International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

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].

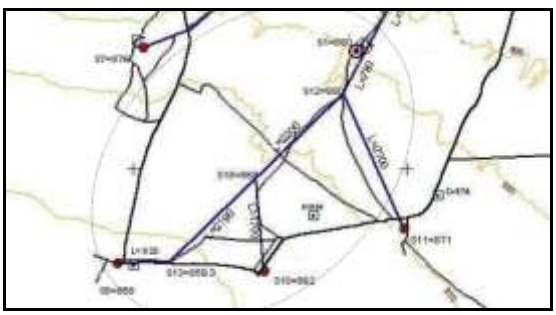

Figure 1: Digital map [4].

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).

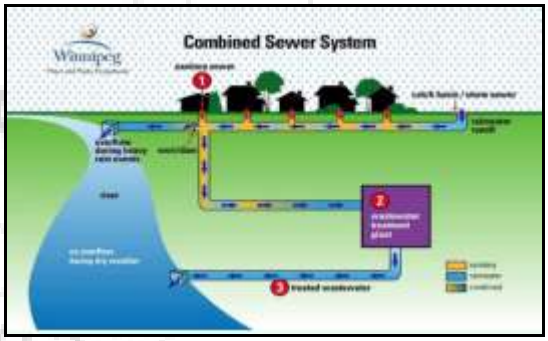

Figure 2: Piping systems [6].

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].

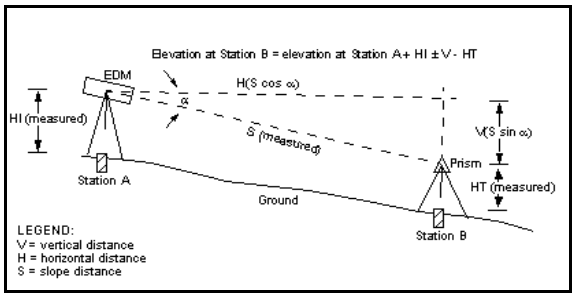

Figure 3: Measurements of Total Station [9].

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.

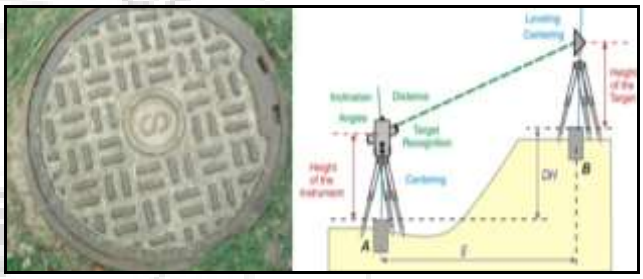

Figure 5: Total Station observations of sanitary sewer manhole

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.

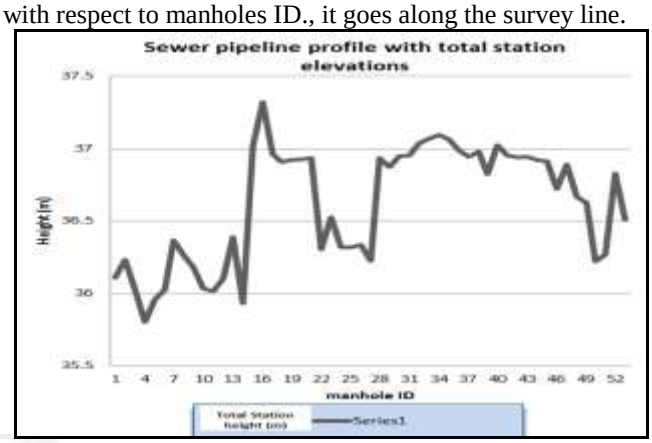

Figure 6: The overview of the Total Station Elevations with respect to manholes ID.

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].

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.

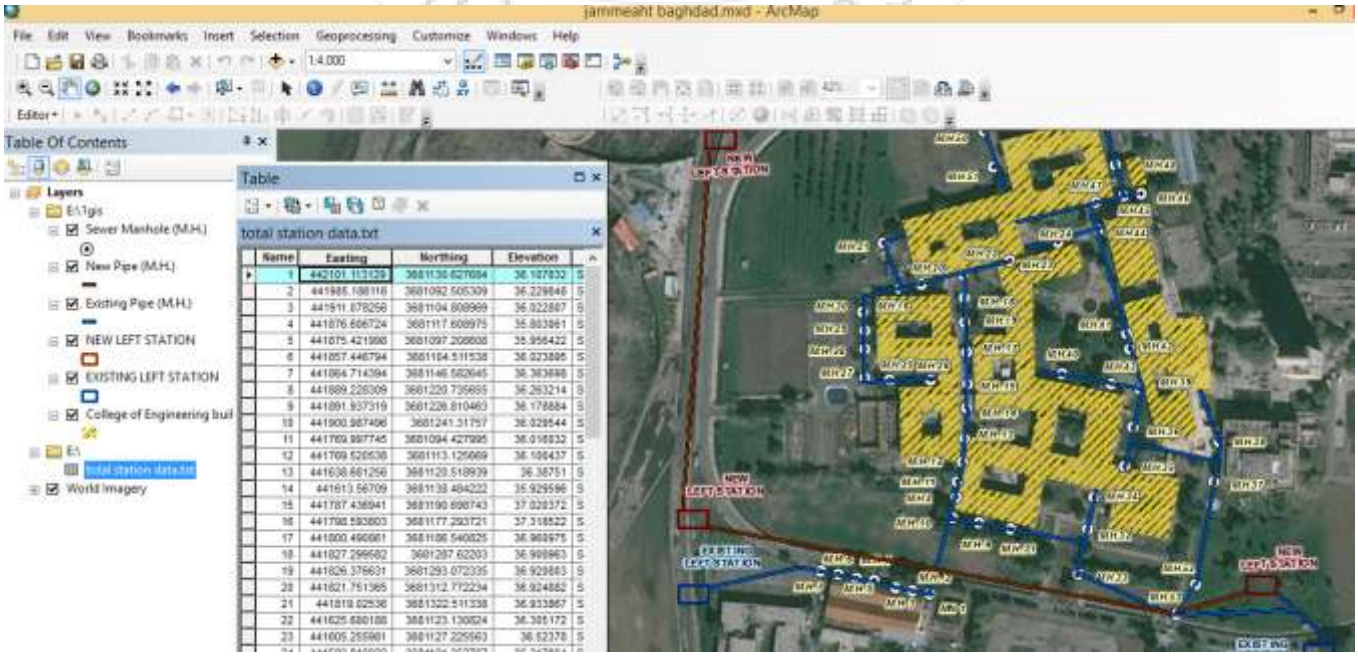

Figure 7: Digital map and the attributes

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.

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=PL2sBQtgS7Y4H8EYoSCvdahCr2VxYz-P_&index=7 [12].

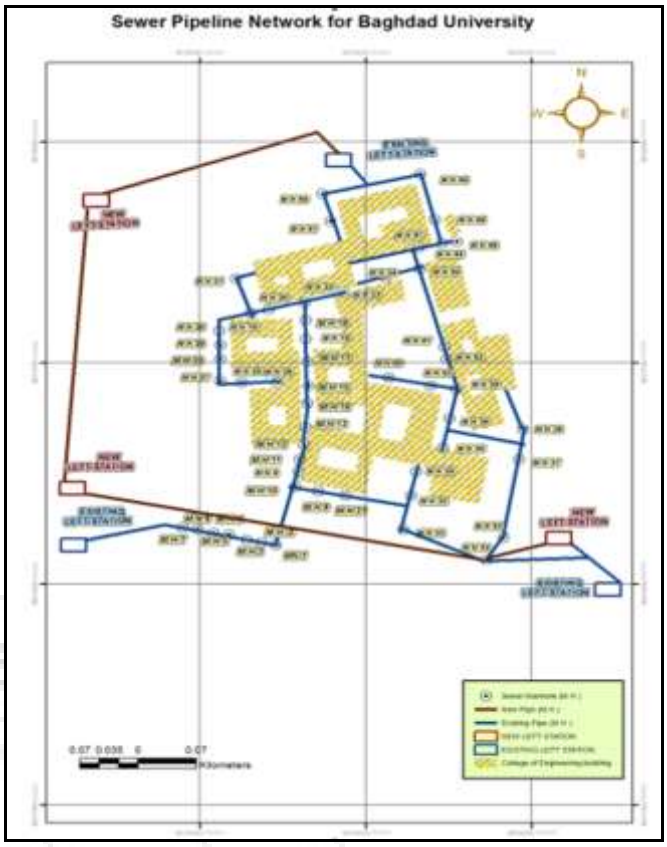

Figure 9: Sanitary sewer pipeline network design in the study area.

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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