Identification of Suitable Site and Design Proposal of Water Storage Structure at VJCET

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Abstract:
Surveying has become an important element in development of human and environment. Coordinates of an unknown point with respect to a known coordinate can be determined using total station. The data obtained from this could be conveniently modified into the required form. This paper deals with the survey of entire campus of Viswajyothi College for coordinates and these serve as an input data for Surfer 10. This software is an effective tool in generation of surface maps, contour maps etc. This also serves the advantage of locating water basin for a given topography. The main aim of this paper is to determine the water basin and the stream path for the college where any water storage structure can be proposed to effectively make use of the rain water and surface run-off. In this identified location a suitable underground tank can be constructed of which’s preliminary design is also aimed to be completed.

Keywords: Surveying, Coordinates, Water-basin, Stream path, storage, design.

I. INTRODUCTION

In Viswajyothi college of engineering and technology water demand is met by the supply from the Muvattupuzha river. Currently water storage is prevailing an underground water rain water storage tank for water storage helps in utilising the rain water and surface runoff water to its maximum. Water-basin area can be found out using surfer software. Surfer is a powerful gridding contouring and surface mapping program for scientists, engineers and who needs to generate maps quickly and easily also a grid based program which interpolates irregularly spaced XYZ data into regularly spaced grid form. These grids are used to form different types of maps like contour, color relief, and 3D surface maps among others. Different grid and map data options are available allowing to produce the map that best represents your data. These files can be edited, combined, filtered, sliced, queried, and mathematically transformed. Surfer is used as a data visualization and map generation post-processor for any scientific modeling system. The input data for surfer is XYZ co-ordinated from the total station. Mostly in engineering projects, more sophisticated instruments are employed to improve the efficiency and accuracy. Total station is newly developed surveying instrument for improving the accuracy of positioning information. Total station determines the position, in three dimensions of features on or beneath the surface of the Earth. The data obtained from total station in particular can now be used to position topographic data and control the setting out of a construction design. The steps of topographic survey and dimensional control will most probably by coordinates (x, y, z) using a total station. Built-up drawing for position from survey points by assistance (Auto-cad) program and the coordinates are transformed into a full-function 3D visualization, contouring and surface modeling package using Surfer-15 software

II. OBJECTIVES
- To identify the lowest point in the campus through surveying.
- To prepare the surface 3d map and identify the location of watershed using surfer software.
- To propose an underground water tank at this location.

III. LITERATURE SURVEY

Peter Oluwatobi Omolabi, Babatunde Joseph Fagbohun,
In their study, sites suitable for location of water storage structures were delineated in the Sokoto-Rima basin by considering the eight factors which is important in suitability analysis for water storage structures. The factors include land use, soil, slope, geology, lineament density, distance to drainage, drainage density and precipitation. Using factors weight computed from Analytical Hierarchy Process, the factors were integrated through weighted overlay analysis. The result showed that 3% area of Sokoto- Rima basin is found to be highly suitable, 9% of the basin area is moderately suitable, 11% of the basin area have low stability for siting water storage structures were delineated in the Sokoto-Rima basin by

Rasheed Saleem Abed., studied on the Experience on using Total Station surveying for mapping and contouring. Total station is a valuable and easy source of surveying data. It is very useful in determining the coordinates of an unknown points with reference to a known points. Comparing with the other modern techniques of surveying it is found to be more precise than others. The data could be easily transferred to a computer and can be modified according to the purpose.

Richard J.U and Dr.Chima Ogba., in detail explained the watershed management that prevent deteriorating existing relation between the use of natural resources. It will provide adequate water for the people, environment, flood protection and good water quality. For effective modelling of water shed SURFER 10 was used for obtaining largest drainage basin in the locality. In modelling using DEM in ArcGIS 10.1 a total of 119 drainage sub-basin and the largest was around Oguta Lake with total area extend of 101920 Ha was obtained.
Rivers and lakes of the study area showed with low pixel value indicated high groundwater potential zones and areas of high pixel showed low ground water potential zones.

Abdulla Umar Naseef. T, Reeba Thomas., in their paper the objective was to identify the suitable sites for water harvesting structures in Kerala. For ideally locating the sites guidelines put forward by NRSA, Hyderabad for IMSD were followed. ArcGIS helped in locating sites by overlaying thematic maps of land use, soil, runoff potential, stream order, soil permeability and slope. The results showed that 37% of the total areas were suitable for constructing check dams, 7% for farm pond, 4% for percolation pond and 2% for subsurface dyke. Meteorological and topographical analysis conducted aided the location of water harvesting structure.

IV. METHODOLOGY

A. Total Station Surveying
Total station is an electronic transit theodolite integrated with EDM used for surveying and building construction. The coordinates of an unknown point relative to a known coordinate can be determined using the total station as long as a direct line of sight can be established between the two points. Distances and angles are measured from the total station to points under survey, and the coordinates (east, northing and elevation) of surveyed points relative to the total station position are calculated using trigonometry and triangulation. The survey using total station was started off from the permanent benchmark established on the college whose easting, northing and elevation was fed as 1000, 1000 and 41.00 m respectively. After the centering and levelling procedures the northing was set. From this point the survey was carried out following the usual steps along the boundary, covering all the important points of grade change. A total of 87 points were surveyed on the campus out of which a few are listed in TABLE I.

![Figure.1. Layout of VJCET](image)

<table>
<thead>
<tr>
<th>Point</th>
<th>Easting</th>
<th>Northing</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>1000</td>
<td>1000</td>
<td>41</td>
</tr>
<tr>
<td>P2</td>
<td>1002.089</td>
<td>990.139</td>
<td>40.472</td>
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<tr>
<td>P3</td>
<td>1004.006</td>
<td>962.844</td>
<td>39.393</td>
</tr>
<tr>
<td>P4</td>
<td>988.704</td>
<td>954.399</td>
<td>40.261</td>
</tr>
<tr>
<td>P5</td>
<td>974.198</td>
<td>948.136</td>
<td>40.246</td>
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<td>P6</td>
<td>943.199</td>
<td>934.418</td>
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<td>P7</td>
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<td>909.483</td>
<td>36.148</td>
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<td>P8</td>
<td>888.497</td>
<td>889.509</td>
<td>33.176</td>
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<tr>
<td>P9</td>
<td>891.333</td>
<td>887.539</td>
<td>33.206</td>
</tr>
<tr>
<td>P10</td>
<td>926.376</td>
<td>917.233</td>
<td>37.364</td>
</tr>
</tbody>
</table>

B. Plotting in AUTOCAD
AUTOCAD is a widely used Computer-aided design and drafting software created by Autodesk. AutoCAD is used across a wide range of industries, by engineers, architects, graphic designers, city planners and many other professionals. The data from total station was transferred to coordinate form using the software SOKKIA Link and with this an AUTOCAD plot was created. This helped in identifying the location of points and joining them appropriately to establish the boundaries.

![Figure.2. AutoCAD Plot](image)

C. Intrepretation using Software
SURFER 15 is a grid based mapping software used to produce different types of maps including contour, 3D surface maps, watersheds maps etc. It enables us to adjust interpolation and gridding parameters, assess the spatial continuity of data with variograms, define faults and breaklines, perform grid calculations such as volumes, transformations, smoothing or filtering. Surfer quickly transforms your data into information. Maps can be displayed and modified in Surfer, allowing you to develop the map that best represents your data. Grid data file was created on Surfer after loading the data worksheet using x, y and z coordinates of surveying. This grid data is the main input for the creation and development of all sort of maps in this software. The contour map, 3D surface map and post map was developed from this. A contour map is the two dimensional representation of a three dimensional data. 3D surface maps are coloured three-dimensional representations of a grid file. Post map and Classed post maps show data location on a map. Surfer also has the main advantage of locating the water basin for a given grid data map.

D. Preparation of contour map
A contour is an imaginary line connecting points of equal elevation. The first two dimensions are the northing and easting coordinates. The third dimension is represented by lines of equal magnitude. The spacing of the contour lines depicts the relative slope of the surface. This map type can be created from a data, image or grid file. It can be added in combination with any other map layer type. The contour interval was taken as 5m with highest contour 58m and lowest 29m.
A watershed map gathers the data from a grid file and divides the grid into basin, or catchment, areas. Basin areas are the space that drain water to the stream. Stream paths are calculated based on the amount of flow into the grid node from all surrounding grid nodes. This visualises the path water will take across the grid. Stream lines denotes the low points on the map. This map type can be created from a data, image or grid file. It can be added in combination with any other map layer type.

**E. Surface 3-D Map**

Surface maps are a three-dimensional shaded rendering of a grid file. The height of the surface corresponds to the Z value of the associated grid node. Denser grids show greater detail on the surface. Colour can be used to show Z values on surfaces. The colours are blended to form a smooth gradation. Once the colour is selected, the lighting can be adjusted, changing the appearance of the map. This map type can be created from a data, image or grid file. It cannot be added in combination with a 3D Wireframe layer. The X axis shows the easting, y axis represents northing and the z axis gives the mean sea level depth or elevation.

**F. Water basin or catchment area**

There have been two water basin or catchment areas identified for the college represented by two different shaded polygons as shown in Fig 6. Among these two the water basin with larger area of contribution and which clearly defines the stream path was chosen. The stream line shows the lowest point where the water ultimately drains off to. It could be concluded after comparing the map and identifying the coordinates that stream line joins the points between the canteen and front gate of the college campus. Considering the feasibility and other topographic features, the best suitable location for a water tank could be low land accompanying the canteen.

**G. Layered map**

An underground rectangular concrete tank is decided to be constructed on the chosen location considering the type of area, feasibility and efficiency. Since the tank to be designed is only a secondary storage which could be used during shortages, the capacity of the tank might not be according to the annual demand of the college. But it must be designed to store the water coming to it as surface runoff during the rains. Hence, the most important factor determining the capacity of the tank is the average annual rainfall of the area. The location of this campus is near Muvattupuzha therefore the average rainfall of this area is 298.25mm. The average annual rainfall to which the tank is designed is 298.25mm.

Total area of the college = 45944.47 sq.m.
Area of the catchment = 185.8061 sq.m
Total rainfall volume $Q = C \times I \times A$
Where $c$ is the runoff coefficient $(0.7 < C < 0.95)$
$I$ is the average annual rainfall in mm
$A$ is the catchment area
$Q = 0.8 \times 0.29825 \times 185.8061$
= 44.33 cubic metre.

Keeping a factor of safety, capacity of the tank to be designed =53.2 cubic metre.
Assume depth of the tank to be 1.5m including free board, Provide length \( L = 3 \times \text{Breadth} \ B \)

\[ 3B \times B = \frac{53.2}{1.5} \quad B = 3.43m \quad \& \quad L = 10.315m \]

**Design an underground rectangular concrete tank of dimensions 10.5 x 3.5 x 1.5 m**

**V. RESULT AND CONCLUSION**

The water basin area for the college was found to be near the canteen using SURFER software. On this location, an underground rectangular concrete water tank (10x3.5x1.5m) with a capacity of 55125 litres could be constructed for collection and storage of rain and surface run-off water to be used during emergency. Location of water storage structure within the water basin area ensures maximum efficiency and the water tank is built considering the rainfall pattern which ensures a sufficient storage for emergency.

**VI. REFERENCES**


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  * No space between resources
  * List resources alphabetically by author’s last name; if no author’s name is available, use the title of the resource
  * Provide full bibliographic information as noted in Specifications for References
  * Additional Resources section goes after the References section.

**SPECIFICATIONS FOR ACKNOWLEDGMENTS SECTION**

As noted in the Assignment, an Acknowledgments section is required, and is the place to acknowledge sources that were

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