3.4 CREEP TEST

CREEP RESISTANCE:

It is the resistance offered by the material for its continuous deformation under steady load.

Creep **(sometimes called** cold flow**) is the tendency of a solid material to move slowly or deform permanently under the influence of persistent mechanical stresses. It can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material. Creep is more severe in materials that are subjected to heat for long periods and generally increases as they near their melting point.**

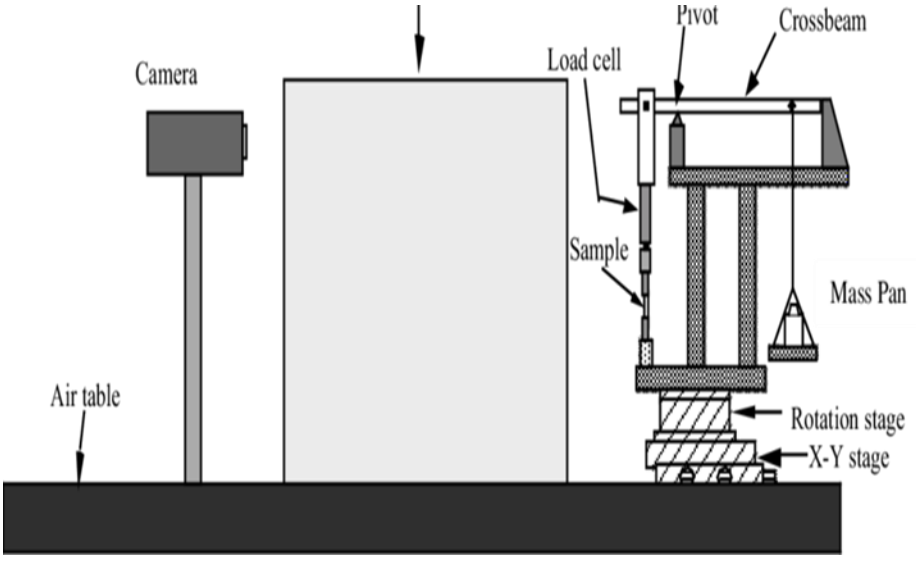

Fig 3.4.1 Creep test machine

Method for determining creep or stress relaxation behaviour. To determine creep properties, material is subjected to prolonged constant tension or compression loading at constant temperature. Deformation is recorded at specified time intervals and a creep vs time diagram is plotted. Slope of curve at any point is creep rate. If failure occurs, it terminates test and time for rupture is recorded. If specimen does not fracture within test period, creep recovery may be measured. To determine stress relaxation of material, specimen is deformed a given amount and decrease in stress over prolonged period of exposure at constant temperature is recorded Viscoplasticity is a theory in continuum mechanics that describes the rate-dependent inelastic behaviour of solids. Rate-dependence in this context means that the deformation of the material depends on the rate at which loads are applied. The inelastic behaviour that is the subject of viscoplasticity is plastic deformation which means that the material undergoes unrecoverable deformations when a load level is reached. Rate-dependent plasticity is important for transient plasticity calculations. The main difference between rate- independent plastic and viscoplastic material models is that the later exhibit not only permanent deformations after the application of loads but continue to undergo a creep flow as a function of time under the influence of the applied load.

The yield surface is usually assumed not to be rate-dependent in such models. An alternative approach is to add a strain rate dependence to the yield stress and use the techniques of rate independent plasticity to calculate the response of a material. For metals and alloys, viscoplasticity is the macroscopic behaviour

caused by a mechanism linked to the movement of dislocations in grains, with superposed effects of inter-crystalline gliding. The mechanism usually becomes dominant at temperatures greater than approximately one third of the absolute melting temperature. However, certain alloys exhibit viscoplasticity at room temperature (300K). For polymers, wood, and bitumen, the theory of viscoplasticity is required to describe behaviour beyond the limit of elasticity or viscoelasticity.

In general, viscoplasticity theories are useful in areas such as the calculation of permanent deformations, the prediction of the plastic collapse of structures, the investigation of stability, crash simulations, systems exposed to high temperatures such as turbines in engines, e.g. a power plant, dynamic problem s and systems exposed to high strain rates, deals of rate-independent plasticity that have a rate-dependent yield stress.

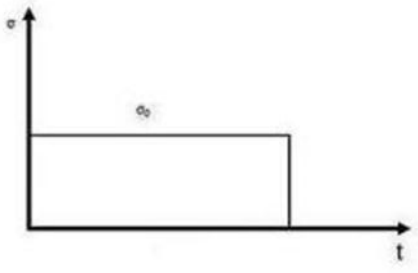

Figure 3a. Creep test

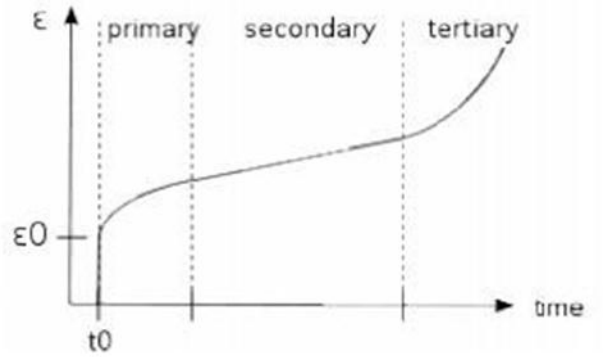

Figure 3b. Strain as a function of time in a creep test.

Creep is the tendency of a solid material to move slowly or deform permanently under constant stresses. Creep tests measure the strain response due to a constant stress as shown in Figure 3a. The classical creep curve represents the evolution of strain as a function of time in a material subjected to uniaxial stress at a constant temperature. The creep test, for instance, is performed by applying a constant force/stress and analyzing the strain response of the system. In general as shown in figure 3b, this curve usually shows three phases or periods of behaviour. A primary creep stage, also known as transient creep, is the starting stage during which hardening of the material leads to a decrease in the rate of flow which is initially very high.