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A Review on Various Essential Factors Influencing Design Parameters of Sewerage System

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ABSTRACT

The two basic essential amenities in the community for healthy living are safe water supply & hygienic sanitation facilities. The Sewerage services fall under essential service category. The objective of a public waste water collection and disposal system is to ensure that sewage or excreta and sullage discharged from communities is properly collected, transported, treated to the required degree and finally disposed of without causing any health or environmental problems. When sewerage projects are assessed for their cost benefit ratio and for institutional or funding purposes, they are not amenable for comparative study and appraisal. Also at times different standards are adopted by the Central and State agencies regarding various design parameters. It is necessary therefore to specify appropriate standards and design criteria and to avoid different approaches. This technical note describes the elements involved in designing a sewer system.

KEYWORDS essential amenities, public wastewater collection, disposal system, design parameters, cost-benefit ratio.

INTRODUCTION

Sewage is a water- carried waste, in solution or suspension that is intended to be removed from a community. It is also known as wastewater. It consists mostly of grey water and the human waste that the toilet flushes away, soaps and detergents and toilet paper. Whether it also contains surface runoff depends on the design of its route back to the environment. All sewage ends up back in the environment by any of several routes.

Before the 20th century, sewers usually discharged into a body of water such as streams, rivers, lakes etc. There was no treatment, so the breakdown of the human waste was left to the ecosystem. Today, the goal is that sewers route their contents to a wastewater treatment plant rather than directly to a body of water.

Sewerage system is a network of pipes, pumps, and force mains for the collection of wastewater or sewage from a community. Modern sewerage systems fall under two categories i.e. Domestic or Industrial sewers and Storm sewers. Sometimes a combined system provides only one network of pipes, mains, and outfall sewers for all types of sewage and runoff.

The Sewerage system consists mainly of: -

i) Collection system (sewer, sewer appurtenances),ii) Conveyance system (pumping station, pumping main etc.)&iii) Treatment plant.

Sewer appurtenances are the various accessories on the sewerage system and are necessaryfor the efficient operation and maintenance of the system. These includes:- Manholes, Drop manholes, Lamp holes, Clean-outs, Street inlets called Gullies, Catch basins, Flushing Tanks, Grease & Oil traps, Inverted Siphons, and Storm Regulators.

LITERATURE REVIEW

Zhang Jie, Cao Xiang-Sheng, MengXue-Zheng (2007):

China is facing water crisis. To realize sustainable development in the 21st century, we should first provide enough water resources to every person and keep a friendly, leisurely water environment. Under the idea of sustainability, a concept for a sustainable urban sewerage system (SUSS)

A typical SUSS has four modern features described as follows:

(1) It is the basis for urban water reuse and recycling. A SUSS has the duty of producing reclaimed wastewater as a steady secondary urban water resource. Reclaimed wastewater can be used as cooling water for industry, irrigation water for landscaping, and for any other application where non-potable water may be used. A large volume of reclaimed wastewater could reduce fresh water exploitation, and thus promote a healthy water cycle.

(2) Water resource regeneration in a watershed hinges on SUSS. In a watershed, wastewater drained from upriver cities flows into downriver cities. Outflow of upriver SUSS would be a part of the water resource of downriver cities throughout an entire watershed. Each SUSS should have this water resource regeneration capacity.

(3) SUSS is central to nutrient recycling. As a product of wastewater treatment, sludge should be treated properly and returned to farmland as fertilizer. Nitrogen and phosphates in wastewater should be recovered as fertilizer during the wastewater collection, transportation and treatment process.

(4) SUSS is the basis for scarce resource recovery and energy recovery. Most metabolic products of city dwellers are discharged into urban sewerage pipeline systems and are transported to the wastewater treatment plant. This kind of wastewater contains much energy. Anaerobic treatment of wastewater or sludge could potentially produce methane, which can be used as fuel. Certain valuable metals or other scarce resources are also found in wastewater, particularly in industrial sewerage pipelines. Recycling of valuable substances in industrial wastewater may be an important part of an industrial circular economy.

OddvarLindholm, James M. Greatorex, Adam M. Paruch (2005):

City planners need practical methods to assess and compare the sustainability of different alternatives for urban infrastructure. This article presents the consequences of selecting different methods to normalize the values of sustainability indicators, and the influence of selecting different indicators and different weighting techniques.

Chosen indicators represent use of resources, environment, health and safety, psycho/sociological situation. Infrastructure costs are not included in the indicators, since it is more convenient to weigh them against the sustainability indices of the different systems. All indicators are aggregated into one system index.

The article demonstrates that the method used to normalize the indicators, the choice of relevant indicators and the weighting technique have considerable influence on which system is found to be the more sustainable. The indicators must reflect the three main dimensions of sustainability:

- Ecological sustainability;
- Social sustainability;
- Economic sustainability.

It is possible to include costs as an indicator. However, it is more convenient to keep costs for the alternative infrastructure systems as external parameters and weigh them against the sustainability indices of the different systems. This is because in the real world, market forces and finances play a key role in the decisions made by municipalities and project developers

J. P. Davies, B. A. Clarke, J. T. Whiter, R. J. Cunningham (2001):
This paper provides a review of the numerous factors that have been recognized as influencing the structural stability of rigid sewer pipes. The factors influencing this is considered I three main groups, namely, construction features, local external factors and other factors. Evidence from the studies of the effects of construction standards and construction traffic coupled with evidence from the limited asset age analyses completed, lead to suggestion that the concept of "bath- tub" type failure curve may be applicable to rigid sewers.

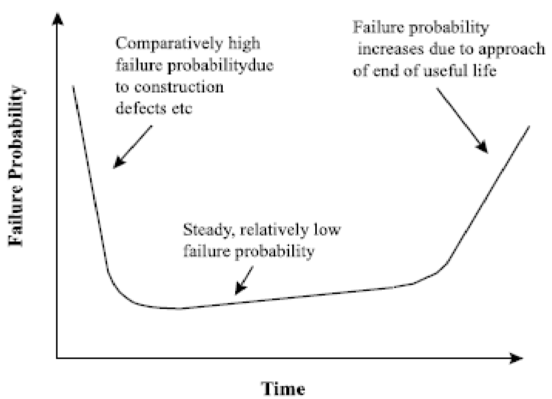

Figure 1: Bath tub curve

• Given the lengthy anticipated asset service life, design assumptions regarding changeable variables such as depth of cover, surface loading, groundwater level and surface type should be made carefully.

• Further research within the field may consider the following aspects:-

- Coincidence of water main bursts and sewer failures.
- Long term testing of sewers to determine the variation of backfill loads with time and the distribution load between the pipe itself and the side fill.
- The effect of maintenance on other buried services and the introduction of road 'patches' on nearby sewers.
- The long-term implications of rising groundwater level.

M. Eiswirth& H. Hotzl (1996):
Contamination of urban groundwater by sewage leakage from damaged sewers is an increasing matter of public and regulatory concern.It is estimated that in Germany several 100 million m^3 waste water leaks every year from partly damaged sewerage systems which contains Sulfate, Chloride and Nitrogen compounds. Besides the ecological point of view, damaged sewerage systems exhibit essential economic problems because groundwater can also infiltrate into the sewers.

This paper presents the result of comprehensive groundwater-quality studies carried out in Southern Germany. The results of hydro chemical groundwater analysis shows that damaged sewerage systems are the main sources for groundwater contamination with sodium, chloride, nitrogen compounds and sulphate. Most of the waste water compounds leaking to the underground are attenuated and biodegraded within the unsaturated zone the groundwater quality is influenced only within a narrow zone next to the sewer leakages.

Therefore the impact of leaking sewers on groundwater is strongly variable and urban effluents mainly produce the potential risk for soil and groundwater.

Tadahiro Mori, TsuguhiroNonaka, Kazue Tazaki, YasuoHikosaka& Shuji Noda (1991):
The corrosion of concrete sewer pipes is one of the most serious problems in sewerage works today. Not only is the construction and replacement of sewer pipes very expensive, but the failure of sewer pipes causes extensive damage to roads and pavements. Thus it is of great importance to find ways to control corrosion of sewer pipes. This paper addresses corrosion by sulphuric acid produced by Sulphur – oxidizing bacteria.

Although several factors affect the corrosion rate e.g. nutrients, moisture, H_2S concentration, temperature, pH and growth of Sulphur – oxidizing bacteria. The objective of this work is to investigate the effects of interactions of nutrients and moisture on the corrosion of concrete sewer pipes.

Following are the three conclusions obtained:-

(1) The heaviest corrosion occurred in the area of concrete around the sewage level and decreased according to the distance from the water level. Nutrients, Moisture and Oxygen had to be present to cause the maximum corrosion rate.
(2) The corrosion rates of 4.3 or 4.7 mm/yr. around the sewage level gave a sewer pipe life of only about 20 yrs.
(3) Two main corrosion products were produced, depending on pH levels. Gypsum was formed at pH levels less than 3 at the surface of the mortar specimen.Ettringite was produced when the pH levels were higher than 3.

RESEARCH NEEDS
Planning is required at different levels: national, state, and regional and community. Though the responsibility of various organizations in charge of planning public waste water disposal systems is different in each case, they still have to function within the priorities fixed by the national and state governments and to keep in view overall requirements of the area. The waste water disposal projects formulated by the various State sponsoring Authorities at present do not always contain all the essential elements for appraisal. When projects are assessed for their cost benefit ratio and for institutional or funding purposes, they are not amenable for comparative study and appraisal. Also at times different standards are adopted by the Central and State agencies regarding various design parameters. It is necessary therefore to specify appropriate standards and design criteria and to avoid different approaches.

CONCLUSIONS
Based on the studied literature it is concluded that under the idea of sustainability, a concept for a Sustainable Urban Sewerage System (SUSS) should be considered which is the basis for urban water reuse and recycling.The corrosion of Concrete sewer pipes is one the most serious problem in sewerage works today and also contamination of urban groundwater by sewage leakage from damaged sewers is an increasing matter of public and regulatory concern. The factors influencing

the structural deterioration and collapse of rigid sewer pipes should also be considered.

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