Design of Wastewater Collection Network

Using SewewCAD Model and Excel Software

for

Najed AlFawaris Area, Azal District, Sana'a, YEMEN

Submitted by

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ABSTRACT

There is no wastewater collection network at present whatsoever in Najed Al-Fawaris *area* in northeast Sana'a*,* Yemen. The sewage from residential and public buildings in the area is drain to cesspits. These have become clogged with time and require frequent emptying. The continued use of cesspits with the increase in population will cause environmental and health problems, and may create future contamination of soil and drinking water.

In every community or area inhabited by humans, generated solid and liquid waste have to be hygienically collected and safely disposed of, in the absence of which diseases and epidemics would spread. Furthermore, emptying cesspools constitutes an offensive odor nuisance to the population. On the other hand, emptying the vacuum trunks in the neighborhoods causes negative impacts on human and visual landscape.

A design of gravity sewage collection *network* was carried out in a new developing area in Najed Al-Fawaris area. SewerCAD was used to design the gravity sewer network with constraints for velocity, slope and depth of cover. The total design flow was (XX,XXX liters/day), and the total pipe length (XXX m). SewerCAD is an extremely powerful program for the design and analysis of gravity flow and pressure flow through pipe networks and pumping stations. The program is compatible with AutoCAD mode, giving you all the power of AutoCAD's capabilities, or in Stand-lone mode utilizing our own graphical interface.

The designed manholes are (XX) in number with a lone outfall. The outcome of the design established that a gravity sewer network can be constructed for future expanded houses of highly populated areas or peri-urban communities. It is recommended that an efficient wastewater collection network for sewage is designed not just for the selected households in the present area but the system could be expanded for new development area in the near future.

The present study considered the annual population growth and their water consumption for the coming 25 years that will be the design period, along with the future commercial and industrial development in the selected study area. The necessary hydraulic calculations needed for the design of the laterals and main pipes was carried out by the SewerCAD model calculations and was compared with an Excel program calculation for verification.

CHAPTER ONE

INTRODUCTION

1.1 Background

There is no public wastewater collection serving Najed AlFawaris area in Azal district, in Sana'a at the present time. Due to the lack of sewage collection network, large areas in the neighborhoods are being contaminated by raw sewage. This contamination will have direct and/or indirect long-term impact on water resources and soils which creates health hazards when utilized for human consumption. For the above-mentioned reasons, serious and major steps are taken by our project system to collect, dispose, and ultimately treat the wastewater before discharging it in open environment.

1.2 Problem Definition

disposal and More than 80% of the water used for domestic purposes and industry turn into sewage and need a treatment for reuse in irrigation or other alternative use. Contrarily, if wastewater not treated and not disposed of, sewage may contaminate sources of drinking water causing water-borne diseases.

In Najed AlFawaris area, no piped wastewater disposal system is available, because of that, wastewater from individual residence is discharge directly into subsurface pits, and septic tanks allowing the wastewater to seep into the surrounding soil and percolate into the underlying aquifer causing health hazards ground water pollution.

Najed AlFawaris area like other areas in the neighborhood has no sewage facility and the people are using cesspits and septic tanks for the disposal of wastewater. These septic tanks and cesspits are deteriorating and they are in bad condition, adding to this the increasing in water consumption and consequently increasing in wastewater production, resulting in overflow from the cesspits and septic tanks would cause excessive recharges through soils and contaminate the source of drinking water.

In view of this bad condition, and since there is no sewerage system exist, along with the fast increase in population and the anticipated deterioration in environmental and health conditions, an evaluation and design of wastewater collection system study become necessary so as to solve all expected problems before it happen. This project includes evaluation of the area and design of the sewage system as well as considering the annual growth of people and their water consumption for the coming 25 years, which will be the design period, along with the future commercial and industrial development in the area.

1.3 Purpose of Project

The overall purpose of this project is to investigate and evaluate wastewater collection and treatment processes along with conceptual designs that are suitable for Najed AlFawaris area. More specifically the main purposes of this project may be classified as follow:

1. Display the current situation of wastewater disposal in Najed AlFawaris area.

2. Define the types of sewage facilities and their locations that will need to be constructed.

3. Propose wastewater collection system for the area and design the laterals and main pipes of the proposed sewerage collection network.

4. Estimate the cost for construction of the collection network.

The project will help in reducing the threat to the environment, water and land resources and to the health of the people living in Najed AlFawaris area.

1.4 Scope of the Work

The scope of the work of this project is to evaluate and develop preliminary conceptual design for sewer network for Najed AlFawaris area of the Azal district. The preliminary design will incorporate a variety of design criteria including investigation of site, site suitability, environmental consideration and cost estimate.

1.5 Project Area

Najed AlFawaris area is located 8 km northeast of the capital Sana'a city center as shown on the project location map (Figure 1.1). The total population within the project area as of the year of 2022 is about (XXXX). The elevation within the area ranges from 2900-3000 m above sea level.

The average annual rainfall is about 500 mm, the minimum average annual temperature rises to 12 º C, and the maximum average annual temperature rises to 25 º C. The per capita water consumption for domestic use does not exceed 120 liter per day. The present total area of the project is about 6 hectare, where building for population occupies 0.06 Km^2.

Phase 1: Collection and Analysis of Data

During this phase, available data of population and other information necessary for the design purposes were collected from reliable sources. Moreover, frequent site visits to the project area were undertaken. The first phase included the following tasks:

1. Collection of aerial and topographical maps of the area.

2. Collection, analysis and augmentation as necessary data on population, land use, residential, and commercial houses, water consumption and environmental conditions.

Phase 2: Perform the Surveying Works

The tasks which were performed in the second phase are:

1. Determine the coordinates of points using ARC GIS and GPS Systems.

2. Evaluate of the contour maps and matching it with actual ground levels.

3. Performing and selecting topographic survey for the sewage network.

Phase 3: Design of the Sewage Network

During the third phase, the areas to be served by sewage were defined, the layout was established, and the necessary hydraulic calculations needed for the design of one of the lateral and main pipe were carried out. The tasks performed in this phase, are as follows:

1. Define the service areas and establish the boundaries.

2. Establish a system layout, which includes the topography of the areas, existing streets and roads.

3. Determine the main catchments areas, routes of the sewer, and locations of manholes.

4. Prepare a design criterion of the sewage contribution and wastewater flow through the year 2047.

5. Perform the necessary hydraulic calculations and find out the type of sewer pipes and diameters.

Phase 4: Preparing Plan Drawings and Profiles

Plan drawings and profiles with appropriate scales for the wastewater collection system were prepared.

Phase 5: Preparing Bill of Quantities and Cost Estimates

As soon as the project team finishes the design calculations for the project components, the team prepared the bill of quantities and estimate the cost of the project.

Phase 6: Writing the Report

Upon the completion of the work and writing the report, a full text of the project documents and drawings were prepared and submitted to the Department of Civil Engineering in the College of Engineering at the University of Science and Technology (UST).