AQUATIC ENVIRONMENTAL SURVEY

FIS 407
LECTURE GUIDE

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LEVELLING

This deals with the determination of the relative heights of points on the earth's surface. The process of this determination is either direct or indirect. A direct measurement is one taken up or down from one point to another which may be made by spirit level, water level, and brick layer's level or indirect measurement made depression from one point to the other.

Data from levelling operations are used to prepare topographical plans and map. These drawings show the main physical features on the ground, such as rivers, lakes, roads,etc as well as the changes in elevation between land forms such as valleys and hills(called vertical reliefs).Plans are usually large-scale (e.g. 1cm for 100m) drawings; maps are small-scale (e.g. 1cm for 200m) drawings. A plan shows information on farm features such as dikes, ponds, drainage canals or outlets structures. Topographical map shows the fish farm site. These are very important in fish farm construction. They help guide in choosing a site, planning the fish farm, and designing the structures that are needed for the farm. They also guide in the layout, so that one can follow the plan that has been made for the fish farm, and build the structures on it correctly.

SOME TERMS USED IN LEVELLING OPERATIONS

1. Bench mark (BM): it is a fixed point on the earth's surface whose level above ordance datum is known.
2. Ordnance Datum (OD): it is the mean sea level to which all other levels are related.
3. Back sight (BS): is the first sight taken after the level has been set up. A sight taken to a point whose height is known or can be calculated.
4. Foresight (FS): The last sight taken. A sight taken to a point whose height is required to carry on the line of level.
5. Intermediate Sight (IS): it is any other sight taken.
6. Reduced Level (RL): calculated level of a point above or below the datum.
7. Height of Instrument (HI): The height of the line of collimation above the datum.
8. Line of Collimation (LM): It is an imaginary horizontal line drawn between two points.
9. Rise and fall: The difference is height or is level between two is referred to as a rise or fall.
10. Change Point (CP): the point at which both a foresight and then a back sight are taken.

LEVELING INSTRUMENTS

These include:

. A Level e.g. theodolite, transit dumpy level(automatic level),e.t.c.

. A staff

. Devices for angle measurements e.g. graphometer, magnetic compass, prismatic compass, orientation compass

. Chain or tape

. Pegs, arrows and ranging poles

TACHEOMETRY

This is the operation of measuring distances by means of stadia hairs. Measuring the distances using stadia hairs involves setting the instruments at one end of the line being measured and a leveling staff is held vertically at the other end. The points where the stadia hairs cut the staff are read. The difference between the readings is the staff intercept, S. Assuming H is the horizontal distance between the instrument and staff, then

$$\mathbf{H = KS + (f + C)}$$

Where K = constant multiplier

(f +c) = additive constant

Note that K = f/i

Where f = focal length of the objective lens.

i= interval between stadia hairs

The equation above is applied to external focusing telescope, but when an anallactic lens is fitted is the telescope to bring the focal point on the vertical axis and therefore remove the need for additive constant.

$$\mathbf{H = KS.}$$

But when the ends of the line being measured are on different levels such that the telescope has to be elevated of depressed through an angle of Θ^0, the formulae above changes to:

$$\mathbf{H = KS\ Cos^2 \theta}$$

`and reduced level:

$$\mathbf{V = KS\ Cos\ \Theta\ sin\ \Theta + HI - H}$$

HI = height of instrument

h = staff reading

Occasionally, if θ exceeds 45^0, it is better to tilt the staff so that it is perpendicular to the line of sight. Short sight is therefore attached to the staff to enable this to be done accurately. The method is called normal staffing then the formulae becomes:

$$\mathbf{H = KS\ Cos\ \theta + h\ sin\ \theta}$$

$$\mathbf{V = KS\ sin\ \theta + HI — h\ cos\ \theta}$$

TYPES OF LEVELLING

1. Continuous leveling
2. Reciprocal leveling

METHODS USED IN CONTINUOUS LEVELLING

- Collimation method or height of instrument
- Rise and fall method.

In collimation method height of instrument

$$\mathbf{HI = BS + RL}$$

And reduced level

$$\mathbf{RL = HI - FS}$$

At the end computation, the difference of the sum of BS and FS must be equal to the difference of first RL and last RL data recorded. Meanwhile in Rise and Fall method, a rise will occur when the staff reading is less than the reading on the proceeding station. The data recorded are also checked for correctness as above, but this time, rise and fall are used instead of BS and FS.

TRAVERSE DURING LEVELLING:

Definition:

A traverse is a continuous frame work of line connecting a number of points, the lengths of the lines and their angular relationship to each other being measured. The lines are known as legs and the points as stations.

USE

Traverse surveys are used where site conditions make the chain triangulation method impossible e.g where the survey is of as large area and details are not required.

TYPES:

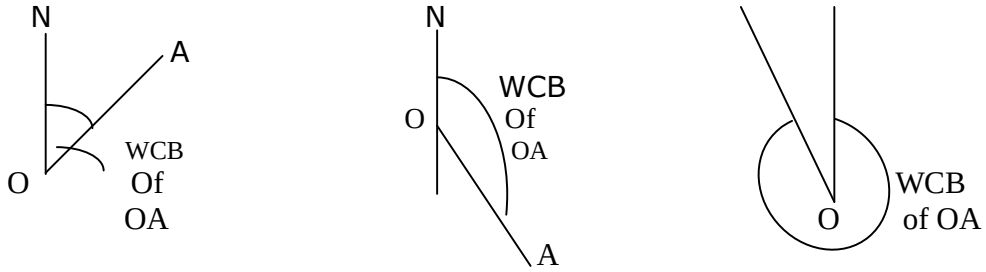
1) Closed traverse – when the frame work form a closed figure (or when the traverse connects two stations whose position are known). This type of traverse is used for surveying lakes or other areas across which known check line can be run. Such traverse is easily checked, as the survey starts and finishes at the fixed points.
2) Open traverse – a traverse whose starting and finishing stations do not coined or are not both fixed or known points. This type of traverse is used to survey rivers e.t.c. To enable the work to be checked, sights are taken on to some reference objects, such as well defined landmarks

Note:

a) Chain traverse √
b) Compass traverse √
c) Theodolite traverse √

Terms:

a) Bearing – the term bearing refers to the angle between the line and the north -south line or median.
b) Whole - circle bearing - the bearing from north to the leg is measured in a clockwise direction and the angle from the north line right round to the leg is know as a whole – circle bearing (as W.C.B)



Forward and Back Bearing: with A as the starting station of traverse and the direction of the survey being forward B, the angle between north and AB at A is known as the forward bearing of AB. The angle between north and AB at station B is known as the back bearing of AB, this should differ from the forward bearing by exactly 180^0.

The forward and back bearings of a leg will differ by 180^0 except there is local attraction. The presence of metal, metallic ores or electric currents will divert the compass needle from the north– south line, and thus cause the readings taken to be inaccurate. Stations should therefore be chosen so that they are beyond the influence of this attraction.

Correction for Effects of Local Attraction:

Line	Bearing	Diff of FB and BB
AB	60^0	180^0
BA	240^0	
BC	120^0	180^0
CB	300^0	
CD	210^0	178^0 (-2^0)
DC	32^0	
DA	317^0	182^0 (-2^0)
AD	135^0	