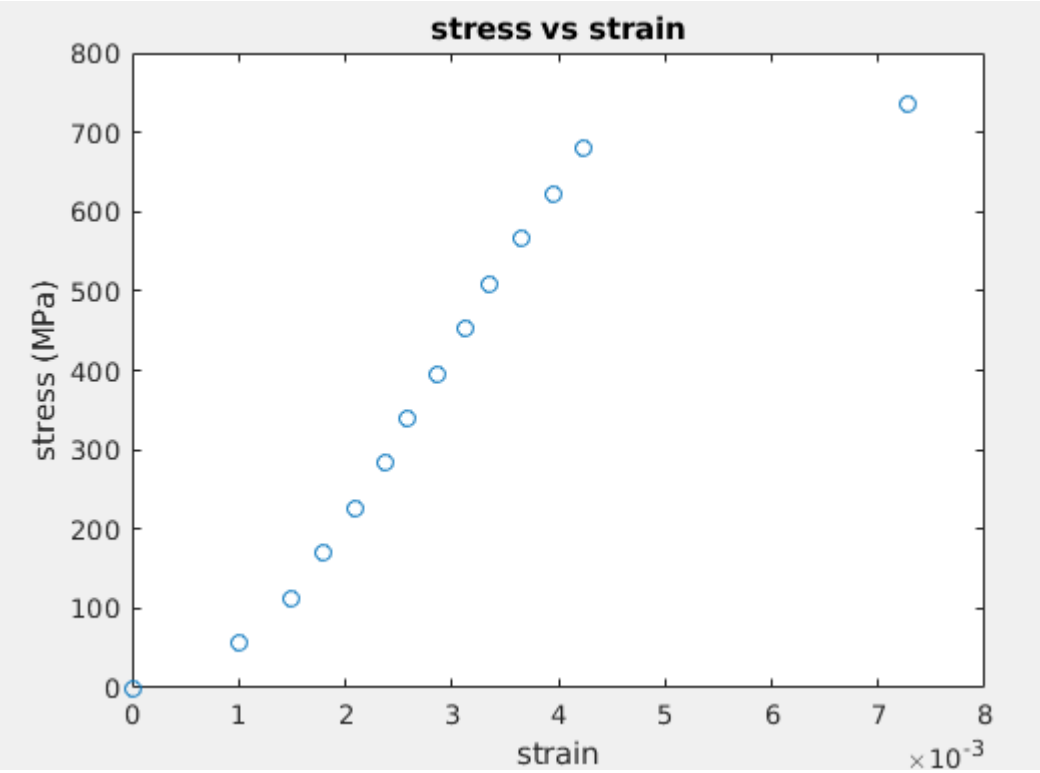
1.

a. Stress(GPa) Strain

0	0
0.0566	0.0010
0.1132	0.0015
0.1698	0.0018
0.2264	0.0021
0.2829	0.0024
0.3395	0.0026
0.3961	0.0029
0.4527	0.0031
0.5093	0.0034
0.5659	0.0037
0.6225	0.0040
0.6791	0.0042
0.7356	0.0073

b.



c. 176.72 mm2

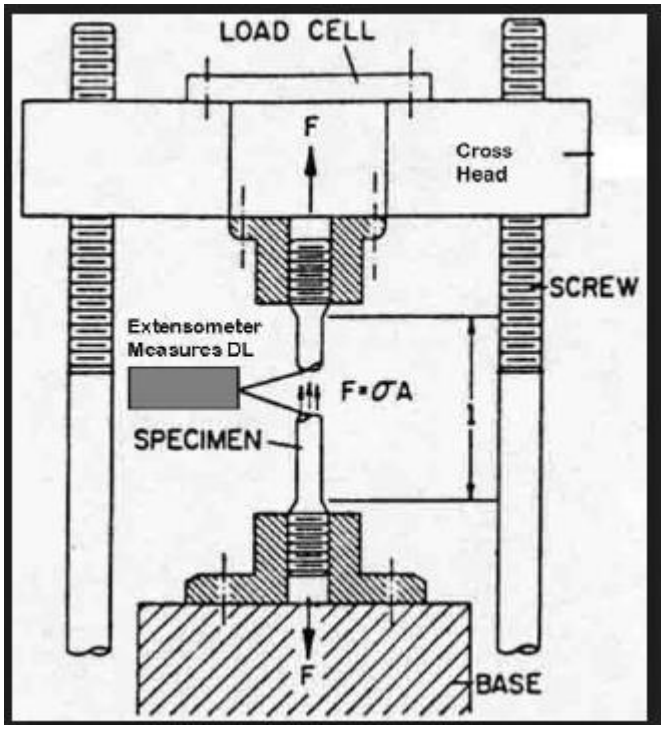
d. Young's modulus is defined only in the linear region and linear regression gives the value 210.8 GPa

e. Yield strength is appoximately 735 MPa

f.

g. Falls in the range of Steel

2.

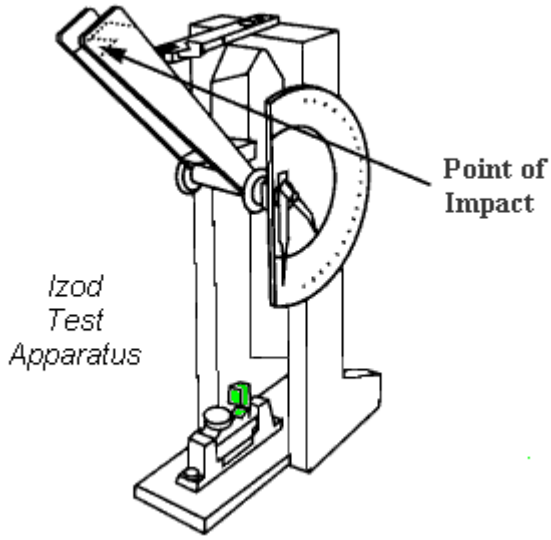


The universal testing machine has a screw driver system which can deliver high force with accurate displacement. A specimen with standardised dimension and shape is fixed to the machine and the machine is set for elongation. The displacement is increased linearly as opposed to the load, which is the only way decreasing of stress can also be measured. As the test progresses, necking will be observed and then failure will occur. The experiment stops here. From the obtained values and the pre known values, the stress-strain curve can be plotted

3.

a. Specimen is 3 is a soft material but with relatively high toughness. Softness is essential for the conformability and the ease of installation. This is ideal for IC engine bearings
b. Specimen 4 is among the hardest and is the toughest in the given specimens. The crash barriers need to absorb maximum energy and needs to be hard

c.



The sample is prepared to be broken. An arm is kept at a recorded height and then let loose to rotate and break the specimen. After hitting the specimen, the arm rebounds to a maximum height which is also recorded. The difference in the energy at the two states is the energy absorbed

4.

a. 2 planes (either side of the clamp) are being sheared
b. Shear force at each plane = 0.5 * F
$0.5 * F/A = 240\ N/mm^2$ where A is area
From this F can be obtained to be 18.85 KN

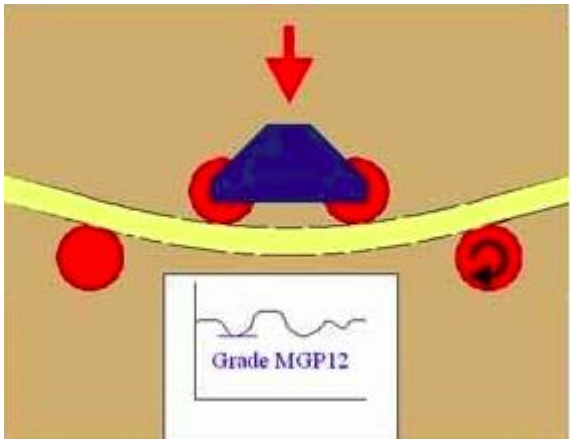
5.

a. The inside of the mould should be coated/moistened to reduce the effects of different surface friction. The residue left before the mould is lifted should be removed
b. True slump, zero slump, collapsed slump and shear slump respectively

6.

a.
   i. The curing period should be strictly maintained
   ii. Make sure that no shocks occur during testing and this will produce large errors
   iii. Ensure minimum foreign objects for maximum accuracy
   iv. Ensure correct dimensions to the appropriate tolerances
b. The three cylinders, apart from serving as replacements in case of fault experiments (which would result in another long period of preparation), can be used to check errors
c.
   i. 31.2 MN/m2
   ii. 27.5 MN/m2
   iii. The characteristic strength is much below than the required grade which is more closer to the mean of the distribution. This means that more than desired fraction of the systems are likely to fail

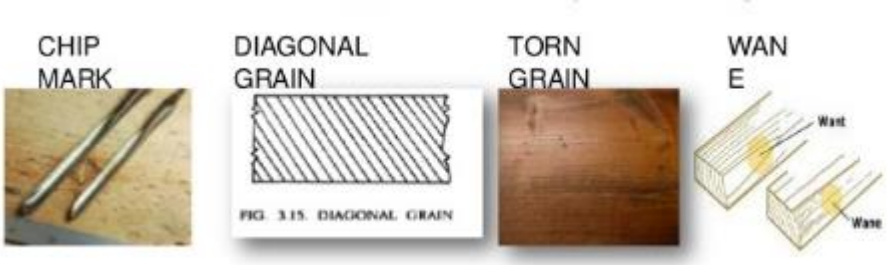
7.



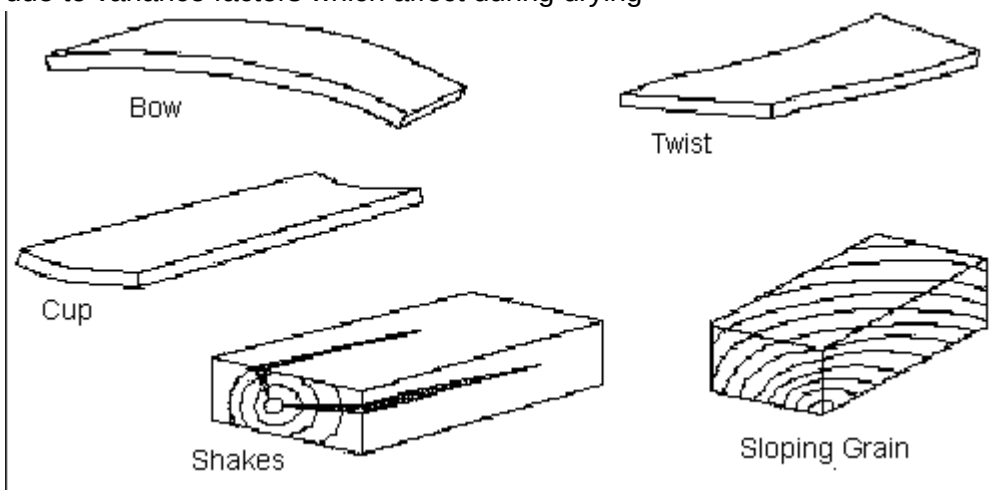
A simple test is to apply 4 point loading and with a relation between the observed deviation,stiffness and strength, a grade can assigned. It is important to carry out visual inspection to check the properties at the ends of each piece as the machines are unable to do so

8.

a. Defective conversion



b. Defects due to fungi: High moisture content promotes fungi growth causing various types of rots and stains
c. Defects due to insects: Beetles, marine borers and termites are the primary insects which are primary insects in this category. Beetles causes the timber to be converted to fine particles, marine borers result in loss of color and strength while termites can eat away the timber
d. Defects due to natural elements: It can be classified again into two, before processing and after processing. Knots and shakes are results of environmental conditions of the tree while other effects like bow, twist etc are due to variance factors which affect during drying



9. Bitumen sample needs to be heated up to sufficient temperature (< 90 C) where it is fluid. Make sure by stirring that no air holes remain.For this experiment, a calibrated viscometer can be used. The basic principle involves measuring the time it takes to flow across two graduated points through the viscometer. The viscosity can be calculated by multiplies the calibration constant with time
   The lower the viscosity, the better. When bitumen is sufficiently heated, the fluid form will be used to pave the road after which once it sets, the bitumen needs to be rigid. This warrants a need for viscosity testing
10.
    a. First, record the mass of the density bottle. Then, bitumen needs to be heated to pouring temperature and then poured to the density bottle. Difference in mass gives the mass of the bitumen in the specific volume. Divide mass by volume to get density
    b. Bitumen is soluble in trichloroethylene. This property can be used to check the purity of bitumen. First mix the sample with trichloroethylene and then pass this through a filter. Any thing that remains is impurity and can be quantified
11. The NDT in the image is magnetic particle inspection. Current when passed through a metal can produce magnetic fields. Magnetic inspection works on the principle that magnetic flux leak through in subsurface discontinuity. This can be detected by applying ferrous particles and observing these particles
12. The principle can be stated as “the rebound of an elastic mass depends on the hardness of the surface against which its mass strikes”.
    Precautions: Right angle needs to be ensured and the surface should be smooth. Horizontal orientation is ideal to reduce errors due to gravity