Urban Utilities Planning: Water Supply, Sanitation and Drainage
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Module - 10
Sewer appurtenances
Lecture - 50
Laying of Sewers and Utility Corridors

Welcome back. In lecture 50, we will talk about Laying of Sewers and Utility Corridors.

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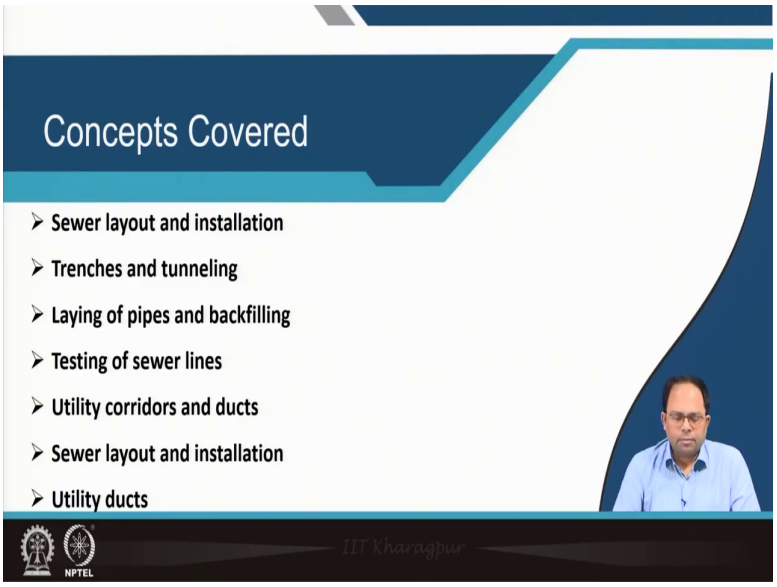

The concepts covered in this lecture are on sewer layout and installation, trenches and tunneling, laying of pipes and backfilling, testing of sewer lines, utility corridors and ducts, sewer layout and installation, and utility ducts.

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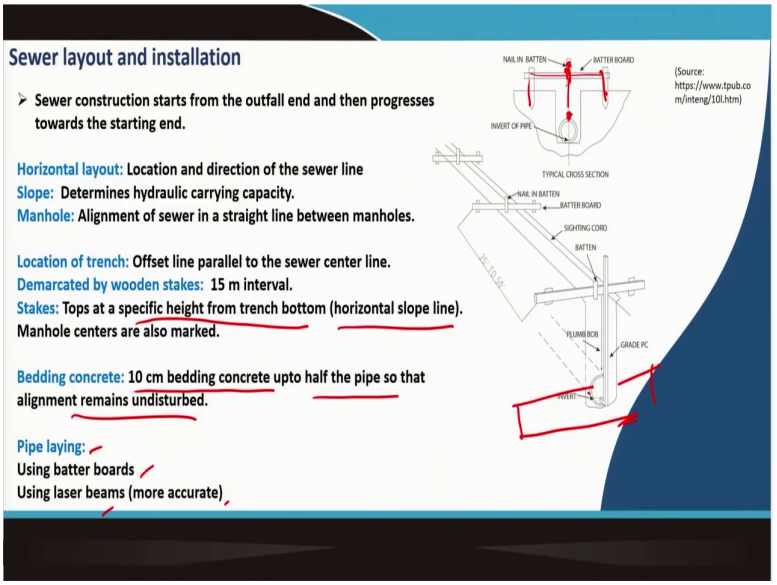

Sewer layout and installation

Sewer construction starts from the outfall end and progresses towards the starting end. So, first we have to design the outfall and from there we have to lay in the lines and then we have to go to the starting end. So, that should be the progression of the sewer construction.

Usually, we are concerned about the horizontal layout, which determines the location and direction of the sewer line. We have to know the slope because that determines the hydraulic carrying capacity of the sewer. Finally, manholes, at every alignment or depth change of the sewer. Usually in between two manholes, the sewer is aligned in a straight line. So, these are the three things that is required.

Once that is done, we have to determine the location of the trenches to be dug, where we will lay our sewer lines. This is done by creating offset parallel lines from the sewer center line and this is usually demarcated by wooden stakes at 15-meter interval. Manhole centers are also marked along with the sewer center line. We also try to mark the trench bottom as per the the horizontal slope or the invert level of that sewer.

This is usually done using two techniques: One is called a batter board, other is using a laser beam which is more accurate. This actually helps us in laying of the pipes or determining the

invert level of the pipes. But before we do that, we also need to provide bedding concrete at the bottom of the trench.

The standard design of the bedding concrete is 10-centimeter bedding concrete up to half the pipe, so that alignment remains undisturbed. The pipeline is thus properly secured into this bedding concrete, and the slope is also maintained.

In this particular image, we can see the batter boards along the trench and top line.

Batter boards are supported by two stakes at the sides of the trench, and within the batter board the center point is marked using a nail. From there, we drop a plumb bob (a string connected with a weight) that actually helps us in determining the depth of the invert from the top of the sewer line.

So, based on that we can understand the profile of the sewer line or the longitudinal profile of the sewer line, and accordingly we can keep digging the trenches or adjusting the trenches or keep doing the bedding concrete and determining the invert levels of the sewer pipe.

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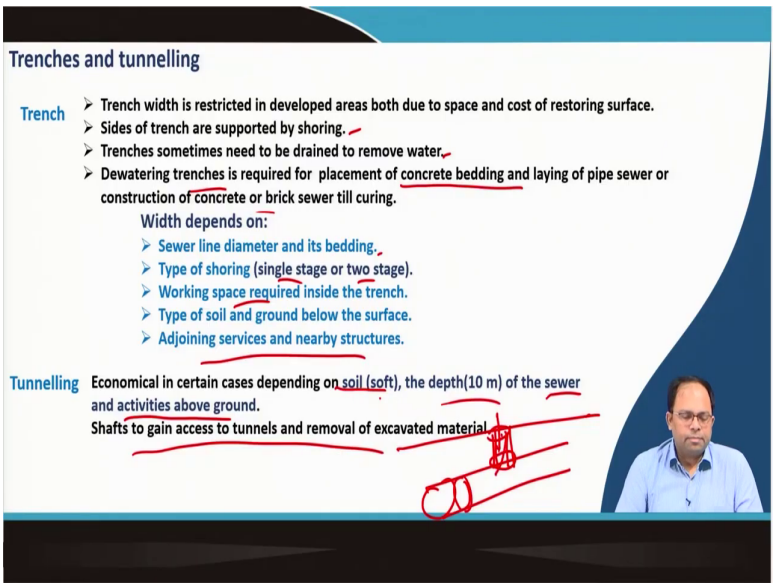

Trenches and tunnelling

There are two ways of laying sewer lines: via trenching or via tunneling. The trench width is restricted in developed areas both due to space constraint and cost of restoring surface. The

trench is made as small as possible because the more we cut, the more we have to fill, and more the surface has to be restored which will increase the cost. However, the size of trenches depends on many things. First of all, trenches have to be supported via shoring for which there are different techniques. Trenches sometime needs to be drained to remove water because whenever we dig, if the groundwater table is at a higher level, then it gets filled with water and for that we need to do dewatering of trenches with the help of pumps. This is pertinent because we have to do a concrete bedding for laying of pipes, and to ensure that the concrete is properly cured, we need to dewater trenches.

So, the width of trench depends on many things. It depends on the sewer line diameter, the kind of bedding used and on the type of shoring. The different kinds of shoring used are single stage storing and two stage shoring. The width of trench also depends on the working space required inside the trench. Then, type of soil and ground water below the surface also determines the width. Adjoining services and nearby structures also determines the size of the trench.

Tunneling is taken up in case the depth is higher than 10 meters, and the soil is soft, which does not support shoring or it may result in caving of the trenches. It also depends on the activities on ground and if these cannot be disturbed, then also we will go for tunneling. So, whenever we have tunnels, we have to create access shafts to the tunnel to gain access and for removal of excavated materials.

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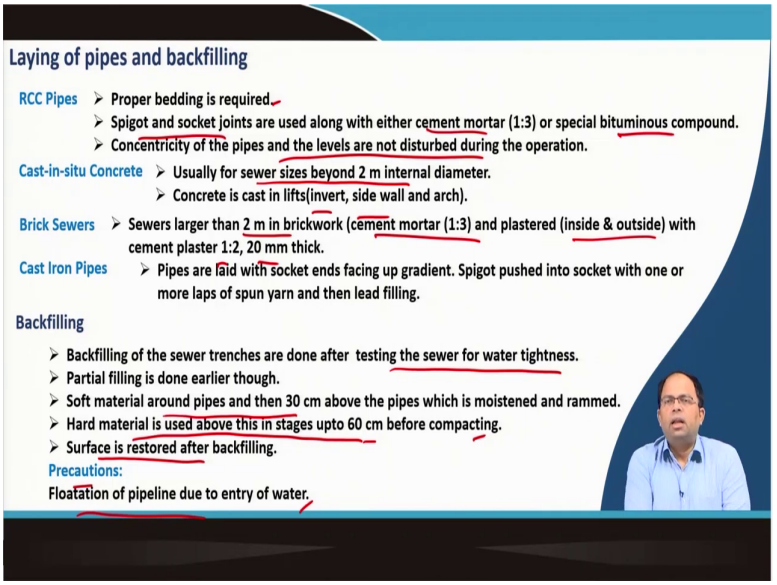

Laying of pipes and backfilling

Different kind of pipes could be laid as storm water sewers such as RCC pipes, cast-in-situ concrete pipes, brick pipes and cast-iron pipes. For RCC pipes, we need to provide proper bedding with either spigot and socket joints used along with cement mortar (1:3) or special bituminous compound. The concentricity of the pipes and the levels are not disturbed during the operation, so that it is laid properly.

Then we have cast-in-situ concrete pipes which are used when the sewer diameter is more than 2 meters. Concrete is cast in lifts; first do the invert level, then the side walls, then the arch and then the top arch. So, gradually different levels could be cast for this particular concrete pipe section.

The brick sewers are laid when the sewers are larger than 2 meters in diameter. Brickwork is laid in cement mortar of 1: 3, and these are plastered both inside and outside with cement plaster 1: 2 and these are 20 millimeters thick.

Lastly, we have cast iron pipes. These pipes are also laid with spigot and socket joints.

So, once we have laid in the pipelines or we have constructed the pipelines in situ, then the next job is to backfill. And then we do the surface and complete this particular task. Initially

partial backfilling could be done, but full backfilling is only done when the sewer has been tested for water tightness. Partial filling actually helps us make the pipeline fixed, so that there is no movement of the pipelines, and the invert levels are also fixed.

Soft material around the pipes up to a height of 30 centimeter is first put in and then they are moistened, and rammed, and solidified, and after that hard material is used for a height of 60 centimeter and then compacted. So, this is raised to height of 60 centimeter. Once compacted, the surface is restored.

If the groundwater table is high in this particular area, we need to check that the pipelines do not float due to entry of water. So, if that is the case, then the ramming and backfilling, has to be done following some other methods also.

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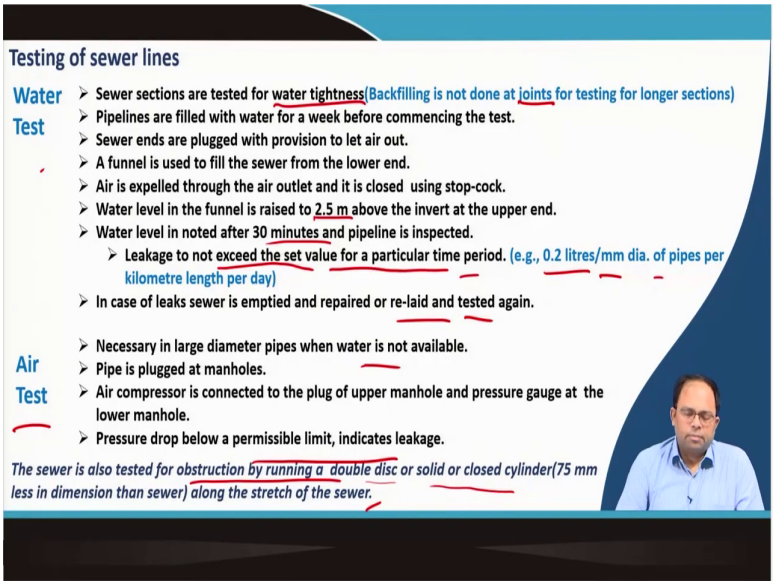

Testing of sewer lines

Before the backfilling, we need to carry out certain tests. Only partial backfilling is done before we conduct these tests. The sewage sections are primarily tested for water tightness, and backfilling is not done at the joints and it is left open.

The pipelines are filled with water for a week before the test is done, so there is time for the water to actually move into every corner to check for leakages. Then the sewer ends are

plugged with provision of air outlets. A funnel is used to fill the sewer from the lower end so that we can raise the water to a particular height of around 2.5 meter in the funnel and we leave the water there for 30 minutes and then check the water level in that funnel. If the water level has gone down, then there is leakage. But there is a certain volume of leakage in the sewer pipeline which is expected. For different diameters of the pipeline, for different time period, there is a value for allowed leakage. If it is more than that then we should be concerned, and then we have to actually re-lay the pipeline and then we have to test it again. So, the allowed amount of leakage is around 0.2 litres per millimeter diameter of pipe per kilometer length per day. If it exceeds than that, then we have to again re-lay the pipeline.

In case it is a large diameter pipe line and water is not available to test it, we can do an air test and that is when the pipe is plugged at the manholes. We use an air compressor to plug the upper manhole and then the pressure gauge is provided at the lower manhole. The pressure drop below a permissible limit indicates leakage.

However, the water test is more conclusive. Whereas in an air test there may be chances of air leakage from many ways. Sometimes, in case water is not available this is the only way that we can use to test pipes.

Finally, the sewer is also tested for obstruction. The sewer is laid manually and there are chances for some materials are left inside or there may be blockage. We have to check for the same before we seal the entire trench. For this purpose, we can roll a disc or a solid cylinder of 75-millimeter diameter, less than the diameter of the sewer. If it passes on easily from one section to another, one manhole to another, then it shows there is no obstruction.

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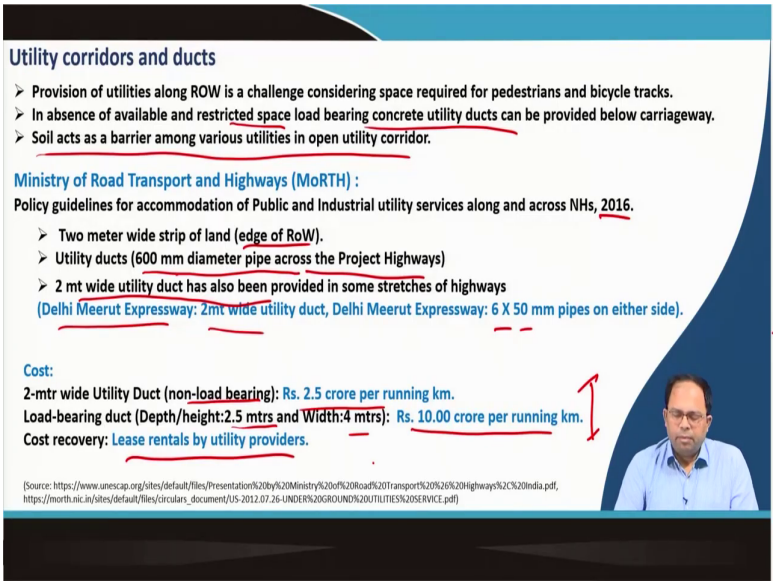

Utility corridors and ducts

Utilities include, water supply, storm water, sewer lines, television lines and power lines. So, there has to be space reserved along the ROW for laying this utility networks but finding space is a challenge. In that case, we may think of some other way of laying these utility lines.

The normal method is whatever space is available at the side of the roads, that part is left open and we can lay the lines at certain distances at certain depths in that particular zone. But if the space is not adequate, then the alternative is to go for utility corridors or ducts.

So, in the absence of available and restricted space, load bearing concrete utility ducts can be provided below carriageways, and soil which acts as a barrier among the various utilities in open utility corridors.

But in case where we are doing a duct, we have to make sure that some amount of segregation is there in the pipeline which we have to create artificially. The ministry of road transport and highways in India have given certain policy guidelines for accommodation of public and industrial utility services along the national highways. It states that 2-meter-wide strip of land has to be reserved at the edge of the right of way, so that we can lay utility lines.

Utility ducts could be also provided, using 600-millimeter diameter pipe across the project highways.

For example, in Delhi-Meerut express way, 2 meter wide utility duct has been laid. It also involves six 50-millimeter-diameter pipes on either sides of that utility duct.

So, let us look at the cost of these ducts and utility corridors. A 2 meter wide, non-load bearing utility duct costs around rupees 2.4 crores per running kilometer. Whereas, load bearing ducts, depth and height around 2 to 2.5 meters and width 4 meters comes to around 10 crores per running kilometer.

Some ways to recover the cost is by lease rentals by the utility provider. So, if the lines are for a 30-year periods, at the end of the day some amount of rental has to be paid per month by the utility provider.

So, these are expensive infrastructure. However, sometimes these are essential, and some sewer lines has to cross other utilities such as electricity, water line, gas line, pipes, telecommunication cables etc. and for that we need to maintain some amount of segregation.

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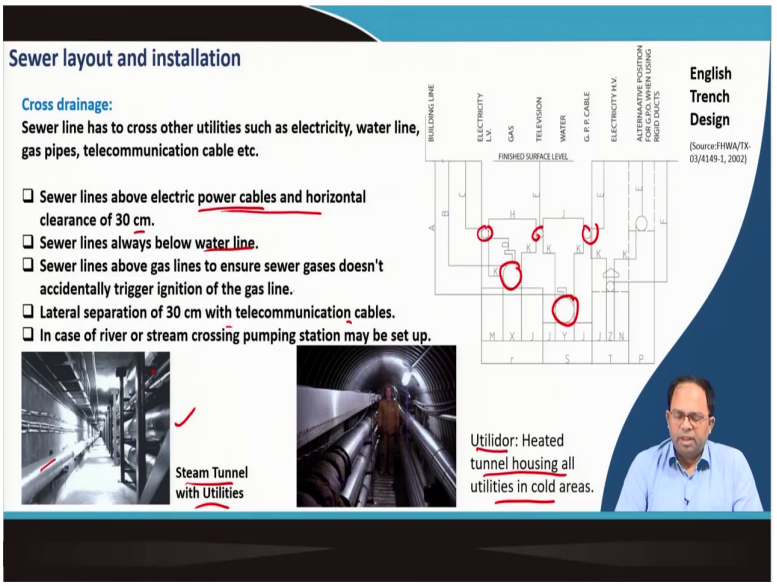

Sewer layout and installation

Whenever multiple utilities are laid together, sewer lines are kept above electrical power cables and horizontal clearance of 30 centimeter is maintained. The sewer lines should always be above the water line, and then sewer lines are above gas lines to ensure sewer gases does not accidentally trigger ignition of the gas line. Lateral separation of 30 centimeter with telecommunication cables needs to be provided. In the case of a river or stream crossing, pumping station may also be required to be set up.

In an English trench design different kind of utility ducts such television lines, gas lines, electricity lines, water supply lines and other cables are being laid separated by soil at different depths.

These are other examples of underground structures or corridors with utility pipes segregated to a certain extent. And then, there are utilidors which are heated tunnel housing all the utilities in cold areas.

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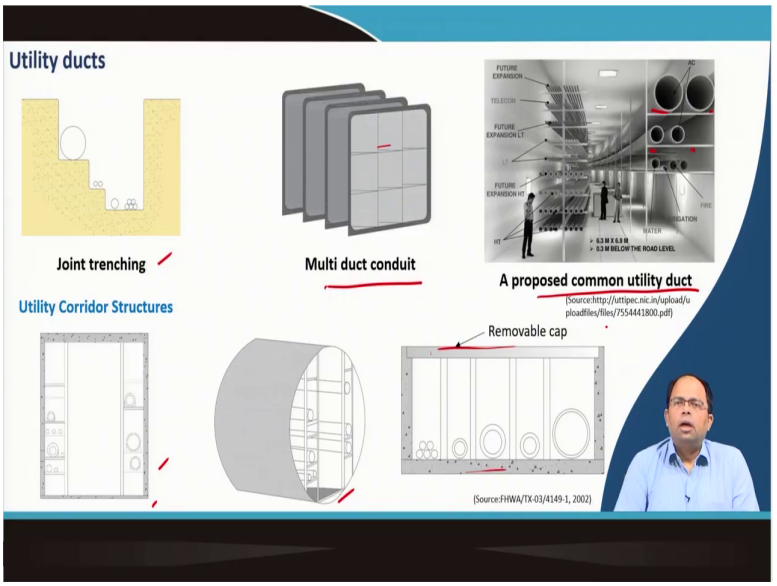

Utility ducts

There could be different ways to have this utility corridors or ducts. In joint trenching, the lines are laid at different depths with some amount of segregation so that we can save on cost.

Then, there are utility multi duct conduits through which we have separate channels. A proposed common utility duct has got several lines going through it, with the entire chamber going throughout the road network. Then there are other designs; rectangular design, round circular design, and a box with a removable cap which could be removed for maintenances.

So, these are designs of utility corridors or utility ducts which could be also designed for urban areas.

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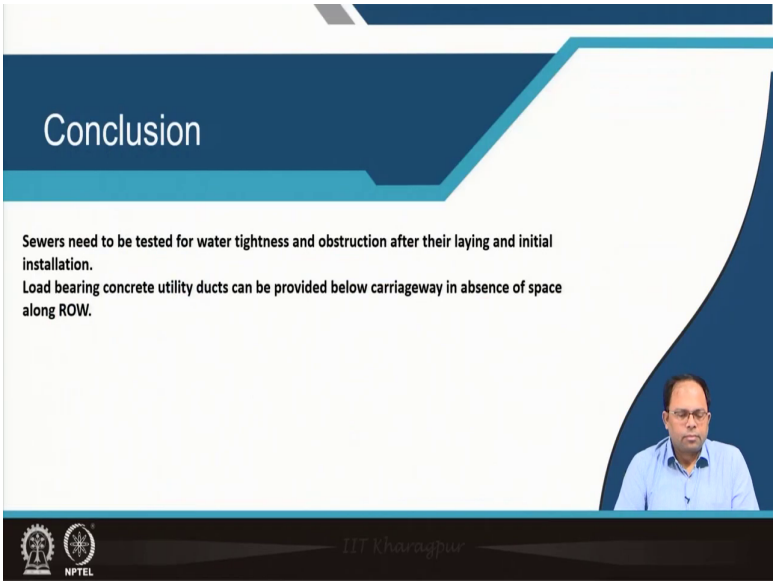

Conclusion

So, to conclude sewers need to be tested for water tightness and obstruction after their laying and initial installation. Load bearing concrete utility ducts can be provided below carriage ways in absence of space along ROW.

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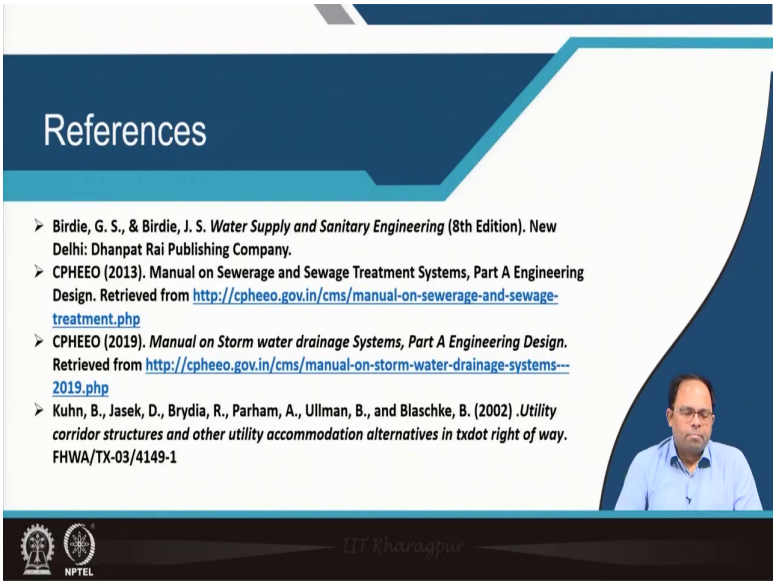

So, these are some of the references that we can use. Thank you.