AVERAGE STRENGTH AND RELATED PROPERTIES
OF FIVE FOREIGN WOODS TESTED AT THE
FOREST PRODUCTS LABORATORY

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Published in
Manufacturer's Section of
FURNITURE INDEX
March 1937
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Although the Forest Products Laboratory has not included in its regular program the testing of foreign woods, it has, in connection with various cooperative projects, obtained some first-hand data on the strength and related properties of a number of foreign species that are of current interest to the American trade and consumers. These data have been recently assembled in the accompanying table which is here published for the first time. The species included are mahogany, khaya, tanguile, prima vera, and Spanish cedar. Khaya is often referred to in the trade as "African mahogany"; tanguile as "Philippine mahogany"; and prima vera as "white mahogany."

It is the purpose of this article not only to present strength data on the foregoing five species but also to give a brief description of the material used in the tests, including place of growth, moisture condition, amount of material represented, number of tests, and the like.

The tests on foreign woods reported here, except for selection and matching of material, were made in accordance with the same standard procedure as employed on woods grown in the United States. As far as test procedure is concerned, therefore, the data are comparable with data on our native woods already published. The specimens tested were 2 by 2 inches in cross-section, the length depending on the kind of test. The testing procedure used at the Laboratory has been adopted as standard by the American Society for Testing Materials and published in the 1936 Standards of the Society. A detailed description of the test methods and explanation of terms used in the accompanying table will be found in U. S. Department of Agriculture Technical Bulletin 479, "Strength and Related Properties of Woods Grown in the United States." This bulletin may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 25¢, cash or money order.

Selection

The material for test was selected from random run of logs or sawed stock. The identification of all the material as to genus or species...
species was verified microscopically at the Forest Products Laboratory prior to testing.

Description of Material Tested

**Mahogany (Swietenia sp.)**
from Central America

The data on mahogany (Swietenia sp.) from Central America are based on tests of two shipments of material. One shipment consisted of twenty 2-1/2 by 2-1/2 by 40-inch sticks, ten each from British Honduras and Nicaragua. This shipment provided material for 197 tests, divided as follows:

<table>
<thead>
<tr>
<th>Origin</th>
<th>Number of Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Green</td>
</tr>
<tr>
<td>British Honduras</td>
<td>80</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>79</td>
</tr>
</tbody>
</table>

The other shipment included seven butt logs of Central American mahogany (Swietenia sp.), which varied from 23 to 34 inches in butt diameter, and 14 to 16 feet in length. This material supplied 154 tests in the green and 109 tests in the air-dry condition. Since the number of trees represented by the material from British Honduras and Nicaragua was unknown, these two lots were each given a weight of 1 and the material from the log shipment a weight of 5 in obtaining the total or weighted average for clear 2 by 2-inch Central American mahogany.

**Mahogany (Swietenia mahagoni)**
from Cuba

This material was unseasoned when received at the Forest Products Laboratory and consisted of two 2-1/2 by 2-1/2 by 40-inch sticks from each of five different logs. Part of the material was dressed to 2 by 2 inches in cross-section and tested green, and the rest was allowed to air season before dressing and testing. A total of 66 tests in the green and 18 tests in the air-dry condition was made.

**Khaya (Khaya sp.)** from Africa
near Grand Bassam, Ivory Coast

The khaya tested consisted of two shipments, one comprising two 2-1/2 by 2-1/2 by 40-inch sticks from each of five different logs and the other comprising five butt logs of khaya varying from 28 to 38-1/2 inches.
in butt diameter and from 16 feet 2 inches to 16 feet 8 inches in length. The first shipment furnished material for 82 tests on green and 17 tests on air-dry specimens, and the second shipment furnished material for 110 tests on green and 36 tests on air-dry specimens. Although the khaya of the smaller shipment represented five different logs, the number of tests was so limited that this shipment was given only a weight of 1. The larger shipment was given a weight of 5 in obtaining the weighted average for this species.

Tanguile (Shorea polysperma) from the Philippine Islands

The data on tanguile were based on tests of two lots of material, one consisting of about 1,000 board feet of 2-inch stock and the other consisting of 40 pieces 2-1/8 inches square by 30 inches long. The first lot supplied 1-3/4 by 1-3/4-inch specimens for 339 tests, and the second lot 2 by 2-inch specimens for 157 tests, in the air-dry condition.

Prima vera (Tabebuia donnell-smithii) from Honduras

The prima vera tested also consisted of two lots of material, one comprising ten 2-1/2 by 2-1/2 by 40-inch sticks in the green condition as received, and the other comprising 670 board feet of 2-inch stock in the air-dry condition. The first lot supplied material for 72 tests in the green and 17 tests in the air-dry condition; while the second lot supplied material for 169 tests in the air-dry condition. Since the second lot supplied the greater number of tests it was given a weight of 3 as against a weight of 1 for the first lot in obtaining a weighted average for air-dry prima vera based on a 2 by 2-inch specimen size. The test values for green material were adjusted by multiplying the combined values for air-dry material of both lots by the ratio of original green values to original air-dry values of the shipment of 40-inch sticks at 12 percent moisture content.

Spanish Cedar (Cedrela sp.) from Nicaragua

The Spanish cedar tested consisted of ten 2-1/2 by 2-1/2 by 40-inch sticks which supplied specimens for 61 tests on green and 19 tests on air-dry material, 2 by 2 inches in cross-section.

Limitations of Data

The data on foreign woods as summarized in the accompanying table are in a form somewhat similar to that used in presenting data on
native American woods. Because of the relatively small number of tests and the lack of information as to whether or not the material is representative of the species, the results although the best available, should be used with these limitations in mind in connection with any comparisons made. It is probable, of course, that the averages would be modified in some instances by further tests on more representative material.
<table>
<thead>
<tr>
<th>Species</th>
<th>Place of growth</th>
<th>Moisture Tests</th>
<th>Specific gravity, oven-dry</th>
<th>Shrinkage from green to oven-dry condition, based on dimension when green</th>
<th>Stress at maximum load of test specimen</th>
<th>Compression perpendicular to grain</th>
<th>Conversion of moisture to grain, water at proportional limit</th>
<th>Work to maximum load of green specimen</th>
<th>Pressure of rotaturity</th>
<th>Modulus of elasticity</th>
<th>Modulus of rupture</th>
<th>Work to maximum load of green specimen</th>
<th>Density (lb. per cu. ft.)</th>
<th>Shear strength strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahogany (Swietenia macrophylla)</td>
<td>Central</td>
<td>Green</td>
<td>315</td>
<td>58</td>
<td>0.45</td>
<td>0.50</td>
<td>7.7</td>
<td>3.5</td>
<td>2.6</td>
<td>6,100</td>
<td>9,200</td>
<td>1,200</td>
<td>10,2</td>
<td>500</td>
</tr>
<tr>
<td>Mahogany (Swietenia macrophylla)</td>
<td>...</td>
<td>...</td>
<td>167</td>
<td>12</td>
<td>0.45</td>
<td>0.50</td>
<td>7.7</td>
<td>3.5</td>
<td>2.6</td>
<td>6,100</td>
<td>9,200</td>
<td>1,200</td>
<td>10,2</td>
<td>500</td>
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<tr>
<td>Mahogany (Swietenia macrophylla)</td>
<td>Dibar</td>
<td>Air-dry</td>
<td>167</td>
<td>12</td>
<td>0.45</td>
<td>0.50</td>
<td>7.7</td>
<td>3.5</td>
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</tbody>
</table>

1 About two-thirds of the samples were 1-1/2 by 1-1/2 inches in cross-section.
2 Total number of trees tested is not given, nor is the test material obtained on other than log form and the exact number of trees is unknown.
3 The values for air-dry material were adjusted to correspond to 12 percent moisture content. An intersection point of 12 percent moisture content and the actual content at which, at the age of the test, is given the strength properties begin to change. It is an empirically determined moisture content that corresponds closely to the fiber-saturating point.
4 Often referred to in the trade as "African mahogany.
5 Often referred to in the trade as "Philippine mahogany." Data obtained on air-dry mass only.
6 Often referred to in the trade as "Wash mahogany.
7 The shrinkage for tanganile and the amount of shrinkage of prism were estimated by adding together the shrinkage from the air-dry, to the oven-dry condition and the swelling from the air-dry to the saturated condition.