

HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

**PREPARATION OF TOPOGRAPHICAL MAP INCLUDING
CONTOUR LINES USING TOTAL STATION
AND COMPUTER PROGRAMS**

C/983

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JUNE 2004

HIGHER TECHNICAL INSTITUTE	PROJECT NO
	3458

CHAPTER 1

Introduction

SURVEYING DEFINED

Surveying is the art of measuring distances, angles, and positions, on or near the surface of the earth. It is an art in that only a surveyor who possesses a thorough understanding of surveying techniques will be able to determine the most efficient methods required to obtain optimal results over a wide variety of surveying problems.

Surveying is scientific to the degree that rigorous mathematical techniques are used to analyze and adjust the field survey data. The accuracy, and thus reliability, of the survey depend not only on the field expertise of the surveyor, but also on the surveyor's understanding of the scientific principles underlying and affecting all forms of survey measurement.

PLANE SURVEYING

Surveying is divided primarily into geodetic surveying and plane surveying. In geodetic surveying large areas of the earth's surface are involved, and the curvature of the earth must be taken into account. In plane surveying relatively small areas are under consideration, and it is taken that the earth's surface is flat, i.e it gives a horizontal plane. Measurements plotted will represent the projection on the horizontal plane of the actual field measurements. For example, if the distance between two points A and B on a hillside is l , the distance to be plotted

will be $l \cos a$, where a is the angle that line AB makes with the horizontal, assuming a uniform slope.

A horizontal plane is one that is normal to the direction of gravity, as defined by a plumb bob at a point, but owing to the curvature of the earth such a plane will in fact be tangential to the earth's surface at the point. Thus, if a large enough area is considered on this basis a discrepancy will become apparent between the area of the horizontal plane and the actual curved area of the earth's surface.

It can be shown that for surveys up to 250km^2 in area this discrepancy is not serious, and it is obvious therefore that plane surveying will be adequate for all but the very largest surveys. However, precautions are required when connecting such surveys to control points established and co-ordinated by geodetic surveys

GEODETIC SURVEYING

Geodetic surveying is actually a branch of surveying distinguished both by use and by technique. As will be explained shortly, frameworks of angular and distance measurements between points are necessary to control all surveys, and when surveying large areas, such as a whole country, these measurements must be taken to the highest possible standard. Modern methods for this task include satellite positioning systems, which can obtain the three dimensional co-ordinates of any point on the earth's surface to a high degree of accuracy. The study of the size and shape of the earth and its gravity field is known as *geodesy*: hence the name of this type of surveying.

BRANCHES OF SURVEYING

Surveys are often classified by purpose, as follows.

Topographic surveys

These produce maps and plans of the natural and man-made features. There is no clear distinction between a map and a plan, but it is generally accepted that in a plan details are drawn such that it is true to scale, while in a map many features have to be represented by symbols, the scale being too small. Height information can be added either as spot heights, which are individual height points, or as contours, which give a less detailed but more visual representation of the area. Frequently spot heights only are shown on plans.

Plans tend to be used for engineering design and administration purposes only, but maps have a multitude of uses – navigational, recreational, geographical, geological, military, exploration – their scales ranging from 1:25 000 to, say, 1:1 000 000.

Engineering surveys

These embrace all the survey work required before, during and after any engineering works. Before any works are started, large-scale topographical maps or plans are required as a basis for design. The proposed position of any new item of construction must then be marked out on the ground, both in plan and height, an operation generally termed *setting out*; finally, ‘as built’ surveys are often required.

Especially for the design and construction of new routes, e.g. roads and railways,

but in many other aspects of surveying, it is often required to calculate the areas and volumes of land and data for setting out curves for route alignment.

Typical scales are as follows:

- Architectural work, building work, location drawings 1:50, 1:100, 1:200;
- Site plans, civil engineering works: 1:500, 1:1000, 1:1250, 1:2000, 1:2500;
- Town surveys, highway surveys: 1:1250, 1:2000, 1:2500, 1:5000, 1:10 000, 1:20000, 1:50 000.

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