TAPER AND FORM

1. Definitions:

Larsen (1963) defines taper and form and uses them synonymously as the relative rate of change in stem diameter with increasing tree height irrespective of the mathematical expression defining that change.

Gray (1956) defines form as the shape of the solid in
diameter/height of which is determined by power index of the diameter or the particular fashion in which a solid narrows a diameter so as to produce a characteristic shape.

Gray defined Taper as the rate of narrowing a diameter in relation to
increase in height of a given "shape" or 'form'.

Taper is the rate of narrowing a diameter with height of a given shape or form.

Form is the total impression of shape given by the narrowing of stem or crown and the deviation from radial symmetry along the vertical axis of a tree.

2. FORM:

Variation occurs in the form of the main stems of trees, due to the variations in the rate of diminution in diameter from the base to the tip.

The various sections of the bole resemble certain geometrical solids whose cross sections at right angles to their long axis are circular. The commonest geometric solids are: (a) Cylinder (b) Paraboloid (c) Cone (d) Neiloid.

All these except the cylinder taper to a point and may be compared with the entire bole of the tree which seldom approximate either the cone or neiloid and never the cylinder.

Truncated sections severed by cross cuts are termed FRUSTRUM and may be compared with the entire bole length. Truncated paraboloid approaches the form of the average log. But logs may resemble the truncated neiloid owing to ilaring butts.
Top logs may have the shape of truncated cone.

3. TAPER

Taper is the decrease in diameter with tree height and it varies with species, diameter at breast height, age and site.

Cylinger Cone Paraboloid Neiloid

Variation of Taper with Typical Tree Forms.

(a) Typical Excurrent - (i) Conical tip (ii) Paraboloid middle section (iii) Neiloid basal section.
(b) Open grown Excurrent – (i) Long Conical top
(ii) Pronounced neiloid base
(iii) Truncated cone or paraboloid in central section.
(c) Close grown Excurrent – (i) Short conical top
(ii) Central and basal sections approximate to cylinder or truncated neiloid.

TAPER MEASUREMENT

(i) Standing Trees:

Diameter is measured at successive heights by either climbing or using optical devices such as the Spiegel Relasscope.

The use of tapes or calipers, raised on poles. When diameters at successive heights have been taken, plot diameter against height.

(ii) Felled Trees

Tapes, calipers or measuring rods are used. More detailed measurements are possible particularly for under bark of the trees.

STAND MEASUREMENT

Purposes of stand measurement from national point of views:

Measurement is necessary for involving and implementing satisfactory national policies since there is the need to know the location ad extent of forest.

Measurement is also required for Resource Inventory resulting in efficient management.

From the research point of view and for experimental investiageions, detailed measurements and highly necessary.

1. STAND DENSITY

Under the umbrella of stand density, stand structure could be discussed. Stand Structure can be categorized into (i) even-aged stand and (ii) Uneven-aged Stand.

(i) Even-aged Stand

This is a man-made forest in which all trees belong to the same age class and the trees are consistent in height depending on position in the canopy and most trees cluster round the mean.

(ii) Uneven-aged Stand

It is a natural forest which contains a large number of small trees which belong to many ages with corresponding sizes and are all of varying heights.

Stand Density

Stand Density can be defined in 2 ways

(a) Absolute Stand Density: Basal area/hectare

It is expressed as basal area per hectare of which expresses density on specific area basis. It refers to concrete characteristics.

(b) Relative Stand Density: % of stocking based on basal area

The expression is usually based on predetermined standard with which the stocking is compared. It is always expressed in percentage of standard stocking on basal area basis.

Apart from these two ways, there are other definitions of stand density. It could be expressed in volume per hectare/acre. In this case, volume is estimated from height and diameter of individual trees. This is an expensive method, if interest is mainly in density.

Another method is enumerating the number of trees unit area. It is not very reliable, non-precise quantifiable because of wide range of frequency distribution. It is however qualified by tree sizes.

REPRESENTATIVE STAND HEIGHT
Girth diameter Tree of Mean Basal Area.

To secure a representative stand measure, the arithmetic mean is commonly used. It is derived by measuring the required variable for a few sample of trees. For instance to obtain the mean height, measure the height of sample trees, sum up all the values and divide this by the number of sample trees making up the total which will give the arithmetic average i.e. the mean height. Thus, the mean height in this case is therefore an approximation to true mean.

There are various methods of obtaining representative stand measure, two of which are (i) Arithmetic Mean Method – In this case height of sample trees are measured and more weight is given to larger trees and the mean is found.

(2) Graphical Method:

A smooth curve is plotted which has a height of diameter and determine tree to average basal area. Using the height of this to read from the height/diameter curve obtain average mean height if the stand.

Crown Closure and Crown freedom are 2 ways of expressing sstand characteristics.

CROWN CLOSURE:

It is sometimes required to estimate what proportion of total stand crown area is occupied by sample trees.

COMPLETE AND INCOMPLETE CANOPY

Where complete canopy is present, it is required to project the crown of individual sample tree and use if to calculate the area occupied by individual crown – called the crown area. Crown area occupied by sample tree crown will constitute crown closure.

Where a gap occurs in the canopy, gaps can be used to determine the crown density. Where the crowns do not touch, it is said to be crown freedom. Crown freedom is an index of freedom from physical interference, been estimated as the proportion of crown margin actually touching or that may touch when a gentle wind blows against the stand.

Scores are based on an imaginary crown pentagon.
Scale 5 -(no contact) – there is a complete freedom of movement
in a light breeze.
Scale 4 -(minimum contact) – one or two sides of the imaginary
pentagon are in contact with other crowns.
Scale 3 -(medium contact) – free sides of the pentagon are
touched by neighbouring crowns.
Scale 2 -(partial maximum contact) – in which the crown is free at
least on one side. Four sides of the pentagon are in contact with the crowns of neighbouring trees.
Scale 1 -(maximum contact) – Here, it indicates severe crown
competition which free sides of the pentagon are in contact with or threaten to get in contact by the crowns of neighbouring trees.

STAND MEASUREMENT

UNEVEN-AGED STAND

There is an equation to measure the frequency of distribution in an uneven aged stand: $Y = Kx^e$ which can be transformed into

$$\text{Log } Y = \text{Log } K - ax \log e$$

Where Y = No. of trees in a given dbh class
K and a are constants
X = diameter at breast height class

STAND DENSITY

A useful form of finding the stand density of eve-aged stand is by the use of Reineke's Stand Density Index – which is read from a graph in which the logarithm of no. of trees per hectare is plotted against the logarithm of mean deb.

Mean Dbh

INTRODUCTION TO VOLUME ESTIMATION

There are 3 types of dimensions

(1) Linear (2) Area (3) Volume

In forestry practice, are measurement is on two forms (ii) Territorial or Cadastral form (ii) Area in plan related to individual trees.

For instance basal area is obtained by conversion from girth or diameter. Crown are is obtained by direct estimation as an individual area for single tree and by proportion for stand. For individual tree volume, measurement is considered for the stem or bole, any distinct section of the stem and for the crown.

Stand Volume is the sum of volumes of constituent trees. Stand volume can also be obtained by direct estimation.

MEASUREMENT OF VOLUME ESTIMATION

The form of the volume to be estimated normally related to the stage of conversion. There are four main forms of conversion of the trees:

1. The Standing Individual Tree which is unconverted.
2. The Felled Tree with partial primary conversion for transport but with identity of the original tree retained.
3. Primary converted produce collated for transport with the individual tree identity lost e.g. cord wood or fuel wood.
4. Produce after subsequent industrial conversion e.g. sawn-wood, veneer or composite wood-chips, particles or saw dust etc.