Determination of "Brinell" hardness of Tonewood

**Note in explanation**

Searching for an explanation for the higher measured hardness of wood using a dynamic method, wheras there was no difference for the metals tested, further tests both static and dynamic, were conducted on polystyrene foam blocks 45 mm thick. The thickness was such that there was no 'thickness effect' on the results.

A polished steel ball 30 mm dia. weighing 110 g, was loaded directly with a weight of 6.364 kg to determine the static "Brinell" hardness in kg/mm^2 which is the weight supported by the projected area of the impression made by the ball in the polystyrene. Carbon copy paper was used on a flat backing to delineate the outline of the impression.

The dynamic test was done by dropping the steel ball from a height of 0.5 and 1.0 m resp. onto the surface of the polystyrene block and from the energy transferred in making the depression, the effective mass and the projected area gave a measure of the dynamic hardness. The table below summarises the values obtained.

"Brinell" hardness in kg/mm^2

| Static | Dynamic | |
|---|---|---|
| | 0.5m | 1.0m |
| 0.020 | 0.030 | 0.033 |

It is thought the cellular nature of wood (and polystyrene) accounts for the difference in hardness values measured.

Calculation of hardness values:

Static hardness HB = (6.474 x 4)/(3.142 x 20^2) = 0.020 kg/mm^2

Dynamic hardness: Steel ball 30 mm dia.; 110 g wt.

Equations used:

v^2 = u^2 + 2as where u = 0 = initial velocity
v = 2gh = final velocity
h = height of fall
g = 9.81 m/s^2

Fs = 1/2(mv^2) where F = force of impact
s = depth of penetration
m = mass of ball

s = R - (R^2 - r^2)^1/2 R = radius of ball
r = radius of impression

For a height of drop of 1 m and a measured diameter of impression of 25 mm.

s = 15 - (15^2 - 12.5^2)^1/2
= 6.71 mm

$$F = (0.110 \times 19.62)/(2 \times 6.71 \times 10^{-3})$$
$$= 160.9 \text{ N}$$

$F = Mg$ where $M$ = effective mass

$$M = 160.9/9.81$$
$$= 16.4 \text{ kg}$$

Thus "Brinell" hardness $HB = (16.4 \times 4)/(3.142 \times 25^2)$
$= 0.033 \text{ kg/mm}^2$