Subject Name: **Advance surveying & remote sensing**

Subject Code: **CE-3004**

Semester: **3rd**

Unit III

CONTROL SURVEY

Providing frame work of control points, triangulation principle, reconnaissance, selection and marking of stations, angle measurements and corrections, baseline measurement and corrections, computation of sides, precise traversing

Providing frame work of control points- Horizontal and vertical control are developed to create a framework around which other surveys can be adjusted. These control surveys are used for accurate mapping projects in the construction of underground utility systems, roadways, power lines, tunnels, and many other high precision projects. Gresham and Associates, Inc. incorporates a complete range of Global Positioning technology including Static GPS, Real Time Kinematic (RTK) and OPUS control to provide high precision solutions for horizontal and vertical control monumentation.

Principle of triangulation - TRIANGULATION

Because, at one time, it was easier to measure angles than it was distance, triangulation was the preferred method of establishing the position of control points. Many countries used triangulation as the basis of their national mapping system. The procedure was generally to establish primary triangulation networks, with triangles having sides ranging from 30 to 50 km in length. The primary trig points were fixed at the corners of these triangles and the sum of the measured angles was correct to ±3.

These points were usually established on the tops of mountains to afford long, uninterrupted sight lines. The primary network was then densified with points at closer intervals connected into the primary triangles. This secondary network had sides of 10– 20 km with a reduction in observational accuracy. Finally, a third order net, adjusted to the secondary control, was established at 3–5-km intervals and fourth-order points fixed by intersection. Figure 12.2 illustrates such a triangulation system established by the Ordnance Survey of Great Britain and used as control for the production of national maps. The base line and check base line would be measured by invar tapes in catenary and connected into the triangulation by angular extension procedures. This approach is classical triangulation, which is now obsolete. The more modern approach would be to measure the base lines with EDM equipment and to include many more measured lines in the network, to afford greater control of scale error. Although the areas involved in construction are relatively small compared with national surveys (resulting in the term 'microtriangulation') the accuracy required in establishing the control surveys is frequently of a very high order, e.g. long tunnels or dam deformation measurements.

General procedure: (1) Reconnaissance of the area, to ensure the best possible positions for stations and base lines.

(2) Construction of the stations.

(3) Consideration of the type of target and instrument to be used and also the method of observation. All of these depend on the precision required and the length of sights involved.

(4) Observation of angles and base-line measurements.

(5) Computation: base line reduction, station and figural adjustment, coordinates of stations by direct methods.

A general introduction to triangulation has been presented, aspects of which will now be dealt with in detail.

The laser line is directed to the surface at an oblique angle. It insides on the surfaces and creates a visible line. In case of obtuse angles, the measuring accuracy is low, but large differences in height can be detected. In trigonometry and geometry, triangulation is the process of determining the location of a point ... Optical 3D measuring systems use this principle as well in order to determine the spatial dimensions and the geometry of an item.

Reconnaissance- Reconnaissance is a mission to obtain information by visual observation or other detection methods, about the activities and resources of an enemy or potential enemy, or about the meteorologic, hydrographic, or geographic characteristics of a particular area. Reconnaissance is checking out a situation before taking action. Reconnaissance: • This is an exhaustive preliminary survey of the land to be surveyed. It may be either ground reconnaissance or aerial reconnaissance survey. • Reconnaissance is made on arrival to site during which an overall picture or view of the area is obtained. The most suitable position of stations is selected, the purpose of the survey and the accuracy required will be drawn, and finally the method of observation will be established. Objectives of reconnaissance 1. To ascertain the possibility of building or constructing route or track through the area.

2. To choose the best one or more routes and record on a map

3. To estimate probable cost and draft a report. The basic principles and process surveying Introduction So far , we have discussed the meaning, object and major classifications of surveying. Now let us move further to discuss the basic principles and process of surveying. objectives. · To enable students understand the basic principles of surveying. · To expose the students to the process of surveying.

Selection and marking of stations- Some station marks are permanent markers, and some are temporary markers, depending upon the purpose of the traverse. A traverse station that will be reused over a period of several years is usually marked in a permanent manner. Permanent traverse station markers are of various forms, including such forms as an iron pipe filled with concrete; a crosscut in concrete or rock; or a hole drilled in concrete or rock and filled with lead, with a tack to mark the exact reference point. Temporary markers, on the other hand, are used on traverse stations that may never be reused, or perhaps will be reused only a few times within a period of 1 or 2 mo. Temporary traverse station markers are usually 2-in. by 2-in. wooden hubs, 12 in. or more in length. They are driven flush with the ground and have a tack or small nail on top to mark the exact point of reference for angular and linear measurements. To assist in recovering the hub, a 1-in. by 2-in. Wooden guard stake, 16 in. or more in length is driven at an angle so that its top is about 1 ft over the hub.

Angle measurements and corrections- Points on the ground or on a map are related to each other through a horizontal distance and a horizontal angle (or direction.) Horizontal angular measurements are made between survey lines to determine the angle between the lines. A horizontal angle is the difference between two measured directions. Horizontal angles are measured on a plane perpendicular to the vertical axis (plumb line).

Vertical angular measurements are measured to determine slope of survey lines from the horizontal plane (level line). When the vertical angle is applied to the slope distance, the horizontal and vertical distances may be calculated. Vertical angles are measured on a plane passing through the vertical axis perpendicular to the horizontal plane. In order to facilitate the trigonometric calculations of horizontal and vertical distance, the reference or zero angle is on the vertical axis directly above the instrument, which is termed the zenith angle.

Corrections-

A. Adjustment Adjustments should be made at regular intervals and particularly before work on any control survey is started. Such adjustments should be made under the most ideal conditions available, normally in the highway yard or shop. Adjustment should be done in accordance with the user's manual of the specific instrument.

B. Servicing Instruments requiring major adjustments should be serviced at an authorized repair shop as specified by the Survey Operations Manager.

C. Level Bubbles and Optical Plummet Normal measuring procedures do not compensate for maladjustment of either the plate bubble(s) or the optical plummet. These components must be checked more frequently than others. On base and control traverse projects, the optical plummet should be checked at least once each day. The plate bubbles should be routinely checked on each setup.

D. Double Centering Double centering compensates for lack of adjustment of almost all components of the instrument and should be standard practice for all angles measured (or laid off with a transit). Double centering consists of two repetitions (one direct and one reverse) with a transit.

E. Parallax Parallax occurs when the focal point of the eyepiece does not coincide with the plane of the cross hairs. The condition varies for each observer because the focal length depends in part on the shape of the observer's eyeball. Parallax is also a major concern in the optical plummet.

1. When to Check Parallax should be checked by each instrument person when beginning to operate a new instrument or one that has been operated by someone else. The optical plummet should be checked on every setup, particularly if the instrument height is significantly different from the last setup.

2. How to Check Focus the telescope on some well defined distant object. Slowly move the head back and forth, about an inch from the eyepiece, while watching the relationship of the object to the cross hairs. If the object appears to move, parallax exists.

3. Eliminate Rotate the knurled eyepiece ring until apparent object movement is no longer present. It may be necessary to refocus the cross hairs.

Computation of sides- Using trigonometry and the measured length of just one side, the other distances in the triangle are calculated. The shape of the triangles is important as there is a lot of inaccuracy in a long skinny triangle, but one with base angles of about 45 degrees is ideal.

Each of the calculated distances is then used as one side in another triangle to calculate the distances to another point, which in turn can start another triangle. This is done as often as necessary to form a chain of triangles connecting the origin point to the Survey Control in the place needed. The angles and distances are then used with the initial known position, and complex formulae, to calculate the position (Latitude and Longitude) of all other points in the triangulation network.

Although the calculations used are similar to the trigonometry taught in high school, because the distance between the survey points is generally long (typically about 30 kilometres) the calculations also allow for the curvature of the Earth.

Precise traversing- The precision of a traverse is expressed as the ratio of linear misclosure divided by the traverse perimeter length.

expressed in reciprocal form

Example

0.89 / 2466.05 = 0.00036090
1 / 0.00036090 = 2770.8

Precision = 1/2771

