National Conference on Recent Research in Engineering and Technology (NCRRET-2015)
International Journal of Advance Engineering and Research Development (IJAERD)
e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

Advanced Technology used in Topography Survey

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***Abstract*—Application of Direct Topographic Methods In general, Land surveys which are a part of topography surveys are mostly carried out by photogrammetry or other remote-sensing processes. Terra model provides superior Digital Terrain Model (DTM) creation and manipulation tools for large projects—Terra model is capable of forming TIN DTMs with up to 8 million points. This makes it the package of choice for manipulating data from airborne or terrestrial laser scanners, photogrammetry projects, and hydrographic multi beam bathymetry systems. Terra model also gives civil engineers a complete tool set for design that enhances capabilities and productivity from the initial survey to final construction. Terra model supports the design of roads, bridges, railways, sewers, surfaces, commercial or residential sites, and new infrastructure with advanced design concepts. Projects are modeled using plan, profile, and cross-section views. Terra model manages large jobs easily as the software handles hundreds of thousands of points and seamlessly integrates survey and construction data in a single project file.**

***Keywords*—Triangulation E-survey; Terra model; DTM; Geo pointsg; co-ordinates.**

I. INTRODUCTION

From the hydrographic point of view a Topographic Survey consists of a series of tasks carried out with the aim of determining the composition of those parts of the earth's surface which emerge from the water. It includes the coastal relief and the location of permanent natural or artificial objects and features. Such information is partly obtained by determining the position of points on the ground, which allows their shape as well as details of the features to be depicted, enabling their location and description to be charted. Other sources of data include remote sensing processes from aerial photogrammetric information, other airborne sensors or satellite imagery products. In these cases it is necessary to create ground control points in order to adjust the information to the reference frame in use. All these meanings share a common external description of surfaces covering a physical body. This chapter deals with the methods applicable to the description of land surveys, particularly with regards to the appearance of the ground and the location of detail. It includes locations and mapping.

A. History

Triangulation is a technique based on principal angular measurements. Before the middle of the 20th century, it was the most common method for establishing geodetic control networks and for sole calculation of conspicuous points, marks and other aids to navigation or photogrammetric ground control points. Since the 1960s Electronic Distance Measuring equipment (EDM) or Electro Optical Distance Measurement (EODM) has superseded the above methods. More recently they have been replaced by satellite methods, particularly since a permanent global coverage was established in the 1990´s

B. Terms

Leveling and its Errors Trigonometric levelling and the possible errors is also includes during survey. It should be noted that in the case of intersections a similar operation can be undertaken with the algorithms and the resultant calculations. It is also be possible to apply them for surveys using polar co-ordinates or EODM tachymetry, when it is particularly useful to have total stations which store (horizontal and vertical) ranges and directions to surveyed points. On processing such information and when ranges over 100 m are used, it is important to verify that the software application includes corrections for refraction and earth curvatures.

Application of Direct Topographic Methods In general, Land surveys which are a part of topography surveys are mostly carried out by photogrammetry or other remote-sensing processes. In such cases the surveyor's main task, when processing information, consists of obtaining a proper interpretation of coastal features, that coastline delimitation poses no difficulty and that data on the ground control points are adequately provided. He must also ensure that aids to navigation signals and stations have their horizontal and vertical positions properly determined.

II. CONTOUR MAPPING

the delineation of any property in map form by constructing lines of equal values of that property from available data points. A topographic map, for example, reveals the relief of an area by means of contour lines that represent elevation values; each such line passes through points of the same elevation. The method is not wholly objective because two investigators may produce somewhat different maps whenever interpolation between data points is necessary for construction of the contours. In addition to topography, there are scores of geophysical, geochemical, meteorological, sociological, and other variables that are mapped routinely by the method. The availability of plotting devices in recent years has permitted mapping by computer, which reduces the effect of human bias on the final product.

Contouring needs the determination of elevation of various points on the ground and at the same the horizontal positions of those points should be fixed. To exercise vertical control levelling work is carried out and simultaneously to exercise horizontal control chain survey or compass survey or plane table survey is to be carried out. If the theodolite is used both horizontal and vertical controls can be achieved from the same instrument. Based on the instruments used one can classify the contouring in different groups.

A. Volume Calculation - Contour Method

Volume can be measured by a contour map, but the volume calculated by this method is approximate. It cannot be compared with the volume calculated by the cross-section method. As the full ground irregularities are not predicted by contours, and also as the contour intervals are not small, volume calculated from contours is likely to be an approximate one. To calculate volume by this method, general recommendations of contour interval is a maximum of 2 meters for a regular ground surface, and 0.5 meter for an irregular topography. This method is used mainly to find the capacity of a reservoir. To find out the capacity of a contour, two methods can be adopted.

B. Contour map generation software

Generates smooth contours quickly from point data available in CAD drawings /Levels available in Excel or CSV files.

C. Key features

Import data from CSV, Excel or CAD for Contour generation
Generate Contours directly within CAD
Draw Section for any alignment fixed on the Contour Map
Generate Area and Contour Volume based on Contour
Generate Boundary Based Contours
Generate Contours for Specific Levels
Generate Contours with Break Line Definition
Generate Grid Elevations or Block Levels
Annotate Contours:
At Endpoints
At Mid-points
At Selected Points
At Specified Intervals
At Fence Line Intersection
Draw Grid Elevations from existing Contours
Create 3D Surface with in CAD or Create KML to view in Google Earth

D. Benefits

No additional steps of creating terrain for contour generation
Quick and smooth contours
Lightweight contours thereby reducing the drawing file size
Generate Boundary, Grid Elevation, Grid annotation, Contours, Contour annotation in Single step.
EARTHWORK CALCULATION SOFTWARE

Generates volume calculations and section drawings from point data available in CAD drawings or Levels available in Excel or CSV files.

E. Minimum equipment requirement for pure ground survey using ets/ dgps

1. Total Station Set:
a. Total Station instrument in a hard case
b. Battery charger
c. Memory module/ card, serial cable
d. Rain cover
e. User manuals
f. Tripod
g. Tape Measure
2. Prism Set:
a. Prism
b. Prism holder
c. Centering rod
3. Back sight set:
a. Prism
b. Prism holder
c. Prism carrier (to be fixed on tribrach, with optical/ laser plummet)
d. Tribrach(to exchange prism carrier and total station)
4. DGPS Set (pair of devices):
a. Antenna with receiver
b. Tripod with tribrach for base station
c. Bi-pod for rover
d. Battery with charger
e. External battery for base station
f. Extension rod
g. Data cable
5. Data Processing
a. Laptop computer with serial port or USB port
b. Printer
c. Tera Model / ETS/DGPS survey data management software
d. Digital camera

III. General Requirements

a) The (X, Y) co-ordinates shall be recorded both in Latitude-Longitudinal and Universal Time Meridian with reference to datum.
b) Specifications of the instruments used for GCP surveys shall be recorded.
c) DGPS/ ETS equipment shall be calibrated prior to survey with respect to established base lines.
d) A sketch for each category of the Control Points shall be prepared, showing the location of the Control Points along with their description for easy identification.

e) A District Map showing all the Primary, Secondary and Tertiary Control Points along with their Co-ordinates shall be maintained by State Land Records and Survey authorities.

A. Survey Plan

a) Survey Team shall submit detailed Programme for survey including number of Survey Team to be engaged after being supplied with existing topography Maps from the Director, Land Record and Surveys.
b) Each Survey Team may comprise at least one surveyor and one assistant surveyor.
c) Survey Team is to be assisted by one Amin / Asst. Revenue Inspector (ARI) of Local Tahasil and land owners of the programmed Village during survey.
d) A meeting at the level of Village / cluster of villages shall be arranged by the local Tahasildar. Local officers of the land owning departments such as Forest, Water Resources, etc. and the Panchayat level representatives shall be invited to the meeting.
e) The details of the schedule of the visits of the Survey Team shall be circulated among the Local officials of the Land-owning Departments, so that the Officials from those Departments help the survey agency in the identification of the boundaries of the Land-parcels owned by those Departments.
f) Tahasildar shall maintain record of meetings held in different villages/ cluster of villages.

B. Measurement with Total Station

When both the total station and back sight are finally leveled and centered, the hardware setup is over and the software setup is to be started. The software setup of a total station differs from one make to another. One has to follow the user's manual of each instrument. The list below gives common important settings for most instruments. Most total station memorizes these settings, but it is better to check through the setup menu in order to avoid a false setting.
1. System: Choose appropriate existing interface for data output
2. Angle Measurements: Tilt correction/ Tilt compensator (2 axes)
3. Horizontal angle increments: At right angles (clockwise)
4. Unit setting: Angle in degree/min/sec, distance in meters, temperature in centigrade and pressure in hPa.
5. EDM Settings: Select DR/ IR laser, fine measuring mode, use RL with caution. Set appropriate value for the prism constant (from the user's manual of the equipment)
6. Atmospheric Parameters: Get ppm for the diagram from the manual of the equipment or let the total station calculate from hPa and degree centigrade.
7. Communications: Set all parameters the same for a total station and data logger/ PC. They are baud rate, data bits, parity, end mark and stop bits. Refer the manual for each device.

C. Field Book Maintenance

The Survey officer can record all numerical data and a little text data inthe total station, but descriptive information and graphic information should be recorded in the field book.
The following is a suggested list for the survey records.
1. Place, data and time
2. Surveyor's name
3. Temperature, atmospheric pressure
4. Station coordinate (E0, N0, H0), as per co-ordinate of the survey station (TCP) and height of the instrument
5. Back sight coordination (slope distance, vertical and horizontal angels), (E, N, H), as per GPS co-ordinate TCP and height of the reflector.
6. Azimuth mark HZ, sketch of the telescope view.
7. Sketch map of the sight and measured objects.
8. Description of measurement. Point ID number (from-to), object, height of the reflector. Repeat this for each discrete object, or group of points measured with different prism height. This must be the input to the total station each time it changes.
9. Back sight coordinates measured again at the end.

D. Terra model provides the following features for surveyors

• Data reduction and control network computations • Deformation monitoring tools
• Automated drafting • CAD editing, plotting, and digitizing
• Legal, cadastral, and boundary surveying tools • Surface measurement, volumetric, and contouring tools
• Large data set processing e.g., Lidar or Swath bathymetry • Profile and cross-section creation
• Building interior, elevation and architectural surveys • 3D Visualization—rendered scenes and AVI movies
• Earthworks, mine, and waste cell design • GIS support—Terra model data can be used in GIS systems such as ArcView™

E. Terramodel provides the following features for construction

• Data import and export, verification, and troubleshooting.
• Heavy highway and road engineering
• Mass haul and phasing computations
• Ground works and earthworks designs and analysis
• Volumes from DTM surfaces and cross-sections
• Landfill design and waste cell construction
• Residential, commercial, and industrial site design

• Machine control data preparation and grade checking
• Estimating and material takeoff for contract bidding
• Design and build
• Design adjustment during construction
• Project visualization and data verification
• Plan set and as-built survey records
• Construction GIS
• Stakeout data preparation—points, alignments, surfaces, grids, design models

IV. REPORTING

Terra model provides you with all the reporting tools you need to maintain quality. Standard reports include:
• Control computations and adjustment
• Detail reduction and coordinate listings
• Geometry reports
• COGO: Areas, distances, and bearings
• QA checks
• Stakeout control and cut sheet reports
• Volume reports

A. Digital terrain modeling

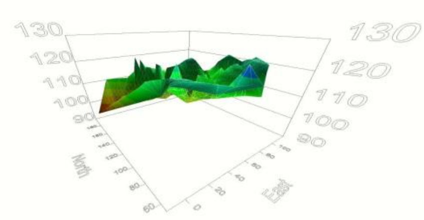
Terra model provides superior Digital Terrain Model (DTM) creation and manipulation tools for large projects— Terra model is capable of forming TIN DTMs with up to 8 million points. This makes it the package of choice for manipulating data from airborne or terrestrial laser scanners, photogrammetry projects, and hydrographic multi beam bathymetry systems.

B. Case study

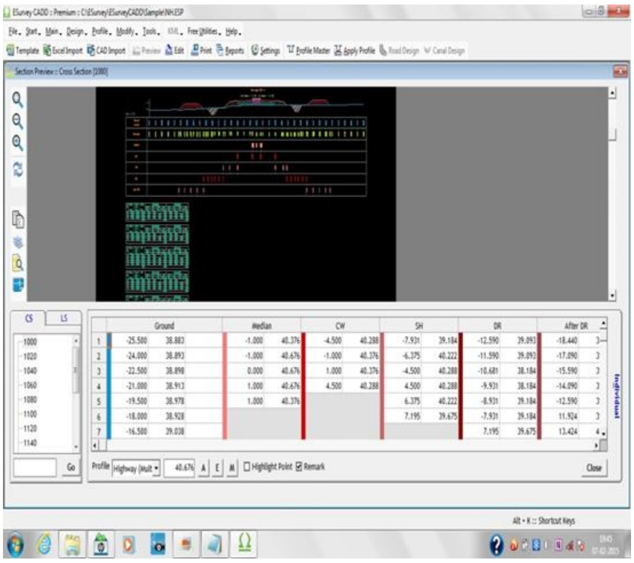
One project has taken as pilot project for generation of digital maps as well as plotted maps at a scale of 1:2,500 using digital techniques. The project area is a small section of the proposed road in vadodara in the state of Gujarat with an area of approximately 12.5 Km.
Taluka Name : Vadodara
District : Vadodara
State : Gujarat
Language : Gujarati and Hindi, Marathi, English
Time zone: IST (UTC+5:30)
Elevation / Altitude: 36 meters. Above Seal level
Sindhrot is a Village in Vadodara Taluka in Vadodara District of Gujarat State, India. It is located 4 KM towards East from District headquarters Vadodara. 7 KM from . 135 KM from State capital Gandhinagar
A digital database of the city comprising of features like, different categories of roads, settlements, water bodies, railway line, agricultural areas etc along with proper annotation and attributes was generated.
This database will be used by the town and country planning department for developing a urban resource information system for urban resource management. Digital elevation model along with contours was also generated. The uniqueness of the project being that contours at an interval of 1m was generated using digital photogrammetric techniques, which would have not been possible to generate through conventional topography technique in shorter time.
The generated datasets will be integrated into an Urban Resource Information System, which will provide with an effective management tool for utilization of the urban resources
1. Urban planning, including town planning;
2. Regulation of land use and construction of buildings;
3. Planning for economic and social development;
4. Roads and bridges;
5. Water supply for domestic, industrial, and commercial purposes;
6. Public health, sanitation, conservancy and solid waste management;
7. Fire services;
8. Provision of urban amenities and facilities such as parks, gardens and playgrounds;
9. Promotion of cultural, educational and aesthetic aspects;
10. Burials and burial grounds; cremation grounds and electric crematoria;
11. Public amenities including street lighting, parking lots, bus-stop and public conveniences;
This facility will aid management of public utilities like water supply, drainage, sewerage system, roads, storm-water drains, streetlights etc. This facility would also cater to town planning schemes, urban and estate management and property tax related matters. The more important components of the new maps will be the precise pinpointing of the water supply pipes; sewage drains that cover the city. It will also help in better transport management of the city.
The urban resource information system is a step towards helping public in a big way. Fire and Health departments find it useful during emergency services since all information is brought around the hot spots with the click of a button. The most beneficial amongst all departments are the roads and building and town planning. The search for maps and documents seems to be over. Where hours are counted to locate maps, now that uncertainty is over.

C. Analysis

1) Field Book based on ground survey



2) *Topo sheet*



3) *Earth Work sheet*

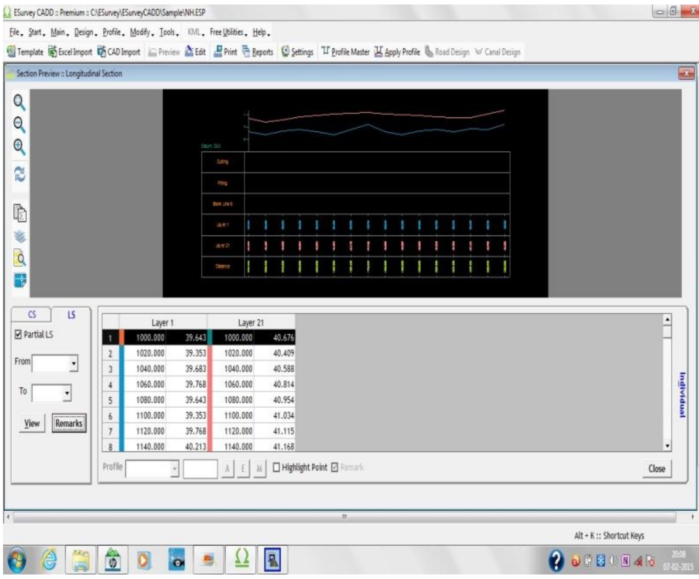
Trimble
5475 Kellenburger Road
Dayton, Ohio 45424-1099, USA
1-937-233-8921
Wednesday, April 20, 2014 12:59:34 AM

PROJECT: C:\Documents and Settings\

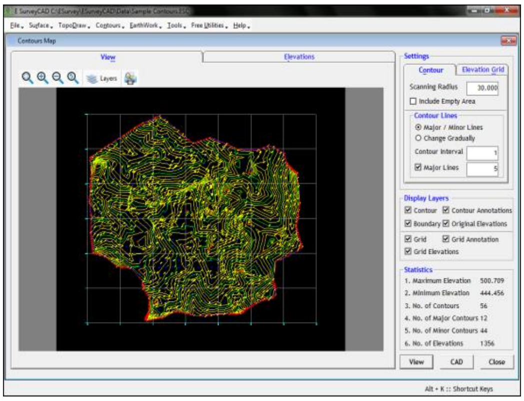
CHAINAGE NORTH
EAST ELEV
DESCRIPTION CURVE DATA
BEARING DISTANCE

INVERSE PLINE
PLINE POINT 0.000 -55.00000
0.00000
159 18'16" 25.014m
PLINE POINT 25.014 -78.40000
8.84000
85 21'36" 10.384m
106 03'20" AR
PLINE POINT 35.398 -77.56000
19.19000
72 11'44" 17.530m
166 50'08" AR
PLINE POINT 52.928 -72.20000
35.88000
56 45'38" 25.742m
164 33'54" AR
PLINE POINT 78.669 -58.09000
57.41000

4) *Cross section*



5) *L-section*



V. CONCLUSION

In view of the rapid urbanization and changing scenarios, it is imperative to have a digital maps and databases to support decision-making and futuristic planning. The advanced technologies like Remote Sensing coupled with GPS, LIDAR etc have made it possible for surveyors to locate their position anywhere on the earth and has also enabled towards the generation of precise and updated maps in a cost-effective and timely manner. The digital maps generated will allow the user to study the urban environment; digital surface models of urban areas can be used to generate accurate and up-todate 3D city models for urban planning and management. Digital mapping is a logical response to the public's evolving demand for the rapid delivery of information, especially in forms that are amenable to spatial and statistical analysis. This information in digital form can be made available quickly and in many cases without cost across the Internet which can be utilized for variety of applications.

The Digital databases will improve the functioning of the municipal departments by enabling the prompt decision making by analysis, easy information retrieval and timely, accurate, complete and updated information. Map making and geographic analysis are not new but a GIS performs these tasks faster and with more sophistication than traditional manual methods do. This technique is likely to reduce large amount of paper work in the day-to-day transactions in the municipalities. The public dealings such as water and electricity bill and related maintenance services would become much faster and more efficient and thus provide a better quality of life in the urban cities.

Hence these advanced technologies for production of digital maps can very effectively be used to handle the present day to-day complex urban problems related to optimum utilization of available resources and infrastructure management.

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