

Unit C: Forest Management

Lesson 3: Measuring Timber Stands

Terms

- Basal area
- Board foot
- dbh
- Diameter at breast height
- Log rules
- Lumber overrun
- Taper
- Wedge prism

How do I calculate board feet?

- A board foot is a unit of measurement represented by a piece of rough wood 2.54 cm thick by 30.48 cm wide by 30.48 long; with a total volume of 2359.74 cubic cm.
- In surfaced or finished lumber, width and thickness are based on measurements before surfacing or other finishing.

How do I calculate board feet?

- Board feet of a piece of lumber can be calculated by multiplying the length of the piece \times the width of the piece \times the thickness divided by 2360.
- In this formula the measurements are measured in centimeters.

How do I calculate board feet?

- To determine the board feet in several pieces of lumber that are equal in size, determine the board feet in one piece then multiply that number by the number of similar size pieces.

CALCULATING BOARD FEET

- **Definition:** One metric board foot that is 2.54 cm thick by 30.48 cm wide by 30.48 long; With a total volume of 2359.74 cubic cm.
- **Formula:** $bf = \text{length} \times \text{width} \times \text{thickness} \text{ divided by } 2360$. (These measurements are done in centimeters)
- **Example 1:** The number of bf in a board that is 3.657 m long, 14 cm wide, and 1.9 cm thick is determined as follows:

$$14 \text{ cm} \times 1.9 \text{ cm} \times 365.7 \text{ cm} = 9,727.62 \text{ cc}$$

$$\frac{9,727.62}{2360} = 4.12 \text{ board feet}$$

- **Example 2:** The number of bf in a board that is 4.267 meters long, 89 mm wide, and 38 mm thick is determined as follows:

$$8.9 \text{ cm} \times 3.8 \text{ cm} \times 426.7 \text{ cm} = 14,430.99 \text{ cc}$$

$$\frac{14,430.99}{2360} = 4.12 \text{ board feet}$$

- Note: To determine the bf in a stack of boards when all the boards are of equal size, determine the bf in one board and multiply that by the number of boards.

How do I measure basal area in standing trees?

- The basal area (cross-sectional area of a tree at breast height expressed in square feet) is commonly measured to determine the level of stocking of a stand of trees, the amount of timber to remove in thinning an overstocked stand, and timber volume calculations.

Basal area may be determined in a number of ways.

- Basal area may be determined by physically measuring each tree with a Biltmore stick, a diameter tape, or calipers.
- A table is then used to determine the basal area from the recorded measurements.

BASAL AREA OF TREES BY DBH CLASSES

	Basal area (m^2/ha)						Average stand height (meters)							
	6	8	10	12	14	16	18	20	22	24	26	28	30	32
2	0	0	0	0	2									
4	0	3	6	9	13									
6	5	9	14	19	23	28								
8	9	16	22	28	34	40								
10	14	22	30	37	45	53	61							
12	19	28	37	47	56	65	75	84						
14	23	34	45	56	67	78	89	99						
16	28	40	53	65	78	90	103	115						
18		47	61	75	89	103	116	130						
20		53	68	84	99	115	130	146	161					
22		59	76	93	110	127	144	161	179					
24		65	84	103	121	140	158	177	196	214				
26		71	92	112	132	152	172	193	213	233				
28		78	99	121	143	165	186	208	230	251				
30		84	107	130	154	177	200	224	247	270	293			
32		90	115	140	165	189	214	239	264	289	314	338		
34		96	123	149	175	202	228	255	281	307	334	360		
36		103	130	158	186	214	242	270	298	326	354	382	410	
38		109	138	168	197	227	256	286	315	345	374	404	433	
40			146	177	208	239	270	301	332	363	394	425	456	
42			154	186	219	251	284	317	349	382	414	447	480	
44				161	196	230	264	298	332	366	400	435	469	503
46					205	241	276	312	348	383	419	455	490	526
48						214	251	289	326	363	400	438	475	512
50							224	262	301	340	379	417	456	495
52								273	314	354	394	435	475	515
54									284	326	368	410	452	494
56										295	338	382	425	469
58											306	351	396	441
60												317	363	410
62													327	376
64														388
66														400
68														452
70														503
72														554
74														605
76														656
78														661
80														717
82														773
84														829
86														881
88														881
90														881
92														881
94														881
96														881
98														881
100														881

Cubic meters/hectare = 0.38791 * MBA * MHT - 9.21137

Where: MBA = Average stand basal area in square meters/hectare and: MHT = Average stand height in meters.

Standard error of estimate: 1.47 cubic meters/hectare.

Values underlined indicate extent of data.

Basal area may be determined in a number of ways.

- One of the easiest methods for estimated basal area is by using angle gauges in optical tree-measuring devices.
- One type of angle gauge is a wedge prism.

Basal area may be determined in a number of ways.

- A wedge prism can be used to determine which trees should be counted and tallied in a timber sample and which should not.
- Prisms are ground to specified basal area factor size. The factors generally vary from 0.7 to 15.2 m²/ha, but the most common size is 2.3 m²/ha.

Basal area may be determined in a number of ways.

- Multiplying the basal area factor of the prism used at a given point in a timber times the number of trees counted with the prism will directly give the square feet of basal area per acre of the trees around that point.

Basal area may be determined in a number of ways.

- When a series of points is taken in a timber stand, average the figures for basal area per hectare from all sampling points to obtain the average basal area per acre for the entire stand.

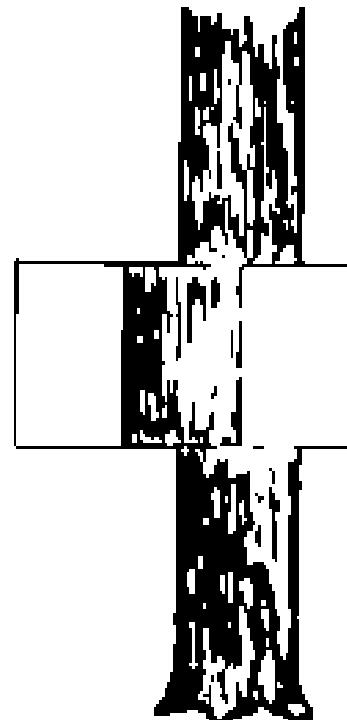
STEPS IN USING A WEDGE PRISM

- 1. Hold the prism at eye level directly over the point to be used to sample the timber stand.
- 2. Look through the prism, and count the number of trees that should be tallied. The face of the largest edge of the prism should be at right angles to the line of sight, and the top edge of the prism should be horizontal to the level ground.
- 3. Multiply the tree count at this point by the basal area factor of the prism to get the basal area per hectare in square meters around this sampling point.

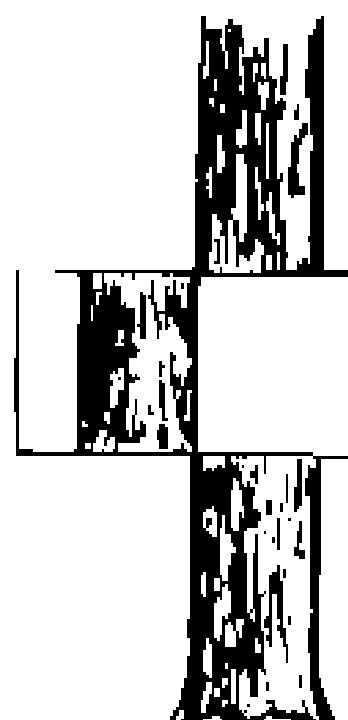
THE WEDGE PRISM



Don't tally



Tally



Borderline
tally **every other one**

(Courtesy, Interstate Publishers, Inc.)

How do I determine tree volume?

- Tree volume tables are available to facilitate estimating the number of metric board feet, cubic meters, or cords in standing trees.
- The volume tables are designed to indicate a specific volume for a tree of a certain diameter at breast height (dbh) and height.

How do I determine tree volume?

- Tree volume tables that give the merchantable content of the standing timber are generally derived from log rules, or tables that measure the volume of individual logs.
- Volumes indicated on log rules are derived by formulas or graphic means.

How do I determine tree volume?

- There are over 50 different log rules used in the world, and the values assigned to trees or logs vary considerably.

The six common log rules are the

- Doyle,
- Scribner,
- International,
- Maine,
- Spaulding, and
- Herring.

Doyle

- The Doyle rule indicates less volume for small-diameter logs than does the other commonly used rules.
 - The lumber overrun, or the production of more lumber than the log rule allows, tends to be high for logs less than 71 cm, but it is excessive for logs less than 40 cm.

Doyle

- In this rule, an arbitrary deduction is made for lumber processing losses from the volume of a cylinder.
- The Doyle rule is most frequently used for the purchase of sawtimber and sawlogs.

Scribner

- The Scribner rule is preferred by forestry agencies.
- It is derived by graphic means and estimates the amount of 2.5 cm lumber that can be sawn from logs of specific dimensions.

Scribner

- This rule, like the Doyle rule, is most frequently used for the purchase of sawtimber and sawlogs.
- Many forest agencies have adopted this rule for timber sale purposes.
- The Scribner rule gives a lumber overrun for large logs.

International log rule

- The international log rule like the Doyle, is derived by a formula and is the only rule that adds volume for taper.
- Taper is a term that describes the gradual diminution of diameter in a tree trunk.

International log rule

- It provides one of the highest estimates of volume of any of the log rules and closely approaches the actual quantity of lumber that can be cut from a tree or log without the normal provision for a slight lumber overrun.

International log rule

- This rule is no longer used for making timber sales, but it continues to be useful for forest survey and research purposes.

Review / Summary

1. Explain how to calculate board feet.
2. Explain how to measure basal area in standing trees.
3. Explain how to determine tree volume.