



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 cm 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:

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

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

$$2360$$

- **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:

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

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

$$2360$$

- **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 (m²/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	<u>3</u>	<u>6</u>	9	13									
6	5	<u>9</u>	<u>14</u>	19	23	28								
8	9	<u>16</u>	<u>22</u>	28	34	40								
10	14	<u>22</u>	<u>30</u>	37	45	53	61							
12	19	<u>28</u>	<u>37</u>	47	56	65	75	84						
14	23	<u>34</u>	<u>45</u>	56	67	78	<u>89</u>	99						
16	28	<u>40</u>	<u>53</u>	65	78	90	103	115						
18		47	<u>61</u>	<u>75</u>	89	103	116	130						
20		53	<u>68</u>	84	99	115	130	146	161					
22		59	<u>76</u>	<u>93</u>	110	127	144	161	179					
24		65	84	<u>103</u>	121	140	158	177	196	214				
26		71	<u>92</u>	<u>112</u>	<u>132</u>	<u>152</u>	172	<u>193</u>	213	233				
28		78	<u>99</u>	<u>121</u>	<u>143</u>	<u>165</u>	<u>186</u>	<u>208</u>	230	251				
30		84	<u>107</u>	<u>130</u>	<u>154</u>	<u>177</u>	<u>200</u>	<u>224</u>	<u>247</u>	270	293			
32		90	<u>115</u>	<u>140</u>	<u>165</u>	<u>189</u>	214	<u>239</u>	<u>264</u>	<u>289</u>	314	338		
34		96	<u>123</u>	<u>149</u>	<u>175</u>	<u>202</u>	<u>228</u>	<u>255</u>	<u>281</u>	307	334	360		
36		103	<u>130</u>	<u>158</u>	<u>186</u>	<u>214</u>	<u>242</u>	<u>270</u>	<u>298</u>	326	354	382	410	
38		109	138	<u>168</u>	<u>197</u>	<u>227</u>	<u>256</u>	<u>286</u>	<u>315</u>	345	374	404	433	
40			146	<u>177</u>	<u>208</u>	<u>239</u>	<u>270</u>	<u>301</u>	<u>332</u>	<u>363</u>	394	425	456	
42			154	<u>186</u>	<u>219</u>	<u>251</u>	<u>284</u>	<u>317</u>	<u>349</u>	<u>382</u>	<u>414</u>	447	480	
44			161	<u>196</u>	<u>230</u>	<u>264</u>	<u>298</u>	<u>332</u>	<u>366</u>	<u>400</u>	<u>435</u>	469	503	
46				205	<u>241</u>	<u>276</u>	<u>312</u>	<u>348</u>	<u>383</u>	<u>419</u>	<u>455</u>	<u>490</u>	<u>526</u>	
48				214	251	289	326	363	400	<u>438</u>	<u>475</u>	512	549	
50					224	<u>262</u>	<u>301</u>	<u>340</u>	<u>379</u>	<u>417</u>	<u>456</u>	<u>495</u>	534	573
52						<u>273</u>	314	354	394	<u>435</u>	<u>475</u>	<u>515</u>	556	596
54						284	<u>326</u>	<u>368</u>	<u>410</u>	<u>452</u>	<u>494</u>	<u>535</u>	577	619
56						295	338	382	425	<u>469</u>	<u>512</u>	556	599	642
58						306	<u>351</u>	<u>396</u>	<u>441</u>	<u>486</u>	531	576	621	666
60						317	<u>363</u>	<u>410</u>	<u>456</u>	<u>503</u>	549	<u>596</u>	642	689
62						327	376	<u>424</u>	<u>472</u>	<u>520</u>	568	<u>616</u>	664	712
64							388	438	<u>487</u>	<u>537</u>	587	636	686	736
66							400	452	503	554	605	656	708	759
68							413	466	518	571	624	677	729	782
70							425	480	534	588	<u>642</u>	697	751	805
72							438	494	549	605	661	717	773	829
74							450	507	565	<u>622</u>	<u>680</u>	737	795	852
76							462	521	580	639	698	757	816	875
78							475	535	<u>596</u>	<u>656</u>	717	777	838	898
80							487	549	611	674	736	798	860	922
82								563	627	691	754	818	881	
84								577	642	708	773	838	903	
86									658	725	791	858	925	
88										742	810	878		
90										759	829	898		
92										776	847	919		
94										793	866			
96										810	885			
98											903			
100												922		

BASAL AREA OF TREES BY DBH CLASSES

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.

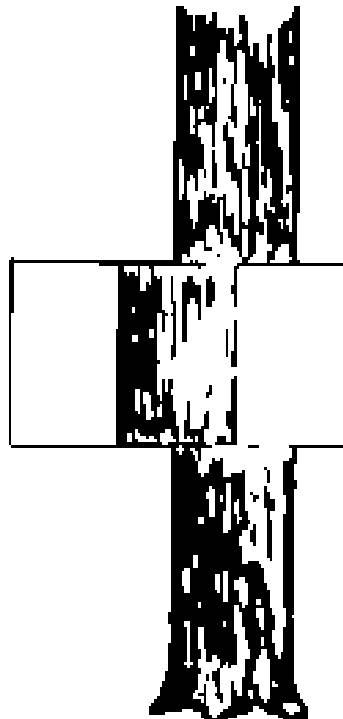
STEPS IN USING A WEDGE PRISM

- **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.