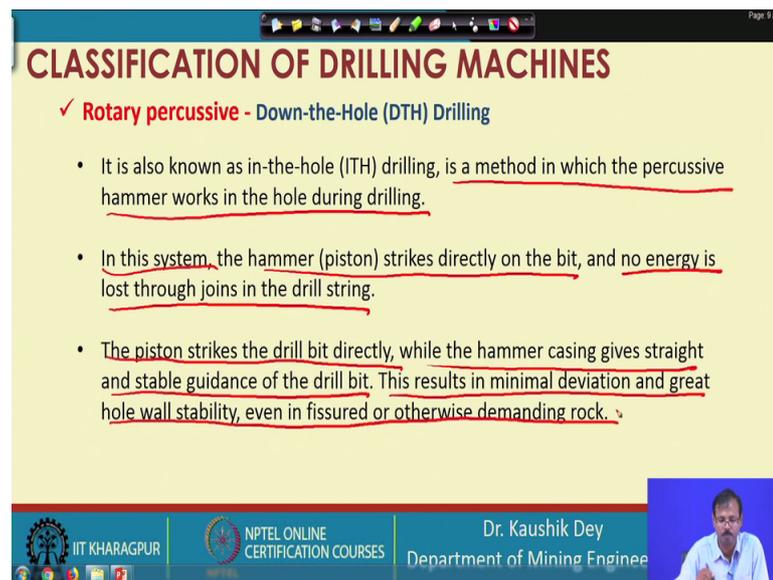
IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

This is down the hole hammer drill DTH means down the hole hammer drill. So, this down the hole hammer drilling, it is also called in the hole hammer drilling; where we place our hammer in the just above the drill bit. The reason of providing this if we are using the hammer in the torque, ok so, if we are having this is the drill steel, we are hammering this is the hammer.

Then a huge energy is lost in the drill steel which is not essentially required. We want the complete energy utilization by providing the hammer at this position. Second one is that this hammering is carried out on this part; so, this portion of drill steel is subjected to a seismic wave that may damage the steel drill steel.

So, this fearing of damaging of this one also can be eliminated if we are providing a hammer here. But the difference is that if we are using the hammer in the down the hole, then the hammer strength will be less. But that is easily accommodative because as that the hammer is utilized on the top of the bit then the hammer can be utilized the performance of the hammer is much, much better than the performance of the top hammer. So, considering this down the whole hammer is also becoming very popular nowadays.

(Refer Slide Time: 05:49)



**CLASSIFICATION OF DRILLING MACHINES**

✓ **Rotary percussive - Down-the-Hole (DTH) Drilling**

- It is also known as in-the-hole (ITH) drilling, is a method in which the percussive hammer works in the hole during drilling.
- In this system, the hammer (piston) strikes directly on the bit, and no energy is lost through joints in the drill string.
- The piston strikes the drill bit directly, while the hammer casing gives straight and stable guidance of the drill bit. This results in minimal deviation and great hole wall stability, even in fissured or otherwise demanding rock.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

So, this is a method in which the percussive hammer works in the hole during drilling. In this system the hammer strikes directly on the bit not onto the drill steel, and no energy is lost through the joints in the drill string. So, basically this is the benefit of using the down the hole hammer. The piston strikes the drill bit directly while the hammer casing give straight and stable guidance of the drill bit. This result in minimum deviation and great hole wall stability even in fissured or otherwise loose formation of the rock.

So, this third the basic reason which allow us to use down the hole hammer drill in the most of the blasting drilling. So, it can see in this case, hammering is carried out in this

portion is called hammer. And hammering action is carried out on this case. So, this is the bit on the top of the bit that DTH hammer is down the hole hammer is placed. This hammer is basically works from a motive power which in most of the cases pneumatic. But we may have it is hydraulic also; if while we are using pneumatic our benefit is that the pneumatic air is allowed to travel through the drill steel.

So, the air is coming through this drill steel, operating the hammer, then coming out as the exhaust from the mouth of the drill bit and allowed to flushing the material from the hole, allowed to flush the material from the hole the. So, the same air may be utilized for the hammering action and for the flushing action also. So, that is why most of the down the hole hammer are considered or opted for using as the pneumatic one, because that may be the beneficial.

Now, will discuss the hammer part a little bit later also; But more or less this hammering action is similar to the handled machine hammering action the jackhammer hammering action you are using. But only that rifle bat part is not required, because rotary action is not required here rotary reaction is given on the drill steel on from the top itself, ok. So, that differences are there, but anyway that also can be accommodate in the different types of hammering system also.

(Refer Slide Time: 08:52)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Rotary percussive - Down-the-Hole (DTH) Drilling**

- The driving fluid of the hammer is compressed air that is supplied through a tube which serves as support and makes the hammer turn.
- The rotation and thrust force are carried out by two separate hydraulic motors (or pneumatic motors) mounted on the surface rig.
- Flushing is carried out with the exhaust air of the hammer through the holes in the drill bit. Since the annulus between the drill pipes and the hole wall is comparative small, a high flushing velocity is maintained, which contributes further to hole quality.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

So, basically the driving fluid of the hammer is compressed air that is supplied through a tube which serves as support and makes the hammer turn. The rotation and thrust force

are carried out by two separate hydraulic motors or pneumatic motors. So, basically it is pneumatic most motors for most of the cases mounted on the surface rigs. So, this actions are given from the those motors, flushing is carried out with the exhaust air of the hammer through the holes in the drill bit.

Since the annulus between the drill pipes and the hole wall is comparative small a huge flushing velocity is maintained which contributes further the to the hole quality. So, what is happened? As the air is coming through the drill steel say considered this is the drill steel this is the hollow part of the drill steel. Then we are utilizing this air in this hammer, these are the inlets, than this is the drill bit which basically have receiving to and fro motion because of the pneumatic motor operation of the pneumatic motor in this place.

And then small hole, small holes are available in the mouth of these drill bits which allow this air to flush out from these small holes. So, as this air this huge quantity of air is allowed to flush out from a small size of hole, the here air velocity is becoming very high, velocity is becoming very high. So, as the air is coming out from the mouth of the bit at a very high speed, the flushing of this cutting material is also very, very good in this case. So, that is why this flushing is very, very easy for the down the hole hammer.

(Refer Slide Time: 11:11)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Rotary percussive - Down-the-Hole (DTH) Drilling**

- DTH method is widely used to drill long holes, not only for blasting, but also for water wells, shallow gas, oil wells, and for geo-thermal wells.
- From an environmental point of view, as the hammer is working in the hole, the noise emission from DTH drilling is comparatively low. This is of particular advantage when drilling in densely populated areas.
- The strike frequency for down-the-hole hammer is usually between 600 and 1600 strikes per minute. The air pressure used is usually between 6 and 24 bar. Rotation speed is about 25-100 rpm, and the feeding force is varied between 6 and 20 kN. → smooth wall circular

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

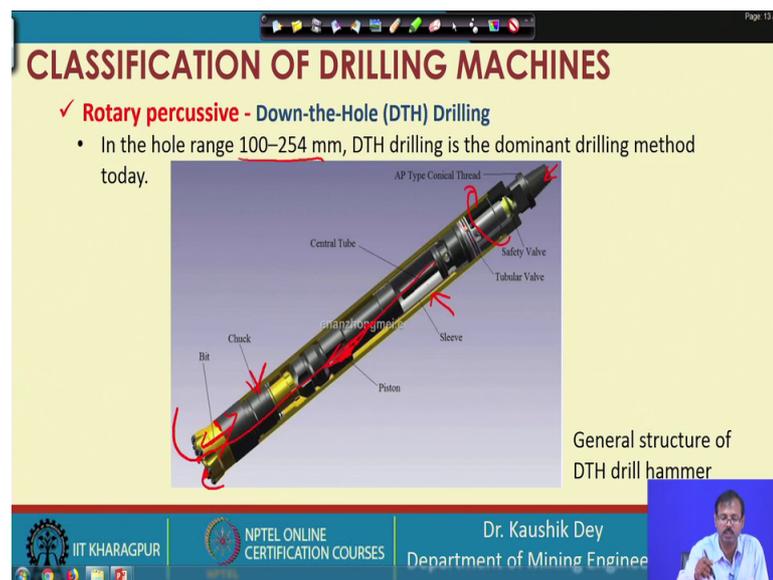
Down the hole hammer method is widely used to drill long holes, because the deviation is less, hammering cost is less, we do not we are not using top hammer energy utilization

is better. So, not it is not only used for blasting, but also for water wells shallow wells gas wells, for all those cases are we are using down the hole hammer drill.

However, for very, very large dia long hole drills generally we opt for the rotary drilling, not that down the hole hammer drill, because with that a increasing the depth deviation of the down the hole hammer drills are also more not like rotary holes. From an environmental point of view, the hammer is working in the hole, the noise emission is comparatively low if you compare it with the top hammer drill. This is a particular advantage for the down the hole hammer, specially when the drilling is carried out in a close proximity of the populated area.

The strike frequency for down the hole hammer is usually kept between 600 to 1600 strikes per minute. And the air pressure used is between 6 to 24 bar, rotation speed of about 25 to 100 rpm is kept so that we can have a smooth wall circular hole. And the feeding force is varying between 6 to 20 kilo Newton so that this allow the consistent contact of the drill bit with the drill bit with the rocks. And this is in generally specification; however, and larger specification smaller specification those are also available. This is in general specification commonly used for the drilling machines used in the mining condition.

(Refer Slide Time: 13:31)



So, let us have a good look onto the hammer part, but before that the hole ranges of 100 to 254 millimeter dia is commonly used for the down the whole hammer drill. So, this is

the hammer part, you can see the air is coming through this, air is coming through this there is a safety valve this is the then the tubular valve is allowing the entering of the air into this.

This is the piston; this is the piston which moves like this way. And this is the outer sleeve which allows the linearity of the movement of the piston. This is the central tube allow the movement of this one, this is the chock, this is the chock which is holding the piston, and the bit is fitted in the mouth. So, along with the movement of the piston bit is also being moved in the forward upward backward direction. The holes are placed, 2 3 holes are placed in the mouth of the bit through, which this compressed air will come out and flush the media.

So, this is a close loop, this is the close loop of the hammer you can see the refill bar is not that to give the rotary action, because the rotary action is given on to the drill steel for the complete hammer and drill still assembly.

(Refer Slide Time: 15:07)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Classification on drilling manner**

✓ **Rotary**

- The rotary drills include two kinds of drilling method: rotary crushing with tricone and fixed-type bits.
- The fixed-type bits, such as claw or drag bits, have no moving parts and cut through rock by shearing it. Thus, these bits are limited to the softest materials.
- The primary difference between rotary drilling and other methods is the absence of percussion.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineer | Page 14/78

So, the next classification of drilling is the rotary drilling. We have already discussed rotary drilling a little bit. So, rotary drill basically includes two kind of drilling method, rotary crushing and with strike on bit with fixed bit. So, what is happened in rotary drill bit drilling? The rotary action is given on to the drill rod where a feed pressure is given on to the drill steel so that the always this bit rotary bit, rotary bit rotates by rubbing the rock layer, and it is inconsistent contact with the rock layer.

So, the thrust requirement feed requirement feed pressure requirement is little bit higher in case of rotary drilling, because its action is abrasion action is taken by the rotary drilling. This rotary drills come with two fixed type of bits.

(Refer Slide Time: 16:16)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Classification on drilling manner**

✓ **Rotary**

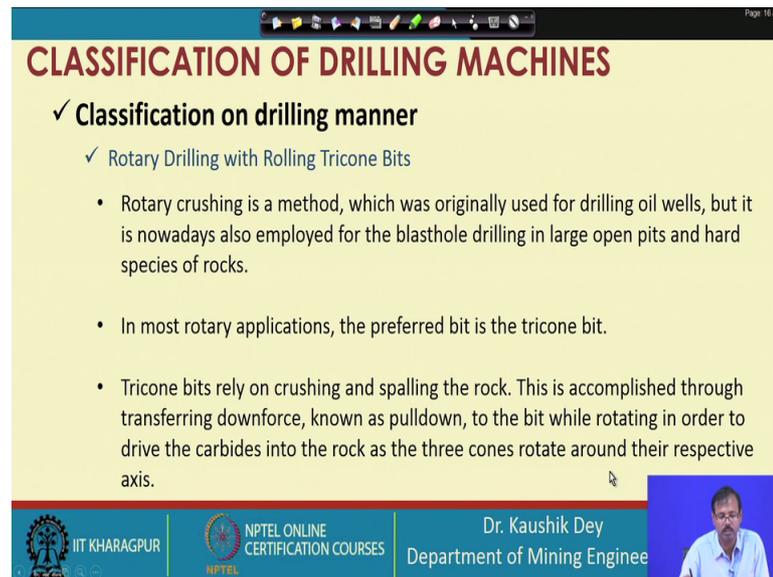
- The rotary drills include two kinds of drilling method: rotary crushing with tricone and fixed-type bits.
- The fixed-type bits, such as claw or drag bits, have no moving parts and cut through rock by shearing it. Thus, these bits are limited to the softest materials.
- The primary difference between rotary drilling and other methods is the absence of percussion.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

One is a drag bit, another is a tricone rock reamer bit, it has no moving parts the bit does not have the moving parts. Only the impregnated tungsten carbide parts are there. And it cut through the rock by shearing it.

So, basically the drag force are utilized these drag bits. Drag forces are utilized to erase or you can say the fails the rock grains on a abrasion. And these bits are mostly used for the softer material whereas; tricone bits are used for the little bit harder material. Most of the time rotary drilling is carried out for the where abrasive where percussive drilling is not carried out. However, for the large dia and long holes rotary drilling is always preferred.

(Refer Slide Time: 17:26)



**CLASSIFICATION OF DRILLING MACHINES**

✓ **Classification on drilling manner**

✓ **Rotary Drilling with Rolling Tricone Bits**

- Rotary crushing is a method, which was originally used for drilling oil wells, but it is nowadays also employed for the blasthole drilling in large open pits and hard species of rocks.
- In most rotary applications, the preferred bit is the tricone bit.
- Tricone bits rely on crushing and spalling the rock. This is accomplished through transferring downforce, known as pull-down, to the bit while rotating in order to drive the carbides into the rock as the three cones rotate around their respective axis.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineer

Now, let us see rotary drilling with tricone rock roller bit. Rotary crushing is a method which was originally used for drilling the oil wells. It is almost nowadays employed for the minings also, for the specially for the dragline blasting where long holes are drilled. Here rotary applications of the tricone bit is carried out, we will see the tricone bit figure of the tricone bit in the next slide.

Tricone bits rely on crushing and spoiling of rock. This is accomplished through transferring the down force that is known as pull-down force to the bit while rotating it in order to drive the carbides into the rock as the 3 cone rotate around their respective axis. So, 3 rollers are 120 degree to each other are placed, these rollers rotates at their own axis.



And it also required slow rotation so that it can properly erase the rock, phase the rock (Refer Time: 19:37) shank shearing the relationship between these two parameter varies with the type of rock; that means, this is very important, the feed pressure and rotational speed combination is very, very important if you are considering the type of rock or the drill ability of the rock. For the soft formation, low feed pressure, high rotation rate can be used and vice versa are to be followed, but the exact value depends on the durability.

Rotation of the tricone bit is provided by a hydraulic or electric motor driven gearbox a generally called rotary head. That moves up and down the tower via a feed system and through a pipe transferring system to the bit. So now, you can see this is the drill rig; this is the drill rig. And this in the drill rig in the mouth of the drill steel this is the tricone rotary bit. You can see these are the big pin connection, if you take out this pin the bit will come up we can replace this from the drill rod. This is the air waters separator these are the lock pins, these are the air tubes no gels, then you can see these are the cutter cones tungsten, carbide cutter cones.

These are basically a hard fastening which struck with the whole wall. These are the conan general trust buttons, these are the knows air exit valve, which allow the exit of the air. These are maintaining the air passage to the bearing. So, these are the different components you may have a better look on this and at a later part from the books or from the internet. You can have to look up this tricone bit.

(Refer Slide Time: 22:01)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Classification on drilling manner**

✓ Rotary Drilling with Drag bits

- A drag bit with no moving parts that cut by a combination of shearing (cutting action) and gouging, predominantly used in softer sedimentary rock types.
- The cutting action of a drag-type rotary drill bit is performed by a variety of tools, including blade and diamond drills as well as rope, chain, and rotary saws.
- Regardless of the geometry of the device, drag action at the cutting surface by two forces: thrust, a static load acting normally; and torque, the tangential force component of a rotational moment acting on the rock surface.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineer

Now, let us see the other part where the rotary drilling is carried out with the drag bit. Drag bit basically is of two types. It may be our button bit or cross bit. In drag bit no moving part is the in tricon those rollers are rolling, but try drag bit there is no moving part. It is just shear, it just shear or cut the rock, while it is on abrasion while it is rubbing the rock surface. So, it is predominantly used for the softer formation, also it is used for the deep holes also, for the deep holes also it is used, but it is it must be carried out in the softer rock. So, cutting action is basically of drug type rotary drill bit is basically using zone variety tools which including blade also the diamond drills are also there where rope and chains and rotary saws use.

So, basically this is drag force are used for cutting action here. The geometry of the device drag action at the cutting surface by two forces, one is thrust and another is the torque. So, basically thrust is giving the trust is giving us the contact of the bit with the rock. And torque is basically shearing. So, basically torque is the main cutting force cutting force and this is the normal force. So, anytime if you are try to have this shearing action. This shearing of action is depending on a normal force and a drag force. So, basically this torque is providing the cutting force and this is the normal force you can have.

(Refer Slide Time: 23:59)

**CLASSIFICATION OF DRILLING MACHINES**

✓ **Classification on drilling manner**

- ✓ Rotary Drilling with Drag bits
- The mechanism of penetration in drag bit drilling is as follows

(a) Drag Bit SHEAR ANGLE

(b) Drag Bit CRUSHING AT THE LEADING EDGE OF THE TIP

(c) Drag Bit SUDDEN FRACTURE OF LARGE FRAGMENT

(d) Drag Bit

a) As the cutting edge of the bit comes in contact with rock, elastic deformation occurs.

b) the rock is crushed in the high-stress zone adjacent to the bit

IIT KHARAGPUR NPTEL ONLINE CERTIFICATION COURSES Dr. Kaushik Dey Department of Mining Engineering

And these are the actions of the drag bit, you can see how these drag bits are crossing at the tip first, then structuring the rock then dislodging the chip. So, the action is first

crossing, first penetration then cracking, then chipping. So, action is more or less similar. So, mechanism of penetration of drag bit is that cutting edge of the bit comes in contact with the rock elastic deformation occurs. Then the rock crushed the high stress zone adjacent to the bit.

(Refer Slide Time: 24:48)

The slide is titled "CLASSIFICATION OF DRILLING MACHINES" and is part of an NPTEL online certification course from IIT Kharagpur. It discusses the classification of drilling machines based on the drilling manner. The main heading is "Classification on drilling manner", which includes "Rotary Drilling with Drag bits". The slide lists two points: (c) cracks propagate along shear trajectories to the surface forming chips, and (d) the bit moves to contact solid rock again, displacing the broken fragments. A handwritten note in red says "Diamond" with an arrow pointing to the text "other materials such as synthetic diamonds or polycrystal, which vary in shape and angle." Below the text are images of various wing rotary drag bits. The slide footer includes the IIT Kharagpur logo, NPTEL Online Certification Courses, and the name of the lecturer, Dr. Kaushik Dey, from the Department of Mining Engineering.

Then the cracks are propagated along the shear trajectories to the surface forming chips. Then the cracks meet each other for may chip. The bit moves to contact solid rock and inform the chips the chips will taken out. And bit moves again to contact the solid rock surface which allow again the repetition of the process by crossing then cracking and then chipping.

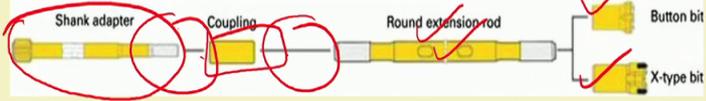
The edge of the drag bit is usually are made of tungsten carbide tip, and often synthetic diamonds polycrystals are also used so, most of the cases these are the different types of drag bits. This is commonly used, diamond drill bits are diamond rotary drilling is also used; where specially for the core drilling where diamonds are kept, diamonds are kept in the periphery part only, middle part is kept hollow so the rock can be cut in the outer part and the inner core can be taken out easily. So, in this type of bit if this type of diamond bits are used that can be used for the core drilling purpose.

(Refer Slide Time: 26:22)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

- To drill a hole, apart from the rock drill, some drilling accessories are required.
- Except the integral drills, the extension drill steel is usually made up of the following elements: shank adaptor, coupling sleeves, extension rods, and drill bits.



Drilling accessories of rotary-percussive drills

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

So, if you look into the rotary drilling, you will find out the shank adaptor is there in the beginning. Then the first drill rod will come, then the second drill rod will be jointed with the first drill rod using a coupling. Then extension rods are there finally, the bits are there either it is a button bit or it is a cross bit generally button bits are mostly used the main reason is that the price of the button bits are lesser than the cross bit. However, no one can tell like this because the cross bit life is more in general more than the button bit life.

(Refer Slide Time: 27:08)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Integral Drill Steels**

consists of a rod with a forged shank at one end and a forged bit with cemented carbide inserts at the other end. Thus, each drill steel is of a specific length and cannot be extended. Once the first drill steel has drilled all the way into the rock, it is withdrawn and replaced by the longer one to drill further into the rock.



Integral drill steels

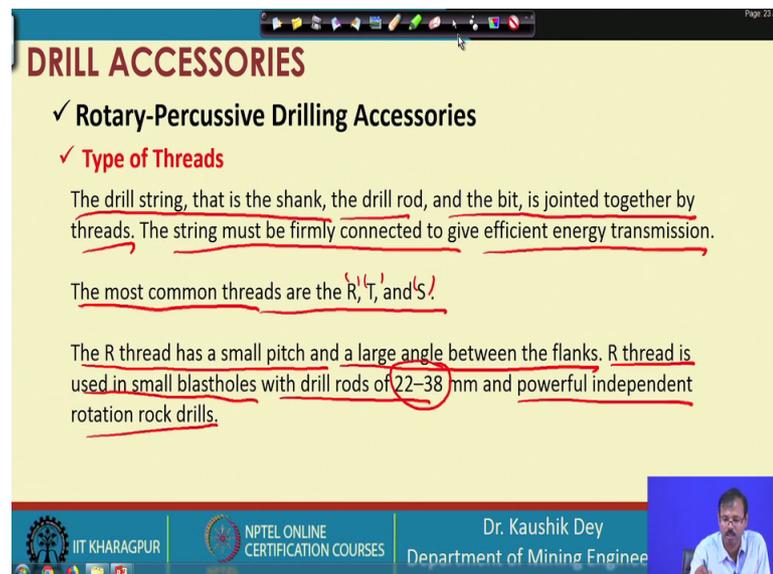
IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

These are the common accessories we use in the rotary drilling. First is the drill steel, this is basically nothing but the drill rod though this figures are basically for jackhammer rod, which are percussive for percussive drilling. But this drill steel are basically pipe type of things, these are hollow in the middle. With a forged shank one side is fixed, at the one end and another is a forged bit for the case of a percussive jackhammer drilling. Or another part may be fitted with a bit or may be a coupled with another rod.

So, these are the integral drill steel where the bits are placed in the mouth. This cannot be reused once the bit is finished this rod has to be a thrown away. So, each drill steel is have a specific length and cannot be extended in this case. And that is why these are limited; these are limited to this length. Often these drafts are used for the handle operators, and in those cases a many drill rod of different lengths are used. First the drilling is carried out with a smaller one. Then the next drilling is carried out in the same hole with a longer one and by this way extended so that the drilling can be carried out.

However, this type of drilling is limited to 2 meter for handheld, but for mechanized using jumbo, this drill length can be extended up to 6 meter also, ok. Integral drill steel can be extended up to 6 meter drilling length also.

(Refer Slide Time: 29:19)



**DRILL ACCESSORIES**

- ✓ **Rotary-Percussive Drilling Accessories**
- ✓ **Type of Threads**

The drill string, that is the shank, the drill rod, and the bit, is jointed together by threads. The string must be firmly connected to give efficient energy transmission.

The most common threads are the R, T, and S.

The R thread has a small pitch and a large angle between the flanks. R thread is used in small blastholes with drill rods of 22-38 mm and powerful independent rotation rock drills.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

Next drilling accessories, is the drilling thread. Drill string is that the shank, the drill rod and the bit is jointed together by this thread. So, this string must be firmly connected to give efficient energy transmission. So, there should not be any play in the shank.

The most common threads you start of R, T and S type. The R thread has a small pitch, and a large angle between the flanks. R thread is used a small blast holes with drill rod of 30 to 38 30 22 to 40 mm dia and powerful independent rotation drill a rock drills.

(Refer Slide Time: 30:19)

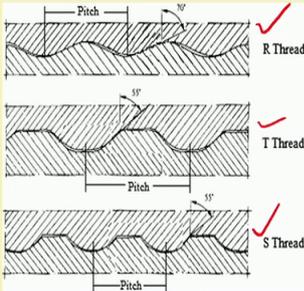
**DRILL ACCESSORIES**

✓ Rotary-Percussive Drilling Accessories

✓ Type of Threads

The T thread is used in most drilling conditions with drill rod diameters of 38–51 mm. It has a greater pitch and smaller flank angle than the R thread.

The S thread has the same angle between the flanks as the T thread but a smaller pitch and used in large extension rods of 51 mm.



Profiles of the R, T, and S threads

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineer

T type thread is used mostly in drilling conditions with the drill rod diameters of 40 to 50 mm. It has a greater pitch and smaller flank angle than the R thread. So, you can say this is the R thread which having a higher the lower pitch. So, if you a see this is having a lower pitch than the, this is the T thread which is having a higher pitch. And S thread is has the same angle between the flanks as the T thread, but a small pitch is used with large extension rod.

So, you can see the pitches are of different type smaller pitches, but it is of large extension rods are provided here. So, this is called a T thread this is S, S thread, this is R thread. So, basically S thread is common for the longer drilling length, and R thread is common for the shorter drilling length. Or you can say a rigorous drilling application S thread is preferred over T and R thread.

(Refer Slide Time: 31:40)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Shank Adapters**

The shank adapter is the component that enables percussive impact and rotation to be transmitted from the rock drill to the drill string. Shank adapter is made of high-quality special steel with excellent wear resistance.



Shank adapters

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

Next is the shank adapter which is very, very important as it is basically enable the percussive impact and rotation to be transmitted to the drill steel from the machine. So, shank adapter is made of high quality special steel with excellent wear resistance because all the wear and tear and the shearing force is basically with stand by this. And any time if the shank is felled the total drill will be felled. So, that is why if shrank is very, very important and it should have high strength steel so that it can withstand all those shearing actions.

(Refer Slide Time: 32:27)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Drill Rods**

- Drill rods can be divided roughly into five categories
  - Shank rods ✓
  - Drifter rods ✓
  - Extension rods ✓
  - Drill tubes ✓
  - Guide rods. ✓



Drifter rods

Extension rods



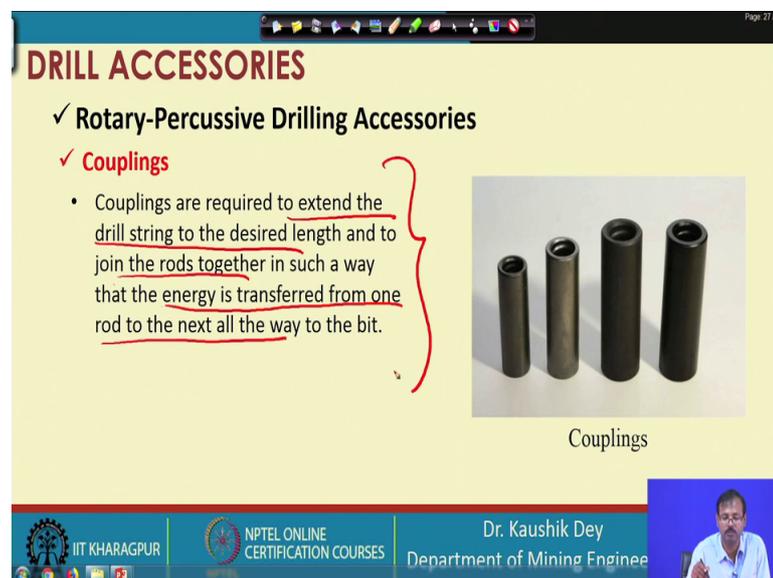
Drill tube

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

We have already discussed the shank is also a guide the drill steel dia drill bit dia and that changing of that one also; then the drill rod which is basically transferring the energy up to the bit. This may be shank rod drifter rod extension rod, drill tubes, guide tubes, guide rods like this. So, these are drifter rods which are directly coupled, these are the extension rod, one-way it is with the drifter rod, another is that a maybe drill bit or maybe the a hammer is fitted here.

So, basically the first rod is the fitted with the shank is the drifter rod, then the extension rod then the other things these are the drill tubes you can absorb these things.

(Refer Slide Time: 33:26)



**DRILL ACCESSORIES**

- ✓ Rotary-Percussive Drilling Accessories
  - ✓ Couplings
    - Couplings are required to extend the drill string to the desired length and to join the rods together in such a way that the energy is transferred from one rod to the next all the way to the bit.

Couplings

Dr. Kaushik Dey  
Department of Mining Engineering

These are the couplings which are basically required to join one, which are basically required to join one drill rod with another drill rod, ok. So, that the desired length of drilling can be obtained and this is also transferring the energy from one rod to the another rod or at the end may be up to the bit. So, this is the purpose of the coupling is required for extending the length of the drilling.

(Refer Slide Time: 34:02)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Couplings**

- Couplings are required to extend the drill string to the desired length and to join the rods together in such a way that the energy is transferred from one rod to the next all the way to the bit.

Couplings

(a) Sleeve or through Type  
(b) Crossover Type  
(c) Full Bridge Type

Three types of couplings

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

So, these are the different types of couplings you can see. This is sleeve type, this is crossover type, this is full bridge type. So, these different types of couplings are available which can be used for drilling purpose.

(Refer Slide Time: 34:22)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Drill Bits**

There are two types of drill bits for rotary-percussive drilling:

- Insert Bits ✓
- Button bits ✓

• For the two types of bits, there are some design characters in common:

- The rods are threaded to the end of the bit thread so that the transmission of impact energy is as direct as possible to the rock.
- The bits have a series of central and lateral openings through which the flushing fluid is injected and they have channels through which the rock particles produced pass upwards.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES | Dr. Kaushik Dey, Department of Mining Engineering

Or drill bits are of different types so; basically we are having button bits or cross bits. For the two types of bit there are some design characteristics characters are common. Most of these rods are threaded to the end of the bit, and that the transmission of impact energy is as direct as possible to the rock.

The bit have a series of central and lateral openings through which the flushing medium or flush the flushing air can be injected, and it can also cool down the drill bit. Essentially, our most of the bits are made of tungsten carbide.

(Refer Slide Time: 35:12)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Drill Bits**

- The bits are designed to be slightly conic, with the widest part in contact with the rock so as to counteract the wear and avoid an excessive adaptation to the blasthole wall.
- **Insert Bits**

There are three types of insert bits presently used for rock drilling: the chisel (I-bit), cross bit, and the X-bit. The chisel bits are commonly used for handheld rock drill for hard rocks.



The slide features a yellow background with a blue header and footer. The header contains the title 'DRILL ACCESSORIES' in red. The main content area has a yellow background with black text. A small inset image shows two types of drill bits: a chisel bit and an X-bit. The chisel bit is a simple I-section, while the X-bit has a cross-shaped tip. Red circles are drawn around the chisel bit and the X-bit in the image.

**IIT KHARAGPUR** | **NPTEL ONLINE CERTIFICATION COURSES** | **Dr. Kaushik Dey**  
Department of Mining Engineering

You can see these are the insert bits either is of I section chisel type or of this is I section chisel type, these are of cross.

(Refer Slide Time: 35:33)

**DRILL ACCESSORIES**

✓ **Rotary-Percussive Drilling Accessories**

✓ **Drill Bits**

**Button Bits**

The button bit is the most popular type of bit in use today for big hole, high production, and blasthole drilling. These bits have buttons or cylindrical inserts of tungsten carbide distributed in various patterns on the face.



The slide features a yellow background with a blue header and footer. The header contains the title 'DRILL ACCESSORIES' in red. The main content area has a yellow background with black text. An inset image shows several button bits, which are cylindrical with multiple tungsten carbide buttons on their faces. Red circles are drawn around the buttons on the bits.

**IIT KHARAGPUR** | **NPTEL ONLINE CERTIFICATION COURSES** | **Dr. Kaushik Dey**  
Department of Mining Engineering

These are the button bits you can see the buttons. You can see the tungsten carbide buttons are placed as per the design specification (Refer Time: 35:47). So, this is more or

less about the different types of drilling machines. We will continue few more part of the drilling is a steel left. We will continue with that in the next class.

Thank you.