Design of Underground Drainage for Anklav Town
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Abstract— Since last decade infrastructure development has been taken place all over Gujarat because of this migration of people from villages to town are also increase and reach up to 50\% of world population leaving in Towns. It also predicted that about 70\% of world population will be leaving in cities by 2050. So development of the town occurs at very faster rate. The study guideline for majority of towns for implementation of underground drainage projects.

Key words: Pumping Station, Collecting Network, Manholes

I. INTRODUCTION
About 2.6 billion people lack appropriate sanitation in the world today. This combined with the lack of clean drinking water - which is faced by about 1 billion people - causes 10,000 to 30,000 deaths daily. It is estimated that roughly 6,000 children die every day from diarrheal diseases only. And 88 per cent of diarrheal diseases are caused by unsafe water and inappropriate sanitation. The social needs of the residents in the towns are increasing day by day and that cause a major problem in services. So that it is very essential to do study and Design of the Anklav towns.

It is absolutely necessary to study of sewerage system to upgrade the status of sanitation of small towns from the consideration of health ground. From the study the society as well as the Government will be beneficial.

A. Need For the Subject:
Govt. of Gujarat has planned to cover all municipalities with underground drainage systems. GOG has floated the RURAL - URBAN (R-URBAN) concept. It is for the rural areas having population 7000 to 15000. Those rural areas are Taluka head quarter but still considered as rural areas. In first phase 380 villages are selected to cover with Road, Street lights, water supply and drainage projects. Five model towns (R-URBAN) are selected (Like Tarapur, Ambaji, Dhanera etc.) and the project approval / Implementation works are already in progress for these towns. So prior to covering all the towns - villages, an attempt is required to study the towns having existing drainage systems. After coverage of all municipalites the final disposal of treated sewage will cause a serious problem of river and ground pollution. To avoid such problem what alternative for such system is required to introduce. The implementation and maintenance of underground sewerage system will be highly expensive so it is also important to know that the local authority will able to manage the system or not. Thus an attempt is required to study all such problems of the town having existing Drainage system. Before this attempt no such study is carried out in Gujarat. The works of preparing detail project reports of underground drainage system for many towns are currently given to many consultants by Gujarat Urban Development Mission (GUDM).

B. Statement of Objective:
To study the existing underground drainage system of Anklav town, to identify the problems, to identify the causes and to design of drainage network by SEWER (Version 3.0) Sewer Network Design Program Software.

C. Methodology:
1) Step 01: Selection of the Town:
In small towns the major problem for not working of drainage system is insufficient water supply. So the basic requirement if enough water supply to the town. The other factors are population, population density, area, road length, existing water supply available, type of the treatment to be provided, sub soil condition, topography of the town (geometric condition), type of population in town, average annual rainfall, present management of the town etc. will be considered for selection of the town.

2) Step 02: Collection of data:
Preliminary data:
- Demographic data
  - Population details
  - No of households
  - Floating Population
  - the town boundary map
- Geographical data
  - Rain fall data
  - Water bodies
  - Geology and soil conditions
- Existing infrastructure data
  - Roads network
  - Water supply data (Municipal & Private)
  - Existing Strom Water Drain details
- Existing underground drainage data
  - Existing layout and zoning pattern
  - Sewerage and sanitation service levels
  - Operation and maintenance details for Sewage department
Secondary Data:
  - Operation of bore wells by municipality as well as the private source
  - Potentiality of the development of the town
  - Problems regarding point of overflow and its timing
  - Manhole locations and its status (Above the ground / Below road level)

3) Step 03: Analysis of The Data:
- The analysis of the data will be done for Selected towns. According to existing drainage condition the analysis of the system will be done in general for both the towns.
  - One town will be in detailed analyzed.
  - Checking of feasibility for utilization of existing system in the area.
– New system for the next 30 year design Period.
4) Step 04: Suggestions for Betterment for The Underground Drainage System:

II. LITERATURE REVIEW

About 2.4 billion people lack appropriate sanitation in the world today. This is combined with the lack of clean drinking water - which is faced by about 1 billion people - causes 10,000 – 30,000 deaths daily. It is estimated that roughly 6,000 children die every day from diarrheal diseases only. And 88% of diarrheal diseases are caused by unsafe water and inappropriate sanitation. (Rosemarin 2004 a, http://www.who.int and http://www.wsscc.org, Excess on 3/2/2011)

Fig. 1: World Sanitation Coverage Map

A. Sanitation Status in India:
Sanitation to be seen as a basic need, as basic as drinking water or food. A sanitary toilet within or near home, provides privacy and dignity to women. Mahatma Gandhi emphasized the link between sanitation and health as a key goal for our society. Sanitation coverage, which ought to be a way of life to safeguard health, is inadequate in our country. Lack of adequate sanitation is a pressing challenge in both rural and urban India. Every day, an estimated 1,000 children under five die in the country because of diarrhea alone, a preventable disease. Prevalence of child under-nutrition in India (47 per cent according to National Family Health Survey III, 2005-06) is among the highest in the world and nearly double that of Sub-Saharan Africa. Child undernutrition is aggravated by the prevalence of diarrheal disease, and is responsible for 22 per cent of the country’s burden of disease (World Bank 2005). Some studies suggest that it affects child cognitive and motor development and undermines educational achievement. Sanitation related illnesses in both children and adults drain productivity and income, ultimately perpetuating poverty. In addition to public health implications, lack of adequate sanitation forces households into the continued indignity of open defecation, which is an acute problem especially for women and young girls.

As India becomes more populous – India’s population will exceed 1.8 billion by 2015 – its growth poses significant challenges to the provision of environmental services such as water, sanitation, solid waste management and drainage. However, in both rural and urban spheres, promising initiatives are underway to tackle the sanitation challenge. Accordingly, this Country Paper is divided into two parts – rural and urban sanitation. (Source: Water AID, Drinking water and sanitation status in India - Coverage, Financing and Emerging Concerns, Water AID India - 2005)

Mohammad Valipour(2012) presented, a comparison has been done between horizontal and vertical drainage in anisotropic soils. For this purpose, using EnDrainWin and WellDrain softwares drain spacing and well spacing, respectively, determined. The results showed that in the same situation, horizontal drainage systems due to the higher spacing between drains (reducing number of drainage and thus reducing the cost) were better than vertical drainage systems. However, vertical drainage systems due to the lower changes in well spacing in different anisotropic soils were suitable for conditions that soil hydraulic conductivity was likely to change.

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Dr. Mrs. S. S. Kulkarni (2012), Presented. The infrastructure of a city, mainly the water supply and sewerage system are vital for urbanization, wastewater generated from urban area is a result of domestic and industrial activities, and domestic wastewater contains organic and inorganic matter in suspended, colloidal and dissolved form. The municipal wastewater management is a critical issue in an urban environment. If the municipal wastewater is not properly collected, treated and disposed, the related effects pose serious threat to the environment. Many small cities do not have proper drainage system, Islampur, Dist. Sangli; Maharashtra, India is one such. As on date all the domestic waste water is either send in open drain or in open area around the houses. This is resulting in hygienic problems and to cater for; Municipal Corporation of Islampur town has come up with underground sewage collection plan. This study aim at designing collection system for Islampur town, the work undertaken uses, GIS as a tool for mapping the collection system (primary and secondary) in order to facilitate further works.

Satish S Kannur (2015) presented, during early years of designing conveyance system, manual calculations were practiced which was laborious to handle the data and results. Now a days, specific softwares are developed to minimize the time for calculation and improved environments for documentation and presentations. One of such software is given by Bentley’s products named ‘SewerGEMS’. The environment of ‘SewerGEMS’ software emphasis on creating set of sewer networks alignments, alternatives such as physical alternative, design alternative etc. The computation of design and analysis for different scenarios is possible by adopting ‘SewerGEMS’ Software. In the proposed paper, the ‘SewerGEMS’ software is used as a design tool to have amicable results for analyzing sewer network for a Zone in Tumkur city. Initial data was provided by city municipality, comprised of parameters related to water supply, number of wards with their population...
distributions, topography and source of sewage. The sewer network is designed by considering the local statutory body regulations along with the commercially available materials. Utilizing these data, analysis was performed to simulate hydraulic conditions of sewers. In order to assess compatibility to accept the outputs of the software results; manual calculations are carried out with the aid of ‘Microsoft Excel’. The variations of the output parameters are analyzed and compared with manual calculations. The results are found in similar nature with slight variations in physical values. Proposed work benefits academics and practitioners (municipal engineers, consultants and contractors) to prioritize plans for forth coming localities which are in need of underground drainage system.

III. STUDY AREA

Anklav town is located in Anand district in the State of Gujarat (India). Anklav Town is the Head Quarter of Anklav Taluka. Anand – Umeta road is passing through the town. District Head Quarter Anand is situated at a distance of 27 Km from Anklav town. Anklav town is located at latitude 22°–22’ N & longitude 72°–57’ E. The town being Taluka Head Quarter is well equipped with all basic infrastructures, like Primary and Secondary Schools, Post Office, Telecom Office, Electricity Office, Revenue Offices etc. Even though the population of the town as per census 2011 is 21027 souls, the town is declared as Anklav Nagarpalika by Govt. of Gujarat.

A. Existing Under Ground Drainage System:
The U/G Drainage System is completed for part of town recently. The town is divided into two zones. The length of sewer system is 5525 M. The 150 mm to 200 mm dia stone ware pipes are used. RCC NP2 class pipes are used for sewers of 250 mm to 500 mm dia and R.C.C. NP3 class pipes are used for sewers of 600 mm to 700 mm dia. The estimated cost of the project is Rs. 125.80 Lacs. Circular Dry well, Wet well type Pumping Station is constructed with Screen Chamber. In Sub Pumping Station 15 H.P. Horizontal Non Clog Pumps -3 sets are installed. Rising main of 200 mm dia D.I. pipeline is laid from Sub Pumping Station to chamber which further leads sewage to Main Pumping Station. In Main Pumping Station 3 Nos. of Horizontal Non Clog pump motor of 30 H.P. are installed. The 300 mm dia A.C. pressure Rising Main is laid from Main Pumping Station to Oxidation Pond. The P.M. is used as per requirement considering inflow of sewage from town. The 3 cells of Oxidation Ponds are constructed with Inlet Chamber. The survey no. 1162 is used as an Oxidation Pond which has an area of Ha 11 – Ra – 3 Sq.M. - 0. The O & M of the scheme is done by local body.

The existing U/G drainage has covered part of town. The scheme was commissioned in year 2008. The existing scheme has covered approx 50% population of the town. The facility of sewerage scheme is served by individual house connection.

<table>
<thead>
<tr>
<th>Year</th>
<th>Anklav Town</th>
<th>Main Zone</th>
<th>Sub Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>21027</td>
<td>3079</td>
<td>1164</td>
</tr>
<tr>
<td>Base Year (2016)</td>
<td>22814</td>
<td>3341</td>
<td>1263</td>
</tr>
<tr>
<td>Intermediate Population (2031)</td>
<td>28518</td>
<td>4176</td>
<td>1579</td>
</tr>
<tr>
<td>Ultimate Population (2046)</td>
<td>34221</td>
<td>5011</td>
<td>1894</td>
</tr>
</tbody>
</table>

Table 1: Population forecast

IV. DESIGN CRITERIA

A. Layout:
To avoid deep excavation, long trunk pipes to interceptors and large pumping station, serious consideration is given to splitting the network in to two or more separate smaller systems although network layout is also an important part of conventional design, the optimization of pipe length and networks subdivision takes on even greater importance in simplified system.

B. Hydraulic Design:
1) Design Period:
The planning for Sewerage System of Anklav & Umreth town is being prepared for the year 2046 (30 Years) as the ultimate planning year. (CPHEEO Manual Sr. No. 3.2 Page 3-1).
2) Flow Assumption:
As intended by the Local body, it is assumed that the Municipality will find ways and means to supply water to the town at a uniform rate of 150 LPCD in all command areas. The rate of sewage generation is usually taken as 80-90% of the water supply. The water table in this area is at depth of 10
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to 15 m from G.L. Hence infiltration is not required to be considered. The estimated peak flow adopted for hydraulic design depends upon contributory population. (CPHEEO Manual Sr. No. 3.5 Page 3-3)

3) Depth of Flow:
It is necessary to size the sewer to have adequate capacity for the peak flow to be achieved at the end of design period, so as to avoid steeper gradients and deeper excavations. For the ultimate design period, the sewers are designed flowing 80% full (d/D = 0.8). (CPHEEO Manual Sr. No. 3.15.5 Page 3-28).

4) Velocity of Flow:
The flow in sewers varies widely from hour to hour and also seasonally, but for purpose of hydraulic design estimated peak flow is adopted. However it is to be ensured that a minimum velocity is maintained in the sewers even during minimum flow conditions. At the same time the velocity should not be excessive to cause erosion.

For design of sewer minimum velocity should be 0.6 m/sec. To avoid erosion in the sewer network, velocity more than 3.0 m/sec will not be allowed. (CPHEEO Manual Sr. No. 3.15.1 Page 3-26)

5) Minimum Depth of Cover:
The starting manhole depth of the proposed sewers ranges from 1 M to 1.5 M depending upon the topography and details of road planning network available. The Minimum Depth of Cover depends on the depth of the starting manhole and subsequent ground level of the road along the sewer. The minimum depth of cover of 1.0 M is provided.

6) Maximum Depth of Sewer System:
In many areas of Anklav town construction of sewers below 6 M becomes very difficult. The maintenance of sewers below 6 M is also difficult. This shall increase the cost of construction and maintenance. Therefore maximum depth of Sewer Collecting System is kept about 6 M.

C. Selection Pipe Material:
Over the years almost all types of pipe materials have been tried and tested for sewerage application. Though there are numerous factors to be considered in designing a Sewerage System, mainly three basic factors influence the ideal choice of pipe material.
1) Hydraulic and structural design.
2) Nature of the effluent to be carried and the soil / ground water condition.
3) Ability to encounter sewage related corrosion and abrasion.

D. Manholes:
Manholes form one of the essential structures in any Sewerage System. They are generally provided at every road junction, at every change of alignment or gradient of sewers at every junction of two or more sewers at head of all sewers or branches, wherever there is a change in size of sewer and at regular intervals in the Sewerage System. They are used for inspection, cleaning and repairing of sewers and other maintenance operations.

E. House Connection & Chamber:
Necessary provision for house connection with chambers & 100 mm dia Stone ware pipe is made in the project. The one chamber will be provided between two houses.

V. DESIGN USING SEWER SOFTWARE

A. Proposed Sewer Collecting Network Details:

<table>
<thead>
<tr>
<th>Location</th>
<th>Diameter of Pipe</th>
<th>Length of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anklav Main Zone</td>
<td>150 mm</td>
<td>3799 Mt</td>
</tr>
<tr>
<td></td>
<td>200 mm</td>
<td>388 Mt</td>
</tr>
<tr>
<td></td>
<td>250 mm</td>
<td>539 Mt</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>41 Mt</td>
</tr>
<tr>
<td></td>
<td>350 mm</td>
<td>75 Mt</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4842 Mt</td>
</tr>
<tr>
<td>Anklav Sub Zone</td>
<td>150 mm</td>
<td>1561 Mt</td>
</tr>
<tr>
<td></td>
<td>200 mm</td>
<td>157 Mt</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1718 Mt</td>
</tr>
<tr>
<td>Total Anklav UGD</td>
<td></td>
<td>6560 MT</td>
</tr>
</tbody>
</table>

Table 2: Proposed Pipe length in Project
VI. CONCLUSIONS

By using sewer version 3.0 following parameter are given:

<table>
<thead>
<tr>
<th>Location</th>
<th>Area to be covered</th>
<th>Diameter of Pipe</th>
<th>From Node to To Node</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anklav Main Zone</td>
<td>Indira Nagari, Bharvad Vas, Pramukh Society, Sachidanand Society, Rajdip Society, Gaytri Society, Church area, Sarvoday Society</td>
<td>150 mm</td>
<td>01 to 59</td>
<td>Red Color</td>
</tr>
<tr>
<td></td>
<td>Anklav Kosindra Road &amp; Anklav Umeta Road</td>
<td>200 mm</td>
<td>59 to 154 &amp; 154 to 162</td>
<td>Dark Pink color</td>
</tr>
<tr>
<td></td>
<td>Anklav Kosindra Road &amp; Anklav Umeta Road</td>
<td>250 mm</td>
<td>66 to 178 &amp; 162 to 176</td>
<td>Blue color</td>
</tr>
<tr>
<td></td>
<td>Anklav Umeta Road</td>
<td>300 mm</td>
<td>176 to 178</td>
<td>Brown color</td>
</tr>
<tr>
<td></td>
<td>Near GEB Sub Station</td>
<td>350 mm</td>
<td>178 to 181</td>
<td>Orange Color</td>
</tr>
<tr>
<td>Anklav Sub Zone</td>
<td>Singaniya Area, Umiya Vasahat, Mujahi Colony, Diwan no Khacho, Rehmatnagar</td>
<td>150 mm</td>
<td>01 to 67</td>
<td>Red Color</td>
</tr>
<tr>
<td></td>
<td>Umiya Vasahat Road</td>
<td>200 mm</td>
<td>67 to 74</td>
<td>Dark Pink color</td>
</tr>
</tbody>
</table>

Table 4:

Fig. 5: Anklav Collecting Network Drawing

REFERENCES

[1] CPHEEO Manual for Sewage works