STRENGTH PROPERTIES OF WOOD

The phrase "Strength of Timber" is vague and almost meaningless unless it refers to a definite kind of strength.

The measure of the resistance by the timber to each kind of force determines the strength value of the timber for that particular force.

These strength values or mechanical properties vary according to the force involved, thus the force required to pull a straight grained piece of timber apart lengthways (tension parallel to the grain) is immensely greater than that required to crush it in the opposite direction (compression parallel to the grain).

The extent and kinds of load which the various parts of a structure will have to bear normally can be calculated.

The designing architect or engineer can provide for them if he knows the strength properties of the particular timber he intends to use for special purposes.

When forces act on a solid body, they change its shape to a greater or lesser degree and there are induced to the body, internal resisting forces which balance the applied forces.

1. STRESS The internal resisting force induced by the load.

2. STRAIN The deformation or change of shape of the body resulting from the stress.

The forces acting on the timber in normal use are referred to as the load and can be applied in a variety of ways.

1. Static Loading.

   Example, the bearers in a stand carrying a tank of water.

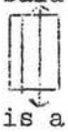
2. Impact Loading.

   When the load is applied suddenly causing a shock or jar. (Sleepers)

3. Wind Loading.

   Such as the long poles (up to 70') used by the S.E.C. in exposed position. Variable Load.

When the applied forces tned to increase the length of a body, it is said to be subject to "tension parallel to the grain"

 or perpendicular to the grain  if the grain is sloping, it is a combination of both  when the forces tend to decrease the length, it is called "Compressive Stress", and can also be parallel to the grain or perpendicular to the grain.
Example, Parallel, House Stumps.
Example, Perpendicular, Floor bearers, when they rest on stumps.

Shear or Shearing Stress

Is set up when the force applied tends to cause one part of a body to slip over another.

This is more likely to occur parallel to the grain than across the grain, our hardwoods will shear most readily along the growth rings.

LIMIT OF PROPORTIONALITY, OR ELASTIC LIMIT

The point at which the STRAIN is directly proportional to the STRESS, beyond this point, the strain increases faster than the stress.

If the stress in a body is below the fibre stress at elastic limit, the body will return to its normal shape or position on the removal of the stress.

If the stress exceeds the fibre stress at elastic limit, the body will not return to normal, this is called "Permanent Set".

Modulus of Elasticity

Is a measure of the stiffness, or resistance to bending, the higher the M. of E. the less the deflection.

In a bent beam, there is compression in the top face and tension in the bottom face with a neutral plan in the centre.

Shearing stresses are set up parallel to the long axis, and are at their maximum along the neutral plane.

As the load increases, so do the tensile, compressive and shearing forces, until the beam fails, usually on the compression face followed by the tension face.

Modulous of Rupture

A measure of the maximum stress at the point of failure, is a direct measure of the strength of wood in bending. The bending strength of a rectangular beam varies inversely as its span, if the span is doubled, the strength is reduced by half, if trebled, by two thirds.

The deflection of a beam varies as the cube of the span, if the span is doubled, deflection is increased 8 times, trebled it is increased 27 times.

Other things being constant, the bending strength of a beam varies directly as its width, if width is doubled, strength is doubled.

Again, other things being equal, bending strength varies as the square of the depth, doubling the depth increases the strength four times, trebling increases strength 9 times.

Deflection varies inversely as the cube of the depth, doubling depth, reduces deflection 8 times, trebling 27 times.

Relation of depth to width if from 2 to 2½ times is about the best compromise where no lateral support is available.

A beam can carry twice the load evenly distributed over its length, than if it is concentrated at the span centre.

TOUGHNESS is the measure of ability to resist shocks and blows and is synonymous with impact strength.

HARDNESS refers to resistance to indentation.

BRITTLE wood is said to be brittle if it breaks easily across the grain, most heart core is brittle.

Ultimate laboratory strength figures are not used in design stresses, these use "Working Stresses", a safety factor of 5 of 1/5 of the laboratory figures.