Urban Utilities Planning: Water Supply, Sanitation and Drainage
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Module - 10
Sewer appurtenances
Lecture - 49
Sewer Maintenance and Cleaning

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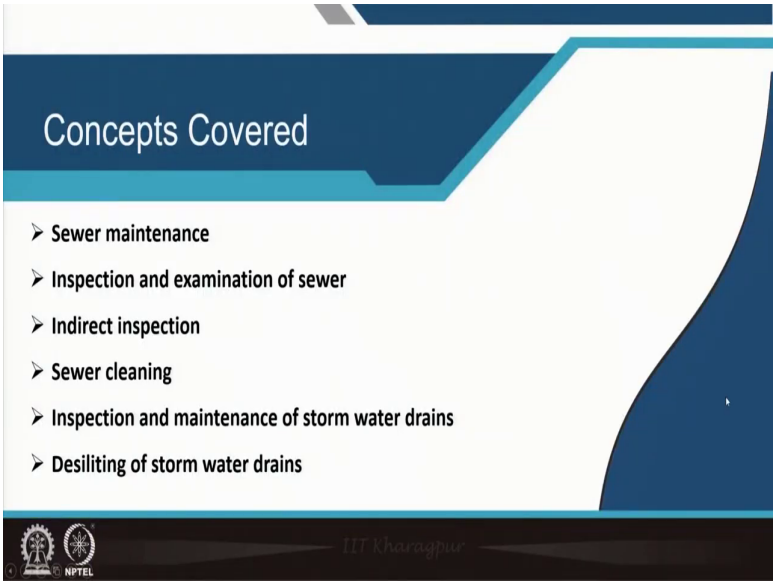

Welcome back. In lecture 49 we will talk about Sewer Maintenance and Cleaning. So, the different concepts that we will cover are sewer maintenance, inspection and examination of sewer, indirect inspection, sewer cleaning, inspection and maintenance of storm water drains and desilting of storm water drains.

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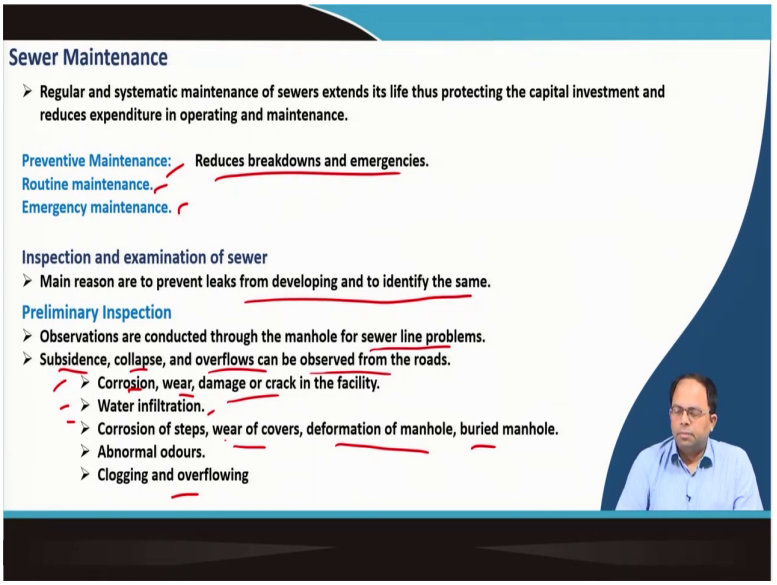

Sewer maintenance

When we talk about sewerage systems definitely operation and maintenance is one of the primary concerns. If we do not maintain them properly and regularly, there would be damage to the sewers and we have to replace them at an earlier date. So, that is why it is important for saving money or reducing the overall cost of operation and maintenance because proper maintenance also reduces major problems and that actually reduces cost.

So, regular and systemic maintenance of sewers extend its life thus protecting the capital investment and reduces the expenditure in operation and maintenance. There are mainly three kinds of maintenance: preventive maintenance, routine maintenance and emergency maintenance. Emergency maintenance is when suddenly something happens to a sewer section which has to be addressed right. Then routine maintenance is done at certain regular intervals for checking certain leaks and other issues. Preventive maintenance is done if we feel that some problem is gradually building up and we have to do some amount of preventive maintenance so that it does not aggravate the problem. So, this will reduce breakdown and emergencies.

The main reason why we inspect and examine the sewer is to identify and prevent leaks from developing. This is the primary goal of inspection of sewers. The preliminary inspection is

conducted through the manhole to identify where the leaks are developing in a particular sewer line. Manholes are provided particularly for maintenance and inspection. We look for subsidence and collapse. Overflows can be observed from the road itself.

For example, the road may have collapsed or we may see overflows from certain manholes which indicates that some blockages have happened. The different kinds of problems we look for are corrosion, wear and tear of the sewer line, damage or cracks in the sewer line or that particular manhole or for any other output means, infiltration of water (water from the surrounding ground water entering into the sewer line), corrosion of steps within the manholes, wearing of the covers of the manholes, deformation of manholes, buried manholes because of repaving of the streets, abnormal odour coming from the sewer, clogging and overflowing of the sewer lines. So, these are the things that we should look for when we inspect a particular sewer line via a manhole.

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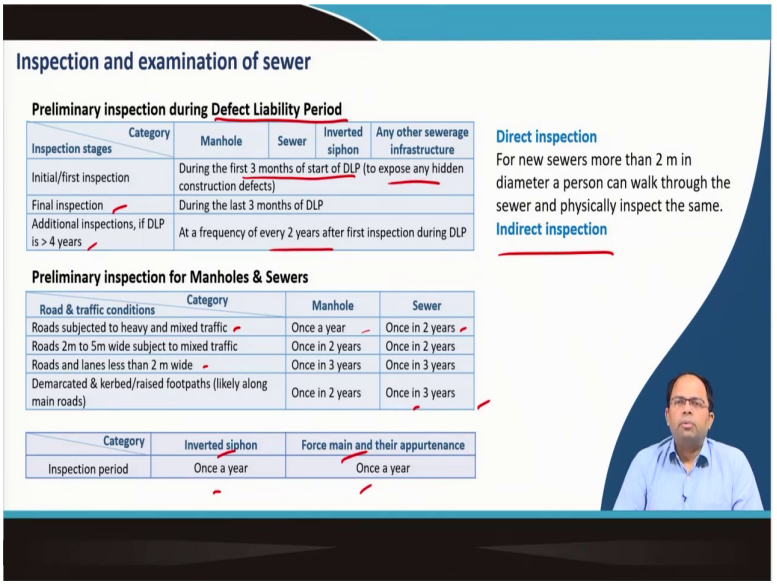

Inspection and examination of sewer

After the construction, there is a particular defect liability period within which the contractor is supposed to repair damages to the sewer whatever they maybe. The initial inspection happens during the first three months of the start of DLP or defect liability period. This is done to expose any kind of problems or any defects in the construction.

The final inspection happens before the DLP is over in case some errors have happened which could be rectified by the contractor. Finally, additional inspections are done at the frequency of every 2 years if DLP is greater than 4 years.

In general, preliminary inspection occurs via manholes and sewer. There is no detailed inspection, but first initial inspection to identify if some problems are there then detailed inspections could be done. The preliminary inspection of manholes and sewers are done at certain intervals.

For example, road subjective to heavy and mixed traffic are inspected once in a year for manholes. For sewers, it is inspected once in 2 years. For roads 2 meter to 5 meter wide and subject to mixed traffic, manhole inspection once in 2 years, and for sewer once in 2 years. Roads and lanes less than 2 meter wide once in 3 years for both and for demarcated and kerb raised footpaths once in 2 years and once in 3 years respectively.

Similarly, inverted siphons, force mains are inspected once in a year. So, there could be both direct inspection as well as indirect inspection. Direct inspection involves getting inside the sewer and inspecting it. In indirect inspection, equipments are used to inspect the inside the sewer.

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In indirect inspection, we use different kinds of technologies. The technologies could be use of digital camera, zoom cameras, push cameras in gravity sewers and for any kind of pipe (material, diameter) and the different kind of defects that could be detected are internal condition, pipe leakage, pipe support.

Similarly, we can use acoustic sensors, sonar, an ultrasonographic sensor which can also sense sound and based on that we can see the profile of the sewer. All kinds of problems cannot be looked at directly. For example, internal condition of the walls pipe wall could be looked at, but leakage cannot be detected when we use certain acoustic, sonar or ultrasonic techniques.

Electromagnetic techniques involve generating electrical fields inside the pipeline and using that we can determine any problem in the pipe wall and leakage. We can also use lasers and other technologies such as infrared thermograph, ground penetrating radar etc.

Primarily, the three systems that used are:

1. Light and mirror system which is a pretty old and standard system. In this method, we drop a light inside a particular manhole and use a mirror and try to reflect the light using that mirror into the internal part of the pipes and then observe what is the situation in that particular pipeline in empty sewer condition.

2. Close circuit cameras could be used by putting in a camera inside the line. This is only effective when the sewer is not flowing.

3. Sonar systems are used even when the sewer is flowing and we can detect leakages and faults in the pipe.

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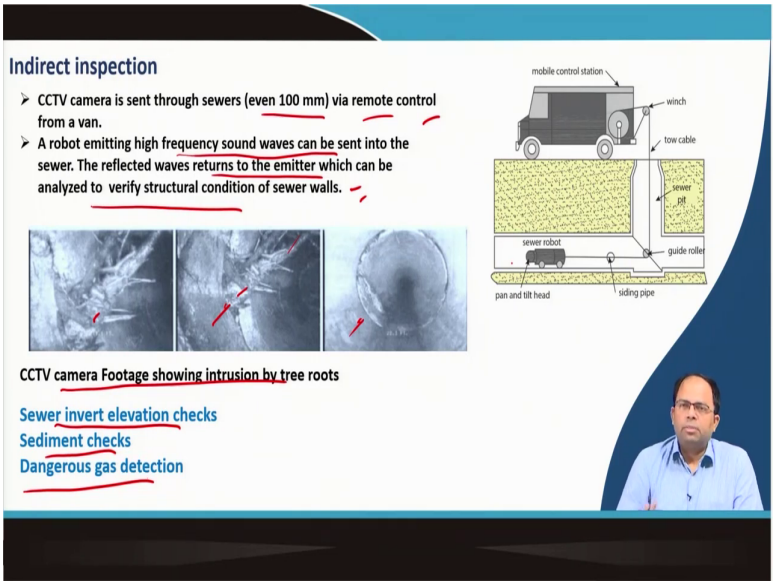

Indirect inspection

In indirect inspection, a mobile control station is used from where we put a sewer robot with a camera in front of it and then it can travel along the pipeline and send us images along the pipeline. So, a CCTV camera is sent through sewers and this is controlled via remote control from the van. Robots which can emit high frequency sound waves can also be used instead of carrying the camera and the reflected waves could be caught in the emitter within that particular system and analyzed to verify the structural condition of the sewer walls.

CCTV or sonars could be utilized to see the condition of the sewers. We check for sewer invert elevations, sedimentation of the sewer, try to detect gases in the sewer because sometimes gas buildup may also lead to some sort of accidents.

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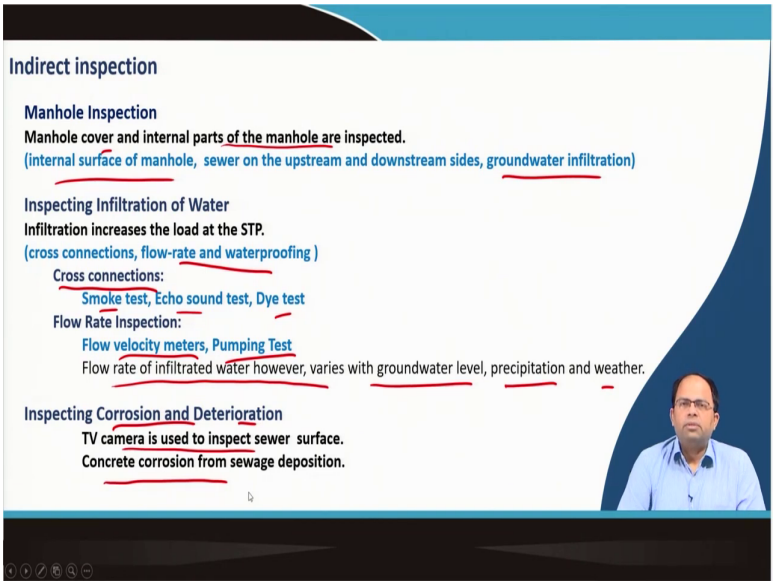

We also inspect manholes for rusting in the sewer rails and manhole cover because they get damaged because of heavy traffic load. We should also check for groundwater infiltration because it will increase the load in the STP and may lead to break down of pumps. The internal surface of the manhole is also checked.

We do it via cross connections and flow rate inspection methods:

1. Cross connection: In cross connection, we use three kinds of test which is smoke test, echo sound test or dye test to check that if the dye that we are putting in one area may be coming to a particular sewer even though it is not supposed to come there.

2. Flow rate inspection: This is where we use meters similar to water supply pipelines to detect the flow in the pipeline.

We can use flow velocity meters, pumping tests to determine flow of sewage in the pipeline. Based on the design flow rates and the observed value, we can determine if some leakage or some ground water infiltration is happening.

Flow rate of infiltrated water varies with groundwater level, precipitation and weather. There is no fixed rate of flow and it varies with different criteria. Hence, it is difficult to analyze unless we have base condition measured during the installation of the pipelines or during

certain time periods. We can measure the base rates at certain intervals and if we notice changes, we can assume infiltration has happened.

We can also inspect for corrosion and deterioration of the pipe sections. TV camera could be used to inspect the sewer surface, concrete corrosion and sewage deposition.

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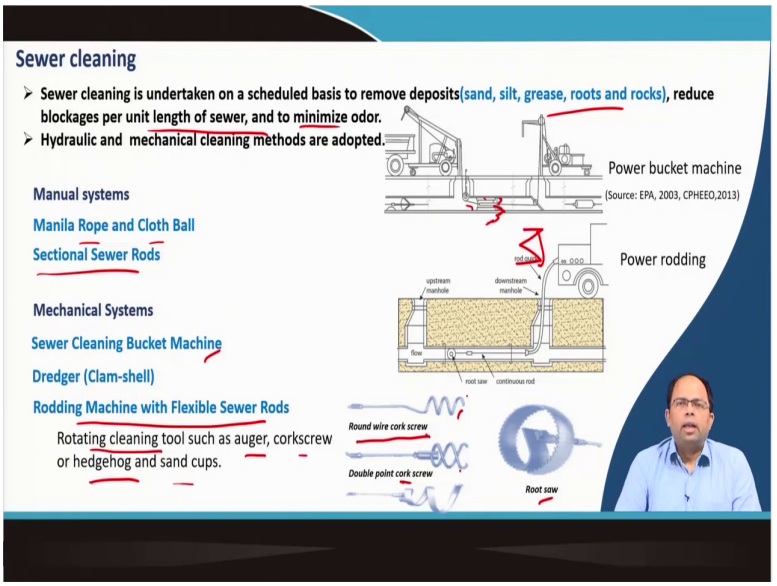

Sewer cleaning

Once we have detected a particular leakage in a sewer pipeline, we need to clean it. Sewer cleaning is undertaken on a schedule basis and we remove sand, silt, grease, roots and rocks from the sewer sections thus reducing the blockage per unit length of sewer and to minimize odour. There are several types of methods utilized such as hydraulic methods, mechanical methods, manual methods and so on.

In manual methods, we use a manila rope and cloth ball system or sectional sewer rods. These are typical methods used for a long time. For example, bamboo sticks are attached to each other to make a longer a rod and is used to clean sewer. In the other method, a cloth ball is attached to a rope and using this rope we can drop the rope from one manhole and send it to another manhole and then we fix this particular cloth ball and we can push and pull it inside the pipeline to clean it.

In mechanical systems, a sewer cleaning bucket machine, a dredger and clams shell are used.

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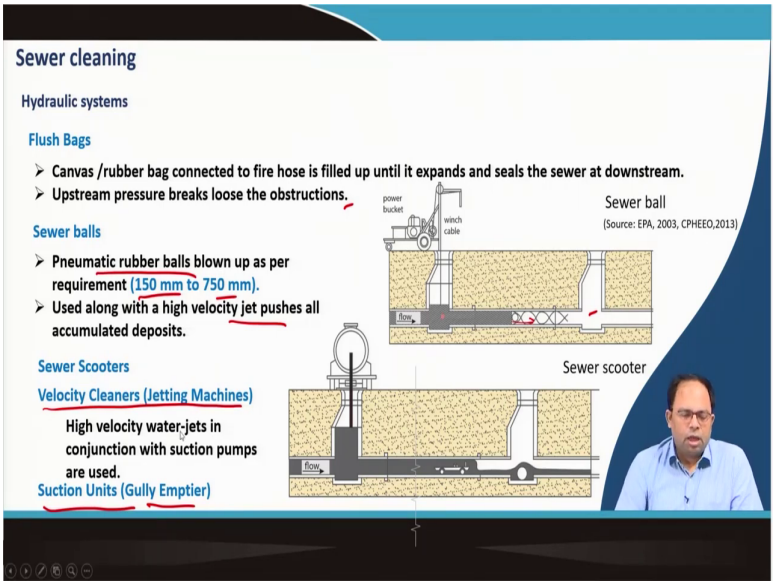

In hydraulic systems, a flush bag is used which is a canvas or rubber bag connected to a fire hose and it is filled up until it expands and seals the sewer at the downstream end and then depending on the upstream pressure of the water that gathers behind this particular bag, it pushes the bag and it can clean the obstructions. We can also use the sewer ball which is also like a pneumatic system, where we fill up a rubber ball with air as per the requirement of the diameter of the sewer line like 150 to 750 mm and this is used along with velocity jets or water jets to push this particular pneumatic rubber ball along the sewer and then we can push the blockages and accumulated deposits to the manhole from the where it could be cleaned. So, that is how we can use a pneumatic system.

We have also got sewer scooters which are machines which could be put inside the sewer and which can push the accumulated garbage. In addition, there are velocity cleaners or jetting machines which uses high speed water jets sent from one side and from the other side suction pumps are used.

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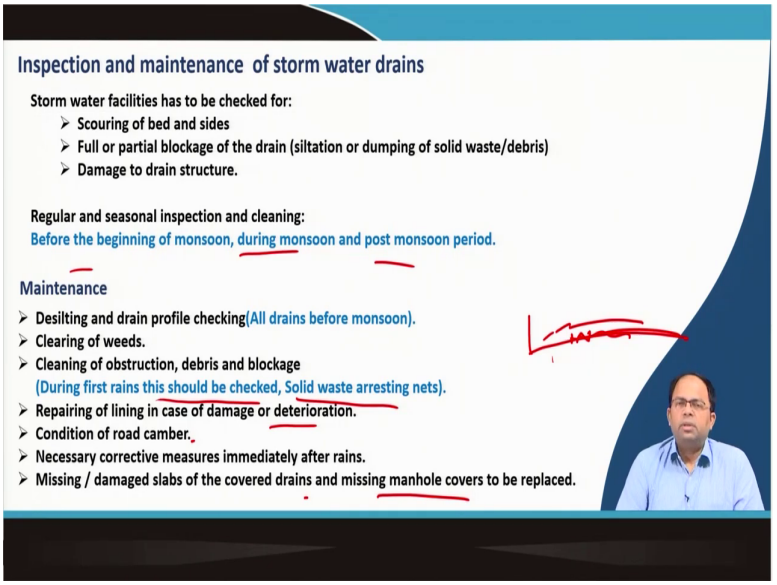

Inspection and maintenance of storm water drains

Similar to sewer lines, we can check the storm water drains as well. This could be the open drains where we check the storm water facilities for scouring of the bed and sides.

Usually, the inspection is done for storm water drains before the monsoon, during the monsoon and in the post monsoon period. The maintenance required for storm water drains involves desilting of the drain profile to check if there are certain blockages which should be cleared to prevent inundation and flooding.

This has to be done regularly for all urban areas. We need to clear weed growth and other kind of obstruction in the form of debris and blockage. This should be removed particularly during the first rains when we can check if there are some blockages and immediately, we have to clean.

It also involves repairing of lining in case of damage or deterioration and checking for condition of road camber. Necessary corrective measures should be taken immediately after rain. After rainfall, missing or damaged slabs of the covered drains and missing manhole covers should be replaced because sometimes when there is inundation, this may lead to accidents.

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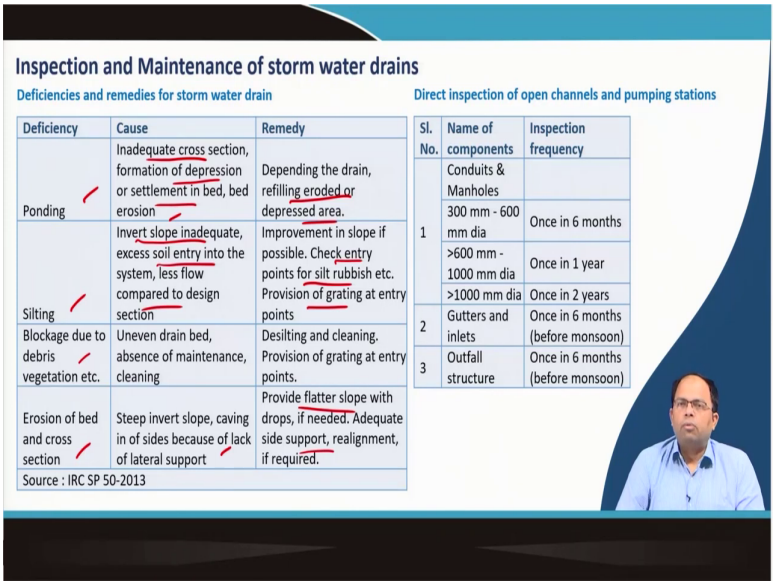

Deficiency	Cause	Remedy
Ponding	Inadequate cross section, formation of depression or settlement in bed, bed erosion	Depending the drain, refilling eroded or depressed area.
Silting	Invert slope inadequate, excess soil entry into the system, less flow compared to design section	Improvement in slope if possible. Check entry points for silt rubbish etc. Provision of grating at entry points
Blockage due to debris vegetation etc.	Uneven drain bed, absence of maintenance, cleaning	Desilting and cleaning. Provision of grating at entry points.
Erosion of bed and cross section	Steep invert slope, caving in of sides because of lack of lateral support	Provide flatter slope with drops, if needed. Adequate side support, realignment, if required.
Source : IRC SP 50-2013		

Sl. No.	Name of components	Inspection frequency
1	Conduits & Manholes	
	300 mm - 600 mm dia	Once in 6 months
	>600 mm - 1000 mm dia	Once in 1 year
	>1000 mm dia	Once in 2 years
2	Gutters and inlets	Once in 6 months (before monsoon)
3	Outfall structure	Once in 6 months (before monsoon)

The inspection schedule and maintenance schedule for storm water drains for conduits and manholes 300 mm to 600 mm diameter is once in 6 months, for diameter 600 mm to 1000-meter diameter its once in one year, diameter greater than 1000 millimeter once in 2 years and for gutters and inlets once in 6 months before monsoon and outflow structures once in 6 months before monsoon.

In addition to the basic inspection, other problems such as ponding and silting should also be taken care of. The cross section may be inadequate resulting in formation of depression, or because of depression in the bed or because the bed has settled or because of bed erosion. In this case, we can refill the eroded area or the depressed area or we can also modify the profile of the drain. Silting maybe caused because the slope is inadequate resulting in deposition of the sediments. To rectify this, we can either improve the slope or we can prevent entry of silt and rubbish into this particular section by providing grating to prevent the entry.

The erosion of beds occurs because of steep invert slope or caving in of sides because of lack of lateral. For this, we can provide a flattered slope and introduce drops in the line or adequate side support realignment if required. So, these are the different things that we need to consider for maintenance of storm water drains.

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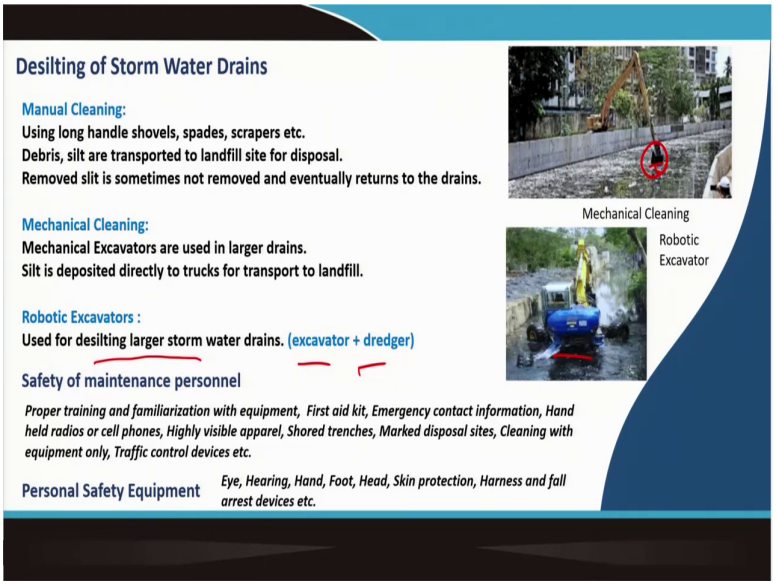

Desilting of storm water drains

We need to desilt storm water drains, particularly the larger channels after certain intervals. For this purpose, we can go for manual cleaning by making use of shovels spades, scrapers. The debris is collected from the channel is taken to the landfill site.

However, sometimes the municipal staff will clean the drain and keep the debris at the side of the drain for the garbage collectors to take that to the landfill. But they usually ignore that because it is not residential solid waste and the debris eventually remains there and when the rain fall happens it gradually is washed away and goes back into the drain thus causing the same problem. So, immediately after the drains are cleaned those material has to be taken to the landfill side.

Mechanical methods can also be adopted for cleaning using mechanical excavators for large drains as well as robotic excavators. Desilting of particularly large storm water drains can be done with the help of robotic excavators as they act both as an excavator as well as a dredger. These excavators can clean and dredge the drain and then they can excavate the silt and put it in vehicles to be transported to landfill sites.

Another factor to be considered is the safety of maintenance personnel because these are risky jobs with high chances of gas buildup and subsidence. Therefore, we need to give proper training and we may have to make the staff familiar with the equipments.

First aid kits have to be provided for emergency. Contact information, hand held radios, highly visible apparel are also provided.

The trench has to be done properly, the disposal size has to be properly marked, cleaning equipment, traffic control devices have to be provided for safety of maintenance personnel. The personal safety equipment like aids/covers for eye, hearing, hand, foot, head, skin protection harnesses and fall arrest devices. So, these kind of safety equipment also needs to be provided to for individuals.

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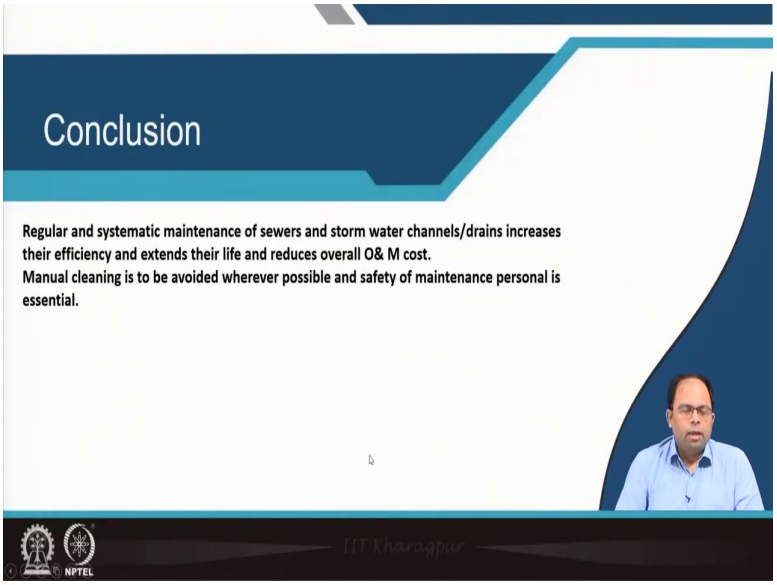

Conclusion

So, to conclude regular and systemic maintenance of sewers and storm water channel or drains increases their efficacy and extends their life and reduces the overall operation and maintenance cost. Manual cleaning is to be avoided wherever possible and safety of maintenance personal is absolutely essential.

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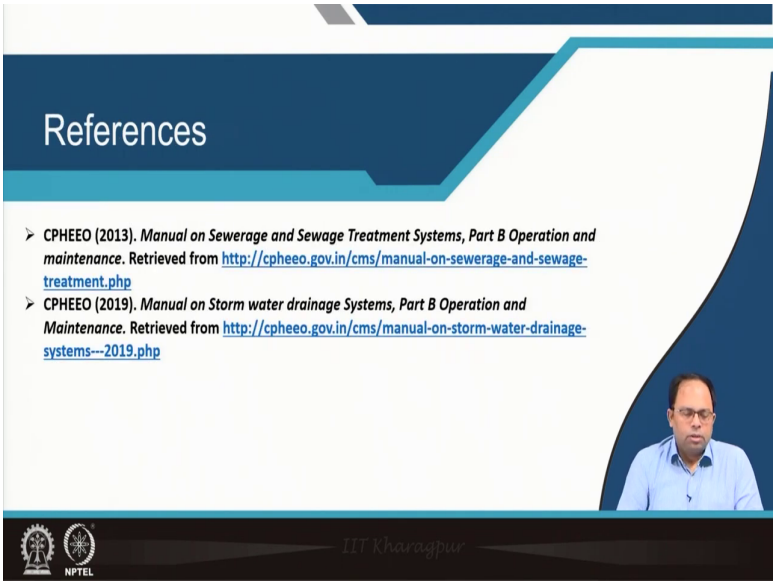

So, these are the references you can follow. Thank you!