

Production a Digital Map with the Aid of Total Station and (GIS)

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Abstract: Geographic information system (GIS) is utilized in a variety of tasks such as, resource management, urban planning, emergency planning in case of accident, and rapid response etc. The aim of this study is to produce a digital map with the aid of GIS and a survey data. A survey data is conducted with Total Station technique on sanitary planning positions. The campus of Baghdad University is chosen to test the execution and accuracy of the results for sewer manholes locations. During the field survey, Total Station (Nikon Nivo) is used to identify the 3-D coordinates for each location. Finally, Geographical Information System (GIS) are utilized to present the digital map of the network sewer pipe line to the end users. Although Geographic Information System survey has many advantages compared to the traditional system that acquired from the traditional survey such as digitizing system because its limitations.

Keywords: digital map, GIS, manholes, location, planning

1. Introduction

The Map helps to determine the location of the target. Maps and map data are important not only for assessors, but also for other governmental agencies, the public, and surveyors. The digitizing process for the map and its data can enhance the ability to manage, summarize, analyze, and display the information [1]. A GIS is often associated with a map digitally. A map is the one way that can work with geographic data in a GIS environment. A GIS utilizes a simple mapping program or adding more data to online mapping tools [2].

1.1 Technologies of the Digital Mapping

At the last years, the worldwide expansion of information technologies has not only led to a spread of information in all areas of applications but also has made the greater number of this information ready in digital form. Digital mapping has penetrated all side of the mapping process, from pure data collection such as (total stations applications, GPS data, and remote sensing) through map collection and design to final form. Progression in mapping technology has changed the conventional stereo plotters with digital imaging systems; see Figure (1). Geographic Information System (GIS) and map production software and the availability of information in digital form have enhanced its utility [3].



Figure 1: Digital map [4].

1.2 Sewer Pipe Line System

Pipeline network are general used in gas, water and pipeline network transportation. Transportation pipelines may have stretch for thousand kilometers underground. Setting the digital maps and the field survey for pipelines (sewer systems, electrical cables or gas pipelines) can save them from damage and cutting that can be avoided when maintaining or setting new projects [5]; see Figure (2).

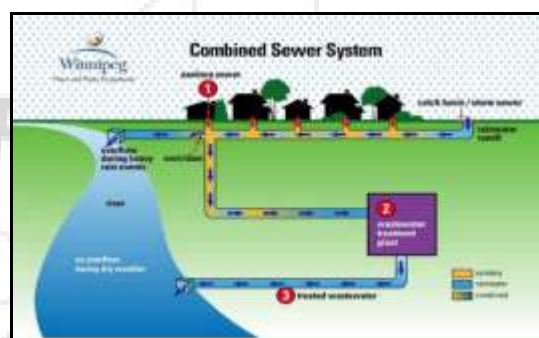


Figure 2: Piping systems [6].

1.3 Total Station Tecnique

Total Stations are an accurate way of measuring distances and angles. These instruments are capable of making measurements during a survey and of calculations X, Y, Z coordinates of points during the survey, see Figure (3). As the data are hold digitally by using total station, they can easily be passed to a computer with program designed to calculate the 3D coordinates of each point and to present the map as a 2-dimensional or 3-dimensional drawing [7]. The Total Station is capable an accurate surveys used increasingly in combination with survey-grade satellite receivers. Satellite receivers determine positions using the differential Global Positioning System (DGPS) and Global Navigation Satellite System (GNSS) [8].

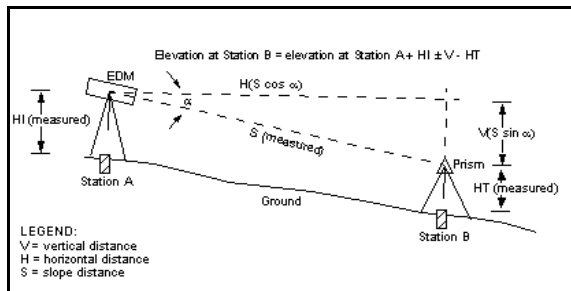


Figure 3: Measurements of Total Station [9].

1.4 Geographic Information system technology

GIS- Geographical Information System supplies some of the most overall tools for manipulation, analyzing and storing. The application of GIS can reduce the time needed for insert data and also a more efficient use of the inputs with high flexibility in scale and time. Geographic information systems also provide the tools for spatial calculations, spatial queries, and spatial data modeling and produce the attribute maps. After storing all the data, both the digital map and it's the database can be updated at any time [4].

2. Reconnaissance Survey and Field Survey

Survey field reconnaissance is a necessary for the survey area. The campus of Baghdad University at college of engineering department was selected as the study area. The data from Consulting Engineering Bureau is used to select the sanitary sewer manholes and pipelines in this study. This data provides required information like: location of points, and its specifications.

Total Station type: Nikon Nivo is used to survey a sanitary sewer manhole around the buildings of the study area. Table (1) shows the specifications of the Nivo Total station instruments.

Table 1: Total Station (Nikon Nivo 5 C) specifications

| Type | Specifications |
|---------------------------|---|
| Accuracy (Nikon Nivo 5 C) | 5" |
| Telescope | Focusing distance: 1.5 m to infinity (4.92ft to infinity) |
| Distance Measurement | Reflector less mode (white target): 1.5m to 300m |
| | Good conditions with single prism: 5,000m |
| Distance Accuracy | Prism/Precise mode: (3+2 ppm X D) mm |
| | Reflector less/Precise mode: (3+2 ppm X D) mm |
| Angle Accuracy | Prism: Precise 1.5 sec / Normal 0.8 sec |
| | Reflector less: Precise 1.8 sec / Normal 1.0 sec |
| Display | Face 1: QVGA 16 bit Color, LCD, Backlit (320 x 340 pixel) |
| | Face 2: Backlit, graphic LCD (128x64pixel) |

Figure (4) shows the main parts of the Nivo 5C, measurements using total station done depend on the link below:

<https://www.youtube.com/watch?v=8PyNEg5S67A>. [10].



Figure 4: Total Station Nivo series

The 3-D coordinates of the sanitary sewer manholes are measured with Nivo Total Station instrument, see Figure (5). Table 2 illustrates the data that are collected.

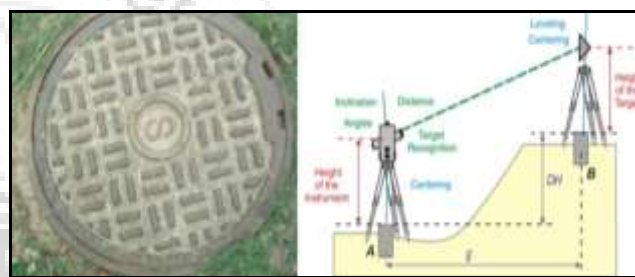


Figure 5: Total Station observations of sanitary sewer manhole

3. Results and Discussion

After the data collection done in the field, the results of the sanitary network are acquired.

3.1 Data Acquisition

Around the survey area, the network of sanitary sewer pipelines included thirty five manholes. Nivo Total station is used to acquire data for this project. Survey Pro. Software on Nivo a board was isolated and exported to a shape file format. Table (2) illustrates the data that were captured.

Table 2: Sanitary Sewer Manhole locations by using Total station &GPS

| Point.ID for each Manholes | Measurements with Total Station | | |
|----------------------------|---------------------------------|--------------|--------------|
| | Easting (m) | Northing (m) | Elevation(m) |
| M.H.1 | 442101.113 | 3681130.628 | 36.108 |
| M.H.2 | 441985.186 | 3681092.505 | 36.230 |
| M.H.3 | 441911.078 | 3681104.809 | 36.023 |
| M.H.4 | 441876.607 | 3681117.609 | 35.803 |
| M.H.5 | 441875.422 | 3681097.209 | 35.956 |
| M.H.6 | 441857.447 | 3681104.512 | 36.024 |
| M.H.7 | 441864.714 | 3681146.583 | 36.364 |
| M.H.8 | 441889.228 | 3681220.736 | 36.263 |
| M.H.9 | 441891.937 | 3681226.810 | 36.179 |
| M.H.10 | 441900.987 | 3681241.318 | 36.030 |

| | | | |
|--------|------------|-------------|--------|
| M.H.11 | 441769.998 | 3681094.428 | 36.016 |
| M.H.12 | 441769.521 | 3681113.126 | 36.100 |
| M.H.13 | 441638.681 | 3681120.519 | 36.388 |
| M.H.14 | 441613.567 | 3681138.484 | 35.930 |
| M.H.15 | 441787.437 | 3681190.699 | 37.020 |
| M.H.16 | 441798.594 | 3681177.294 | 37.319 |
| M.H.17 | 441800.491 | 3681186.541 | 36.961 |
| M.H.18 | 441827.300 | 3681287.622 | 36.909 |
| M.H.19 | 441826.377 | 3681293.072 | 36.921 |
| M.H.20 | 441821.751 | 3681312.772 | 36.925 |
| M.H.21 | 441819.025 | 3681322.511 | 36.934 |
| M.H.22 | 441625.680 | 3681123.131 | 36.305 |
| M.H.23 | 441605.256 | 3681127.226 | 36.524 |
| M.H.24 | 441583.817 | 3681131.353 | 36.317 |
| M.H.25 | 441573.872 | 3681133.316 | 36.318 |
| M.H.26 | 441562.661 | 3681135.561 | 36.334 |
| M.H.27 | 441554.001 | 3681136.946 | 36.222 |
| M.H.28 | 441665.606 | 3681177.231 | 36.932 |
| M.H.29 | 441681.126 | 3681174.393 | 36.871 |
| M.H.30 | 441665.974 | 3681184.579 | 36.946 |
| M.H.31 | 441675.069 | 3681220.513 | 36.951 |
| M.H.32 | 441722.287 | 3681164.608 | 37.036 |
| M.H.33 | 441677.169 | 3681228.140 | 37.068 |
| M.H.34 | 441677.569 | 3681239.151 | 37.095 |
| M.H.35 | 441683.268 | 3681266.552 | 37.064 |
| M.H.36 | 441675.337 | 3681284.418 | 36.985 |
| M.H.37 | 441675.193 | 3681295.618 | 36.942 |
| M.H.38 | 441674.539 | 3681323.326 | 36.977 |
| M.H.39 | 441673.643 | 3681348.462 | 36.822 |
| M.H.40 | 441664.853 | 3681385.533 | 37.021 |
| M.H.41 | 441668.153 | 3681391.411 | 36.950 |
| M.H.42 | 441635.386 | 3681382.458 | 36.938 |
| M.H.43 | 441625.908 | 3681379.446 | 36.943 |
| M.H.44 | 441593.821 | 3681370.510 | 36.919 |
| M.H.45 | 441682.631 | 3681390.528 | 36.912 |
| M.H.46 | 441673.386 | 3681362.543 | 36.720 |
| M.H.47 | 441736.982 | 3681413.831 | 36.891 |
| M.H.48 | 441797.951 | 3681419.321 | 36.667 |
| M.H.49 | 441807.547 | 3681455.331 | 36.625 |
| M.H.50 | 441712.951 | 3681467.393 | 36.217 |

| | | | |
|--------|------------|-------------|--------|
| M.H.51 | 441836.445 | 3681173.183 | 36.267 |
| M.H.52 | 441877.449 | 3681172.240 | 36.825 |
| M.H.53 | 441777.934 | 3681045.775 | 36.509 |

Figure (6) shows the overview of the Total Station elevations with respect to manholes ID., it goes along the survey line.

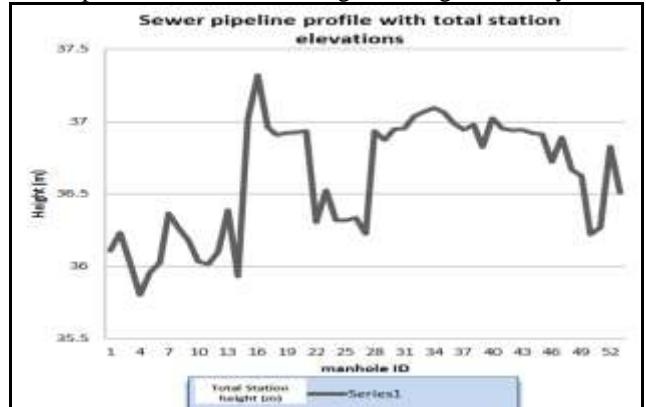


Figure 6: The overview of the Total Station Elevations with respect to manholes ID.

3.2 Arc Map Editing Session

The network map was created using GIS 10.1. Arc GIS is proved offering capabilities for geospatial data manipulation and management as well, see the link below.

[https://www.youtube.com/watch?v=Ehv1bKHNNQ8&index=4&list=PL-2sBQtgS7Y4H8EYoSCvdahCr2VxYz-P_\[11\]](https://www.youtube.com/watch?v=Ehv1bKHNNQ8&index=4&list=PL-2sBQtgS7Y4H8EYoSCvdahCr2VxYz-P_[11]).

The Arc GIS software was applied to supply a digital map with more than one layers and attributes for that study area. Figure (7) illustrate some of these layers (points of the sewer M.H., College of Engineering buildings). Also, attributes were allocated to each feature in the map such as information about manholes and buildings. These table can be edited and updated it.

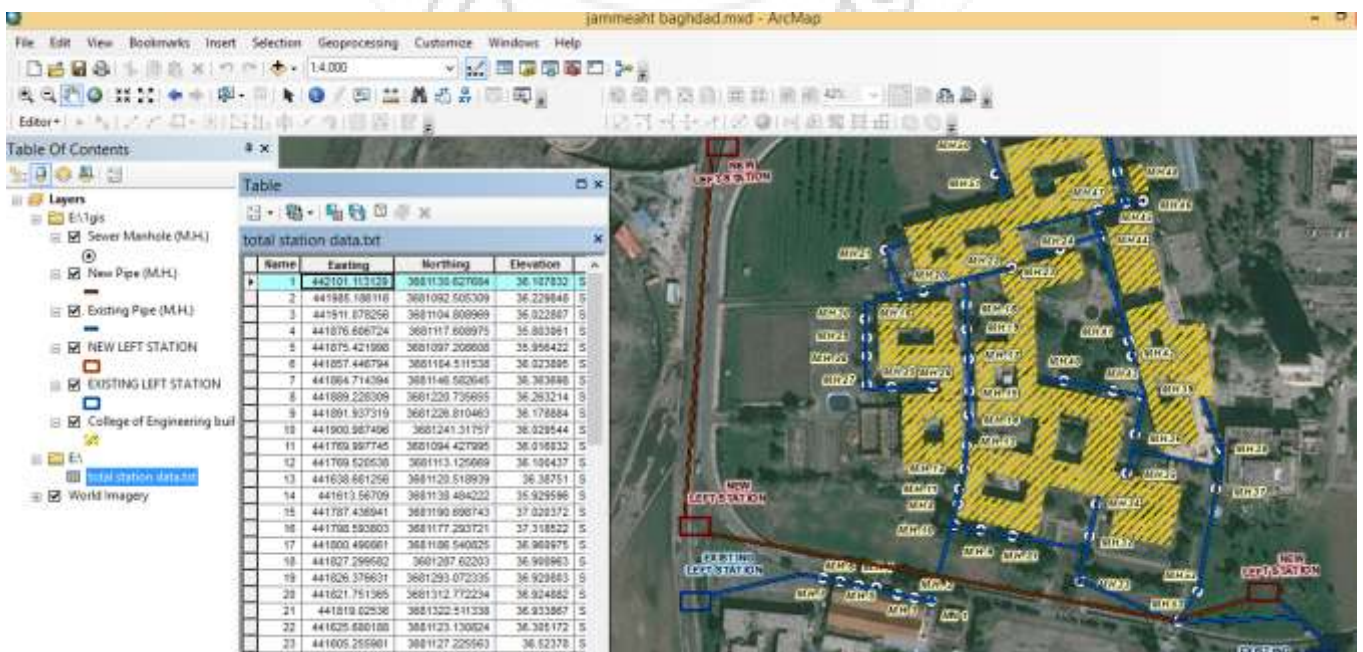


Figure 7: Digital map and the attributes

3.3 Detailed Design Drawing

In this study two different layers of the pipeline are indicated (existing pipeline and new pipeline). The image shown in Figure (8) is the final map design in GIS environment which shows the networking of the route sewer pipeline in Baghdad University at Al- jadiria campus and around the College of Engineering.

Sewer Pipeline Network for Baghdad University



Figure 8: Digital Map and Locations of the selected manholes

The network for sanitary sewer pipeline in the area is offered in Figure (9). It's connected to the selected point inside the area. To do that by using ArcGIS, see link below.

https://www.youtube.com/watch?v=C2yvzCFiMkg&list=PL2sBQtgS7Y4H8EYoSdvdahCr2VxYz-P_&index=7 [12].

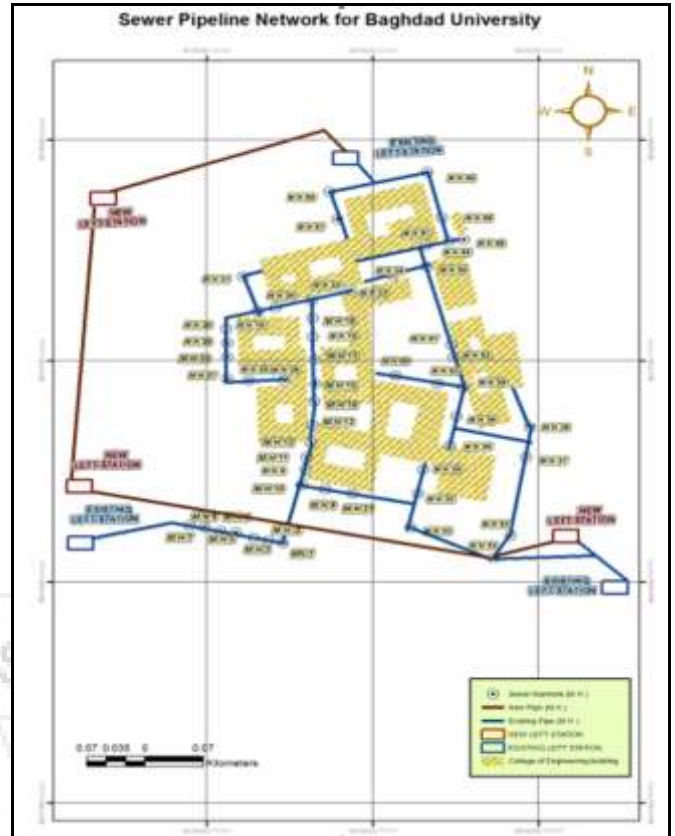


Figure 9: Sanitary sewer pipeline network design in the study area.

4. Conclusion

- 1) Setting the digital maps and the field survey for pipelines (sewer systems, electrical cables or gas pipelines) can save them from damage and cutting that can be avoided when maintaining or setting new projects.
- 2) Thing that may be of generalizing this study at Baghdad University pipelines or Baghdad city to obtain low costs of maintenance.
- 3) It is an effort to generalize the study idea onto the electricity, communications and municipalities.
- 4) Replaced the traditional system with the Differential Global Positioning System (DGPS).

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