Lecture – 57
Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part- III

Welcome students to my lecture number 57; in the series of what I said about Machinery for Land Drainage, Land Reclamation and Estate Maintenance part 3. We have discussed part 1 and part 2, and we saw that what are the different machines which are use, and what are their components, how what are the important things, which we must look into these while we are using.

Now, we will also check what other machines are there which are used for really creating a state maintenance or land reclamation. And what are the problems may come up. We have we have also tried to a demonstrate the essential requirements of these machines, while taking certain numerical examples, which will interest you, and which will help you to understand the system better.

(Refer Slide Time: 01:10)

What is drainage? Well, this has been one of the aspect. Particularly, when you think of when there are floods, lot of water comes, and you would like to drain that water. You would like to see that this water does not stay, because it is not required to be stayed at that particular location. So, this has to be drained out.

Now, how do we do that? What is this drainage then? In the purpose of land drainage system is to removal of excess water from a field, not necessary only form from a field, from wherever is the location. So, removal of excess water, so removal is drainage. You would like to drain this, there has to be you must seen you must have on the roadside. You must have seen the drains which are required, which are carrying other refuse, and sometimes the slurry of the plants, which are refusing certain things. So, those materials may be also there. So, those things we will.

What are the requirement for a drainage machinery? It say it is essential to know what do you understand by the requirement of a drainage machinery. Say to what do you want to do with that, see to get rid of the water, which is their maybe. Excavation and depression in the ground. If it is there, you would like to do this drainage. The for surface and subsurface water removal.

Sometimes this is more of the irrigation equipment is one of the irrigation equipment well. I am not dealing as such, because my other friends in soil and water engineering, they have more knowledge about water irrigation system is, and how what are the equipment used for that. But, as an agricultural engineer and farm machinery person or a person maintenance. I mean responsible for a maintenance of drainage and systems and reclamation of land, is definitely one must know something about the sub surface and subsurface water removal drainage of that.

You see in the photograph has been shown to you here. This scene is photograph here, and see the amount of water, which is over here. Sometimes if these water is of no use, it may give harbor, it may harbor lot of insects and other disease carrying bacteria, which is which we would not like to have it, and we would like to remove this.

So, may be that this is one example of it, but there could be locations, where large area is there and inundated like this, where we would like that this should get removed, and we get the plant. Supposing, we are talking of certain crop and there so much of drainage water has come up, you would like to drain that.

So, what are the machinery, excavators are also the machines, which are required for the drainage. Trench cutting machines. We would like to have longer trenches, so that water which comes depending upon the slope of the total area, then we can have trenches cut,

so that all water gets into the trenches. And then can be transported anywhere, and then goes into the groundwater and so on.

The mole plough. There is (Refer Time: 04:25) the plough, which is which enters into the at a certain depth, and then it can create a certain width of the whole, or it can create some sort of a trench, or it can create some sort of slit in the layer. Particular required for heavy soils, the locations where it is difficult to have other soils other type of equipment, which will be which are used in those soils.

Now, drain cleaning. Sometimes we do need to clean these things, because siltation will take place. There are certain the substances, which are moving through the drains with the water, those may start getting deposited depending upon the flow of water which is taking place, or flow of the whole slurry or flow of the whole material, which is passing through that.

So, in that case, they you would like to clean them. Otherwise, have the drain capacity will decrease over a period of time, and there they are used, so that is why we also need a (Refer Time: 05:24) machine, which are known as jetters. So, as such drainage is this that means, we would like to clean the and what are the requirements, how do we do, and for what purpose is the knowledge which we one must have.

(Refer Slide Time: 05:41)

Excavators. Well, we have shown you several types of excavators, several types of machines, which remove the material from one location to another location. Now, you see here that this is this is an excavator, which is removing the material, maybe it will keep the material from excavate means, and just scoop the material from one location, and try to put it some other location.

Now, it is in this the other part of it, which is here which is actually maintaining this the balance of the whole load, which is coming on to this at this location and the operator somewhere here. And these are meant for particularly you can see that may be road construction is going on, and dyke is being created. So for that, you will lead such excavators.

Construction primary drain yes, may be that you are creating say here may be drain being created here. So, for this, you will require such a thing. What are the components of this? Yes, the components of this particular excavator are the boom, which is in fact is there. Then the stick, which is connected to this. Then the bucket, which is in the here end at where the material is lifted. The cab on which the person will be there, and he will there he will be there. And a rotating platform, yes undercarriage tracks or wheels yes (Refer Time: 07:11). A many times the undercarriage tracks are more important than the wheels.

So, these are the ones which will keep the traction and maintain the location of that at that place, because in balancing of this is very important, while it is doing the job. You can see that so much of cantilever, such operation comes, when the material is scooped from here. And depending upon the type of material which is being scoop. So, we should have these tracks, which will be in a position to withstand the loading, and then it can rotate also. Yes, it is another thing, rotating platform. Because, the platform you have to rotate, so that you can take the material, and then go to some other location, so the it has a platform.

So, all movements and functions of a hydraulic excavator are accomplished through the use of hydraulic fluid, with the hydraulic cylinders and hydraulic motors. Yes, this is needless to write here, but then I can say that until unless you have the hydraulic system. You can see these pipelines and all that, all these have to be used and hydraulics power

has to be used. It is the only power which can be used for all sorts of for farm machinery. So, this is another equipment, which is largely used for these operations.

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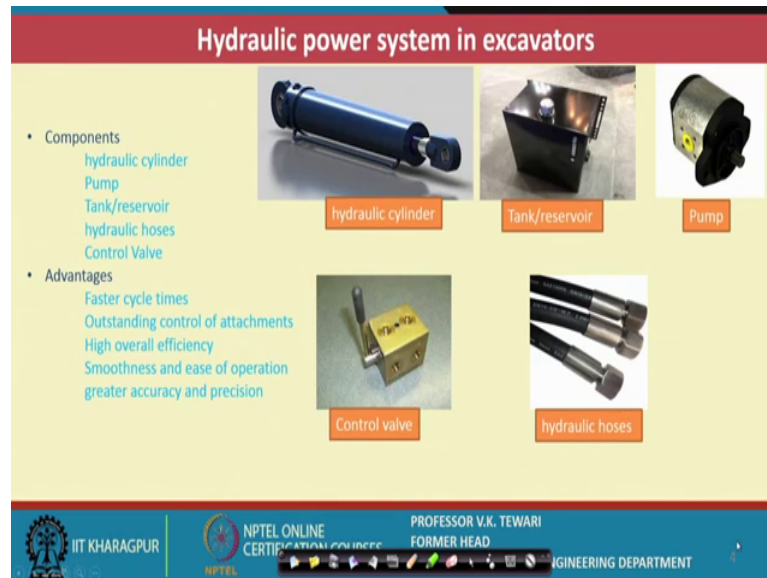
The hydraulic power system in excavators. What are the details of this, what having just an idea about these. The hydraulic cylinder, yes this is the hydraulic cylinder, which you can see when this position and this position it is tight connected. Then the tank or the reservoir for the oil. And this is the pump, which is there, in fact you might have seen that I also they show this particular similar situation, when we are talking about the hydraulic system.

And this is the in the control valves. And the hydraulic hoses, which are important. The name coming, and then hoses which are carrying the oil pressurized oil. The thickness of these and the strength of these are very important. And the nuts which are here, they are very important made of special material, so that they do not go off at very high pressure. And they sustain the load whatever the system has. So, these are the various components.

These components and their advantages. Faster cycle times. You require that the job, when you are lifting material from one to one location to another location. The job must be done faster, it is the prime important, because otherwise then it will take whole day, and the output will be less. And then the person who is hired, he will be at a loss, because he is giving you per day, but the output must be commensurate with what money he has paid for that, or the rent he has paid for the machine.

So, the smoothness and ease of operation. These are some of the advantages of these. The high overall efficiency, I mean definitely it is needless to say that with hydraulic system, what are the things which are there. These are everything which is important, and safe for the operator has to be there through the hydraulic system.

(Refer Slide Time: 10:33)

Well, it we thought that it is worth looking at a numerical and see how we better understand about such a system we are talking of a; so, let me go through this, you can have also look at the thing at any other point of time as well. But, it is worth knowing about how to add sort of a think of a problem, and then look for a solution, what should be the size of the equipment, what should be the time during, which it should be operated and things like that.

So, the question 1, this show is that an excavator to be used to construct 2.5 kilo meter long main drain. Yes, sometimes we require such drains, so one drain is required to be completed for 2.5 kilometer, this is the distance. Now, calculate the number of working day required by 3 excavators. So, how many days cutting a particular excavator will be required. And in fact, there are 3 excavators put into press into service for that.

If the working rate of a machine is 10 a meter per hour that means, if the excavation is taking place is 10 meter per hour, its working rate it should be may be that it is excavating so much deep and then per unit of time, then 8 hour per day and it works for 8 hour per day. We always take in the calculations mind you 8 hour per day, but in actual

situation, it does not happen. If you in (Refer Time: 12:08) manager and engineer safe engineer you will find that the effective time that we get is about 6 hours or so. But then, for the purpose of this particular numerical example, we would like to take 8 hour per day.

And work efficiency 60 percent. Now, the why we have taken work efficiency 60 percent is, see it is not possible to have a 100 percent, because there are several aspects into of that into the excavation work which goes. And you are not aware of what are the things which are there, when the excavation takes place.

How to reach at the location with the whole bulldozer and the other machines, which are there. And how to balance them, whether they are in proper shape or not, what sort of locations will be required for shutting down for some time and all that. So, lot of nitigrity has to be looked into, and then the total time required, so that is why if you take the whole of actual time and the theoretical time, then maybe you will get that only in the work is about hard 60 percent. But then, even 60 percent we can maintain, which is a fair amount, we can do the job economically. So, for that, let us see what is important.

Length of the drain is 2.5 kilometer that is 2500 meters. Then the number of machines, there are 3 machines which we want to use. Then working rate is 10 meter per hour or 8 hour per day. So, what and with the working efficiency of 60 percent. So, from here itself, what do you get, one machine actual one machine and its actual field capacity will be this into this, because 60 percent is its capacity, and 10 meter per hour. So, about 6 meter per hour is the job that one machine is doing.

So, 3 machines will do about 18 meter per hour, this is what is the one, which we are talking of. And actually you can also think that this the total excavation work which is being done by these 3 machines is 18 meter per hour, maybe that it could be the total volume, which is being carried could be also expressed in these terms depends on what do you want to say, but this is but to understand it is a capacity. So, one day at the 8 of 8 hours per day, so this into 8 hours is about so much per day, so about 144 meter per day.

And then for drain of two hundred 2500 meter drain, you can say that it will take about 17.36 days. So, roughly about seven and half days seventeen and half days or about 18 days, you can you can be comfortable with the operations. Because, then if somebody is giving you machines for 17.5 days or 17.36 days that it comes to be, then I think he will

charge you for the whole day as such. So, we can easily say instead of this 17.4, you can say that 18 days will be required very safely we can say this part of it.

So, as such if you are using an excavator, and you know the requirements of your job with the proper working time etcetera, you can work out and see how do you appreciate the job, which an excavator does in the system, which has been shown here. And the problem is very (Refer Time: 15:38) into the action ok. Let us go to the other part of this is lecture.

(Refer Slide Time: 15:48)

Trench cutting machine. You can see here that trenches are being cut actually. You can see that this is this is the trench the there is hole here, and the trenches are being cut. The cutting tools attached to a wheel or endless chain. What is this, in fact there is a endless chain, and then there is a cutting tool. The machine stands centrally along the line of proposed drain. While the machine you can see here that this is their, centrally it is standing in the line in which it has to do the job. And excavated material deposited at the sides. You can see that material is deposited on these sides. This is the material, which has been deposited on the sides, when it is being excavated or the cutting is made for the trenches.

Digging operation never interrupted. Well, generally when we are talking of this interrupted or not interrupted, it depends on the power source, and depends on the capacity of the power source, and depends on the depth at which you are working. The

efficiency twice than backhoe, yes. So, efficiency of this you have been system or this equipment is slightly better than the other one.

Now, maximum digging depth up to 3 meters, it is a very huge amount of 3 meters, you can go up to this. The normal trenching speed 150 to 300 meter per hour, depends on what is the type of the material, what is the design of the blade, what is the material of the blade. And how much is the power of this source which is there, and how much is the width of that, so that you will know how much is the width of the trench which has gone up to 3 meters or so cut. So, trench width or given point 0.2 to 0.6 meters. So, you can see here that this is the width. So, depending upon these, in fact the cutting machines power and its efficiency will depend on that.

(Refer Slide Time: 17:49)

Another problem. We take a problem on this trencher itself, and try to understand where we are a trencher is used to construct a drain in the area of 10 hectares. We are taking a 10 hectare minimum area, maybe 500 meter by 200 meter and cross, with working speed of 4 kilometer per hour with 10 meter drain spacing, mechanical efficiency of the trencher is 75 percent. Calculate the number of working hours to construct this drain, it is a wonderful problem actually. It is a very practical problem. Because, as an agriculture engineer, you will be faced with such situations only, and then you need to look for the machines, you look for the number of machines, you look for the size of the machines, when you have to do these jobs.

So, as such if you if you see what are given here, the width is W 200 meter, it is it is given here. The length is 500 meter. This is the area, because that areas length and widths are given over here. Spacing. Now, spacing is 10 meter drain spacing. This is very important. What is the spacing of the drain, it is about 10 meters. So, as such so the drain length if you can use this, so you get that this is the total drain length. And it depends on how much is the total width, and you can say that there is a spacing of 10, so this by this into 500, 500 is the lengths. Accordingly, you can get about 10000 meter is the drain length that you are going to get.

Then working speed it has been given already 4 kilometer per hour, so this in change in to, so that the units are made proper, we can make 4000 meter per hour. And so, a with the efficiency of 75 percent that is 0.75 here. Then the working hour, which is required is a simple calculation, which comes about 3.3 hours.
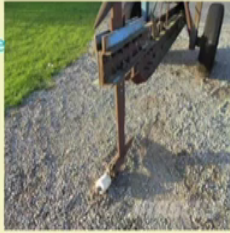
Now, as such theoretically it comes to about 3.3 hours, but then you can have you will have to pay for that person to the 4th hour as well until unless there is a relation. And there is a may be a contract of exact timing, otherwise you will have to pay him about 4 hour or so, because this is job which we have, there will be lot of lost time. Even the trenchers efficiency which is 75 percent is a quite higher one, we had talked of that is about 60 percent or so.

But, when we are talking of the these, one has to look into the details of these. Well, so as such this particular problem enlightens, you have to learn about what a trencher is and how it can create a system by which we can understand better about this particular equipment.

(Refer Slide Time: 20:52)

Well, mole plough. Well, used to make mole channels here, you can have a look at this. This is the one, which is the length of this is connected. And you can see that a bullet or mole attached to the vertical tine, blade drawn through the soil, creates a mole channel. Now, this portion, which is connected here is the one, which creates the width of the channel.

Mole is followed by an expander, which expands and strengthens the channel. So, this mole this is the one, which we will expand. Then heavy very heavy clay soil in a moist condition, used on very heavy clay soils in moist conditions, now where this is a requirement for this mole plough. We will see the whole attachment of this to the system, and this is the length at which from the top, and this is the row here. And this side is the one, which will make it slightly wider.

So, the surface on the ground needs to be free from irregularities or contour. This is important here, for operation of this in that the ground must be a must not be irregular. Mole range diameters vary from 50 to 100 millimeter. And the insulation depth 300 to 600 millimeter. These are some of the specifications are some of the information, which we would like to give you for this particular aspect.

And these are also created for small channels, particularly we are talking with respect to drainage machinery. So, remember that these will help us in draining the moisture, which

is there or the water which is there, wherever is the location. So, depending upon our requirement, we can use this machines.

(Refer Slide Time: 22:50)

Drain cleaning. Yes, this is the one, which I in the beginning I said that sometimes when the material is flowing through the through the drains, if the material if it does not role of along with the water, initially it will be all together maybe a slurry sort of thing. And added transports over a period of length on the in the channel, you will find that at some location depending on its velocity as it moves, it will start their losing some of its particles. And that will start you can say a silting and losing the material, and which will create sort of a base and thickness into the drain, and that we will reduce the capacity of the drain.

And once we have the time will come, when this drain will be will be virtually choked. Now open drains are no problem, but even close drains will create problem. So, we would like that there should be proper cleaning of that. So, for proper cleaning of that, there is a special type of equipment which is your which is used. This is the tile drain from silts and sand.

And components are reel has in having has about 400 meters of plastic hose. Now, you can see here that the hoses are there, and this is the reel, which has so much of this, so that you can pull this the rubbish or whatever is the a slurry which is there. It can be and it has to be tractor driven deliver 60 liter per minute at 40 bar, when driven at 500 rpm.

So, you can see we are still taking power from the from PTO, and then this pipe which has been rolled up it helps in cleaning of that. It is very essential until unless you clean, you will find that over a period of then this will deposit and the flow will decrease.

And hence this siltation will virtually you can see that the proper drainage will not take place, the drainage quality will decrease, and the drainage efficiency will come down. The size of the drain will also reduce, because then this deposition takes place, so the height will decrease. And actually, they should volume which will move through that will also now come down.

So, with these, I think we have talked of all the various types of machines, which are required for land, drainage reclamation and then estate maintenance. And we have tried to give you some overview of the equipment various types equipment, their specifications, and what are the special requirements for them.

We have stressed upon the that the power used for these equipment, particularly the hydraulic power. One must have a clear idea about this the engineer must have an idea that at what pressure this should be maintained, what revolve should be working always, otherwise there is a chance of the pressure going high, and then you may have some problems.

So, as an engineer, you must be clear about all these, particularly the power source, which we are talking off, and then the types of machinery. A proper selection of machinery will help you in doing the operation efficiently, and the economizing on the cost of operation, rent of operation, and the total use of the machines and things like that.

We know that with this information, some idea has been imparted to you. And you will have several questions, when you a common contour such machines, we would like to answer as in when do you require. But, then for the time being, I think we would like to close this chapter here, and look for what you will look forward to your questions in the in future.

Thank you very much.