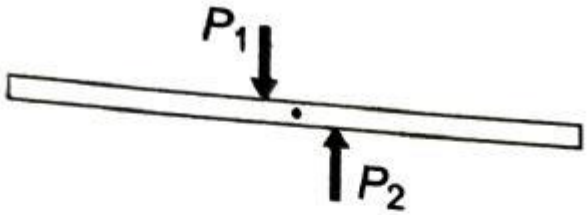
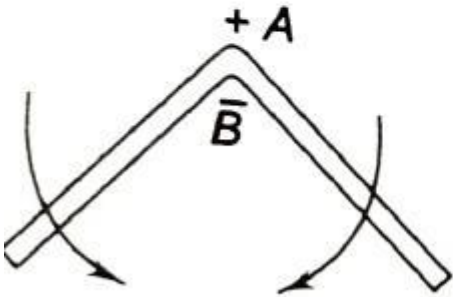
FATIGUE

- When a material is subjected to repeated stresses (repeated loads/alternating loads), it fails at a stress far below the yield point stress. Such type of failure is referred to as fatigue.
- The failure is caused by means of a progressive crack formation which are usually fine and microscopic size
- Fatigue failure is always brittle and catastrophic in nature with no visible warning prior to failure .
- It is observed that about 80 % of failures of mechanical components are due to fatigue failure resulting from fluctuating stresses.
- The decreased resistance of the materials to cyclic stresses is the main characteristics of fatigue failure .
- Fatigue failure is defined as the time delayed fracture under cyclic loading
- Transmission shafts ,connecting rods ,gears ,vehicle Suspension springs, ball bearings are subjected to fatigue failure.

  - ✓ Automobiles in Mechanical Engineering
  - ✓ Bridges in Civil Engineering
  - ✓ Aircrafts in Aeronautical Enginnering
  - ✓ Ship hull in Marine Engineering
  - ✓ Pressure vessels in Chemical Engineering
  - ✓ Tractors involving Agricultural Engineering



(a)



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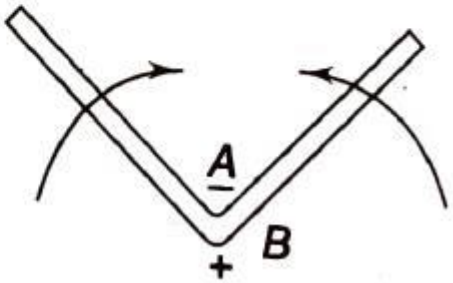
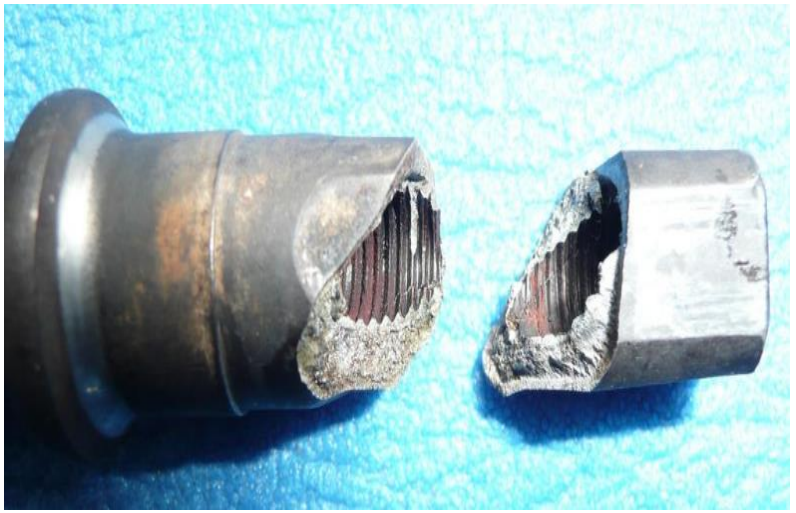


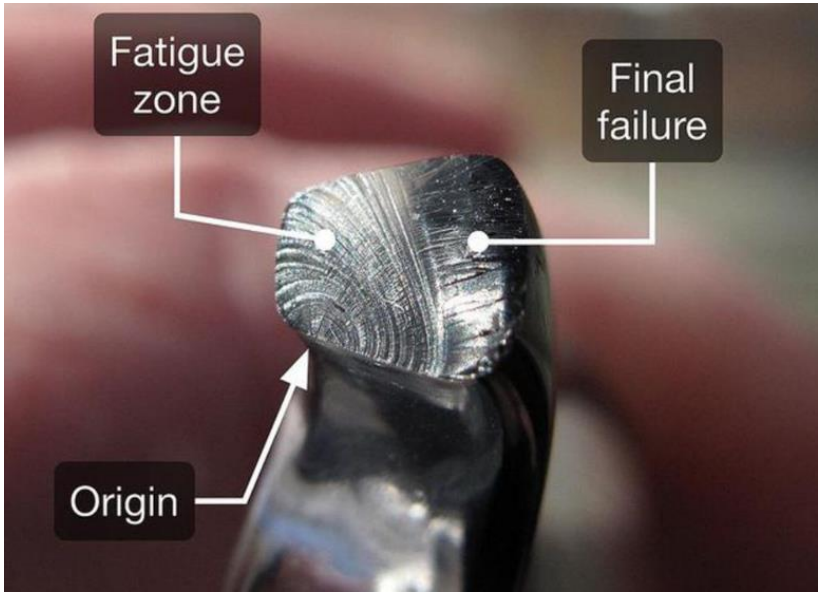
(c)

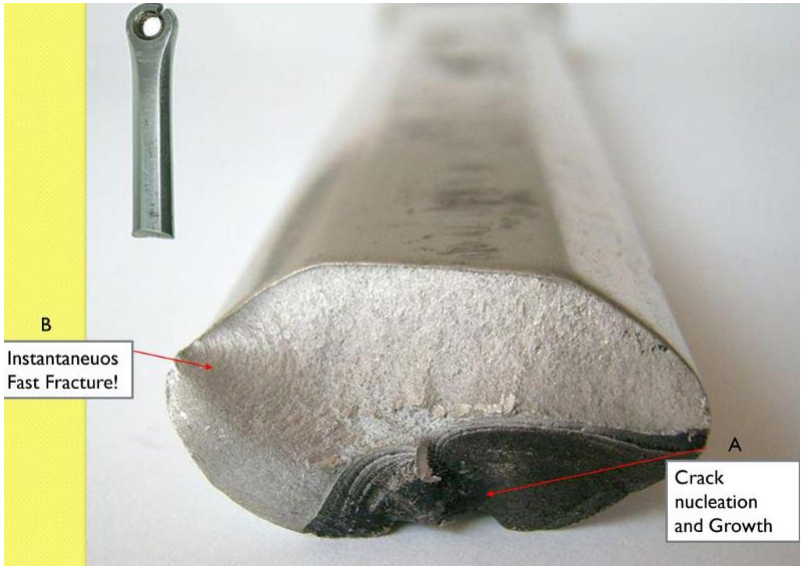
FACTORS TO BE CONSIDERED TO AVOID FATIGUE FAILURE

- Variation in size of the component should be as gradual as possible. Holes , notches and other stress raisers should be avoided.
- Proper stress deconcentrators such as fillets and notches should be provided wherever necessary.
- Components should be protected from corrosion.
- Provide smooth finish on the outer surface of the component ,thereby increasing fatigue life.
- Materials with high fatigue strength should be selected.
- Residual compressive stresses over the parts surface increases its fatigue strength


Break
End of keyway




Fatigue zone
Final failure
Origin

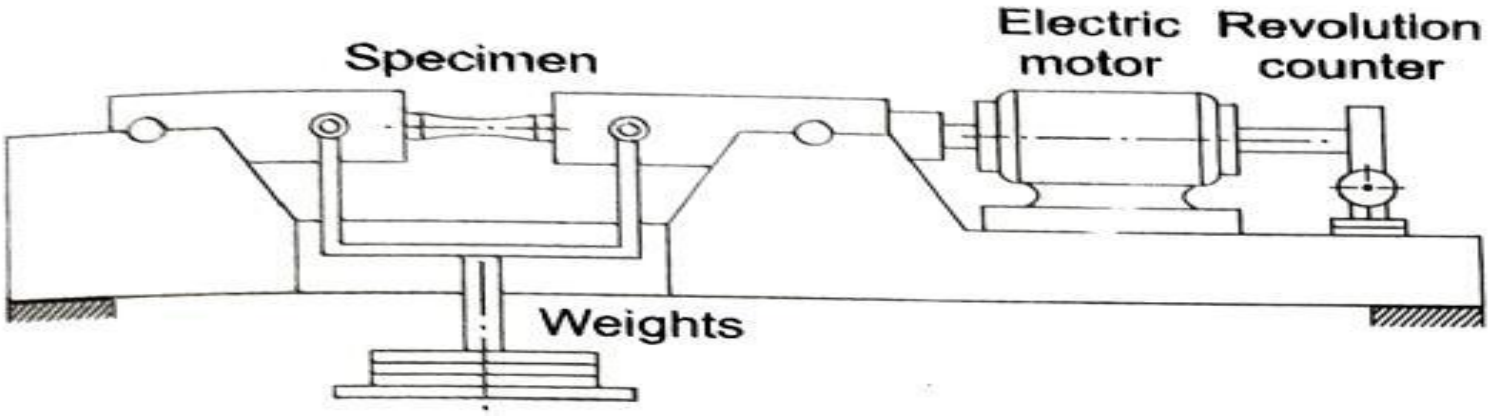

B
Instantaneuos Fast Fracture!
A
Crack nucleation and Growth

Endurance Limit and Endurance Strength

- The fatigue or endurance limit of a material is defined as the maximum amplitude of completely reversed stress that the standard specimen can sustain for an unlimited number of cycles without fatigue failure.

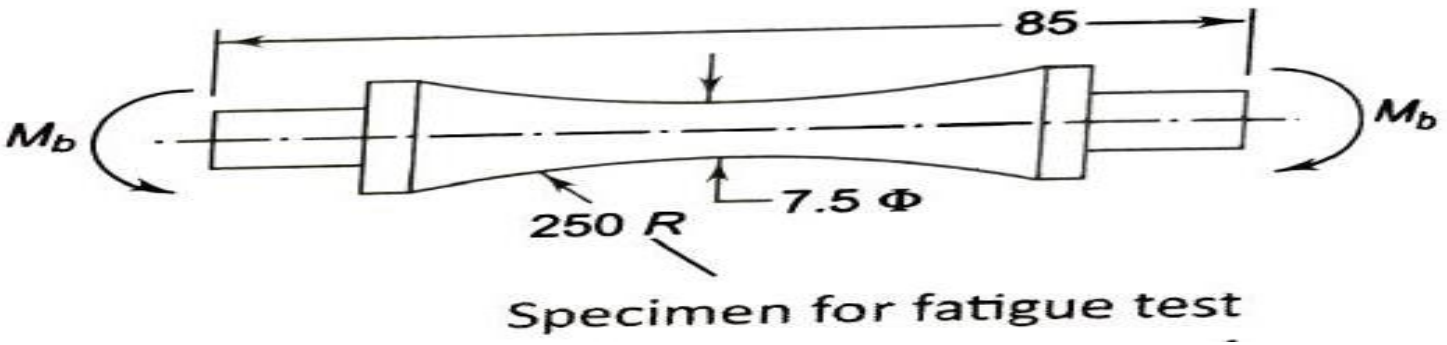
- It is the strength of a material to resist the propagation of cracks under stress reversals.

Endurance Limit Is the stress value below which an infinite number of cycles will not cause failure



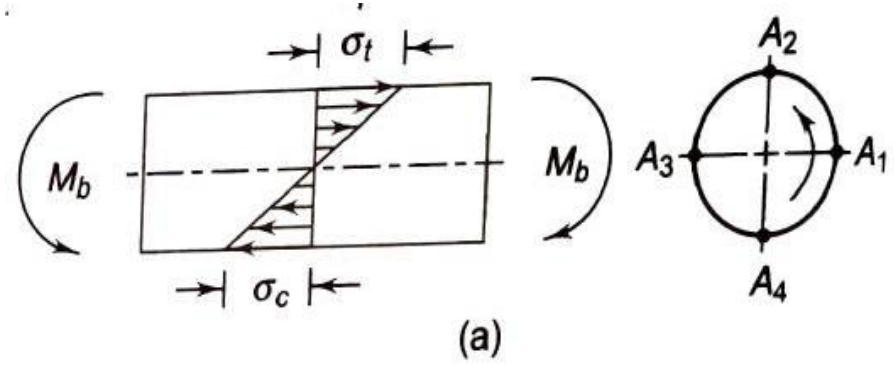
Rotating beam fatigue testing machine

- In order to study the effect of fatigue of a material, a rotating mirror beam method is used called R.R. Moore rotating beam machine
- In this method, a standard specimen machined and polished as shown in Fig.
- The final polishing is done in axial direction in order to avoid circumferential scratches

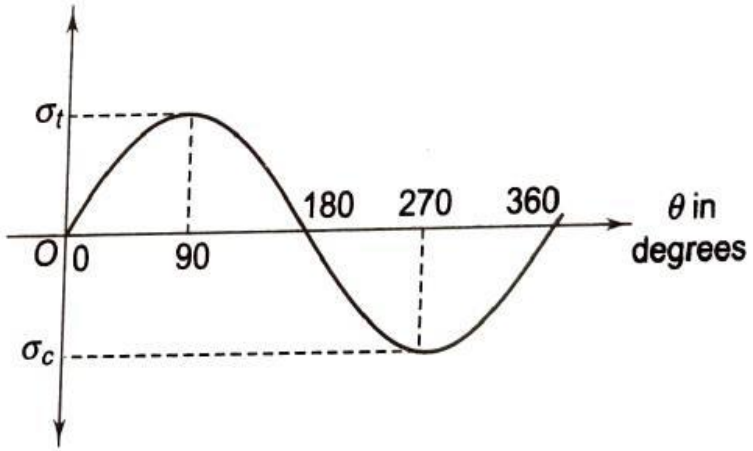


Specimen for fatigue test

Specimen is rotated in a fatigue testing machine while the specimen is loaded in bending.
As the specimen rotates, the bending stress at the upper fibers varies from maximum compressive to maximum tensile while the bending stress at the lower fibers varies from maximum tensile to maximum compressive.
In other words, the specimen is subjected to a completely reversed stress cycle .The number of revolutions before the appearance of the first fatigue crack is recoded on a revolution counter. In each test. Two readings are taken viz. stress amplitude S and umber of stress cycles (N). These readings are used as two co-ordinates for plotting a point on S-N diagram. This point is called failure point. To determine the endurance limit of a material, a number of tests are to be carried out.

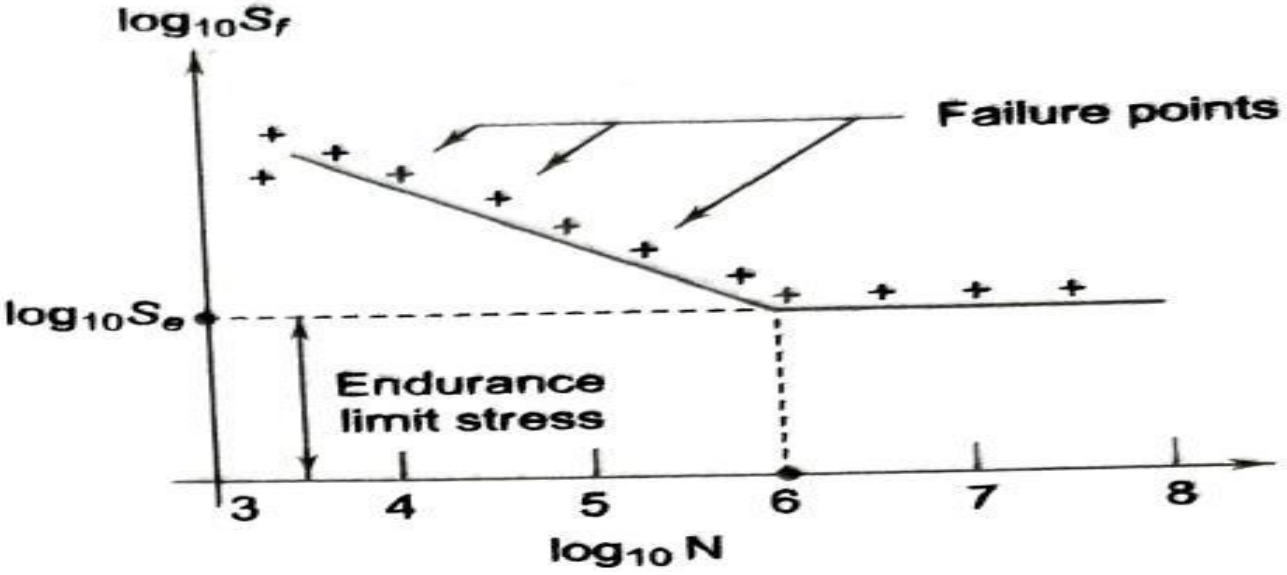


(a)



S-N curve

The results of these tests are plotted by means of a S-N curve. The S-N curve is the graphical representation of stress amplitude (S versus the number of stress cycles (N) before the fatigue failure on a log-log graph paper



The endurance limit, is not exactly a property of material like ultimate tensile strength. It is affected by factors such as the size of the component, shape of component, the surface finish, temperature, and the notch sensitivity of the material