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TECHNOLOGY OPTIONS FOR SEWERAGE SYSTEM

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ABSTRACT

Sewerage System is an important infrastructure for urban needs. This paper aimed to review the alternative sewer or the technology options for the sewerage network system, various implementation technologies and material of construction. There are different technology option in the sewerage network system like, Gravity sewer system, Vacuum sewer system and Pressure sewer system. Also, there are different techniques for implementation of the above system, like Open cut excavation, Trenchless Technology etc., and there various types of construction material are available like, metallic, concrete and plastic pipes and pre-fabricated RCC & FRP manholes etc. The different technologies and alternative material facilitate with ease of implementation and time saving. However, there is cost implication involved in adopting the latest technology, but still the latest technology is being considered where it is warranted. A variety of factors help determine which wastewater technologies are best suited for a particular home or area. Often, communities will use a combination of different approaches in different circumstances to save money, control development, and protect public health and the environment. Alternative sewerage system should be considered as a possible option for groups of homes and businesses in areas like these, or anywhere they can cost-effectively fulfil the health and environmental goals of the community.

KEYWORDS : ***Technology Option, Gravity sewer system, Vacuum sewer system and Pressure sewer system.***

INTRODUCTION

Sewerage system is in great need for urban infrastructure development. The sewerage system also shares the equal importance of water supply system, development and the financial impact.So before going for the implementation of the sewerage system we should always see techno (Design) economical (Cost) feasibility of the system with due consideration of various technology options available for sewerage system. Wastewater can be transported in gravity, vacuum, or pressure-sewer systems that carry wastewater from homes and other buildings to a wastewater treatment facility. This paper mainly deals with the transport of wastewater by pipes. At the end of the pipe, we still need a treatment step. The various categories of Sewerage System are

Conventional gravity sewerage system

Small-bore gravity sewerage

Vacuum sewerage system

Pressurizedsewerage system

The key differences in the designs of the different sewer systems depend upon. Characteristics of the wastewater conveyed (settled or non-settled) and criteria and standards for the design of the sewers (e.g. Minimum velocity in pipe, Minimum slopes of pipes. Minimum pipe diameter. Design peak flow factor). Overview of sewer systems and their possible applications are discussed below

Conventional Gravity Sewerage System:

Design Principle

Large networks of underground pipes, mostly in urban areas, Collection of black water, brown water, greywater and storm water.Wastewater is transported to a centralised treatment facility by gravity. Depending on topography, sewer pumping stations is necessary.The lines are at a depth of 1.5 to 3 m and manholes proved access for maintenance.It must be designed to maintain "self-cleansing" velocity that no particles accumulate

Costs

Initial costs are high because excavation and refilling of trenches to lay the pipes, requires specialised engineers, operators and maintenance costs are high compared to decentralised systems, Extension of the system can be difficult and costly.

Operation & Maintenance.

Maintenance should be done by professionals.Manholes are installed wherever there is a change of gradient or alignment and are used for regular inspection and cleaning.It must be systematically planned and carefully implemented.Overflows are required to avoid a hydraulic surcharge of treatment plants during heavy rain events.

Applicability

Suitable for urban areas that have the resources such a system.They only make sense if a centralised treatment system exists which is able to handle big loads of waste- and storm water. Sufficient water as a transport medium needs to be available.A professional management system must be in place.

Pros and Cons

Advantages:Convenience, low health risk, no nuisance from smells, mosquitoes or flies, Storm water and greywater can be managed at the same time, No problems related to discharging industrial wastewater. Moderate operation and maintenance costs.

Disadvantages: High capital costs. Need a reliable supply of piped water. Difficult to construct in high-density areas, difficult and costly to maintain. Unsuitability for self-help, requires skilled engineers and operators. A problem associated with blockages and breakdown of pumping equipment. Adequate treatment and/or disposal required.

SOLID FREE / SMALL BORE SEWERAGE SYSTEM

Design Principle

Solids-free sewer systems are similar to conventional systems, but the wastewater is pre-settled and solids removed before entering the system, e.g.:Septic tanks, Biogas settlers and Anaerobic baffled reactor. The recommended pipe diameter is 75 to 100 mm and a depth of at least 300 mm.

If well maintained, there is little risk of clogging, thus there is no need of self-cleansing velocity, i.e.;Shallow depths, Small or even ineffective gradients, fewer inspection points, can follow topography more closely. This results in significantly lower investment costs due to the simplified design!

Costs
Solids-free sewers can be built for 20% to 50% less costs than conventional sewerage.Repairs and removal of as well as costs for emptying the pre-settling unit must be considered.

Applicability
Well suited for areas where leaching fields/soak pits are inappropriate due to sensitive groundwater or lack of space for on-site infiltration in growing communities. In areas with a high willingness to pay (for the operation and maintenance) and with locally available expertise and resources.Users should receive some basic training.

Pros and Cons
Advantages:Can be built and repaired with locally available materials. Capital costs are less than for conventional sewers. Low operating costs if well maintained can be extended as a community changes and grows/ Appropriate for densely populated areas with sensitive groundwater or no space for a soak pit or leaching field.

Disadvantages: Requires repairs and removals of blockages more frequently than a conventional gravity sewer. Requires expert design and construction supervision. Requires education and acceptance to be used correctly. Effluent and sludge (from interceptors) require secondary treatment and/or appropriate discharge

VACUUM SEWERS SYSTEMS
Design Principle

A central vacuum source conveys sewage from individual households to a central collection station. (UNEP 2002). Use of differential air pressure ("negative pressure" or "vacuum") to move the sewage.Gravity line carries wastewater from the source to the collection chamber. When a defined height is reached, the vacuum interface valves open and sucks the wastewater into the vacuum sewer main.At the end of this main it is collected in a big tank.After this tank is filled to a predetermined level, the wastewater is transferred to a treatment plant via a conventional/separate sewer system.

Design Principle - Piping
Narrow and shallow trenches (1.0 to 1.2 m). Inspection points for pressure testing. Small pipe diameter (80 to 250 mm). If a pipe is damaged, risk of leaking is low because of the negativepressure.

Costs
It is a high-tech system, thus it is costly. But in comparison with a conventional sewer system, it is cheaper:Small Pipes. Shallow trenches. Independent from topography. Large amounts of flushing water can be saved. A permanent source of electrical power can increase the costs!

Operation & Maintenance
Risk of clogging is low; almost no cleaning/emptying. Periodically pressure testing. Complex and/or technical problems are in the responsibility of the manufacturer.

Applicability
Flat topography: gravity systems demand installation at great depths to maintain adequate flow (pump stations, lift stations).Rock layers, running sand or a high groundwater table makes deep excavation difficult.Areas short of water supply or poor communities that must pay for water, but cannot afford great amounts of water necessary for operation of gravity systems.Areas that are ecologically sensitive.Areas where flooding can occur.Areas with obstacles to a gravity sewer route.Installation of a new fresh water network, allowing sewerage pipe installation in the same trench.

Pros and Cons
Advantages:Requires less flushing water. Considerable savings in construction costs. Shallow and narrow trenches, small diameter pipelines, flexible pipeline construction. Sewers and water mains can be laid in a common trench. Closed systems with no leakage or smell. No manholes along the vacuum sewers. One central vacuum station can replace several pumping stations

Disadvantages: Needs expert design. Needs energy to create the permanent vacuum. Relatively high capital costs. Recycling of nutrients and energy becomes difficult. Unsuitability for self-help, requires skilled engineers' operators. It is still a flushing system. If there is no treatment plant and an unprofessional discharge it can contaminate the environment

PRESSURISED SEWEAGE SYSTEM
Design Principle
This system is not dependent on gravity to move wastewater. Shallow trenches and relatively small pipe diameters. Requires permanent electricity and grinder pumps. Wastewater is collected by gravity in a collection tank. A grinder pump moves it to the sewer, this transfer of wastewater pressurises the sewer. Various pumps along the sewer line move the wastewater progressively.

Generally pre-fabricated products. A collection tank including grinder and pump, non-return valve (prevents back flow from the pressure sewer). The grinding allows small pipe diameters. Wired to the household power supply and regulated by a control panel. The alternative to this unit: a septic tank situated outside on the ground or in the basement. Effluent flows into an underground holding tank containing a pump and control devices from where it is then pumped into the pressurised sewer.

Costs
Costs can be divided into two major components: On-lot costs: pump, basin, controls, building sewer, lateral piping, electrical service, installation. Collection network: includes all the piping in the utility easements that directs the sewage to the treatment facility.

Operation & Maintenance
Regular service is important for all system components. Electricity needs to be available all the time. Pumps should be checked regularly. Pipe connections should be controlled for leakages.

Applicability
Basically, pressurized sewer systems have the same advantages as vacuum sewers. Therefore, they are used in similar surroundings; Flat or hilly topography: gravity systems demand installation at great depths to maintain adequate flow or requires pumping and lift stations. Rock layers, running sand or a high groundwater table makes deep excavation difficult. High groundwater table. Densely populated areas.

Pros and Cons
Advantages: Effective wastewater transportation at minimum depth, minimising the excavation for the piping system. Gravity free; independent from land topography. Lower costs compared to a conventional gravity sewer (pipe size and depth requirements are reduced and many small pumps are cheaper than some large-capacity lift stations). Requires little water only for transporting the excreta.

Disadvantages: Needs expert design, high capital costs. Needs a permanent energy source. A proper recycling of nutrients and energy becomes difficult, because all kinds of wastes are mixed. Unsuitability for self-help, requires skilled engineers & operators. It is still a flushing system which transports wastewater away. If there is no treatment plant and an unprofessional discharge it can contaminate the environment. Leakages may lead to contaminations

CONCLUSION
Construction of Sewerage Scheme and it challenges having various factors at interplay like, Technology, Cost, People's aspirations, Land, Holistic Approach, Water availability for proper functioning of the sewer system

Type of sewerage system and application

Type of sewerage system	Application in conventional sanitation
Conventional gravity sewerage	The common solution world-wide for those who can afford it
Small-bore gravity sewerage	Has been used as a low-cost solution to transport domestic wastewater (after septic tanks)
Vacuum sewerage system	Used for specialized applications, e.g. On cruise ships
pressurized sewerage system	Used to upgrade on-site systems where septic tanks are used (industrialized countries, e.g. USA, Australia)

Alternative Technology of Sewerage System may be a good Option over Conventional sewerage system if

Conventional gravity sewers and on-site wastewater treatment technologies have been determined to be inappropriate or too expensive;

The population in an unsewered area is such that there would be 50 to 100 homes or less per mile of sewer line;

Homes are located in hilly, rocky, low-lying or very flat areas, or areas with shallow bedrock, a high-water table or other site conditions that would make installing gravity sewers impractical; or

Areas are experiencing potentially costly problems with existing conventional sewers that are leaking or otherwise deteriorating.

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