INSTRUMENTS FOR MEASURING DIAMETER AND HEIGHT

A. Diameter Measurement

1. Girth or Diameter Tape: This is usually made of cloth or linen for rough work. But those that are made of cloth – metallic or fibre-glass and steel are for more precise measurement. The graduation can be in inches or centimeters depending on the make or system.
2. Quarter-girth Tape
   It is mostly used in Great Britain. 1 inch on the tape is equivalent to 4 inches of girth.
3. Calipers
   The calipers are used for direct measurement of diameter. A caliper consists of a graduated scale with 2 arms perpendicular to the graduated scale. One arm is being fixed at the end and the other sliding. There are different types of calipers such as (i) Simple or traditional caliper (ii) Fixed arm or fixed angle caliper (iii) Finnish Parabolic Caliper.

The girth/diameter tape is the most commonly used because it is easy to understand, very conveniently used and it is very portable.

Although the caliper gives direct reading of diameter/girth, the main disadvantage is that it is heavy to carry and consequently constituting a problem. All calipers suffer from limitation of size and weight.

Diameter under-bark

Bark constitutes part of the diameter of a tree, but after felling the tree the bark is excluded in use, so, if the interest is in only the wood excluding all roughages the amount of bark should be determined. An instrument that could be used to measure the thickness of the bark is called Swedish Bark Gauge.

Bark thickness tends to vary in a regular manner from the ground towards the tip of the tree. In some species, bark thickness may vary according to size, age, genetic make-up, condition of growth, e.t.c. It is possible to establish a relationship between bark thickness and other stem variables e.g. Dbh ob or Db hub.

Swedish bark gauge could be used for measuring bark thickness of standing or felled trees.

B. INSTRUMENTS FOR MEASURING THREE HEIGHT

There are 2 ways of measuring tree height

i) Direct Method
ii) Indirect Method

DIRECT METHOD:

This method involves climbing and measuring with tape and using a graduated pole in those areas that are inaccessible. Another way is to fell the tree and determine the length of the tree, this method is destructive.

INDIRECT METHOD:

This method could be classified into those based on geometric principle and the ones base on trigonometric principle. It is these types of instruments that are used for the measurement.

1. i) Clinsten's Hypsometer

It is composed of folding scale about 10 inches long with irregular graduation. To use it, hold or place a 10ft. pole upright against the base of the tree to be measured. The instrument is then held vertically at a distance. This instrument is graduated from similar triangles.

Observer

eye piece

s OAB and Oab are similar

$$\text{i.e.} \quad \frac{OAB}{AB} = \frac{Oab}{AC} = \frac{AB - CB}{ac}$$

Thus $\frac{}{ab} = \frac{}{ac}$

$$\therefore \quad ac = \frac{ab\ (AB - CB)}{AB}$$

Example:

For 15 in. instrument (ab) and for a staff which is 10ft long, the tree height is 15 (tree height – 10)

$$\frac{\text{---------}}{\text{tree height}}$$

Thus for tree of 40ft high

$$Ac = \frac{15\ (40 - 10)}{40} = 11.25"$$

Manipulation:

A staff of known height with which the instrument was graduated is placed against the tree in upright position at a distance. At the chosen distance the observer holds the instrument parallel to the tree exis so that the line of sight from the top and the bottom edges of the instrument respectively hit the top and base of the tree. The height of tree is given by reading C cut by the line of sight.

Meirith Hypsometer

The function of the hypsometer is based on geometric principle. It is a crude but simple instrument made of straight graduatd stick which is held vertically with its lower end 25" from the eye and in line with the base of the tree. In using this instrument, the overserver must stand at a predetermined distance to the tree.

The main problem in using the instrument is that it may be possible to hold it vertically and precisely at 25" from the eye.

C. INSTRUMENTS BASED ON TRIGONOMETRIC PRINCIPLES

Take a horizontal distance OC between the observer eye "O" and the tree Ab.
OAC and OBC are right angled triangles.
If OC is known, then AB = OC tan (<AOC + <BOC)

Observer's eye
piece

Two cases are known:

Case I: The observer stands at any convenient distance, OC is measured. <AOC and <BOC are determined with an instrument. Tangents of the angles are read from the table and the tree height is derived arithmetically. An instrument that can be used to determine angles is Abney Level.

Example:

If the horizontal distance is 20m and angles AOC = 55^o and BOC = 15^o, then the tree height will be 20 (tan 55^o + tan 15^o).

Case II: The observer stands at a specific distance or multiple or fraction of it for which the instrument is graduated. (Sme instruments are graduated in term of tangent of successive angles and the specific distance s that AC and CB can be read directly). The instruments in this category are (i) Topographic Abney Level, (ii) Engineering Abney Level, (iii) Haga altimeter and (iv) Spiegel Relascope.

AB = {OC(tan)} - {OC(tan)}
AC = OC tan <
BO = OC tan <
.
. . AB = AC - BC
= OC tan < - OC tan <
.
. . AB = OC(tan < - <)
AC = OA tan <a
AB = OA tan <x
BC = OA tan <a - OA tan <x
= OA (tan <a - <x)