Irrigation and Drainage
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Lecture – 43
Drainage System: Structures

Welcome friends. On the lecture number 42 we were discussing on the Drainage System on the pipe drain. So, mostly the pipe size and so the drain pipe we were discussing. Now, in this lecture we will be talking about the Structures ok. So, what kind of structures really we will be using in drainage. So, we are going to discuss those so, ok.

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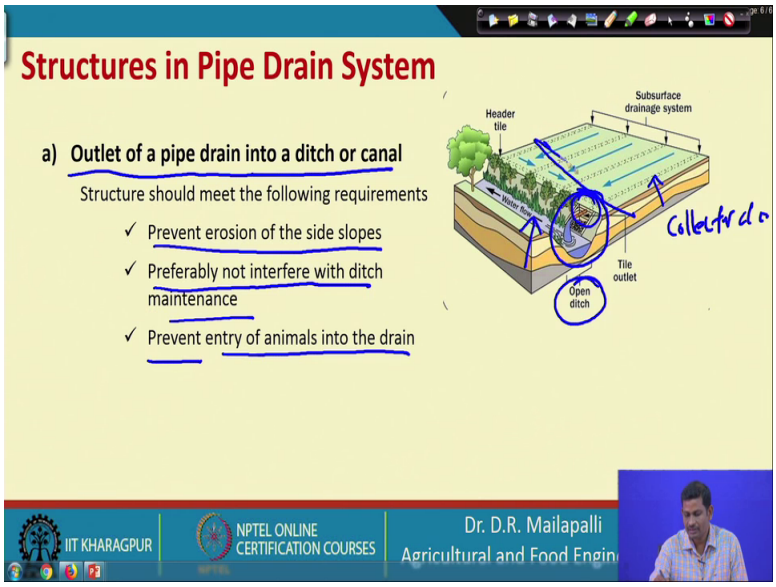

So, the structures in pipe drainage if, we see this; the first thing is the outlet of the pipe drain into the ditch or canal. So, if you see here, so this is the outlet. So, is the basic purpose is to prevent erosion of the side slopes and preferably not interfere with the ditch maintenance ok. So, this is the ditch. So, it should not interfere with the ditch maintenance and it prevents entry of animals into the drain. So, these are the main you know functions, before you know constructing the outlet of the pipe.

So, clearly if you can see the outlet here. So, these are the collector drains right, these are the collector drains and then you have an outlet ok. So, this is the singular outlet because the collector is I mean the collector is directly opening into the open ditch ok. So, if it is a composite so; that means, the open ditch I mean all the field drains are all the field

drains or collectors field drains are connected to a common collector ok, so, then from there, so this will be connected to the outlet that is a composite.

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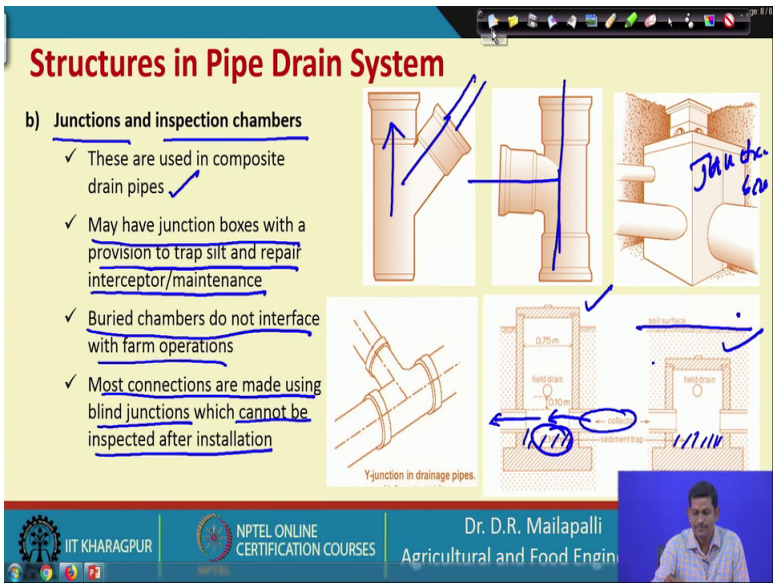

So, and the second is a junction boxes; so, junctions and inspections or inspection chambers. So, these are used in composite drain pipes because, if you see in composite, so all the collector I mean the field channels or field tiles are connected to a collector right with different joints. So, may have junction boxes with a previous a provision to trap silt repair interceptor or maintenance ok. So, here, so these are the junction box.

Suppose so, this is the field drain and it going here and then you have collector. So, this kind of joints be used in herringbone kind of you know, structures. And then you have the parallel system ok. This is called a T and you have this is called a junction box right, this is a junction box. So, the junction box if you see here, I mean the closely, so this is I mean above the land surface and this is below the land surface soil surface. So, the advantage of junction box installed below the land surface is, it does not interfere with the forming operations ok. And here if you see, so, about 0.3 meter is left you know below the collector. So, this will be this portion will be used to collect the sediments, so, like this is called a sediment trap.

So, whatever the sediments which is present inside the drainage water, that will be settled here. So, then the clean water will leave the junction box ok. So, then buried chambers do not interfere with a forming operations just like here. And most connections are made

using blind junctions which cannot be inspected after installation. So, here so, mostly the blind junctions, the blind junctions are difficult because, once they installed that will be buried inside. And, it is difficult during the you know maintenance and it is difficult for inspection purposes ok.

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And then sometimes, if you see the junction boxes so big like, if you see here these are the junction boxes clearly we can use the most of the urban drainages like; the big-big junction boxes can be used to dispose the water, I mean waste water here.

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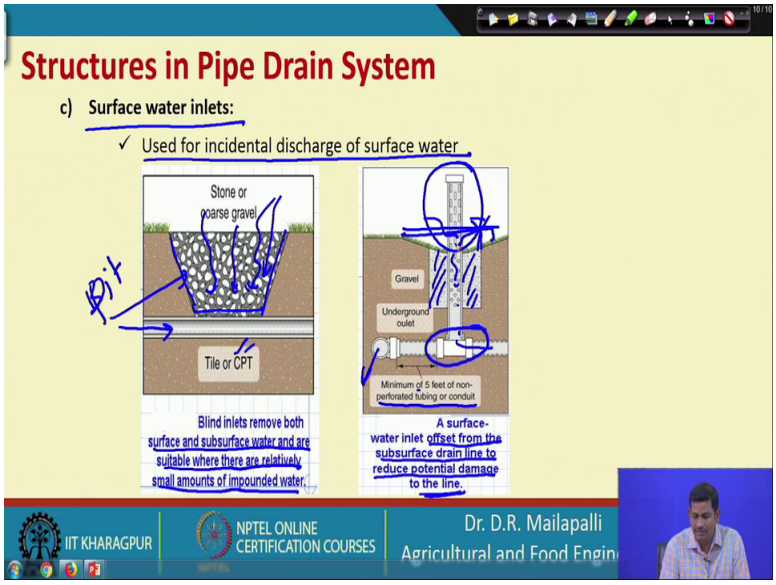

So, structures in the pipe drainage system, so, the c the surface water inlets. So, outlets and surface water inlets. So, this is mainly to facilitate you know, to easy infiltrate water the drain water into the tile or pipe ok, so, the tile pipe; so, used for incidental discharge of surface water.

So, this basically the pit ok, so, this is the pit and which has a stone or gravel you know the rectangular pit, which consists of a you know stone or gravel, which is because that will help in infiltrating you know, the water into the tile or CPT is the Corrugated Pipe Tile drainage ok. So, here the blind inlets remove both surface and subsurface water and are suitable where there are relatively small amounts of impounded water. So, this is very important, when there is a of water is impounded the small amount. So, one is to remove you know excess water from the root zone and as well as from the surface. So, both it will do both purposes.

So, here the other example sometimes you know this will be half the ground. So, that is a surface water inlet offset from the subsurface drain line to reduce potential damage to the line ok. So, here so, this will be little bit away from the main drainage system and then there is a gravel and this is underground outlet. So, this is a minimum 5 to 5 feet of non perforated tubing or conduit ok; this one is non perforated tubing or conduit. So, the water which is stored here or impounded here, that will be passed through the you know pores and enters through this here and then this will be removed. So, this will be removed through the drain pipe ok.

So, here also the advantage here is, so, the water which is pounded on top surface can easily you know escape through the; so, if you have depression here right if you have a depression here, so, water can easily pass through this. So, pounded water can easily pass through the perforations and then the extra water also will enter through this and finally, through the drain pipe.

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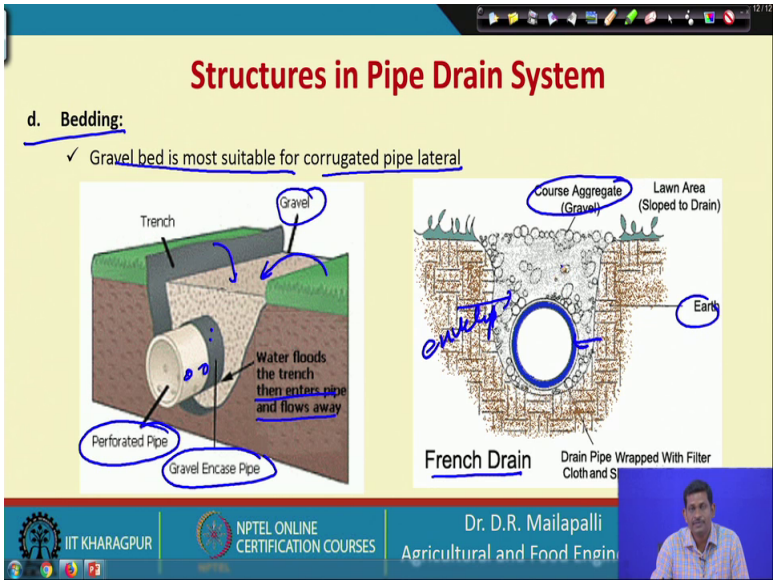

So, this is a surface water inlets. And then the other one is known as the bedding ok. So, the bedding so, the gravel bed is most suitable for corrugated pipe lateral. So, if you see this, so, this is perforated pipe right, you see the holes here. And then water floods the trench then enters the pipe and flow away. So, what happened this is a gravel so right.

So, water which is entered through this to the gravel and then gravel encase pipe. So, this is gravel encase pipe, this is kind of you know which is, which protects the perforated pipe from the gravel pressure ok. So, then there is a French drain called where this is the main drain and then the gravel or course aggregates. This is the lawn area and earth. So, this is another you know, the bedding kind of things once you install the pipe drainage, so, you will be constructing the envelope this is all called envelope right. So, envelope has a few material properties like; it acts as a filter media and the and also it protects the, protects from compaction of the pipe, of if any physical or mechanical stress acting on the top ok.

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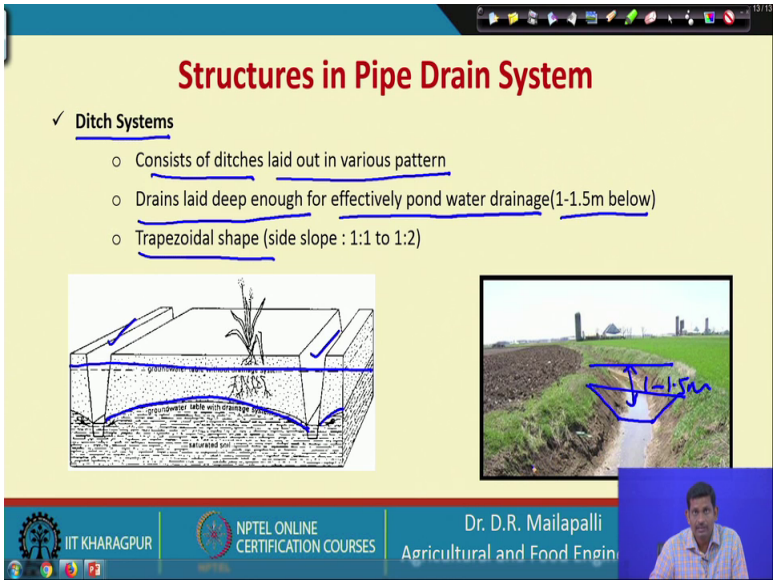

So then there is a ditch system. So, the ditch systems generally, what happens the open ditches. So, if you see in this picture, so, this is the water table right and this is sorry the initial groundwater table. And, if you want to remove water below the root zone here right the open ditch system, so, these are the 2 ditch ditches that will take away the water or drains the water from the root zone. So, the ditch system consists of is laid out in various patterns.

The drains laid deep enough for effectively pond water drainage that is, 1 to 1.5 meter below. So, the ditch will be constructed you know, 1 to 1.5 meter below the ground and mostly the trapezoidal shape will be used in case of grass watershed. So, like this is the trapezoidal if you see clearly right. So, the trapezoidal shapes are generally used for ditch systems ok, in order to get more stability.

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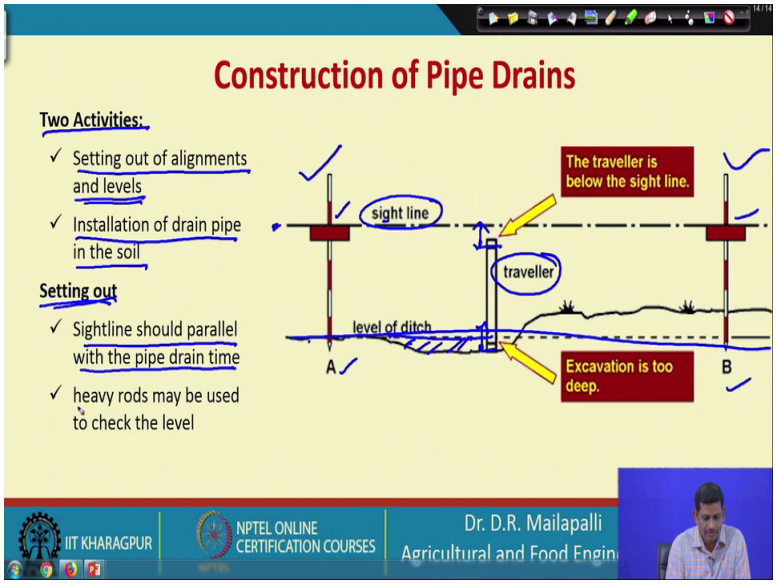

So, then the next is construction of a pipe drainage. So, construction has a two activities here; the first is setting out of alignments and levels. So, because the pipe drainage are requires very well grade or slope so, that the water which is drained from the surface or root zone will be well drained to the collector drain ok. So, then installation of the drain pipe in the soil; the first one is make the soil level then install the pipes. So, how, to this alignment is very important. The setting out so, that is called alignment. So, here if you see in this picture clearly right. So, there will be two ranging rods this is called ranging rods, this is I mean the rods will be used in surveying.

So, the first initially so, these two ranging rods are installed in the ground ok. And then, so, there is a sight line, there is a slight line, so, for example, here a person is watching. This is a based on the particular you know the particular slope, the particular slope. So, these two points are fixed. And then this is the traveller, one guy will be holding this rod right and from here to here from A to B. So, he will be walking through and setting up here ok. So, for example; this is the mark right, this is these two are the marks ok. So, at this point for example, here, so, this is the valley ok, this is a valley. So, we need to add soil right, we need to add soil to bring this ranging this traveller road to the sight line ok, to the sight line.

So, like that, there be cut fill method. By using that you will be knowing, where to be cut and where to fill the soil; so, that the required or desired slope is maintained ok. So, once this sightline should be parallel with the pipe drain line ok. So, the heavy rods may be

used to check the level. So, this are the travelling rods and all other rods are used to check the I mean the, the grade. So, the next is installation.

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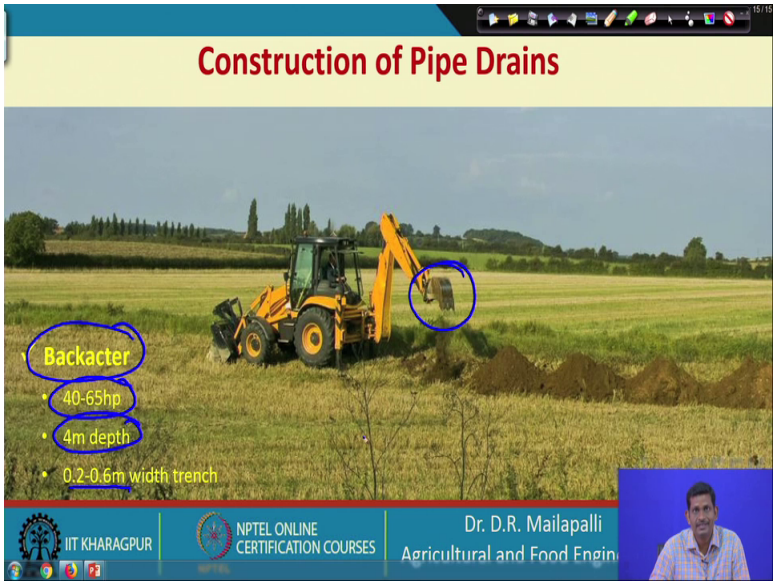

So, the construction; so, once the land is levelled and then the pipe drain system is demarcated, so, then, you have to use the missionary to construct or excavate the trenches to install the pipe drains ok.

So, here for example; the backacter, so, the backacter it is kind of heavy bulldozer, if you see here. So, this portion so, this will be used to excavate the soil for the from the and to achieve the desired depth ok. And so, the mostly these backacter will have 40 to 65 hp and 4 meter deep it can excavate and 0.42 to 0.6 meter width of trenches it can make ok.

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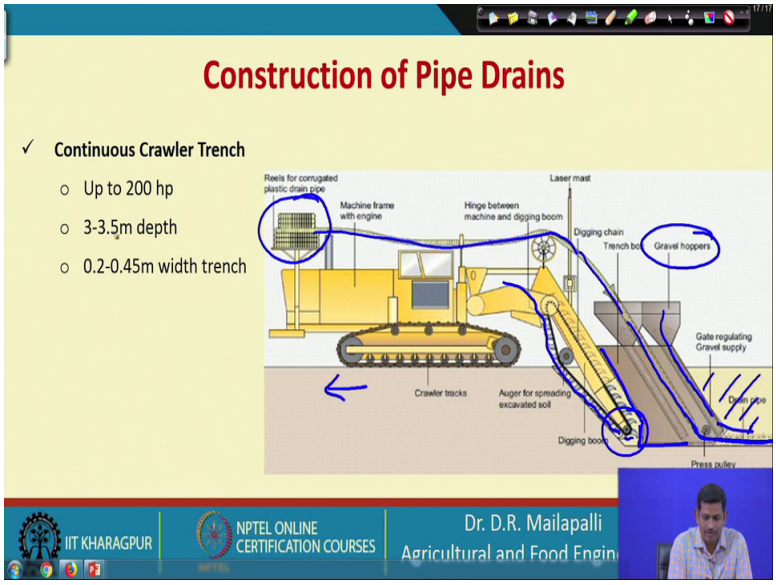

So, the next is the continuous crawler trench, ok. So, this is up to 200 hp and it can make 3 to 3.5 meter deep trenches and 0.2 to 0.45 meter width of trench ok. So, if you see here, so, the continuous crawler trench will have this kind of you know, the crawlers the crawlers. So, then so, this is the corrugated drain pipe ok. So, look at this, the corrugated drain pipe is bounded or to a vertical shaft and then from there this is all the way conveyed to the trench and then it is gets installed.

So, then major things are here; this is the blade ok. So, this is the blade the moment it goes further right. So, the trench has a cutting tool, that is going to cut and the same time the pieces which are coming from the cutting, are going to conveyed through the conveying belt and removed or thrown outside right through this and it is thrown out side. And then, so, this will be every time. So, this portion will be freed and cutting will be taking place.

So, once that is done and there is a gravel hopper right. So, so then yeah, so, next is the reel I mean the corrugated pipe will be installed and simultaneously the gravel hopper force the gravel and similarly this envelope will be made. So, this is a kind of simultaneous operation both cutting, installation of the drain pipe and then filling the drain hole with the envelope material. So, all three operations will be taken place using the crawler trench here and then yeah.

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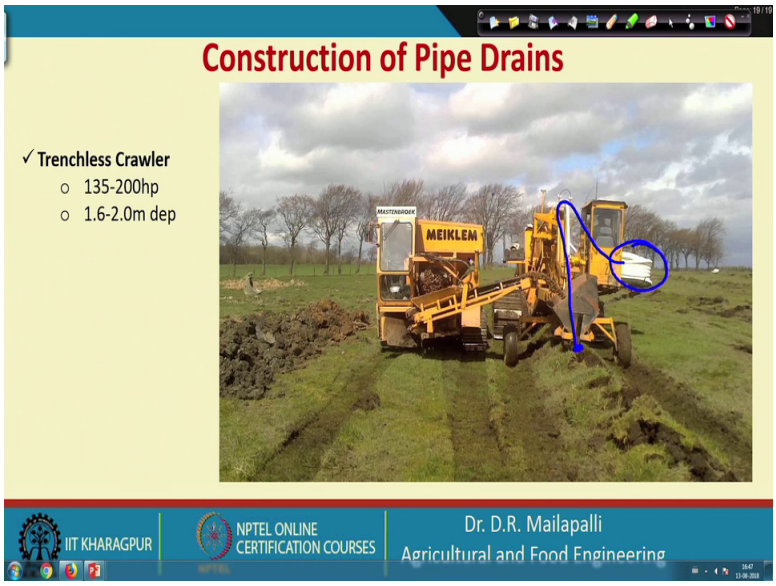

So, the next is trenchless crawler. So, this is also very popular because, in trenchless crawler it does not make any trench ok. So, and it has 135 to 200 hp and 1.6 to 2 meter deep ok, this is the deep And then here if you see, so, this is the cutting tool ok. So, this is the cutting tool. You do not see any trench here, this is all underground ok. So, there is no trench is seen.

So, the pipe, so, this is corrugated pipe. So, this will be gone inside right, one this tool makes a open or opening, so, immediately simultaneously on this trench will be installed insides sorry the drain pipe will be installed, without opening any trench ok. So, this is the advantage of this trenchless crawler.

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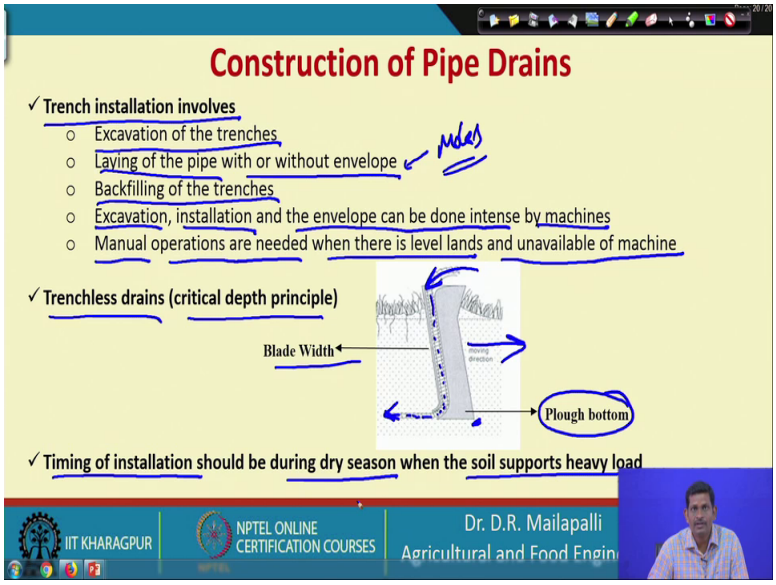

So the next is trench installation, which involves excavation of the trench trenches. The first one is excavation opening the soil and laying of the pipe with or without envelope. So, laying of the pipe with envelope if, the trench is opened without envelope if, the if it is a trenchless ok.

So, mostly, without envelope is in case of moles right mole range. So, you do not required to add any envelope because, the clay soil which is surrounding the pipe, can access you know the envelope. So, the backfilling of the trenchless trenches then, after the once it is opened installed then, then, the backfilling, then excavation, installation and the envelope can be done in tense by a machines that, we have seen in the previous pictures. And manual operations are needed when there is a level hands level lands an unavailable of machines. So, if you do not have machines available and the land is flat, so, you can use by hand tools, you can make trenches and install the drain pipe.

So, the trenchless drains, the critical depth principle, if we use that what happens here, so, you have seen in the previous slide how the trenchless crawler right, so, that works. This is a plough bottom it contains a cutting tool or the plough right and then. So, this is what you call the corrugated pipe. So, that will go all the way through the slot, which is present inside the plough I mean the cutting tool ok. So, that will be laid off and this is the moving direction. So, the tool will move this direction and the I mean the corrugated pipe will laid in this direction ok. This is the blade width and this is the cutting tool ok. So, this way I already explained this figure the cutting mechanism previously.

So, mostly the installation timing should be during dry season, when the soil supports heavy load because, here we will using you know heavier equipments, we are using heavier equipments, the soil should be I mean favourable for traffic ability and also workability.

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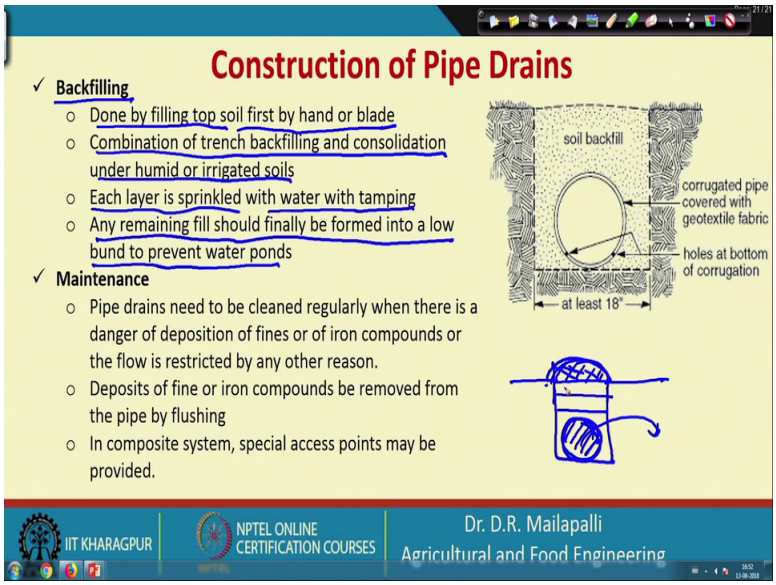

So, the next is construction of pipe drains. So, and then backfilling, this is very important. So, once open the drain and install the pipe to the backfilling needs to be done. So, this is mainly done by filling top soil first by hand or a blade. So, first is the top soil, then the combination of trench backfilling and consolidation, so, then after that backfilling consolidation, so under humid and irrigated soils.

So, each layer is sprinkled with water with tamping. So, if the soil is too much dry, so I am I mean backfilled compact and add little bit of water and then add the soil and compact it. So, any remaining fill should be finally, be formed into a low bund to prevent water ponds. Suppose so, this is the trench right and you fill the soil, you fill the soil, you fill the soil and since this much you know this much soil is still left in the ground. So, that can be that that can be put as bound on top of the ground ok, on top of the ground. So, what happen in the future, so, this will help in you know adjust in the soil because, it will be compacted anyway in the future. So, this will go down again.

So, the maintenance; the pipe trench need to be cleaned regularly, when there is a danger of deposition of fines or iron compounds or the flow is restricted by any other reason. So,

you will be kind of a you know, watchdog always looking at the flow drain out flow and see whether the flow is really taking place or not. If the flow is not taking place and there is a problem inside the drainage system, so then that needs to be maintained or cleaned out, any dirt material or anything. So, the deposits of fine or iron compounds be removed from the pipe by flushing. So, flushing is the method by using that we will be removing the fine particles and iron deposition.

So, in composite system special access points may be provided. So, composite system it is difficult to because, it is under underneath the ground and also lot of joints. It is difficult to you know; go through each and every joint to see what is going inside the pipe drain system. So, that is why there are special access points are provided in case of compound systems.

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So, the next is so, this is the you know, system used for cleaning the drain pipes. So, for example; here if you see so, there is a there is a flashing truck. So, that will be that will have a pipe right. So, which has you know the water flow to the flush out the. It contains the jet you know, jetting nozzle at the front and the jetting nozzle goes into the drain pipe. This is you can see this is kind of a access point special access point.

So, through this the jet tool will be introduced inside the drain pipe. And then with a high velocity jet, the I mean, the flush or the particles which are deposited inside the pipe will

be flushed out into the drain pipe ok. So, this is the cleaning of drain which is taking place.

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So, some of the useful videos are available in YouTube. You can go through these videos, so and this will help you how the installation of drain pipe in case of you know, backacter and then trenchless crawler ok. So, all those things are available. You can also watch some other videos that is available in YouTube. So, this will give an idea, how the drainage pipe or the tile drain or corrugated pipe is been installed underground and how that is been connected to the ditch system ok.

So, this is all about this lecture and thank you so much. And so, we will move on to the next lecture in which, we will be talking about the hydraulic principles drainage system.

Thank you so much.