Mining Machinery
Prof. Khanindra Pathak
Department of Mining Engineering
Indian Institute of Technology, Kharagpur

Module - 08
Lecture - 42
Automobiles in Mines and Mining Truck

Well, we have started discussing our surface mining transport and transportation machinery. And in the last class, we have discussed about total area of transportation and in that we will be discussing now the first type of machinery, that is your mine trucks.

Now, in the mines you have seen this lot of different size of big big dump trucks and dump (Refer Time: 1:01) are there; but to understanding this machines, their operation are basically same as your automobiles. So, that is why today's class, we will be just have a brief review of the what you have learnt about the machine elements.

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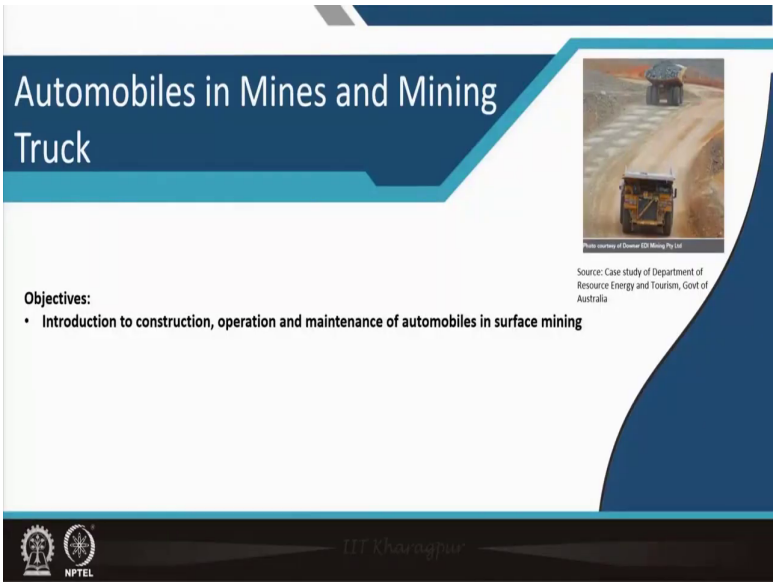

And we will be talking about these automobiles in our mining. And then let us see that how you can start yourself to study, this is a different mining transportation machinery.

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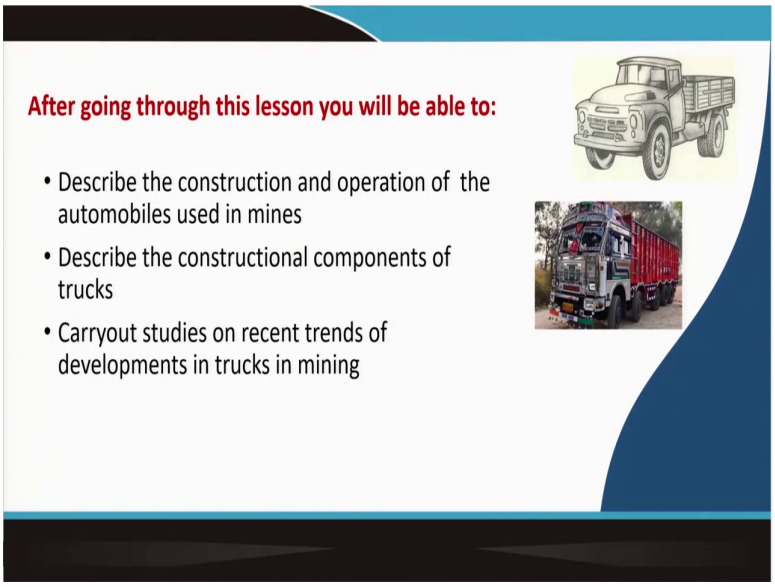

Now, when we talk about automobiles you might have seen that say that, we used to say lorry or this trucks, these are there for as a transportation means. And there you can see very high overload trucks; these are in Bihar, UP you can find some of this these type of trucks which 6 up to 5, 6 axels big trucks are coming with higher engine capacity.

So, this type of automobile system is there. And an automobile engineering, where people study the different types of designs of your vehicles or the automobiles of different types.

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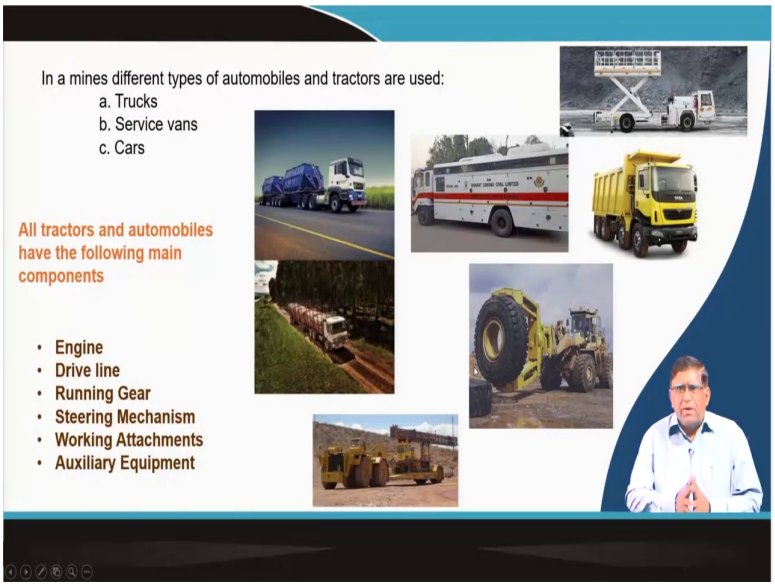

Exactly the automobiles the word it is a, it can be applied to a many things. So, that in the mines, you may find some special type of vehicles. So, that is to study and to know about this particular machines or the particular vehicles how you have to deploy in mines, you need to know about that. Say in the mines automobile sectors, there will be particularly for the dump truck; but there are other things also, say for example, the rescue vans.

That in a mine rescue van is a very important service van; similarly there will be a mobile workshop for serving different machinery for this maintenance van we say, that maintenance van is also one particular type of automobile. Sometimes you might have heard about this canteen van; that in the mines that where the group of workers are working at different places, you will have to take supply their refreshments at different time of the shifts.

So, for that there will be a particular type of the, that special purpose vehicle like your mobile canteen. Now, in these areas, there are not many works; you will not find many mines, where there is a modern sophisticated mobile canteen or a mobile workshop are still not working.

Now, with the; this more consciousness towards these operators that is workers comfort and all; there could be in near future a very good design, comfortable design for refreshments that during the tea break how exactly your canteen van can give a good type. And then sometimes those service vans also can be used for training the people.

So, that means weather the mobile workshop or a mobile this your maintenance van; that can be thought of having a LED screen in front of it, so that onsite training of the new recruitee or the that could be working serving as a mobile VTC. So, that is the different type of things, with the machines you can think of, how your mine management can improve which machinery.

Here in this figure you can see that, some of these even these are used in underground mines, underground metal mines for roof dressings and purposes such type of vehicles can be taken.

Then there could be this has a tyre handler, we are telling yesterday last time while introducing transporting machinery or the there are very high capacity trucks; that high capacity this large size dump trucks, their tyers cannot be replaced by manually, we need to have a tyre handlers.

Similarly, in the mines there you require some of the low height transporting machines. There are number of automobiles, which will be used as a transporting machines; there could be a lot of innovations depending on the type of mines. Then there are also sometimes strange. In Australia there is exactly there is a vast area, where there is no populations; so they maintain a very good wide roads.

And from there even sometimes more than 1200 kilometer distance from the farm lands to the port, they have got rail; that is your trains of this road trains they say, where there will be a

trucks that is with a 128 axles. So, that is could be a huge type of things; we will be discussing few of those innovation which are there in the mining industry also been served by those road trains.

Here you can see also, a road train with had two wagons being carried by a truck with an articulated system. This type of special purpose vehicles, which are nowadays with the application of I o T and then that is these are called smart trucks. Now, how the smart truck can be introduced to our mining, that we need to know about the basics of these automobiles.

All these machines on different things, which will be coming across, basically these automobiles have got some basic components which are your engine, your driveline, your running gear, steering mechanism, working attachments, and some auxiliary equipment. In this group, you can study the things. Now, I will request you to go through those machine elements, which were discussed to you earlier; I can give a brief review or just quickly we will scroll through some of the components today.

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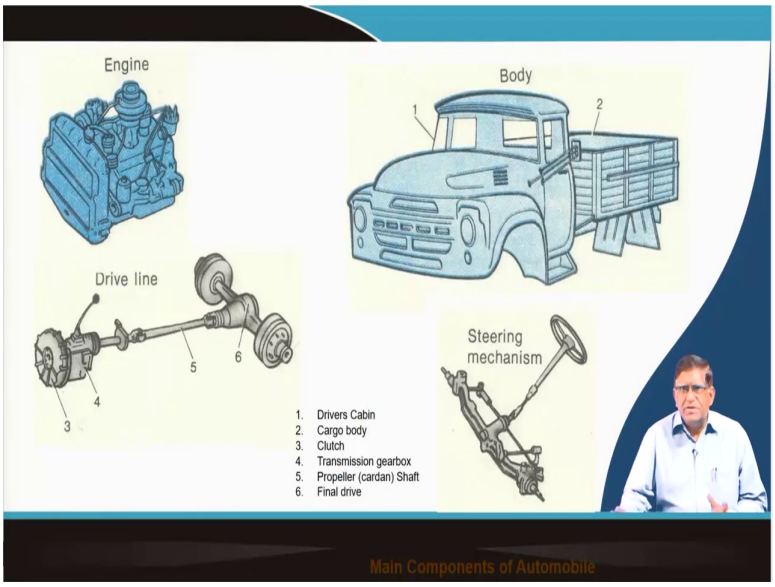

So, for example, in any truck systems, in any automobile, there will be a body, and that there will be an engine, and there will be a drive line; the drive line is that from the engine, how the power is given, so that torque is available at your this wheel. So, that the resistances to motion is overcome and the truck can be driven, so that is the drive line.

So, in that what normally you will find; that is a exactly in the body part, there will be a drivers cabin and then there will be a cargo body. And then for the driveline, you will be having basically a clutch and then you will be having this transmission gearbox and a propeller shaft. And then it will give drive to the final drive by a differential.

So, this system which is there in your car, in your bus, in your truck everywhere and this is automobile is so widely used; so you must have a general understanding how it works. So,

these are all the components you have studied in your module 2, where we or model 3, where we are discussing about the components.

Now, please go through once again to that. And then you are having a steering system, this is a thing how does the steering work; exactly there is a just with that your both the wheels, they can be directions can be changed on the basis of by having a manual control by the operator. Now, when we are having these days automated vehicle; that means no man that is operator will be there.

So, once you know this steering how it works, exactly by observing over here, which is to be moved how much. So, once you know they how to control these things, means you know the physics and the mechanisms involved over there; then you can develop the algorithm by which you can automatically make the things to move. So, that means to go to go through the I o T or to apply your artificial intelligence, you will have to know this systems exactly how the engineering is done.

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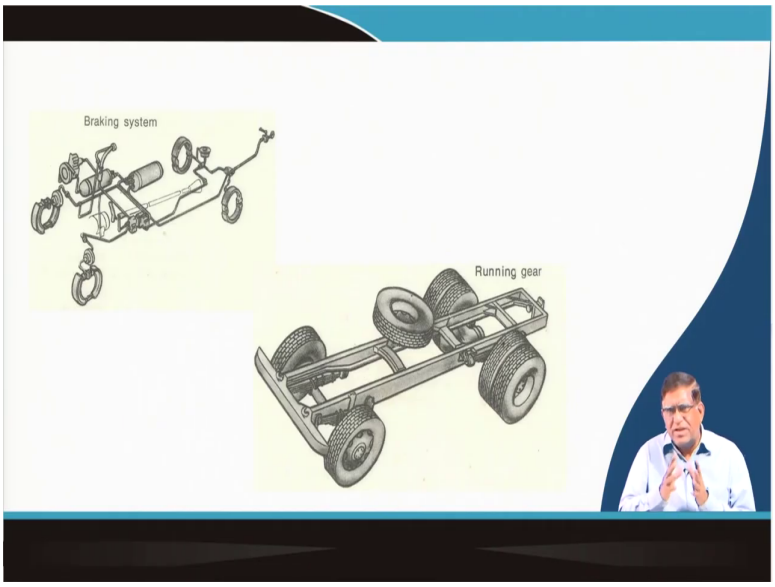

And for that, you will have to first; so this is exactly a very basic things which are there, you need to have a general understanding and you can get it well learned by going to any garage and you see any of the truck or car or any jeep repairing shop. Then from there you can find out, what is the latest development how it is going, how exactly; this is a very preliminary basic things, which are not far from that the that force, which were there.

It is this particular design is existing for now more than a hundred years; the basic design is same, only the modifications and developments have come. Then there a braking system is a very very important one; because your things will be moving, that in a moving mass there is a high momentum and change of momentum is the amount of force.

So, that means if you are getting anything in front of it; say for example, you are having a 300 ton that the truck is moving at a particular speed say your 20 kilometer per hour, then with

such a momentum, if it gets it is stucks, hit a car coming in front, then you can easily understand that how much energy will be coming. So, you will have to apply the brakes to stop it.

Now, to stop that, how much energy will be required to stop this car within a particular distance? So, you will have to know how to calculate that braking distance and how much power will have to be applied over there and then how you can exactly administer that break force to the wheel. Then for that the braking system, where you are having a paddle that you can see on the wheel, there are thus disc brakes are there. You have studied in your machine element, the shoe brake; the shoe brake, disc brake.

And now, disc breaks are actuated, how it is actuated hydraulically; that means when the that is your operator will be pressing the that your peddle, with the peddle movement, how the hydraulic force will be applied to the disk and then it will be closed. So, that mechanism will have to be learnt. So, you make a plan from today's class that what are the things you will be learning about.

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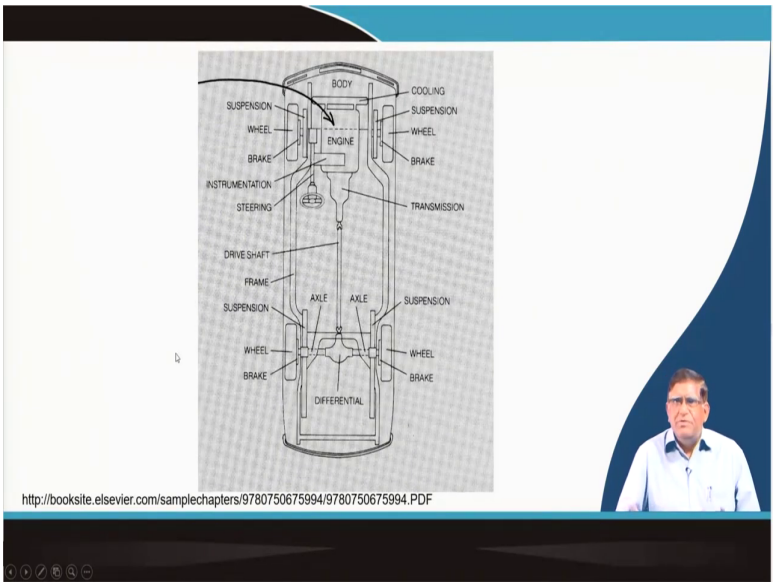

Now, as a general, you should have the basic understanding in an automobile what is there. Now, some of the terminology, when we say as a suspension; that means you may be hearing this word very much that, while on undulated road if you go in some car, you will so much of jerk.

But, if you go with Innova or with some high end car, you do not feel that there is a some; that means the wheel on the at the top of the wheel where the body or the chassis is mounted, between that things you are having such an arrangement that the shock or vibration which is coming due to the undulation of the road surface is observed.

So, that mechanism how it is given, that is called your suspension system. Now, that suspension if the old cars and all it was all some spring loaded; then it came hydraulically how you can suspended. Then all your suspension system, it will be whether with a hydraulic,

with a pneumatic, with that is a with a gas and oil; there are different types of suspension systems in a big trucks like your the 200 ton or 100 ton trucks, they will have to have this suspension system is very very important.

Because the vibrations of a very big machines if it comes to the operator, then it can cause a lot of damage to their health. So, that is why the suspension is one of the very important things. So, that is that machine is a your exactly this is a four wheels are there you can see with a two axels. Now, as I said, a train that is your road train which will be having 128 axels; so that means there will be having number of, this type of axels will be connected and they will make a train type of things and will go.

Normally you might have seen on the road some of the trailer; maybe you can see at the back side most of the trailer on Indian roads you will find that number plate if you read, it is that NL, that means from Nagaland, that is a all these big trailers are there. I do not know why all those trailers get manufactured or that is car body is made in Nagaland.

But, you will find their sometimes 8 axels, 10 axels, 6 axels that a big transporting trucks which are moving in Indian highways are there, that is a different type of arrangements how that exactly will be placed over there.

Now, the most important thing in design in those things, how exactly the center of gravity is managed, how your that is your turning; your turning radius how it will be done on a different type of road those things need to be taken care of while thinking of a long distance, that is a what will be the distance between two axels.

And this is exactly the total load coming onto the truck or car or things will be that is supported by this four point supports. And depending on that where the center of gravity will be there, how the other components will be placed in the car those are designed by the automobile designers.

But, basic component wise you should know that, this wheels there are depending on the nature; if your where you will be using, you can give the drive or power to all the wheels or at the rear wheels. Most of the cars and trucks you will find that, this is given at the rear wheel.

And here the power is coming from where, from the engine; there will be your this gearbox and then there will be torque converters, their this your transmission system they say, from the transmission it is going to a propeller shaft, they are connected by an universal joint.

We have discussed in our machine, machine elements what is joint is, how the universal joint work. Now, these two universal joint it is connected to a differential, the differential we also discuss their that to get; that is when your it will be turning the two, two of this depending on the training duration, one of the wheel will be having a low speed, another wheel will be having a higher speed.

So, that the distance travelled by the outer tyre is little more, so that the car or the truck can the take a turn properly. So, you have understood that, how these are oriented and their steering is from here and from there; that means your the there is a no steering onto the rear wheel. In the front wheel, they will be doing the steering purpose.

And then as because they are rigidly connected, they will be moving and following the path of that and you can take the turn. So, basically and there the brakes can be applied, your all the wheels have got the break; you can apply depending on how your. Another thing is there, the breaks also in a big trucks and vehicles you will be having different type of break for the parking brake.

In your car also, you have seen there is a hand break; when your parking it, you apply that one. And there is a this break braking system is very very important when you are talking of a very high capacity trucks; because on the slope if it is to stand, then exactly by its own weight, it may get motion to go and that is why that adequate braking force must be applied. So, proper break need to be designed.

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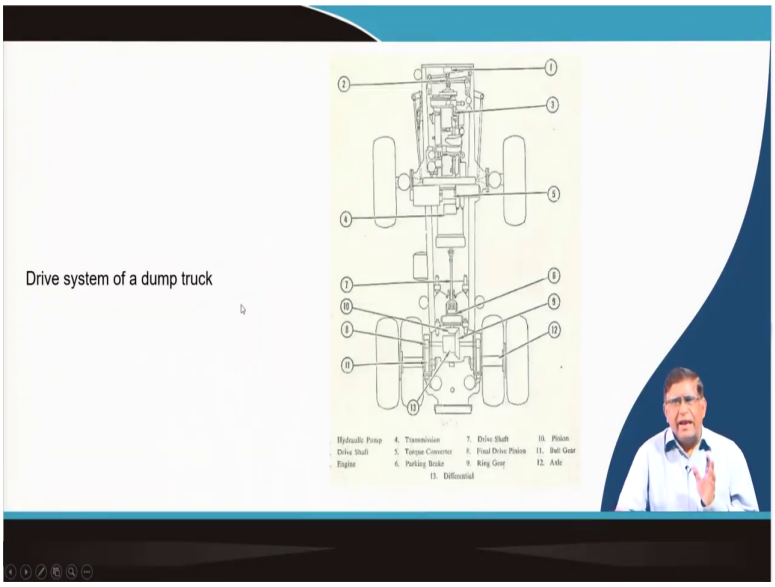

So, these are the basic things in an automobile and that what in a truck from that you can see here; the trucks you might have seen, there is a double tyre, that is a double wheels are there, so that the total loads can be now getting on a, that is to the road that for the bearing surfaces for which on which the load will be coming is increased.

So this type of diagram you please try to draw yourself and identify what are the main components in a the power, how the power is transmitted through this. So, that then only you can calculate, how to calculate that how much will be the power; at least if you know the total load and total speed over there, how can you determine, what will be the requirement of the engine power, that will be depending on the resistance of the road, resistance of the wind and then resistance of the grade on the total load coming on to the curve.

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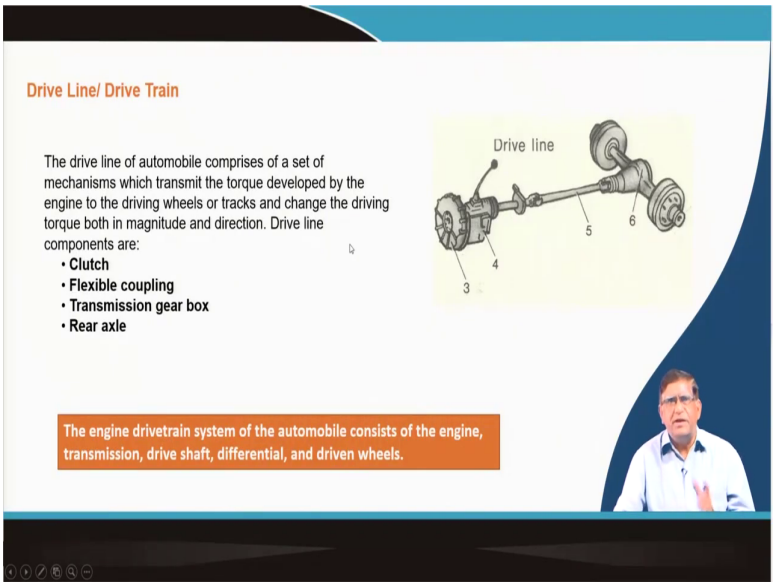

We will see to it how it does. Now, as we see this of the particular components; please go through once again to your the machine element clutch and then find out how what is the basic principle of their work.

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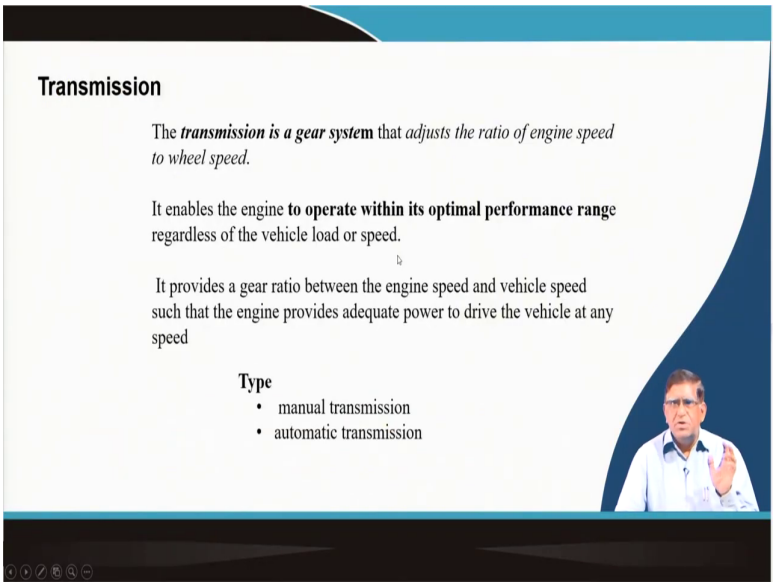

So, this the transmissions that is very very important when we will be discussing about the big trucks to these trucks; this transmission are all automatic transmission. And then how exactly that hydro hydraulic transmissions, whether it is a hydrodynamic transmissions being carried out that we will have to study.

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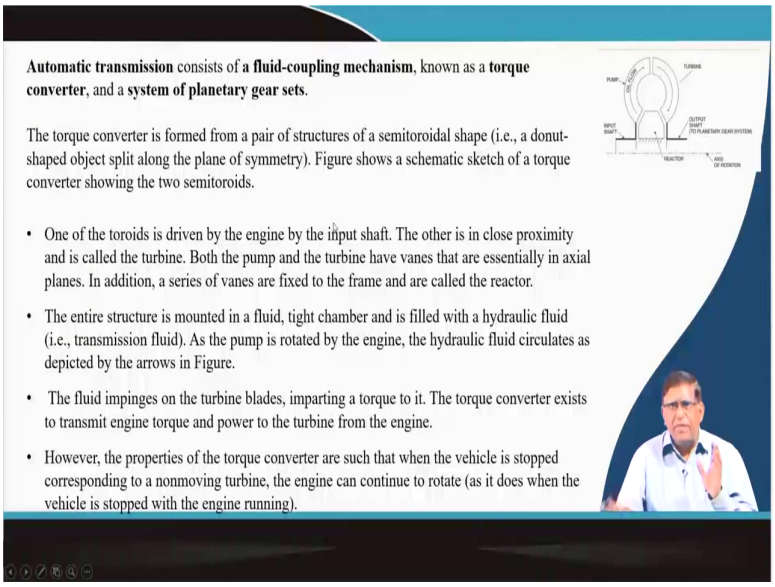

But one day you know in a normally all these modern vehicles, there are the two things very important; that is your you are having a torque converter. Now, in a torque converter, basically the principle of your fluid coupling.

You have studied in our that; that means I think we discussed about the application of fluid coupling, we talked about the how in a conveyor belt drive we need to get a fluid coupling, so that that initial starting torque to the motor does not go very high. So, here also in automobile, we have got a this torque converter and this in which two things are very very important; one is how that gearing system is done with a planetary gear, that is epicyclic gears they use.

And then in a torque converter is basically it turbine one part, that is your half portion is shown as that as two toroids are there. In which, in a toroid you know just like a tube; if you take a tube type of things that is a toroid, then you are keeping the fluids over here.

And when the fluids will be rotating, it this from the your driven side; then the fluid will be, that is your fluid from the driving side will be rotating and then there to input the motion to the driven side. So, that part of the things is the inbuilt in your torque converter.

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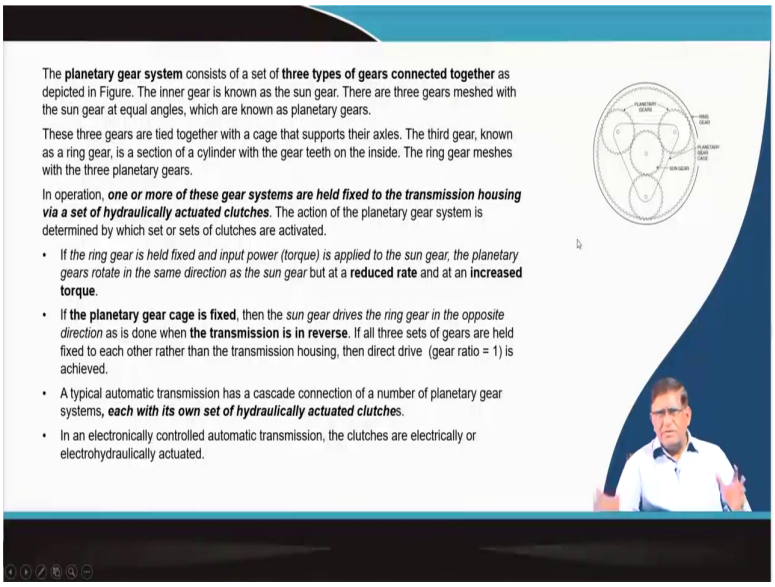

And then the just like your planetary gear system which is used, that also you have studied in your machine element. Once again you find out how the basic calculations are done in a planetary gear system, where we depending on this exactly, how you want to control your the

speed and how you want to control your this vehicle, that will be depending on the gear system and the transmissions.

And the transmissions and gears you know that how many different speeds can be there and how many, how whether you will be doing a forward motion or reverse motions this things will be taken care of.

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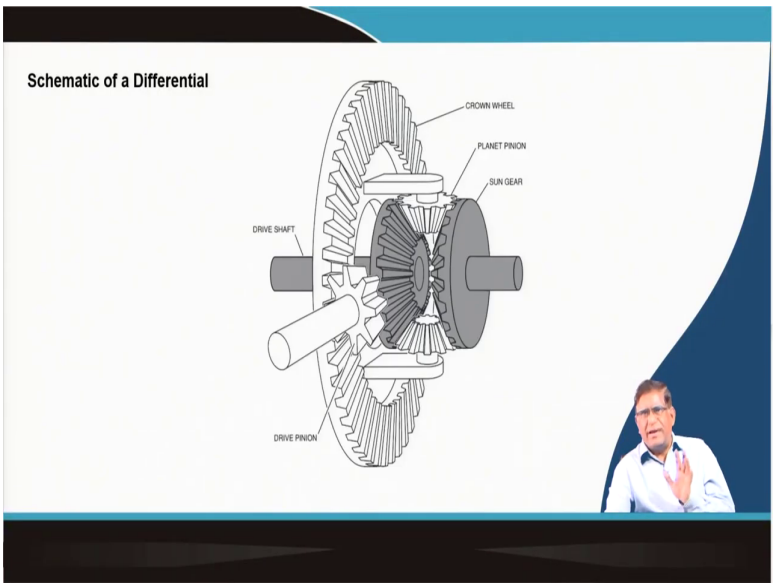

Similarly, you have studies also the differential, in which from the that is your that your propeller shaft how the, that your the motion exactly the final drive will be getting over here. From the propeller shaft, it is going to the differential; from the differentials your with the help of again a double gearing, you are bringing the power to the wheel in the two sides separately. And these arrangements also you have studied in your machine elements class.

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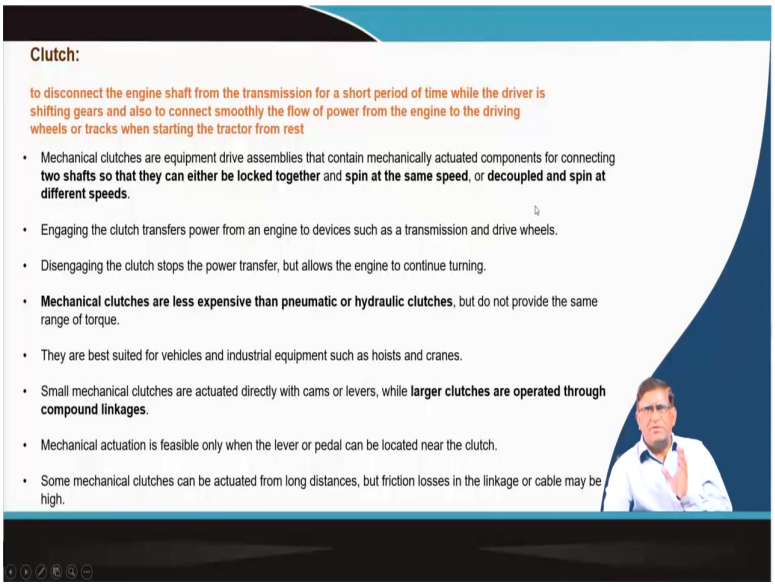

And clutches which are you know, that is while driving the this your car; at that time when things are moving, at that time you need to change the gear, that is your you are engaging different shaft over there and that whole operation is done by your clutch system.

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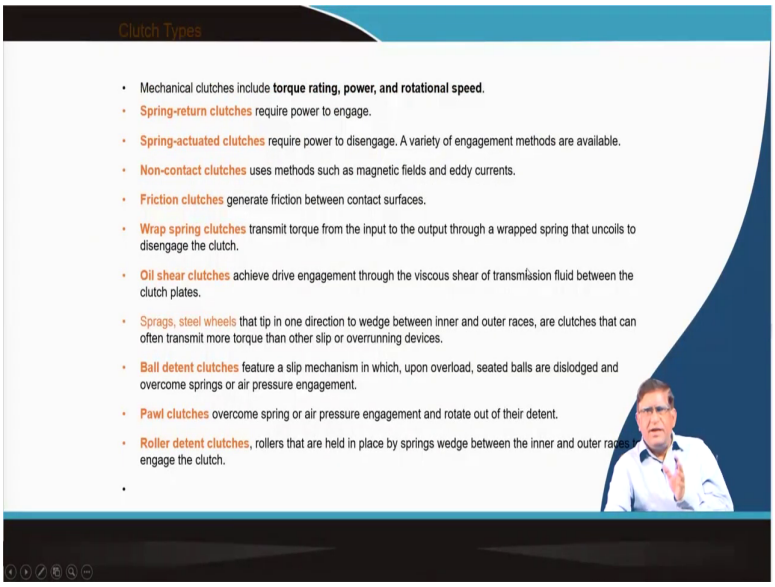

So, this you please once again revise these ideas of how and what are the different type of clutches are there. Once you will start studying the development, how this different clutch system came in the automobile industry or automobile engineering; you will find that there is a different developments came with the clutches.

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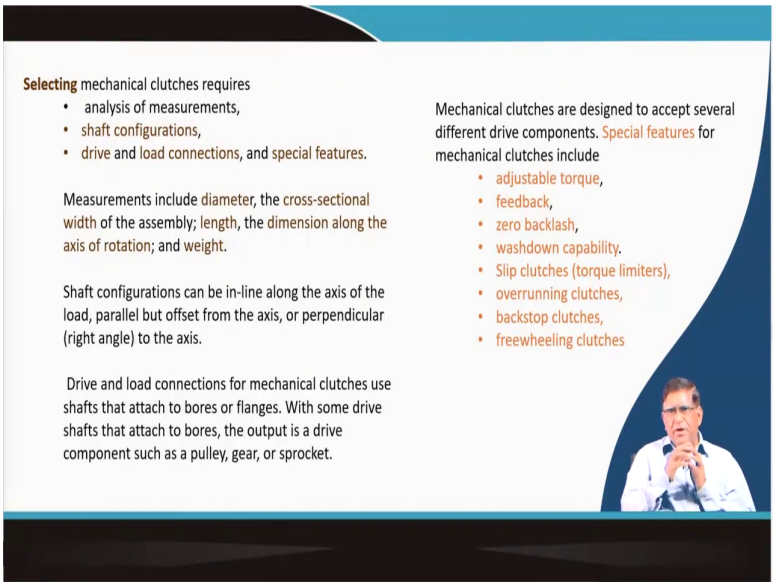

And as you go for the higher end cars, you are getting the sophisticated operations; like in your automated cars this whole clutching operation is done by sensor operated and they have got a different system.

So, now, this your how you will select a particular clutch that will be again depending on exactly how your, what type of uses and how you make the that is your shaft configurations, your what are the different load connections will be coming, depending on that you will be calculating out and finding out what type of clutches are there.

Now, the you need to know that basic things which are required in your clutch arrangement is your the torque, how it will be there; then your whether you have got a backlash it is a we consider properly.

Then your whether there will be a clutch it should not slip; because there could be a lot of accidents if your the clutches slipping and then you cannot say change the gear and then you cannot change the speed, at that time there will be a lot of problems there.

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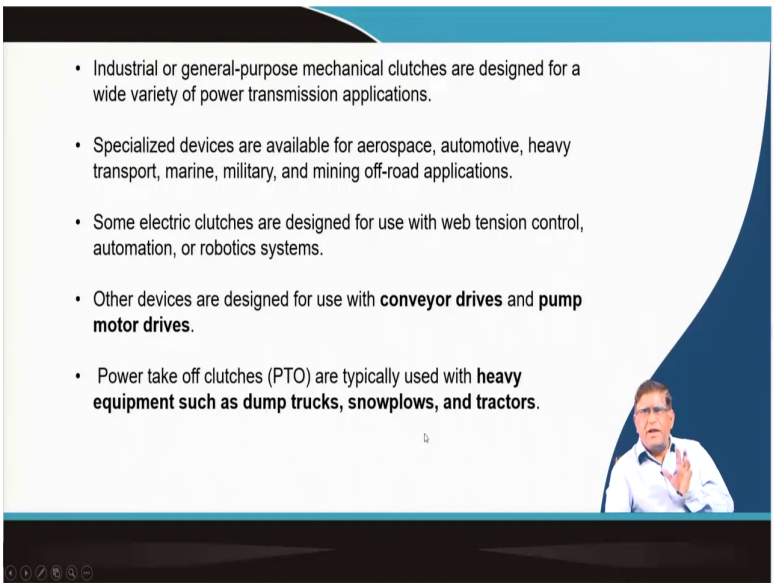

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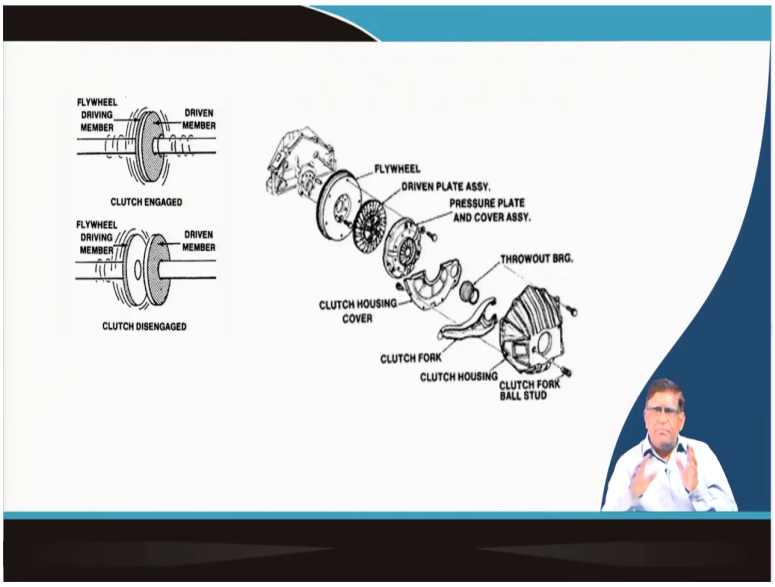

So, these are the part of the automobile engineering, which you need to know about while going for your the study with the mining machinery, particularly the dump trucks. Because dump trucks will be having these arrangements of your different machine elements are combined and designed for that specific purposes.

So, your here this is your how clutch are engaged and these engaged is shown over here; at these engaged clutch means, your the driven member, which is a if it is driving member is connected and placed over there, then they starts rotating and you get the power and taken over there.

So, these at your engaging and disengaging clutch means, basically your how the driven member; that is your the wheel will be getting the main power from there. So, there are the

different components how they are brought, these are the things when you go to the detailed engineering you will have to study it.

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Similarly, this is your when you study this clutch and the discs, their connections and their designs that intricate mechanical engineering you may not be interested. But, how it operates if you know it over there, then you will be knowing that exactly which components need to be given more importance while selecting; because depending on the type of design, their expected operational performance is there.

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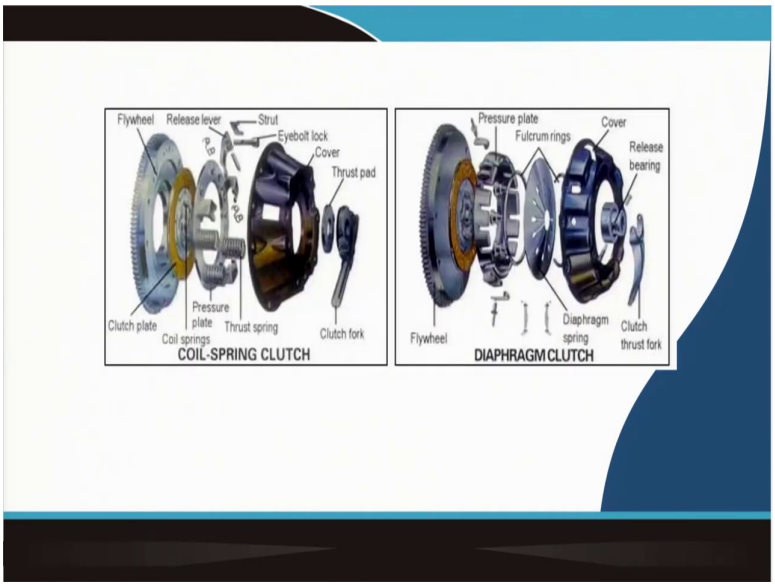

And as a mining engineer, your basic input basic objectives is to get the machines the capacity utilization higher; that means the down times should be less, that means the that components which are being used, they should be giving you a longer life.

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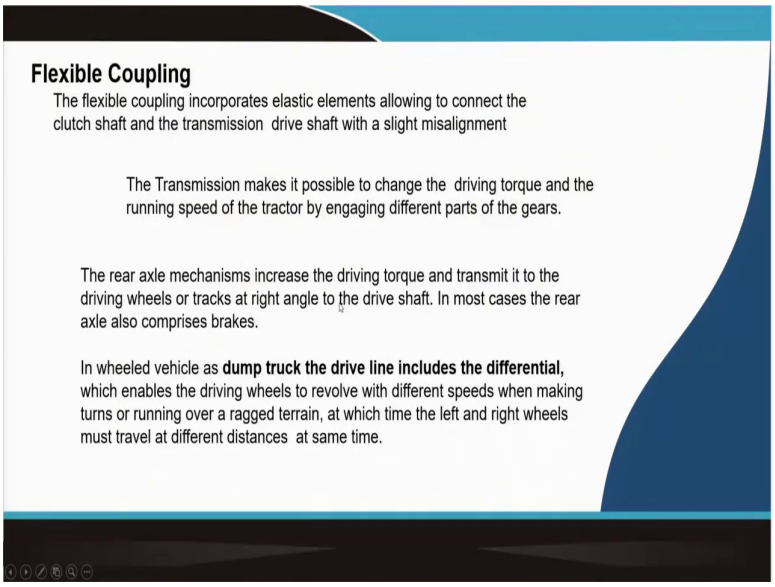

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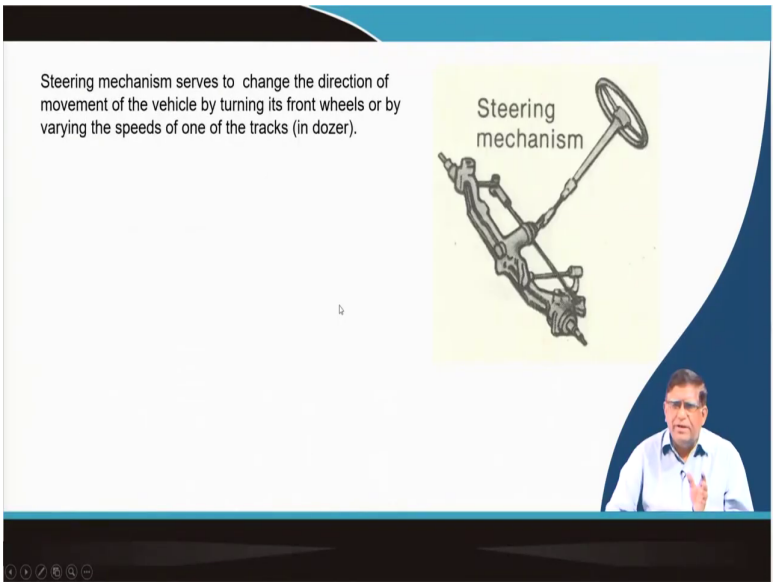

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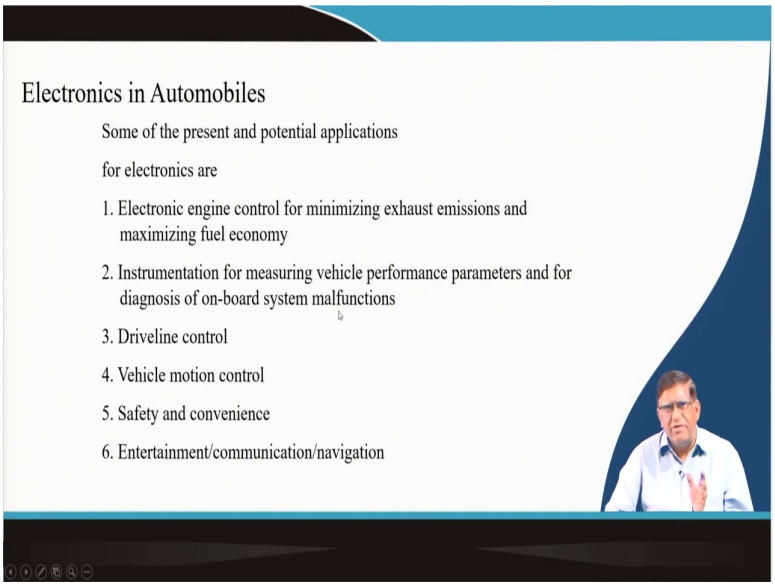

So, for that purpose you will have to use this the, you know the basic type of systems and then also you will be do knowing about that your couplings how it is done, steering will be learning. And also there are different electronics are used in automobiles. Nowadays we will be discussing as well in our next class will introduce you about the mining trucks, that is which has done a lot of development over the years.

And the electronics and your information and communication technology has become a part of these big machines. And you may understand this say for example, now the mining truck is no more a truck that is operated by some of the drivers which are driving, having experience of the roadside driving, that is no more.

A mining trucks that when we will be talking about, it is a big machines with a lot of electronic control; particularly there will be for the engine control, for the monitoring all the

parameters, so that the fuel consumptions and the power consumption can be there, whether it should be giving a warning of a future problems, which may maintenance problem may be coming.

And then also that the controls, that is where when the driver should be alerted for what type of control should be given, for all these things are monitored and then they need to be displayed and then there should be. So, the drivers cabin will be a big computerized system with a lot of enunciation panel and monitors and all.

As a result the driving of such type of vehicle requires a special training and then even modern this your virtual reality trainers have been there. If you can if you go to south eastern coalfield limited in Bilaspur's the headquarter or if you go to this northern coalfield, even that many of these coal mines now they are having a simulator by which they will be training the people.

And then this is there even the operator are going to be a graduate engineer. As I know in Australia that is your the graduate mining engineers are appointed for driving the trucks and that has started; now I think 22 girls engineers are recruited by Tata steel to make them, the train them for operator for the dump trucks of the mines.

So, to if you want to get a very high salary job, say for example in Australia, a dump truck operator get about one lakh twenty five thousand US dollar a year for this the job of as a dump operator; because that is a main productive machinery. So, if you want to be a field engineer to be a dump operator, that basics which I have said need to be known before we go to the other things.

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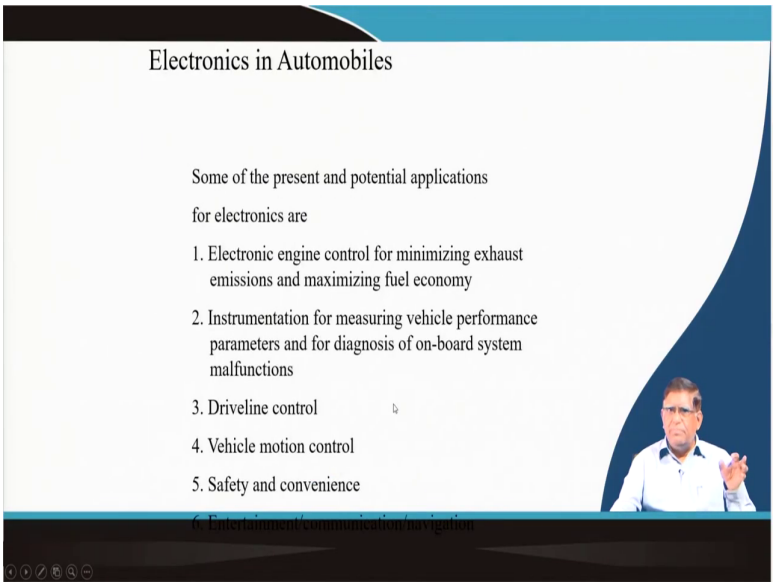

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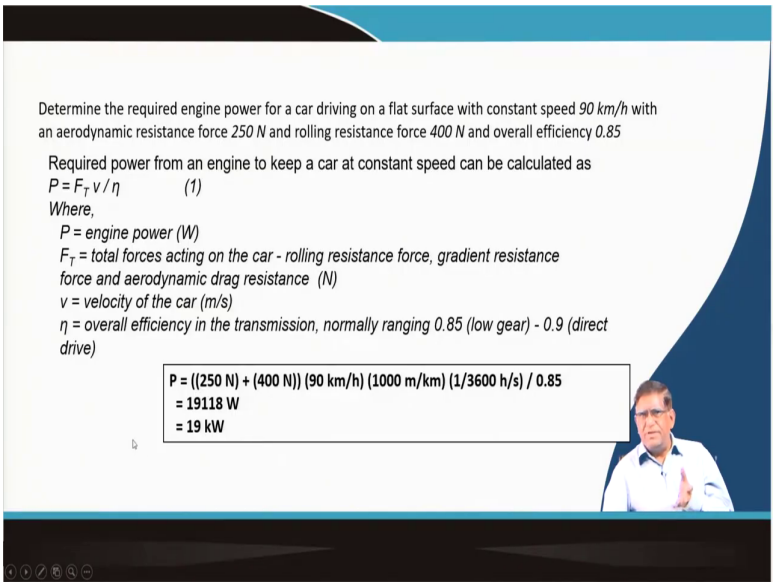

Now, some of the things basic calculations also you should be able to do. If I ask you that determine the required engine power for a car driving on a flat surface with constant speed of say 90 kilometer per hour with an aerodynamic resistance of 250 Newton and rolling resistance of 400 Newton and overall efficiency of 0.85. It is given over here; just only to know that exactly that to get the tracks power calculations, you will have to know the aerodynamic resistances.

So, how the wind velocity and other things will be giving resistance, depending on the design of the trucks should be known. Here it is been given a particular value, but you should know that the rolling resistance which will be coming from the road and tyre interaction; what type of tyre will be there and what type of road surface will be there under rainy conditions, under

pothole conditions, these resistance is will vary. So, it can give you an idea that to know the engine power, you will have to have those external information and data.

So, whether our mines is maintaining those data properly or not to decide a particular engine, which will be required in their car or in the truck is a question. So, you know now about this is a very basic simple questions; if you know that engine power can be calculated from the total forces and velocity, that is your the your Newton into meter Newton meter per second will give you the Watt.

So, very simple calculation, but that will be depending on the velocity. So, whether this in a basic calculations of the trucking system, how to determine those resistances and the that will be the main things. So, that resistances will be coming from your particularly the face design how will do it.

So, if you calculate these once, you have just simply putting that formula in the equations; only what you need to know, that is your the velocity whatever is given, you are putting it take care of the your units, then your calculation is very simple.

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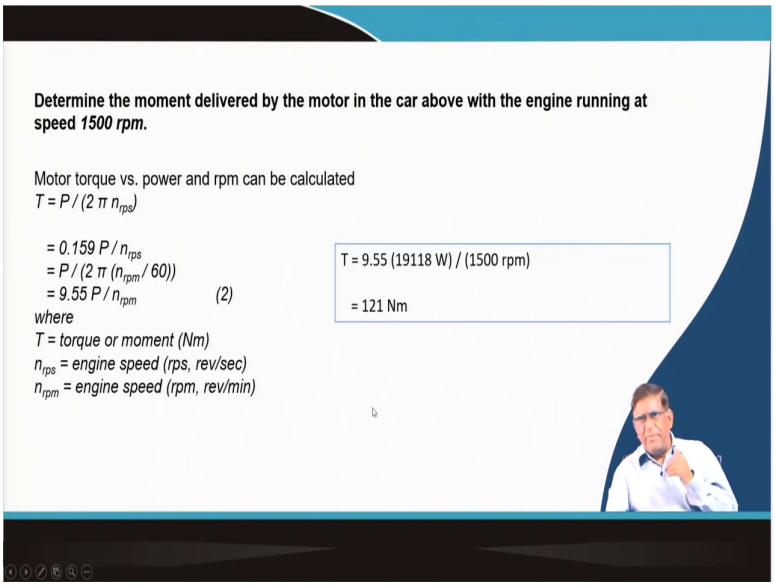

Similarly, if you are ask to determine the moment delivered by the motor in a car above the engine running at the speed of 1500. So, if you have to know that is your the torque, how much torque it will be coming; you can find out that torque or the moment can be calculated from the power, if in that divided by 2 pi n.

Now, that 2 pi n if your, the numerical and all you need to see whether it is given in your revolution per second or revolution per minute; depending on that you use and convert it and then you can easily calculate it out.

So, if you are having a particular problem, you can create it something like that; if you are given the values, you can find out how much is the Newton meter, that is what type of torque

will be coming. Because this is where exactly will be giving you the required speeds and things like that.

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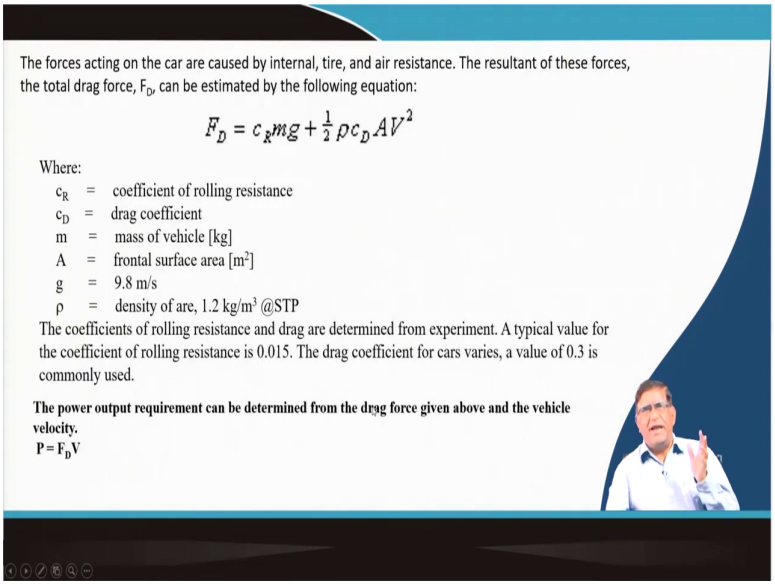

So, that is the different forces acting on the car also can be calculated, very simple by only the total resistances from this is coming from the velocity, this is from the weight; then if you calculate, that will be giving and the power equation is just a force into velocity.

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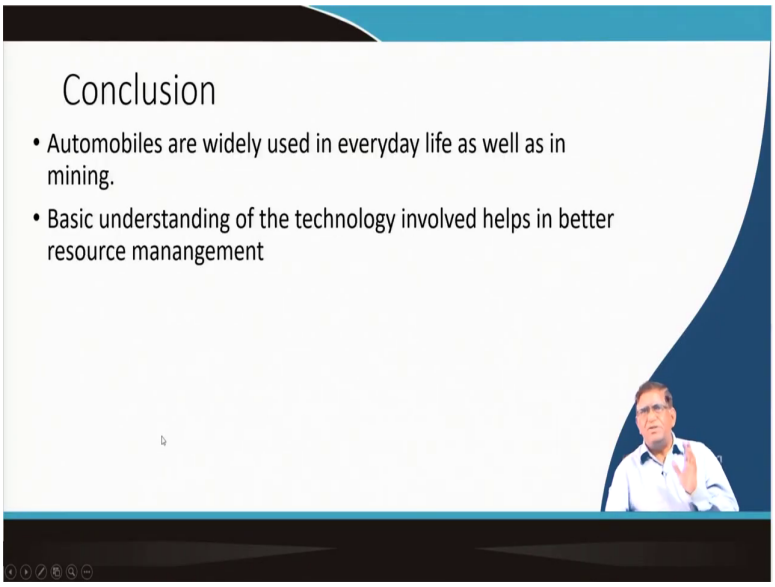

So, you can calculate this type of things and there is a these automobiles are widely used and you will have to have the basic understanding of the technology, so that we can go for studying the big mining trucks, maybe our next class we will be discussing about it.

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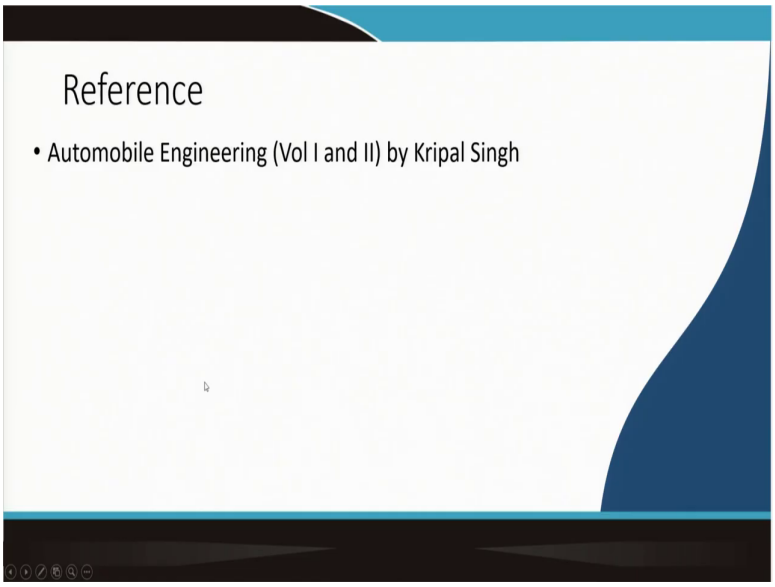

You can start reading some of the basic automobile engineering book or you can study from the net a lot of basic information's required to be a mining engineer; because a mining engineer must know the mining trucks just like your shovel, dragline and other basic face machinery, transport precision machinery.

Because transportation makes only more than 75 percent of the that operations in the mining in surface mining is transportation. So, please study this subject very carefully and try to make your own plan of study, how you will be under, how you will be working with the mining trucks.

Thank you very much.