

Chapter 7

Tree Diameter

DBH = average diameter, outside bark, measured at 4.5 ft (breast height) on the uphill side of the tree.

Measurement of irregular trees:

- A. Leaning trees: uphill side of tree
- B. Forked trees:
 - 1. Forked above BH; measure below swell
 - 2. Forked below BH; measure as 2 separate trees
- C. Swell butted trees:
 - 1. Measure at 1.5 ft above the swell

Tools:

A. D-tape: $C = \pi D$ thus $D = C/\pi$ thus 1" dbh = 3.1417 in. circumference

B. Biltmore stick: $grad. distance = \sqrt{\frac{AD^2}{A + D}}$

where A = arm reach (inches)
D= any diameter (inches)

DBH	Cum Dist
2	1.92
4	3.71
6	5.39
8	6.96
10	8.45
12	9.86
14	11.21
16	12.49
18	13.72
20	14.91
22	16.05
24	17.14

C. Caliper: average 2 measurements taken at 90 degrees

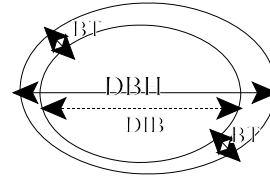
Increments: 1-inch classes 1= 0.6 - 1.5, 2= 1.6 - 2.5, ..., 6= 5.6 - 6.5, 8= 7.6-8.5
 2-inch classes 6 = 5.1 - 7.0, 8=7.1 - 9.0, 10=9.1 - 11.0, 12=11.1-13.0
 The mid-point of the class is an integer number; i.e. 2, 4, 6, 8, etc.

Upper stem diameter = diameter, inside or outside bark, measured on any portion of the main stem

Bark Thickness

Measured with a bark gauge at point inside of bark fissure.

Used to compute or obtain DIB, diameter inside bark, or DOB, diameter outside bark.



$$DIB = DOB - 2(bt) \quad \text{Or} \quad DOB = dib + 2(bt)$$

Basal Area

Cross sectional area of a tree or group of trees at breast height expressed in square units.

$$ba_{tree} = 0.005454 D^2 \quad (\text{If Area} = \Pi r^2 \quad \text{then how do you derive the } 0.005454 D^2 \text{ ?})$$

$$\text{Stand BA} = \sum ba_{tree} \text{ for } n \text{ trees per acre}$$

Quadratic Mean Diameter

The diameter of the tree of mean basal area .

$$\bar{D}_{qm} = \sqrt{\frac{\bar{ba}}{0.005454}}$$

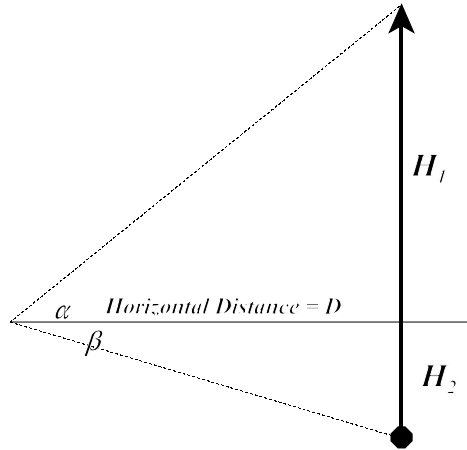
$$\bar{D}_{qm} = \sqrt{\frac{BA}{n * 0.005454}}$$

Tree Height

Total height = height (or stem length) from ground line to top of terminal bud.

Merchantable height = stem length (or height) from assumed stump height to an arbitrary, fixed upper-stem diameter (ib or ob)

Height Measurement Principle: tangent function of right triangle; $\tan \alpha = \text{oppos/adjac}$



$$\begin{aligned} \tan \alpha &= H_1 / D & \text{thus} & \quad H_1 = D * \tan \alpha & \text{(height above horizontal)} \\ \tan \beta &= H_2 / D & \text{thus} & \quad H_2 = D * \tan \beta & \text{(height below horizontal)} \\ \text{Height} &= H_1 + H_2 \end{aligned}$$

Height Measurement Tools

Merritt hypsometer:
$$\frac{\text{Arm Reach (in.)}}{\text{Horizon Dist (ft)}} = \frac{\text{stick interval (in.)}}{\text{height interval (ft)}}$$

Thus, for a 25 in. reach @ 66 ft from the tree, an 8 ft height interval would be 3.03 inches apart on the side of the Biltmore Stick.

Clinometer: Read direct at 66 ft (topographic scale) or 100 ft (percent scale)
Has circular wheel that be read while viewing height point.

$$\text{height} = \left[\frac{\text{horizontal distance (ft)}}{\text{index distance (ft)}} \right] (\text{Reading@top} - \text{Reading@bottom})$$

Abney level: Has scale pointer that can be set at height point and then read at any orientation.

Ultra-Sound Devices: Haglof Vertex uses horizontal DME distance and angle

Laser Devices: can use either distance and angle or slope distance.

Tree Form

Form Factor = ratio of stem volume to the volume of a geometric solid

Form Quotient = ratio of upper-stem diameter to dbh

Girard Form Class = ratio of dib at top of 1st 16 ft log to dbh
= ratio of dib at 17.0 ft (16 ft + 1 ft stump) to dbh

Thus if dib at 17 ft = 16 inches and dbh = 20 , the FC = .80 or 80%

Form class expresses taper of 1st log only; not the upper log tapers.

Using an upper-stem taper function, the scaling diameter (i.e dib or d_{hi}) at any height point (h_i) can be calculated with the equation:

$$d_{h_i} = \left(\frac{FC}{100} \right) DBH + 0.56562 - 0.06878DBH + 0.00027(MH)^2 - 0.00154h_i^2$$

where: MH = total merchantable height of tree

h_i = cumulative height to d_{hi} point

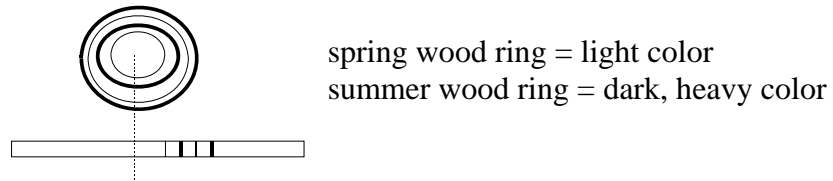
Required Reading: Article 1: Parker, R.C. 1993. "Field and Computer Application of Mesavage and Girard Form Class Volume Tables"; Southern Journal of Applied Forestry. p 81-87

Example: For a 16 inch dbh tree with a merchantable height of 3.5- 16 ft logs and a form class of 80; the scaling diameters at the various heights are:

Height	d_{hi}
16	12.8
32	11.6
48	9.6
56	8.3

Tree Age

From Annual Rings: Spring wood and summer wood rings = 1 year of growth



Measurement: extract core at bh with increment borer and count rings
add x-years for years to attain height to bh (4.5 ft)

count rings on a cut stump.

Crown Class

Not a true indicator of age, but rather competition for sunlight

1. Dominant = trees with crowns above the general crown level.
receives sunlight from above as well as on the sides of the crown.
2. Co-dominant = trees with crowns forming the general crown level.
receives sunlight from above, with relatively little on the sides of the crown.
3. Intermediate = trees shorter than the general crown level.
receives little sunlight from above and none from the sides.
4. Suppressed = trees entirely below the general crown level.
receives no direct sun light from above or from the sides.