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ENGINEERING SURVEY

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HONOLULU, HAWAII

MARCH 2022

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INTRODUCTION

The course is aimed at giving and understanding of basic surveying . that is how to do surveying, why we do surveying, what are the techniques, what are the instruments. Its set the understanding to utilize surveying techniques and equipment in real life problems. It gives the knowledge of being able to conceptualize how to use a set of tools for problem solving in an optimal way. As we do surveying in the field, there are many possibilities a single problem can be solved by. But we need to know which one is the best one. So we need to always find the optimal solution in terms of time, resources and accuracy. Understanding of the pitfalls of surveying. These are like errors which often occur during field work. It all begins with Geoinformatics (Geo+information+matics). Geo is for everything in the surface slightly below or above on the earth, information is about those features which are there at the surface of the earth, and matics stands for measurement . another one more aspect of geoinformatics is management . so the measurement and management of geoinformation is call geoinformatics. Geoinformation is any artificial or natural object or phenomena on or below the surface of the earth. Examples are like land parcels, roads, topography, forest, houses, rivers, flooding and glaciers. Geoinformatics has two basic divisions.

Measurement of geoinformation: measurement is in two part:

- 1) Geometry: which is about what is where?
- 2) Identification: which is about what is what?

Management of geoinformation: It also has two parts

- 1) Management of storage retrieval and presentation of information
- 2) Manipulation of analysis based on information

Geoinformation measurement have tools that were use progressively as human developed, we have: The primitive techniques: this was done by pacing hands, guessing and rod ,the land surveying techniques which was done with chains, tapes, compass and theodolites. As time went by the electronic measuring tools were developed which were the electronic distance measuring tool and the robotic total stations were used. The area photogrammetry then appeared during war world 1 and was widely use. Today satellites are being used. All these methods lead to geographical information system which has now lead to modern surveying which is the purpose of this course.

CONCEPT OF SURVEYING

Surveying is the collection of data or information. The concern is of geoinformation for engineering projects, for geographical mapping. For example to construct a house, we go to the area do site selection and knowledge of topography (map) to plan the building on it and transfer the building on the site. Surveying is the art and science of obtaining quantified and qualified measurements and understanding the interpretation of these measurements and meaningful presentation of their results. It is the means of bringing the ground terrain in the laboratory and working upon it. It is about measurement and the need of reference systems for fixing positions of points. It about measuring distances, angles and positions on or near the surface of the earth. Surveyors are the first people of every building site, the results of their measurements are then used by architects to understand and make the most of the unique landscape when designing the structure. civil engineers make structural designs accurately and safely ensuring buildings not only fit with the landscape but are able to be constructed. In other to be a qualify engineering surveyor, one need to go through the following topics:

Linear measurements

Compass surveying

Theodolites and total stations

Triangulations and trilaterations

Leveling and contouring

Plane tabling

Computation and adjustments

Obtaining maps

Project surveying

Global positioning system

DISTANCE OR LINEAR MEASUREMENT

The aim of this chapter is to set the following:

- Understand the difference between slope, horizontal and vertical distances and why all of these are used in engineering surveying
- Describe on-site procedures that are used to measure distances with tapes
- Recognize the mistakes that occur frequently when taping and how to avoid these
- Calculate and apply a range of corrections to taped measurements in order to remove systematic errors from readings
- Discuss the precision that can be obtained when taping

After studying this section you should be aware that distances are defined as slope, horizontal and vertical and that all of these are used in construction and civil engineering, one should know what the difference is between steel and fibreglass tapes and you should be able to describe the procedures for measuring short and long distances with either of these. You should be aware of the mistakes that can occur when taping and the procedures that can be used to reduce these to a minimum, one should understand that taping is subject to a series of systematic errors that must be accounted for in order to improve the precision of a measured distance. You should also be aware of the techniques involved and corrections that have to be applied to remove each of these errors, one should appreciate that the precision of taping can vary according to which systematic errors are accounted for in the measurement process.

This section is very important for construction engineering because its widely used in small and medium size structures.

TOATL STATION

In surveying, total station can do almost 100% of the work required during construction project survey.

The aim of this topic is to set the following:

- Understand how total stations measure distances
- Identify and describe all the features of total stations that are used for angle and distance measurement
- Distinguish between the different categories of total station and assess the best applications for each of these on site
- Discuss the various methods by which survey data can be stored and transferred between total stations and computers
- Evaluate the effect of instrumental and other errors on angle and distance measurements taken with a total station and how these can be minimized
- Understand how a total station can be used for measuring heights

After studying this section you should be aware of what an integrated total station does, how it is used on site and the accuracies it can achieve, one should be able to explain how total stations measure distances using the phase measurement and timed-pulse methods. You should be familiar with the different types of reflector than can be used for distance measurement and understand that total stations can also measure in reflector less mode. Since lasers are now used in nearly all total stations, you should be aware of safety issues when using these, one should be familiar with the various categories of total station and the applications for which each is intended. You should also be aware of all the components and features of a total station that are used for measuring angles and distances in site surveying, one should be aware of all the various methods used with total stations and other survey equipment to store and manage survey data. one should be aware of the sources of error that can occur when using a total station. one should also know that a total station should be calibrated regularly and that proper field procedures must be implemented to eliminate or reduce the effect of these errors. In addition, you should be aware of some of the common causes of error when setting up and using total stations and how good practice and handling can help prevent these.

These equipment is the most used equipment especially for large scale projects.

TRAVERSING AND COORDINATE CALCULATIONS

The aim of this topic is to:

State what control surveys are and why these are an essential part of surveying

- Discuss the advantages of defining position for most surveying projects in the form of plane rectangular coordinates
- Carry out coordinate calculations using rectangular polar and polar rectangular conversions
- Derive transformation parameters for converting coordinates from one plane rectangular grid to another
- Explain what a traverse is and describe all of the fieldwork involved in traversing
- Perform all of the necessary calculations that are required to obtain traverse coordinates from measured angles and distances
- Describe how total stations are used for traversing
- Calculate the coordinates of points fixed by intersection and resection
- Discuss how networks are used in control surveys

After studying this section you should know what control surveys are and be aware that they can include both horizontal and vertical components. One should appreciate that different methods are used for control surveys depending on the size of the site. One should know that the positions of control and design points on site are defined in the form of plane rectangular coordinates. One should also know what polar coordinates are and how they define position. One should be able to calculate rectangular coordinates from bearings and distances and vice versa. One should understand what coordinate transformations are and how to calculate transformation parameters for these. One should understand what traverses are. One should also appreciate that proper planning is essential for these and you should be aware of the methods used to measure angles and distances for traverses. One should have a full understanding of how to calculate the coordinates of traverse stations from measured angles and distances.

The techniques of this topic are very use full for engineering surveying.

GLOBAL NAVIGATION SATELLITE SYSTEM

The aim of this topic is to:

- Describe how Global Navigation Satellite Systems (or GNSS) have developed and the impact they have had on engineering surveying
- Explain how the Global Positioning System (or GPS) can be used to take code and phase measurements to determine position and be able to explain the difference between these
- Identify the various sources of error in GPS and explain how each of these affects the accuracy obtained
- Understand the reasons why differential and relative methods are essential for high precision surveying with GNSS
- Outline the methods involved when performing static and kinematic surveys with GNSS
- Distinguish between the different types of GNSS receivers and systems currently available and be able to find further information to help choose one of these for engineering surveys
- Identify the main applications for GNSS in civil engineering and surveying
- Keep up with developments in GNSS and network RTK

After reading this section you should know that the term Global Navigation Satellite Systems (GNSS) refers to the Global Positioning System (GPS) and all of the other satellite positioning systems currently in use and under development. You should also understand the reasons why GPS was originally planned and developed. One should know that the space segment of GPS is the satellite constellation and the control segment consists of a series of tracking stations and control centers. You should be aware of the function that each of these fulfills and be aware of the information that each satellite broadcasts. You should know that in addition to GPS, there are several other satellite navigation systems being deployed or under development. One should be aware that there are two basic methods for determining position with GPS equipment – code ranging and carrier phase measurements. You should understand how each of these is used to determine position and you should appreciate the difference in accuracy that these are capable of producing. One should be aware of the various sources of error, and their possible magnitude, in GPS surveys. You will be aware that these errors fall into one of three categories: satellite-dependent, receiver-dependent and signal-dependent. You should also know that the errors can either be modeled or suitable field procedures can be used to minimize or even remove them. You should

also be aware that the types of error expected for GNSS are similar to those for GPS. One should know that the accuracy of GPS is improved considerably by using differential and relative methods. You should be aware that differential methods are used with code measurements and relative methods with carrier phase measurements. You should have an understanding of how these methods bring about a better accuracy. Furthermore, you should appreciate that differential and relative results can be real-time or post-processed. One you should be familiar with the methods that can be used with GPS and GNSS receivers to take survey measurements. One should be aware of the different types of GNSS receiver that are available for engineering surveys and their accuracies. You should know that there are two types of receiver that can be used – GIS and GNSS receivers. You should also realise that for nearly all work on site, high-precision GNSS receivers are required. One should have some understanding of the planning and fieldwork required when using GNSS for site work.

MEASUREMENT ERRORS AND SPECIFICATIONS

The aim of this topic is to:

- Discuss the reasons why the analysis of errors is important in surveying
- Describe the different types of error that can occur when surveying and give examples of how these are either eliminated or minimised
- Define what is meant by the most probable value of a quantity and give reasons why these are used in surveying
- Explain the difference between precision and accuracy in a surveying context
- Calculate most probable values and standard errors for repeated measurements in a survey
- Understand the concept of weight and how this helps to assess the precision of survey measurements
- Analyze how errors propagate through a survey
- Use various sources of information to assess specifications and tolerances for engineering surveying
- Discuss the reasons why least squares is essential for all survey analysis and adjustment.

After studying this section you should be able to describe how gross, systematic and random errors can occur in surveying and you should be familiar with some of the methods used to manage these. You should also understand why the least squares method is used to analyze survey measurements and what the significance of a most probable value is. you should understand the difference between precision and accuracy. You should know that standard errors are used to measure precision in surveying and be able to compute these. Furthermore, you should be familiar with the concept of weight when applied to survey measurements and how this is linked to standard error. Finally, you should be able to compute weighted means. you should appreciate that errors from individual measurements will propagate through a survey according to how they are used to derive new quantities. You should also be able to calculate error propagations and understand how it is possible to use these to determine the precision of some survey methods that are in everyday use on site. you should realize that tolerances and specifications given for surveying are important on site and that every effort must be made to meet these. You should know that advice on how to do this is available in a number of published standards and guides and that it is also possible to use error propagation theory to assess the precision of measurements required to meet specifications. you should know that least squares is the most popular

method used for carrying out the analysis and adjustment of survey measurements. You should also be aware of the advantages of using least squares in preference to other methods.

SETTING OUT

The aim of this topic is to:

- Understand the roles of the various different types of personnel who are involved in the setting out process
- Understand the aims of setting out
- Refer to the different types of plans that may be used during the setting out process
- Appreciate the good working practices that should be undertaken in order that the aims of setting out can be achieved
- Understand the procedures required to ensure that the horizontal and vertical control requirements of the setting out operations can be met Set out design points on site by a number of methods including angle (bearing) and distance, intersection, measurements from a baseline and using GNSS receivers
- Undertake first-stage setting out operations such as setting out a pipeline and setting out a building to ground floor level
- Apply horizontal and vertical control techniques to second-stage setting out operations such as locating formwork, establishing column positions, controlling verticality, transferring height from floor to floor, establishing pile positions and setting out bridges
- Appreciate the applications of laser instruments in surveying and setting out operations
- Understand how earthmoving machinery being used in setting out operations can be controlled using total stations, GNSS and lasers
- Appreciate the need for quality assurance and accuracy in surveying and setting out and be able to refer to some of the current British and international standards plus other publications covering these topics

After studying this section you should understand that setting out is simply one application of surveying and involves many of the instruments and techniques used in surveying. You should be aware of the different types of personnel who are involved in the setting out process and how they interact with each other. You should understand that the responsibility for setting out on site lies with the Contractor. you should know that the aims of setting out are to position the Works in their correct relative and absolute positions, and to ensure that they proceed smoothly and that their costs are minimized. You should appreciate that the chances of the aims being achieved will be greatly enhanced if suitable control methods are employed, if the correct plans are available and if good working practices are adopted. You should be familiar with the

different types of plans that are associated with the setting out process and you should understand some of the good working practices that should be employed. you should appreciate that in order for the construction being set out to be located correctly on site accurate setting out procedures must be employed. You should understand that these procedures include a range of horizontal and vertical control methods and positioning techniques. You should be aware that many of these procedures require the establishment of horizontal and vertical control points on or near the site as close as possible to the design points. You should understand how to set out design points on site from the horizontal and vertical control points by a number of different methods involving tapes, theodolites, total stations and GNSS receivers. You should know that the most widely used of these methods involves coordinates, but appreciate that coordinate methods are not always the most appropriate for every situation, particularly where precise alignment is critical. you should be aware that setting out can be categorised as first stage setting out (initial site clearance and sub-surface activities) and second stage setting out (establishing the elements of the construction that are above ground level). You should understand how horizontal and vertical control together with positioning techniques can be used to set out pipelines, ground floor slabs, formwork, columns, piles and bridge abutments. You should appreciate how verticality can be controlled in multi-storey structures and you should be aware of methods by which height data can be transferred from floor to floor. you should know that the laser instruments used in surveying and setting out have beams which are either visible or invisible. You should understand the safety classification system used to categorise individual laser surveying instruments and be aware that you must not use a laser instrument if it does not have the correct labels on it. You should appreciate that there are generally two different types of laser surveying instruments, either alignment lasers or rotating lasers, each of which has been developed for different types of applications. You should understand how alignment lasers can be used to control verticality, pipelaying and tunnelling and you should appreciate the use of rotating lasers for general site levelling and setting out internal fittings. you should understand that earthmoving machines and other large construction plant can be controlled automatically by a number of different systems, including ones based on total stations, GNSS receivers and laser instruments. You should appreciate that such systems have considerable advantages over conventional methods involving sight rails and travellers. In particular, you should be aware of the savings in time and materials and the improvements in the accuracy and uniformity of the finished surfaces that can be achieved with automatic machine control systems. you should appreciate that if the setting out is to proceed smoothly and meet the accuracy requirements of the project concerned then the quality of the work must be of an appropriate standard. You should be aware of the term Quality Assurance and how organisations aspire to BS 5750 accreditation to assure their customers of their quality. You will appreciate that the

question of accuracy in surveying and setting out arises at all stages of the construction process. You will understand that personnel involved in engineering surveying work must know the limitations and capabilities of their surveying instruments and must adopt suitable working practices in order that the quality requirements of a project are met.

LEVELING

This topic is about:

Discuss the various types of datum and bench marks that can be used in leveling including Ordnance Datum Newlyn (ODN)

Describe how automatic, digital and tilting levels work

Describe the field procedures that are used for determining heights when leveling

Perform all the necessary calculations and checks for determining heights by leveling including an assessment of the quality of the results obtained

Appreciate that levelling is subject to many sources of error and that it is possible to manage these

Outline some methods used in levelling to obtain heights at difficult locations

After studying this section you should understand the differences between horizontal and vertical lines or surfaces and why these are important in leveling. You should know what a levelling datum is and be aware that a national leveling datum has been set up by the Ordnance Survey and is known as Ordnance Datum Newlyn (ODN). You should be aware that bench marks are points of known height specified on a chosen datum and that these can either be Temporary or Transferred Bench Marks (TBMs) or Ordnance Survey Bench Marks (OSBMs). In addition, you should appreciate the difficulties of using an OSBM for any leveling and why these are being replaced by GNSS-based heights. you should be able to describe the differences between tilting, automatic and digital levels. In practical terms, you should know how to set up and use a level, how to handle and read a leveling staff and how to carry out a two-peg test on a level. As well as this, you should understand the operation of a survey telescope, what parallax is and how it can be removed. you should understand how height differences can be determined from staff readings and you should be familiar with the terms back sight, fore sight and intermediate sight, together with rise and fall in a leveling context. In addition, you should appreciate why it is important to start and finish all leveling at a bench mark. you should know how to calculate heights (reduced levels) by the rise and fall method and the height of plane of collimation (HPC) method. You should be aware that it is very important to carry out arithmetic checks on these calculations.

REFERENCES

Joseph L. 2018 Surveying for civil and mine engineers: theory, workshops, and racticals

J.CLENDINNING 2006 Principle of Surveying

John Uren and Bill Price 1978, 1985, 1994, 2006 and 2010 Surveying for engineers

M. Can Iban 2008 Engineering Surveying

Valeria shank 2012 Surveying Engineering and Instruments