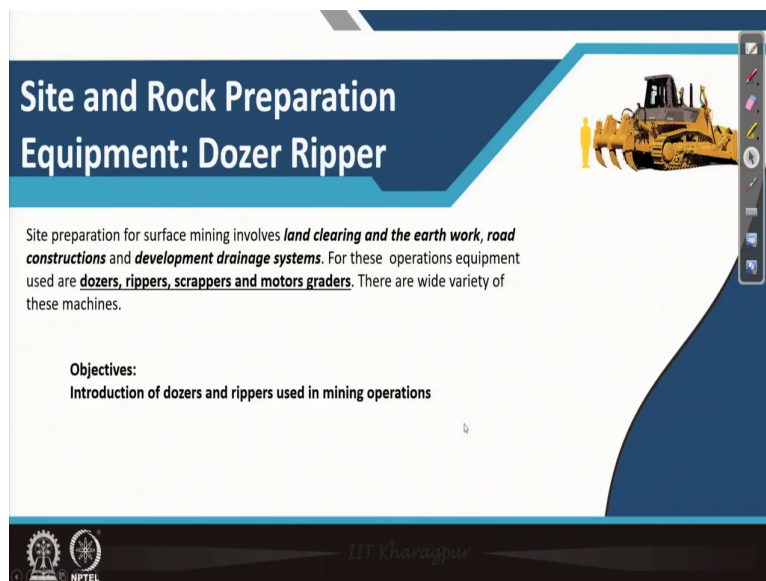


Mining Machinery
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Module – 04
Lecture – 13
Site and Rock Preparation Equipment: Dozer Ripper

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Site and Rock Preparation Equipment: Dozer Ripper

Site preparation for surface mining involves *land clearing and the earth work, road constructions and development drainage systems*. For these operations equipment used are dozers, rippers, scrappers and motors graders. There are wide variety of these machines.

Objectives:
Introduction of dozers and rippers used in mining operations

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Today, we will be discussing the Site and Rock Preparation Equipment that is in Mining Machinery, for different purposes are different, you know that before starting any mine the site need to be prepared for different operations that is called your site preparation.

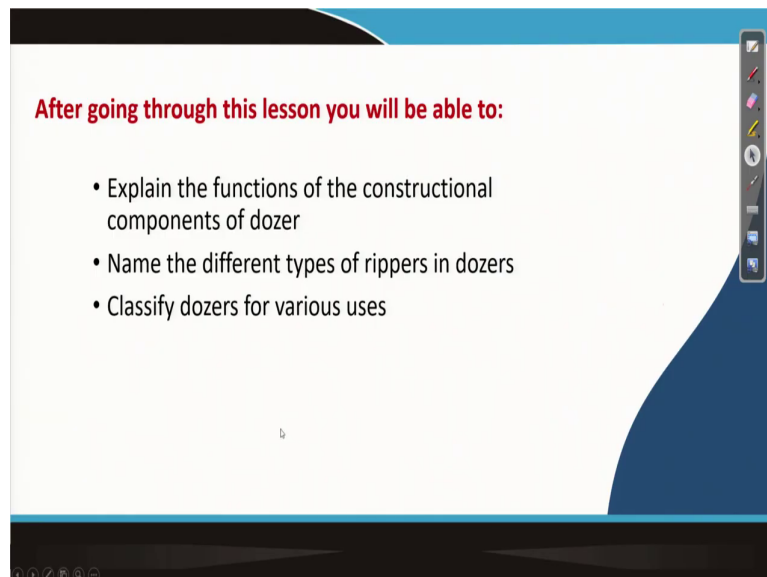
Which is basically cleaning the forests area or adjusting the new area for construction operations, for different premises to be built roads others need to be starting; so, for that some civil construction machinery will be necessary. And, also there is a once the site is prepared

then we will have to do the rock preparation that is the once the surface is ready for doing the surface mining. Then, we will have to prepare the rock for its fragmentation.

So, for that different types of machines are used the first machine which is brought is the Dozer. And, this dozer with a ripping blade as you can see in this photograph of this dozer, there are the rippers at the back of it. So, this Dozer Ripper it is used then other machines like scrappers and motor graders, they are brought for constructing the scrappers for taking out the top soil for preserving.

And, the motor graders for construction of the roads and also there are in the site preparation use sometimes the compactors that road building machines all those civil machines are working. So, today we will be talking about this dozer ripper that how it is used in the mining operations.

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After going through this lesson you will be able to:

- Explain the functions of the constructional components of dozer
- Name the different types of rippers in dozers
- Classify dozers for various uses

After going through this lesson you should be able to explain, the functions of this constructional components of a dozer. How a dozer is made of, how it functions, what it is there what are the how it is powered and what are its major components, how it is to be selected for different operations?

Those things you will be able to know. And, then forgetting yourself familiar with the machine you must know, what are the name of different components. So, you will be able to tell this components name and also how you classify that different manufacturers are making different types of dozers.

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So, there are different makes; makes this company liebherr, they makes this caterpillar Komacho. Then, also in India we have got this indigenous manufactured dozers that is by

Bharat earth movers limited Bangalore, they have this BML dozers very widely used in Indian mining and construction sites. So, we will be talking about this dozer.

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Now, coming to what is a dozer how will you define? You can see this machine, it can be a crawler mounted or tire mounted. That means, the mounting means that under carriage on which the machine is working that is called on which it travels, that is the travel gear or undercarriage. This travel gear can be a crawler mounted, this is or a track mounted sometimes it is called.

And it is a self propelling; that means, it has got its engine which gives the power to this crawler and, it is a self propelling machine. And it has got a front mounted, this is a front mounted hydraulically operated blade, hydraulically operated means, this blade can be slightly raised lowered or it can be tilted or it can be pushed down these operations can be

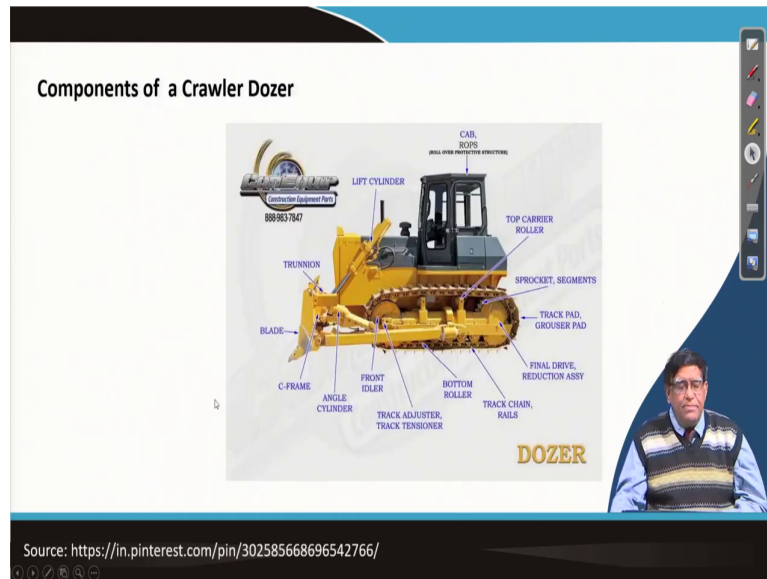
done by hydraulic operations. There were dozers even the there is a fixed type of things, without any movement wereare there in old days.

Now, the hydraulically operated blade, which is connected to a push beam, there is a push beam is there by which it is connected. And, then we can see here how it can do a tilting operations and it is used for cutting and pushing earth material with it. So, it can cut even semi consolidated or loose material depending on that what type of the situation is there.

With these three figures you can find out that this is a real life, those are photographs you can see the operator is sitting inside. It has got a very good operators cabin, which can be your protecting with say noise dust. And, then there is a very good cabin top, if any rocks or anything fall over here you will be protected.

And that engines has got the hydraulic power pack. So, that this hydraulic pump can work and give the sticks to the actuator. And, this blade you can see here how a push arm is there and there is called a pitch arm by which you can just make give some movement to the blade, it can raise lower and things like that. And, in the for cutting forces, which is there it is given by the pushing of this vehicle.

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So, when this move basically will be moving it will give a pushing actions. So, now, coming to the constructional component, you can write it down this names at least, it has got a blade, which is the main functional component. And, then it is a trunnion point above which it can tilt or it can move this point is a just a trunnion point. And, this is called your C frame on the front of which the blade is mounted here.

Then, it has got a lift cylinder by which this blade can be moved up and down. There is a angle cylinder by, which a angling action that build can be giving an angle up and down, that motion can be given by this hydraulic push. Sometimes, there are some manual angling blade in which there will be groups, you can manually connect it to give at a particular angle.

And, then it will be a whole operations it will be doing at a particular angle of the blade. So, there are boards that angling can be done manually or by hydraulically. And there is a, this is the crawler track or chain, the track chain which is between two idlers or sprockets are here.

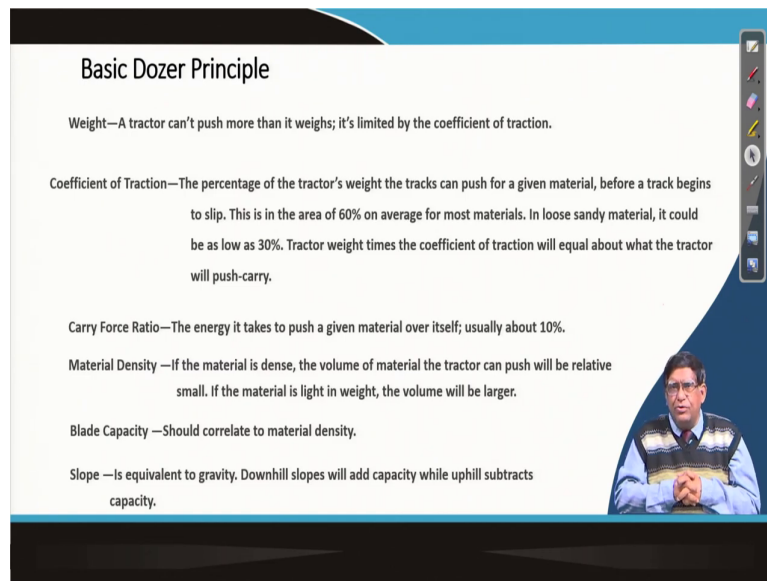
This is your driving sprocket and this is your idler sprocket that which it has got the power is given to the driving sprocket.

And, then the this is your idler front idler it is said it is just because of that chain is getting the by friction the motion is coming and that chain will be moving. You have whatever in the chain drive you have studied the same principle works here. Now, this chain is supported on this you have got the carrier top carrier roller, and you can see that there are bottom rollers.

So, these bottom rollers and carrier roller in between this this chain moves. And, then these chain can be there is a arrangement for tensioning, sometimes it this this idler can be this the distance between these two idler can be increased and lowered depending on that we can mention, that you can maintain a particular toughness or tension in this chain.

And, then you have got this your that your roll over protection structure, roll over protection structure is the, that where that cabin is there the operator is protected if any rock from the slopes fall down on it will not break. So, that sufficient strength is given over there.

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Basic Dozer Principle

- Weight**—A tractor can't push more than it weighs; it's limited by the coefficient of traction.
- Coefficient of Traction**—The percentage of the tractor's weight the tracks can push for a given material, before a track begins to slip. This is in the area of 60% on average for most materials. In loose sandy material, it could be as low as 30%. Tractor weight times the coefficient of traction will equal about what the tractor will push-carry.
- Carry Force Ratio**—The energy it takes to push a given material over itself; usually about 10%.
- Material Density** —If the material is dense, the volume of material the tractor can push will be relative small. If the material is light in weight, the volume will be larger.
- Blade Capacity** —Should correlate to material density.
- Slope** —Is equivalent to gravity. Downhill slopes will add capacity while uphill subtracts capacity.

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So, you can see that the different functions of these operations, their basic principle you should know, that a tractor cannot push more than its weight it is limited by its coefficient of traction. So that means, whenever you are going to select a dozer that is we will have to know. How much material, how much load you want to push depending on that what will be the weight of your this system that you can find it out?.

Then, the coefficient of traction it is the percentage of the tractors weight. The track can push for a given material before a track begins to slip, because if there is a more load is coming. Then, that your roller will not be able to move over there and then slip is will take place.

This is the area of 60 percent of average for most materials; in loose sandy material it could be low as 30 percent. Because, it cannot give it push that is that this coefficient of traction this concept is you should be very careful about using this while selecting dozers.

Then, tractor weight times the coefficient fractions will equal about what the tractor will push carry. So, how much material it can carry can be determined from that. Then, there is a carry force ratio the energy, it takes to push given material over itself usually 10 percent of material it can push, that is how much total amount of material it can work.

Then, material density makes a very important contribution. If the density is more then, definitely the weight will be more and that is why the you will be able to less volume can be pushed. And that material that which get in front of the dozer blade, how much material get piled up that is called your dragging prism, that is how much material it has come and then it will be able to push it over here.

Then, the blade capacity shall correlate to material density that is, how much material it can carry that will be because the resistance to motion it will be providing on the basis of that the whole the capacity of the dozer will be depending. And, then also it is the slope is important, whether you are dosing down the slope or you are dosing up the slope, depending on that also the capacity will vary.

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Major component: Undercarriage

50% of all maintenance costs are for expenses related to the undercarriage

Komatsu's Track Management System

- Uses ultrasonic tool to measure thickness of undercarriage components
- Assesses current wear
- Predicts when repairs are required
- Reduces unscheduled downtime and repair expenses

The slide also includes a small video inset of a man in a blue shirt and glasses.

So, these are the basic principles we need to remember while working with a dozer. Now, coming to this that what is the major component is the undercarriage. Under carriage can be a different type of this is also, here the driving sprocket is here and these two are the idler rollers. In one case here this is the driving sprocket; there you can see the differences.

And, now the main components is you have got these are the your the sprocket on which you are giving a driving sprocket over here, then you have got these rollers on which it is this step of carrier rollers are there. And, then this is the track chain at the top, there is a track chain. This track chain is made of number of this pads, it can be different type of you can see here. These are dozers crawler chain has got this grouser type of so, like that a grouser portion is there.

And, then because of this grouser portion when it moves on a gradient, it will be gripping it will not slip down. And in case of your shovel or other machines, you may have a flat surface. Now, these two pads are like that then you can have see this is a partition next item can come and it can be just putting over here.

So, you can in between these two there is a pin by which it is connected, you can think of this crawler chain is nothing, but just like you may have seen some of the steel chain of your watch. It is similar to that exactly number of this pads they make this chain. And this chain is rolling over this your sprockets.

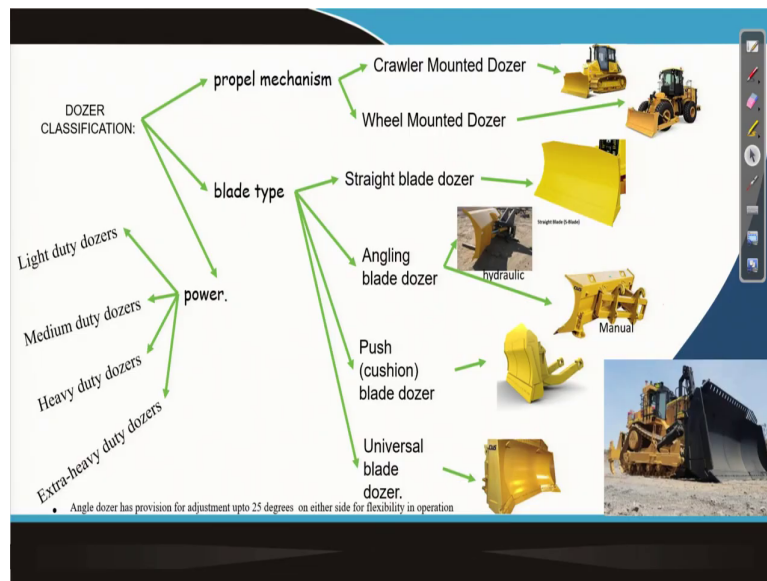
So, now, the this is a very important that while you are you should not keep this track too tight or too loose, it should be a correct tension should be maintained. If it is not there will be a breakage of the pin by which thesetwo pads are connected. And, then what will happen the whole machines with this chain will be coming out. And, there will be a lot of problem for refittingit. And that all the maintenance work in a dozer is to be done, on this crawler track which is called your in under carriage.

And, because of that nowadays we have got your maintenance tool or the Komatsu; they have given a track management system. In which they uses ultrasonic tool to measure thickness of the undercarriage components, because if the pins which are there if they wear out if the blades, if they wear out or if the teeth of the sprocket, if they wear out after uses. Then, there will be problem the chain will become loose, then your total power will not be consumed, there will be wastage of energy.

All these things can be measured or can be known by measuring the wear of it. That it assesses the current wear whatever the wear is there. And, then after some operations it can predict that when that exactly should be repaired or when it should be stopped. And, then it can make it so, that you this is a principle of condition based maintenance system, by developing such type of surveillance system in the machinery you can do it.

So, nowadays everywhere this all the data, which will be collected, from that data you will be developing your software to predict when the maintenance will be done. That is the way how modern mining machinery are being managed.

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So, now this dozer, how you classify? The dozer you have seen a this type of dozer with a back side there is a ripper blade. Now, these dozers can be classified on the basis of the propel mechanism; propel means, how it travels it can be travel either on the basis of the on the supporting on a crawler. It is called crawler mounted dozer or it can be on tire it could is called wheel dozer or wheel mounted dozer.

And, then it is also classified with the type of blades, you should remember that this dozers blades can be a straight blade dozer. There is a straight there is a that only it will be pushing down the material and then it will go, or it can be a angling dozer in which that exactly it can

as you have said by pushing it hydraulically, the blade can be in front of the blade can be pushed in one side.

So, it become an angle in one way it can cut other way, it can be just it can tilt only one corner will be cutting. So, particularly when you are making a road. The road surface need to be having a crown.

So, in the side you need to make that [vocalized-noise] ah dozer blade can be made an angle. So, that it will give a side cut over there. So, there is also a push cushion type of blade, there is it is not a cutting blade sometimes in your surface mining class you might have studied that, how the scraper machines are pushed sometimes in a dozer will be pushing the scraper.

So, let us say when a scraper is worked with the help of a dozer, that scraper need to be pushed. So, a push block or a cushion blade will be given this is not for cutting the rock or it is for just pushing a scraper the dozer is used. Then, also universal blade dozer that straight dozer you can see there is no side, but here a side blade is also there. So, the material can be retained over here, and then more material can be pushed.

So, this is how you can see a universal blade there is a straight blade is there and on the side we have got this blade. So, that and then here this is a dozer used for pushing coal; coal has got less density that is why the blade size is more.

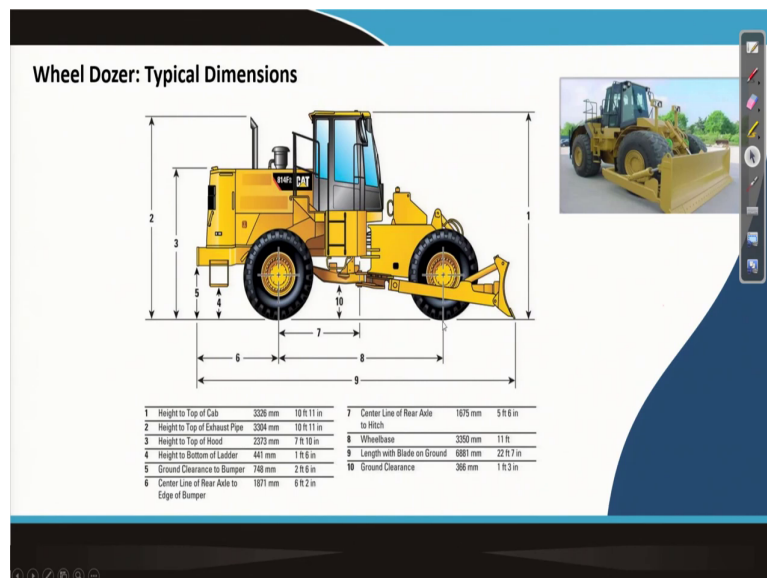
So, with the same dozer power engine, power it can take more volume that is why, the blade is of special design. So that means, depending on the type of material you use depending of the job you use, you can use different type of blades and the dozers can be said as a straight blade dozer, angle dozer push button dozer or universal dozer.

Other than that, you can also classify on the basis of the power, that can be a light duty dozer, medium duty dozer, heavy duty dozer or extra heavy duty dozer. Now, particularly in some dozer where with a ripper, they use as a primary mining machinery particularly if you go to

the bauxite mines of NALCO at Panchpatmali. There, you will find the dozers are exactly doing without drilling and blasting with the dozer you cut the rock mass.

And, then you make it to be loaded by shovel on the truck to take it away. So, in that thing you have got a very heavy duty, your very high horsepower engines are placed over here. So, this is and then when you are using this angle dozer we can give a 25 degree on either side it can tilt or move.

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So, this other than that we have got this wheel dozer, in the wheel dozer you can see that the dimensions matters. So, here in this we can see a height of the top cab can be your just 3.326 meter. So, and then what is the height of the exhaust pipe here it is going. So, that is your giving this total height becomes your 3.34 meter. So, that is your the total height coming over

here, and you can see this your, the total length of the machine. The total length of the machine, it goes about your 6.8 meter.

So, that dimensionally your, this machine, why it is important depending on your mining site your what is the benchheight and then how you are operating this dimensions need to be taken care of.

So, whenever you are selecting or specifying a machine specifications for a particular operations, you should know that what should be this height and what should be the ground clearance. And, then what should be the blade height this all items are given then the manufacturers can find out that what will be your matching type.

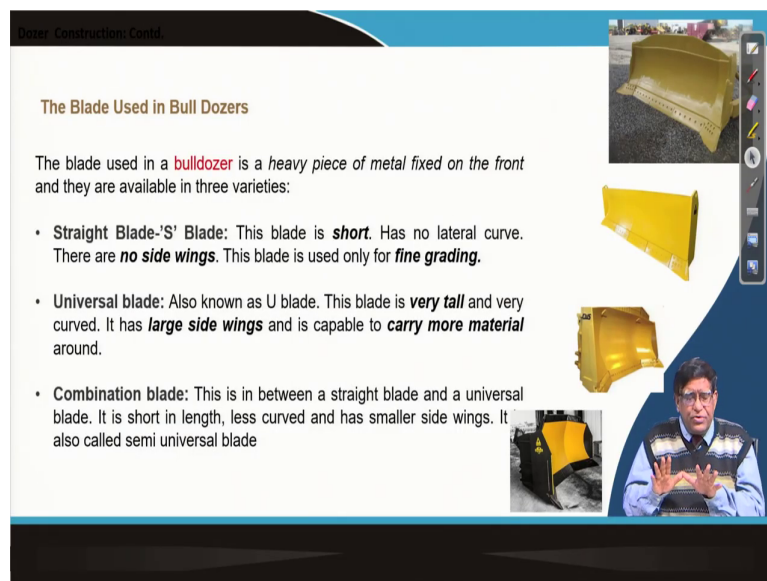
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Blade Construction Contd.

The Blade Used in Bull Dozers

The blade used in a **bulldozer** is a *heavy piece of metal fixed on the front* and they are available in three varieties:

- **Straight Blade-'S' Blade:** This blade is **short**. Has no lateral curve. There are **no side wings**. This blade is used only for **fine grading**.
- **Universal blade:** Also known as U blade. This blade is **very tall** and very curved. It has **large side wings** and is capable to **carry more material** around.
- **Combination blade:** This is in between a straight blade and a universal blade. It is short in length, less curved and has smaller side wings. It also called semi universal blade



So, this blades already I have said that there is a classic blades of the dozer, it is the main operating member or the main functional element. And all your energy from your engine it is going to come over here, how the energy from the engine is exactly giving your hydraulic motor the hydraulic power pack is there in the dozer.

And, it is running a hydraulic motor which is there to drive the, your this driving sprocket. And, then when the machine propels, then it gives through the push arm it can give a load and then it can work. Similarly, for steering also you can just in dozer steering, is it has got this two crawlers. Now, if one crawler is stopped the other crawler is that is your will be rotating, then it will giving a turn. Similarly, if this one is moving and this is stopping, then it will be giving a turn.

So, that is, your if you are moving you are driving this right hand, then it will be giving a turn towards left. If you are driving the left, it will be giving a turn to the right, that is the way by disengaging the drive to one of the crawlers they stop.


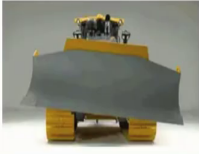
That means, that it shows that the total power transmission in a dozer goes from the engine through that your hydraulic motor. It is given independently to the two crawlers, which each one of them you can individually just stop it. And from that that is the way how the steering is done. So, when you study this different blades and then how energy is going over there you can see.

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Deere Construction Contd.

PAT BLADE

- PAT stands for **power, angle, and tilt**.
- Though commonly referred to as a type of blade the PAT blade is normally a straight blade combined with multiple hydraulically controlled tractor attachment points allowing for angle, elevation and tilt blade adjustment by the operator.
- Enabling quick and easy operator control the PAT blade enhances dozing productivity and tractor versatility.



Then, another thing is you have got a patblade that is your power angle and tilt. There are the, these pat blades, they have got the all are hydraulically operated, you can see how this particular of this blade is not parallel to the ground surface. That means, it has got an angling operations and it can tilt; that means, if the blade is like this you can raise the blade you can lower the blade, you can give a and tilt over here and also you can make it rise like that.

So, all the 3 dimensional movement at the back of it done by hydraulically and that is why it is called a pat blade power angle and tilt. So, it can give a extra push to the material by that hydraulic or it can give a extra cut, that is how deep it will penetrate this blade depending on the productivity will be there.

In your surface mining you normally study, that how it will be deployed in the site. That means, how much exactly it will penetrate into the ground depending on that your what will be the advance or the how much how the your mining rate will be coming that is determined.

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Dozer Operations

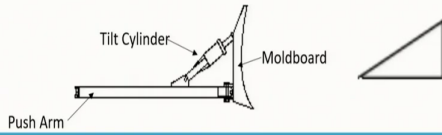
You can watch operating a dozer:
<https://youtu.be/L0kFsr5TMo>

The powered functions of a dozer are:

- Travelling at different speeds and reverse: travels on crawler, while travelling it cuts and pushes materials
- Blade hoisting and lowering: to give the cut and release load from blade
- Tilting or Angling of the blade
- Steering of the machine

Basic Principle of Dozer Blade Tilt Mechanism

Dozer Tilt is controlled by a structural triangle formed by the Push Arm, the Dozer Moldboard and the Tilt Cylinder. So long as all three sides of the triangle remain unchanged the shape of the triangle remains unchanged. Change any one of the sides of a triangle when two corners of the triangle are in fixed locations, then the third point must move.



The diagram illustrates the mechanical linkage for blade tilting. It shows a horizontal 'Push Arm' connected to a 'Tilt Cylinder' which is pivoted to a 'Moldboard'. These three components form a triangle. A separate simple triangle is shown to the right to illustrate the geometric principle. A small video inset of a man in a sweater is visible in the bottom right corner of the slide.

And this dozer operations are basically, it will be travelling at different speeds and it can reverse. So; that means, the dozer operations you have got just like in a gear, you can change the gear at different speeds, but the speeds that which gear you will be selecting it will be depending on how much total load is coming up.

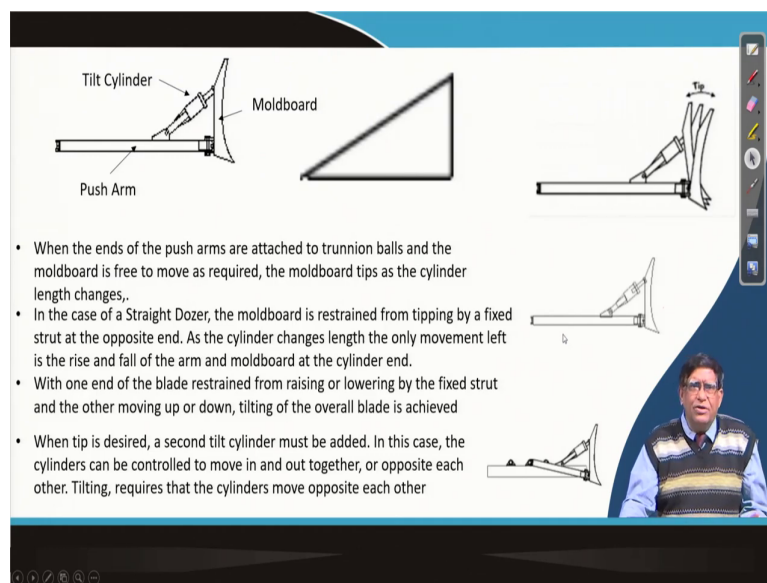
And, then there is also the blade hoisting and lowering operations is done, tilting operation is done and the steering machine. So, these are the powered functions as I said there is a in any machines you need to know what are the powered functions.

So, this requires your, the power and then you can study that what will be the control over there. So, you can control the speed by that controlling the drive of the driving hydraulic

motor. So, those controls are there in the operators cabin through his lever, he just controls the flow of fluid and then he controls the, that its speed its directions and all.

Then, the basic principle of the dozer blade tilt mechanism, that you can see, there is a tilt cylinder. And the push arm is there and then in front of that mold board on which the blade is there.

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The slide contains several diagrams illustrating blade tilt mechanisms. On the left, a diagram shows a 'Tilt Cylinder' connected to a 'Push Arm' which is attached to a 'Moldboard'. A central diagram shows a simple triangular blade. To the right, there are three smaller diagrams showing different configurations of the blade and its attachment to the push arm and moldboard, including one with a fixed strut.

- When the ends of the push arms are attached to trunnion balls and the moldboard is free to move as required, the moldboard tips as the cylinder length changes.
- In the case of a Straight Dozer, the moldboard is restrained from tipping by a fixed strut at the opposite end. As the cylinder changes length the only movement left is the rise and fall of the arm and moldboard at the cylinder end.
- With one end of the blade restrained from raising or lowering by the fixed strut and the other moving up or down, tilting of the overall blade is achieved
- When tip is desired, a second tilt cylinder must be added. In this case, the cylinders can be controlled to move in and out together, or opposite each other. Tilting, requires that the cylinders move opposite each other

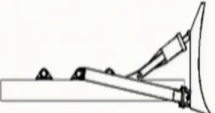
So, by giving a different combinations of this how much you push here and how much you do there on the basis of that you can tilt. You can see here; that means, by taking out this hydraulic cylinder, this piston movement will be giving the tip of the blade will be going forward or backward or doing like this. So, similarly this whole thing the blade movement is done by hydraulic systems. As you have studied in our pneumatic and hydraulic power, how different speed that actuator works that basic thing is there.

So, while maintaining the, operate that dozers, you will have to know the hydraulic circuit which is exactly responsible for giving over here. Your this oil which is being used how they are flowing and then there will be number of hose pipes and this valves. So, that your hose pipes and valves should be in a properly maintained conditions then, you will get the trouble free operations.

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TILTING AND ANGLE DOZER

Angle Dozers are restrained from tipping by the connection between the back of the blade and the c-frame. In fact, the moldboard is attached at it's center to the c-frame in such a manner that it pivots to allow tilting and angling. Hence, when one side rises the other must fall. To accommodate this, Dual Tilt Cylinders are used. As one cylinder extends to raise the end of the blade, the other retracts to lower the opposite end.



The diagram illustrates the mechanical linkage between the dozer's blade and the C-frame. It shows two hydraulic cylinders (dual tilt cylinders) positioned at the rear of the blade. These cylinders are connected to the blade's structure, allowing it to pivot and tilt. The text explains that as one cylinder extends to raise one end of the blade, the other retracts to lower the opposite end, preventing the blade from tipping.

Source: <http://www.cwsindustries.com/images/pdf/techdata/dozertilt.pdf>

Similarly, in the tilting we have got a, another the cylinder, this keeps by pushing it over there you can tilt the blade.

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Dozer Applications

- Road construction
- Site preparation ant construction sites
- Face preparation for mining
- Trunk uprooting
- Grading
- Ramp preparation
- Stock pile dressing
- Ground filling
- Pushing scrapers, shiftable skid mounted structures
- Demolishing and clearing job

Dozers on difficult terrain

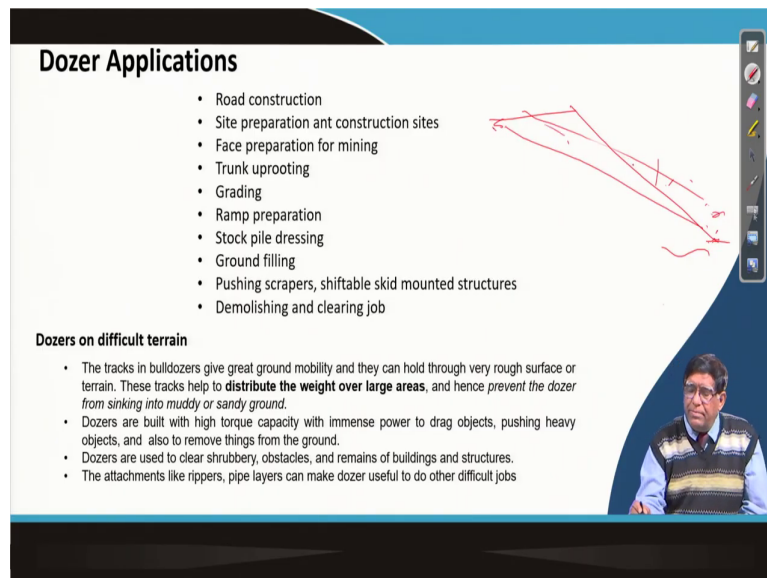
- The tracks in bulldozers give great ground mobility and they can hold through very rough surface or terrain. These tracks help to **distribute the weight over large areas**, and hence *prevent the dozer from sinking into muddy or sandy ground.*
- Dozers are built with high torque capacity with immense power to drag objects, pushing heavy objects, and also to remove things from the ground.
- Dozers are used to clear shrubby, obstacles, and remains of buildings and structures.
- The attachments like rippers, pipe layers can make dozer useful to do other difficult jobs

So, these operations exactly are used in this dozer, then how you apply it. You can apply it for road constructions you can apply for site preparation on the construction sites, you can have a in a mining you have got the facepreparation job; that means, when you are working with a shovel or in the while working with shovel. You can see here that when a mine, if your shovel is working over here. That shovel is a crawler mounted machines. So, you are having a bucket which is taking this material.

Now, when a crawler mounted machine is working over here, this should be all the time and then properly maintained, that the gradient should be it should not be a undulated surface. Because, on an undulated surface if this crawler mounted shovel, it moves it will be giving operational difficulty, crawlers may fail and also the productivity that is the production rate will be decreased.

So, what is done? This a dozer is normally working in combination with so, that it dries the things it brings the material over here. So, that that shovel gets a easy way to take your material out. So, then sometimes what happens? Whenever your, you have got this.

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Dozer Applications

- Road construction
- Site preparation ant construction sites
- Face preparation for mining
- Trunk uprooting
- Grading
- Ramp preparation
- Stock pile dressing
- Ground filling
- Pushing scrapers, shiftable skid mounted structures
- Demolishing and clearing job

Dozers on difficult terrain

- The tracks in bulldozers give great ground mobility and they can hold through very rough surface or terrain. These tracks help to **distribute the weight over large areas**, and hence *prevent the dozer from sinking into muddy or sandy ground*.
- Dozers are built with high torque capacity with immense power to drag objects, pushing heavy objects, and also to remove things from the ground.
- Dozers are used to clear shrubbery, obstacles, and remains of buildings and structures.
- The attachments like rippers, pipe layers can make dozer useful to do other difficult jobs

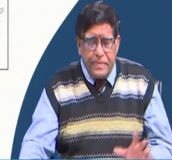
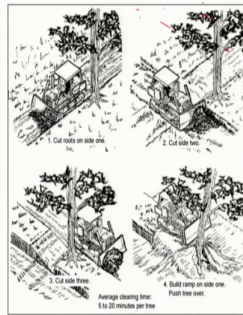
From here if you need to go up to here, you will have to give create a ramp. So, that you can a vehicle and all go up here. So, this type of ramp creations also can be done by dozers. Similarly, dozers can operate in different difficult terrain. Because, where no machines work, there the dozer can easily work, because it has got that grouser crawler it can go at a high gradient also, and it is a very high horsepower engines are there. So, it has got a robustness in this machine that is why in the mining the dozer is indispensable.

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Dozer Applications: contd....

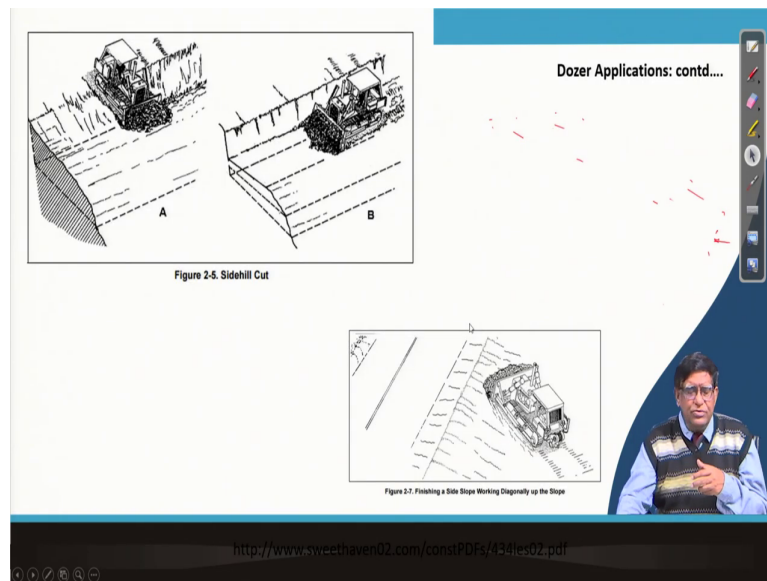
Tree Clearing

- Step 1. Start on the side opposite the proposed direction of fall, and make a cut deep enough to sever some of the large roots. Make the cut like a V-ditch, tilted downward laterally toward the roots.
- Step 2. Cut side two.
- Step 3. Cut side three.
- Step 4. Build an earth ramp on the same side as the original cut to obtain greater pushing leverage. Then push the tree over and, as the tree starts to fall, reverse the dozer quickly to avoid the rising root mass. After felling the tree, fill the stump hole so that it will not collect water.



And also it is initially for site preparation purposes that uprooting of the trees. It is necessary and dozers are used for uprooting the tree, and then you can push it over there. Then, sometimes if the trees are cut, then the stump is there for the stump removal these dozers are used.

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Then, there also in a side hill cut they can cut these things in a side hill, they can make the layer by layer, they can cut and create a slope over here.

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Dozing Operation

Dozer Applications: contd...

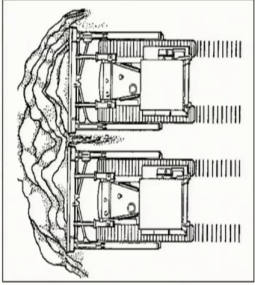


Figure 2-8. Side-by-Side Dozing

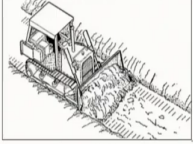
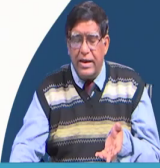


Figure 2-8. Front Dozing



And, then the mining exactly can start initially. Sometime the dosing operations are done in the mining that is the material by using two dozers, simultaneously they can push the material. And, then they can expose say the overburden can be removed like this, and then the minerals can be collected over there. That I was telling the dragging prism this amount of material which is getting in front of the blade that is called a dragging prism.

Now, the productivity of this dozer, it will be depending on how much material is exactly getting accumulated in front of the blade and how it is being moved. So, if we know the total volume of this material. And, if you know at what speed it is giving that volume into the speed that will be giving exactly the production that rate by multiplying with the density, we can find out what is the tone per hour it can move.

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Dozer Applications: cont'd

Ditching

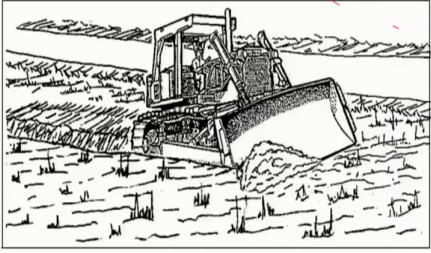

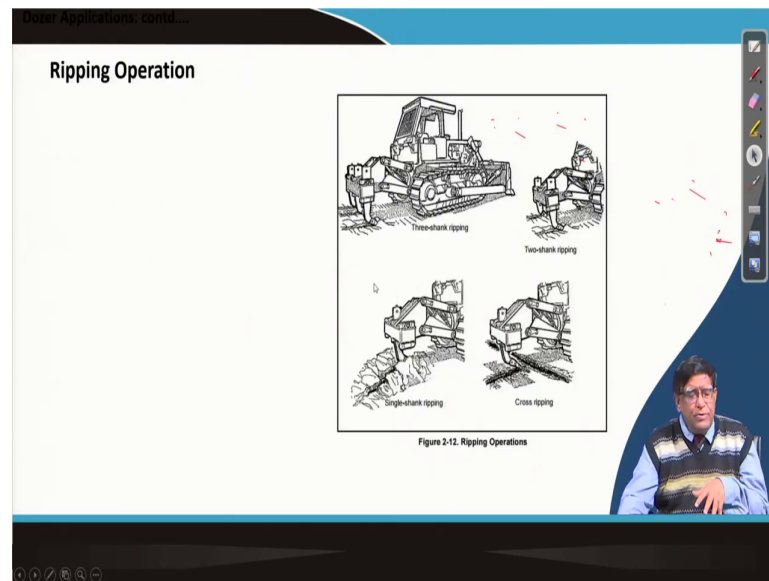


Figure 2-11. Tilt Dozer Ditching



So, this will be having a then sometimes, you want to do a ditch cut that is you might have seen many civil constructions, where they are constructing ditches with the help of dozer. Here this is by till dozer, a portion one corner is tilted and then the material from this is getting taken it over.

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So, then the rippers are exactly the ripping blade or the shank blade, here is a single ripper, here is a tree rippers, here are two rippers at the back side of the dozer is there. So, that it will be cutting that just like a plough it will be that making the rock loose, by which after that from the front it can push that material out like that the dozer operates.

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Dozer Calculations

DOZER PRODUCTION ESTIMATES

Working Conditions:

- A 60-minute working hour (100 percent efficiency).
- Power-shift machines with 0.05-minute fixed times are being used
- The dozer cuts 17 m (50 feet), then drifts the blade load to dump over a high wall.
- The soil density is 1.365 te/cubic meter (2,300 pounds per LCY.)
- The coefficient of traction equals 0.5 or better for crawler machines and 0.4 or better for wheel machines.
- Hydraulic-controlled blades are being used

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Now, well calculations of the dozer involve basically, depending on the it will have to get under what working conditions, how it will be working. You can do a dozer calculations to determine, what should be the height of the blade, what should be the length of the blade for a given operations?

Normally, one example you can see here that if you are having 60 minute working hour for 100 percent efficiency you assume that in power shift machines, about 0.5 minute fixed times are being used, and that dozer cuts say about 17 meter.

And, then it takes the blade to the loop in the front sides and the soil density is given. Then, normally the, that your loose cubic yard that is what that usedas a pound per loose cubic year, there this is the density expressed over here. The coefficient of tractions equals to 0.5 hydraulic control blades are being used if these given conditions.

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The supplier of dozers provide some information regarding production capacity as shown below:

Figure 2-13. Estimated Maximum Production for D3 Through D6 Tractors With Straight Blade

Figure 2-14. Estimated Maximum Production for D7 or D8 Tractors With Universal or Straight Blade

Figure 2-15. Dozer-Production Grade Correction Factors

Table 2-2. Operator Factors for Track Dozers

| Operator Ability | Daylight | Night |
|------------------|----------|-------|
| Excellent | 1.00 | 0.75 |
| Average | 0.75 | 0.58 |
| Poor | 0.60 | 0.45 |

NOTE: These factors assume good visibility and 80-minute working hour efficiency.

Table 2-3. Operating-Technique Correction Factors

| Operating Technique | Factor for Crawler Tractors |
|---------------------|-----------------------------|
| Side-swing | 1.2 |
| Side-by-side swing | 1.18 to 1.25 |

Table 2-4. Material-Type Correction Factors

| Material State | Factor for Crawler Tractors |
|---|-----------------------------|
| Loose, stockpile | 1.2 |
| Hard to cut, frozen, with bit cylinder | 0.8 |
| Hard to cut, frozen, without bit cylinder | 0.7 |
| Hard to drill, dead (dry, noncohesive) material or very sticky material | 0.8 |
| Rock (rippled or blasted) | 0.6 to 0.8 |

Then, you need to see that dozer operators that dozer manufacturer, they give some standard chart. The standard charts are exactly for different type of dozer, whether it is a that D 7 dozer or D 8 dozer their various dozing distance.

And, then how much loose cubic yard, they are taking these are all in the FPS system that disperse material is being. If it is say for example, a dozing distance is say 200 meter in a 7, this 7 D dozer D 7 dozer, they will be taking about 300 loose cubic yard per hour. It can produce that is the productivity you assess from there.

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Dozer Productivity Determination

A. Determine the average hourly production in compact (Bank) cubic meter (CCM) of a straight-blade D7 (with tilt cylinder) moving hard-packed clay an average distance of 65 m, down a 10 percent grade, using slot dozing. Estimated material weight is 1.483 t/loose cubic meter. The operator is of average ability and will work during daylight hours. Expected efficiency is 50 minutes per hour. Consider loose to bank conversion factor 0.63.

B. Determine the total time required to move 2500 BCM of hard-packed clay, using one D7 dozer with this production rate.

C. If the dozing is to be completed within the 7 hours of a shift, how many dozers will be required?

A.

Step 1. Estimate Uncorrected maximum production
From the graph converting 65 m to feet and reading for the D7 dozer gives 300 LCY per hour i.e 229.3 cubic meter per hour.

Step 2. Apply Grade correction factor: for 10% down grade Grade correction factor from the graph = 1.15

Step 3. Material-weight correction factor (graphs are for density 1.365 t/m³ and for given material it is 1.483 t/m³)
The ratio as the correction factor is: 0.92

Step 4. Material-type correction factor: From the information table material type correction factor for a hard-to-cut material = 0.8

Step 5. Operator correction factor: Using information table = 0.75

Step 6. Operating-technique correction factor: For slot dozing, using information table = 1.2

Step 7. Efficiency factor = ratio of working time per hour i.e for given 50 min: 50/60=0.83

Step 8. Dozer production = 229.3*1.15*0.92*0.8*0.75*1.2*0.83 = 144.977 m³/h per dozer (Loose Material)

Step 9. Material conversion factor: For converting loose to bank material for compact cubic meter = 0.63
Therefore Bank cubic meter production=0.63*144.977 m³/h per dozer =91.34 m³/h per dozer

B.

Total hours required for one dozer = 2500/(91.34x1)=27.4 hours

C. **Number of dozers required=(2500/(91.34x7)=3.91 i.e 4 dozers**

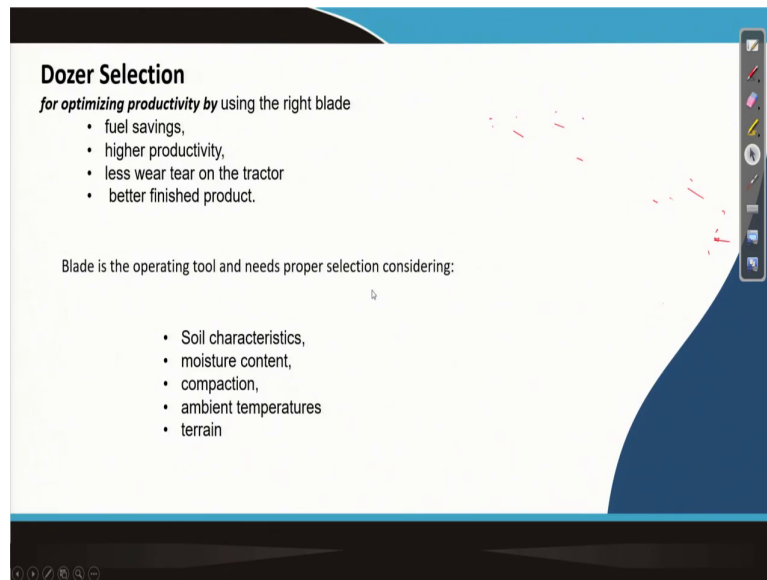
Similarly, in a different gradient of the soil, how it will be done. The this type of tables are used for solving a problem, you may be having a problem say like. You may be asked determine the total time required to move a bank cubic meter of 2500 bank cubic meter means, the hard rock soil and then loose cubic meter means loose.

So, that if you are using such type of dozer how we will determine that. So, there are step by step you can work, from estimate the uncorrected maximum productions. Then, from the graph you convert them and then you find out that how much cubic meter per hour it is taking. Then, the different correction factors are placed. And, then ultimately you can calculate the dozer production rate.

So, this is the way that step by step the calculations are there, as you will have to practice as a practical to work with these things. In the next assignment class, some assignments will be

given which is solve problems. And, then you will be doing some unsolved problems will be given to you, by which this experiment this testyou can conduct.

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So, the selection of dozer will be basically, for you have to optimize the fuel saving, higher productivity, less wear tearon the tractor and better finish product, how you get that one, it will be depending on the site conditions. So, the whole dozer selection problem is basically matching with site conditions and your machine specifications.

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Recent Developments

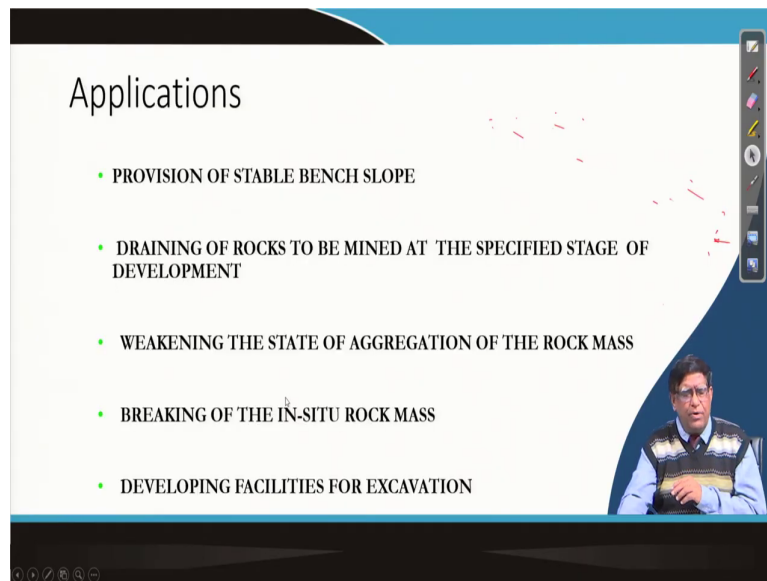
- Drive trains which can perform automatically.
- Blades are controlled by means of hydraulic cylinder instead of brake and mechanical grade control.
- more manipulation of blades
- automated controls.

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Then only you can get a productive machine. And modern dozers have got lot of electronic gadgets are coming up with their and their, they have got the advanced technology being used. So, as I said that there will be the track management system, there will be that, your blade monitoring system. There will be automated control; that means, you want to give a how much tilt and things like that, it can be programmed and that machines can work.

And the other thing is the dozers are now remotely operated particularly, when you are working on a dangerous slope of overburden dump. The operator need not be there on the dozer, it can be operated remotely from here.

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Applications

- PROVISION OF STABLE BENCH SLOPE
- DRAINING OF ROCKS TO BE MINED AT THE SPECIFIED STAGE OF DEVELOPMENT
- WEAKENING THE STATE OF AGGREGATION OF THE ROCK MASS
- BREAKING OF THE IN-SITU ROCK MASS
- DEVELOPING FACILITIES FOR EXCAVATION

And, that is why this their applications are in a different area, already I have said that it can be for site preparations.

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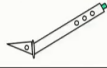


| DOZER SELECTION | |
|---|--|
| DOZER BLADE | |
| STRAIGHT OR BULL DOZER | U-SHAPED DOZER |
| PUSHING MATERIAL IN STRAIGHT PATH | FORWARD CURVING SIDE WINGS |
| OPERATING IN A SELF-CUT SLOT | BLADE AT 90° TO TRAVEL DIRCTN. |
| GOOD PENETRATION | LENGTH MORE THAN STRAIGHT BLADE |
| CAPABLE OF HANDLING HEAVY MATERIAL | BLADE TILTED AT ONE CORNER TO GO BELOW GROUND LEVEL |
| PUSHING BLADE-CORNER BELOW THE GROUND LEVEL (0.5 TO 0.25 M) | DESIGNED FOR LIGHT MATERIAL |
| TOP EDGE PITCHED FORWARD OR BACKWARD (5 TO 10 DEGREES) | CAN HANDLE LARGE LOADS FOR LONGER DISTANCE |
| ANGLE DOZER | PUSH DOZER |
| BLADE MOVEMENT TO 25° TO EITHER SIDE FROM CENTRE LINE | THE BLADE REINFORCED AT THE CENTRE WITH HEAVY STEEL PLATES |
| DESIGNED FOR SIDE CASTING | DESIGNED FOR ON-THE-GO PUSH LOADING (PUSHING OF SCRAPER) |
| SMALLER CAPACITY | |
| CARRY A FULL L LOAD CONTINUOUSLY AT GREATER SPEED | |

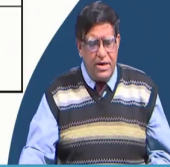
And, it can be for pushing these things and as we said that there are different types of dozer like straight bulldozer, or U shaped dozers, or angle dozer, or push dozer. Push dozer are used for the scraper pushing U, shaped dozers are for forward curving and then at a blades are at a 90 degree travel directions.

This is a straight bulldozers, it can give a very good penetrations, then your angled dozers it can do the side cutting for that crown. So, like that your different type of dozers are working at a different jobs. So, what you will have to do? As an assignment write down that, what are the differences in different types of dozer, and what are their applicability?

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RIPPER SELECTION

| TYPE | USAGE | SKETCH |
|---------------------|--|---|
| STRAIGHT SHANK | SLABBY AND BLOCKING MATERIALS. |  |
| CURVED SHANK | FINE GRAIN, UNBROKEN MATERIAL |  |
| DOUBLE OFFSET SHANK | NON-ABRASIVE COAL, LIGHT EASILY FRACTURED MATERIAL |  |



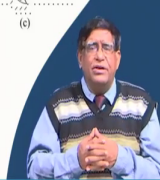
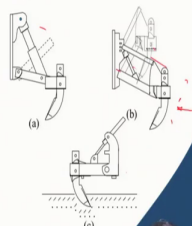
Lot of materials are available you should see that and, then the ripper. Ripper is basically that what type of ripping blades you are using, just like a plough you have got a curved shank, you have got straight shank and you have got double offset shank.

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RIPPER SELECTION

FACTORS AFFECTING RIPPER SELECTION

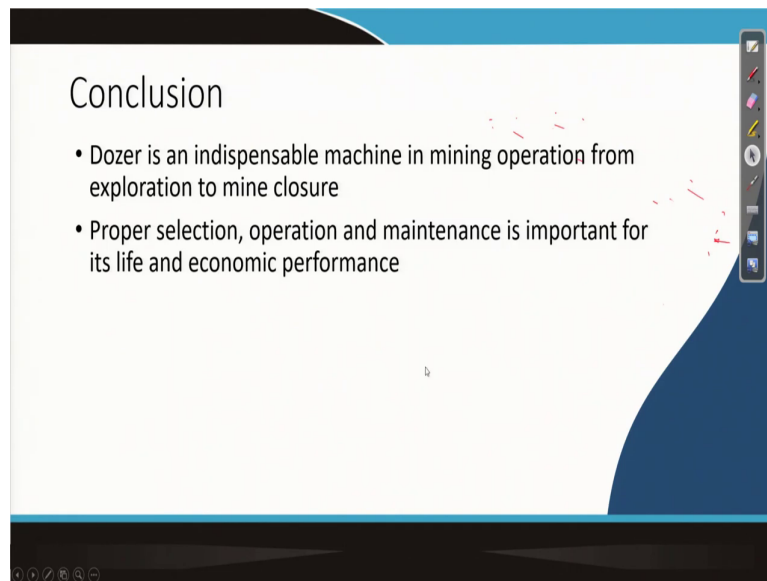
| | |
|---------------------------------|---|
| Mass of the tractor | This ensure the penetration of the working member of the ripper. |
| Type of ripper | The trailed ripper provides depth of ripping up to 0.4-0.5 m and tractor mounted rippers up to 1.5 to 2.0 m. |
| Power rating | This determines the capability of the machine on the given rock. |
| Number of teeth | Rippers may have up to 5 teeth with solid or composite tips. Weathered igneous and metamorphic rocks are prepared for mining with the aid of single rippers. Dense rocks are loosened with ripper with multiple teeth. |
| Teeth Shape | Low or medium joint weathered igneous or metamorphic rocks are ripped with teeth having straight upright. Brittle and heavily jointed rocks are loosened with ripper teeth of intricate shapes. |
| Ripper geometry | The working tool of ripper is characterised by cutting angle (γ), tip edge angle (α), clearance angle (β), tooth thickness and length and tooth spacing. (Figure 1) For weathered igneous or metamorphic rocks ripper angle selected is $30^\circ-45^\circ$. An increase of ripping angle from 40° to 60° double the resistance of ripping. The tip edge angle is in the range of $20^\circ-30^\circ$. Its magnitude must be such that with any penetration of the teeth into the ground the clearance angle is within $5^\circ-7^\circ$ when dealing with compact igneous and metamorphic rocks. A smaller ϕ causes crushing of the rock by the back face of the tip, increases its wear and the resistance of the rock to ripping. |
| Direction of application | The loosening or rippability of rocks depends on the direction of ripping with respect to the system of joints. Ripping at right angles to the direction of the main jointing proves to be most effective. |



Now, these are fitted at the back side of the dozers, which can be a hydraulically controlled this shanks or it can be your rigidly fixed. Now, when this ripper backside how you fix, it has got number of parameters like that what is the type of ripper you will be using, that is your whether you have the fixed, or hydraulically operated. And what will be the teeth shape, and the what is the geometry of the ripper say? Here the geometry can be changed, here the geometry is fixed.

And, then in a which directions you are doing that is your the during the forward movement you are cutting. So, that the in your how exactly you are loosening the material.

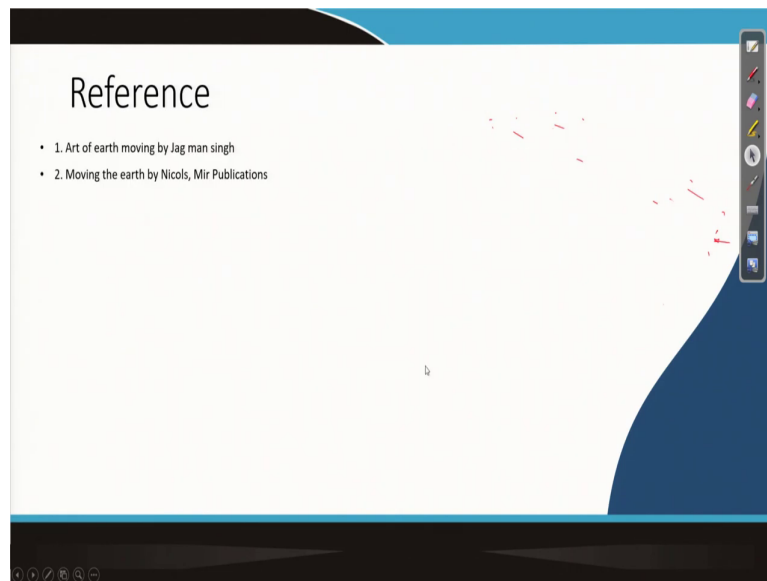
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So, the ripper main purpose is to loosen the material so, that the dozer can push it. So, dozer is indispensable in mining operations, and then it is used during the explorations time to make the roads in the jungles, road in the un accessible areas. And, it is also during the, that when you are making your first camp, to construct the buildings, construct the drains. Then, clearing of the roads making the or accessing over climbing a slope. The dozer is the first machine which is used over there.

So, proper selection of operation and maintenance is very important for this. So, today of course, just I have introduced over here, I will be giving you the tutorial sheets, in which there will be some solved problems. As well as you can get some of the, that your assignments, which you can do by yourself studies.

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But, main thing you can read the books of this art of earth moving by Jag Man Singh or the moving the earth by Nicols, these old books they give a very good description of your how dozer operates. So, I wish that you develop a little interest about this machines make from the internet search about the different make.

And study the specifications and develop an understanding of what is the present trend of this machinery. How the modernization of this machinery is taking place, with different advance of hydraulic systems, different advancements on the control systems are being incorporated in this machines.

Thank you very much.

