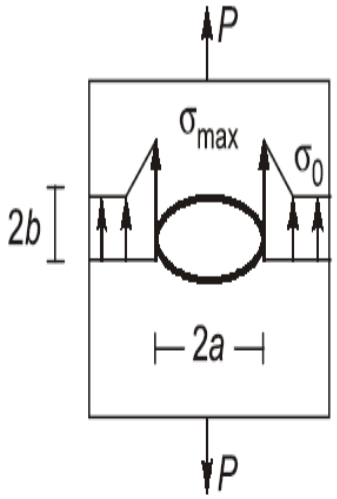
Stress Concentration Near an Elliptical Hole

The stress at the joints away from the hole is practically uniform and the maximum stress will be induced at the edge of the hole.

$$\sigma_{max} = \sigma\left(1+\frac{2a}{b}\right)$$

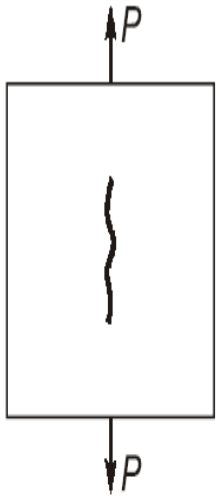


$$k_t = \frac{\sigma_{max}}{\sigma_0} = \left(1 + \frac{2a}{b}\right)$$

For circular hole $a = b$

$k_t = 3$

(a) Elliptical Hole

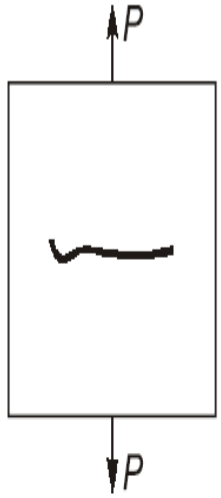


$a = 0$

$$k_t = \frac{\sigma_{max}}{\sigma_0} = 1$$

$\sigma_{max} = \sigma_0$

(b) Crack parallel to load

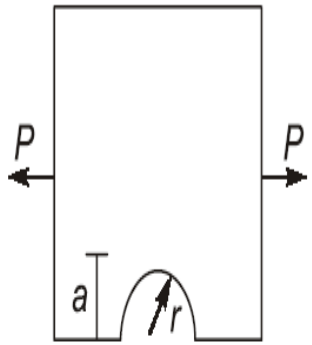


$b = 0$

$$k_t = \frac{\sigma_{max}}{\sigma_0} = \infty$$

$\sigma_{max} = \infty$

(c) Crack perpendicular to load



a - depth of notch

r - radius of notch

$$k_t = \frac{\sigma_{max}}{\sigma_0} = 1 + \frac{2a}{r}$$

(d) Circular Notch

Fluctuating Stress

It is observed that about 80% of failure of mechanical components are due to fatigue failure .

There are three types of cyclic stress.

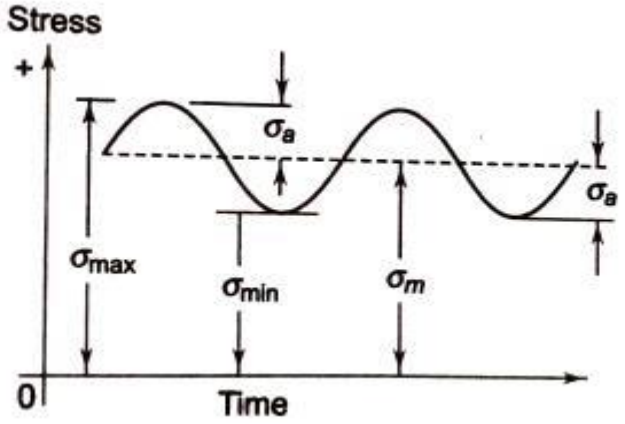
1.Fluctuating or alternating stress

2.Repeated stress

3.Reversed stress

Fluctuating Stress

- Varies in sinusoidal manner with respect to time
- It Fluctuate between two limits max. and min.
- The stress can be Tensile or Compressive or Partially Tensile and Compressive



$$Mean\ stress:\ \sigma_m = \frac{\sigma_{max} + \sigma_{min}}{2}$$

$$alternative\ or\ variable\ stress \sigma_v = \frac{\sigma_{max} - \sigma_{min}}{2}$$

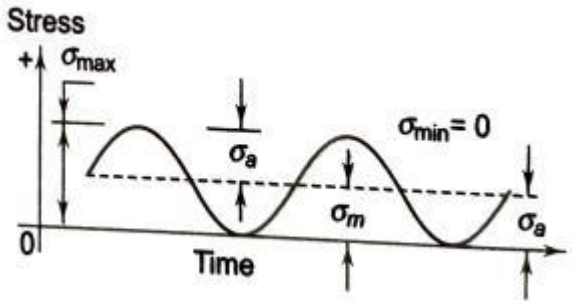
Repeated stress:
Varies in sinusoidal
max. value
The half portion of
stress

Mean stress,

$$\sigma_m = \frac{\sigma_{max}}{2}$$

Reversed stress component or alternating or variable stress,

$$\sigma_v = \frac{\sigma_{max}}{2}$$



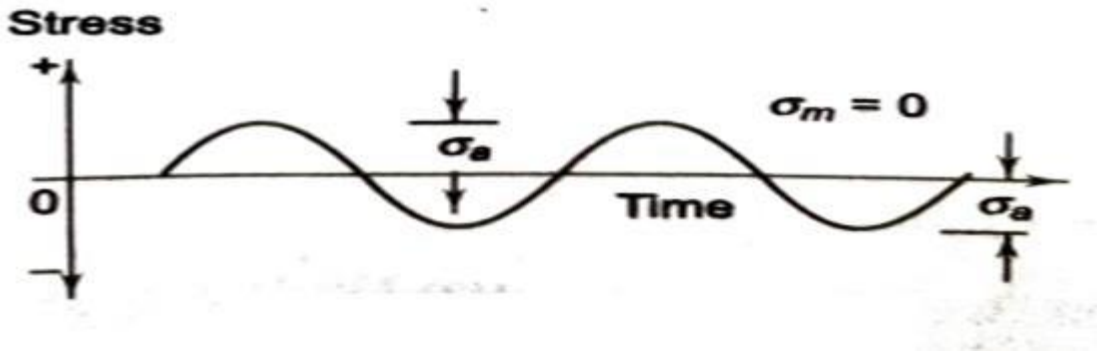
$$\sigma_{min} = 0$$

$$Mean\ stress: \sigma_m = \frac{\sigma_{max}}{2}$$

$$Reversed\ or\ alternative\ or\ variable\ stress \sigma_v = \frac{\sigma_{max}}{2}$$

Cyclic or Reversed stress

Completely reversal from tension to compression between two values

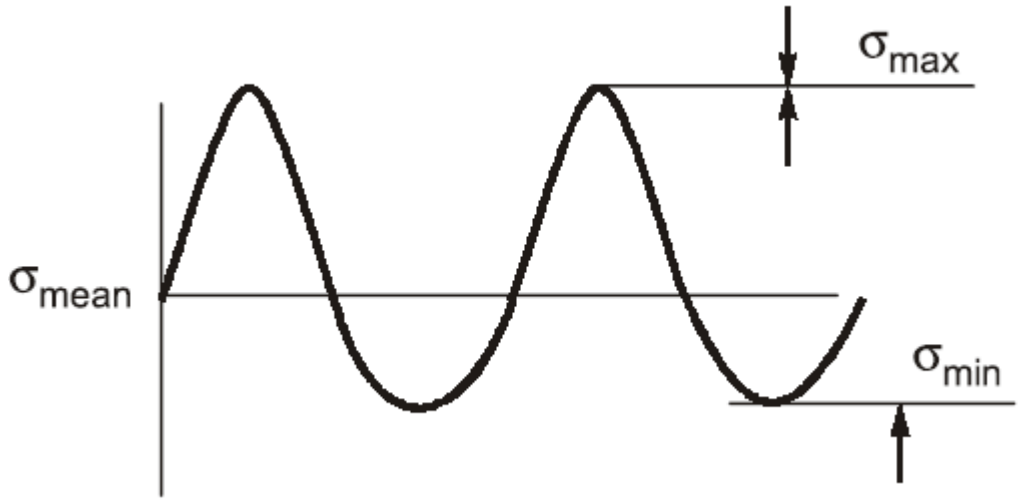


$$Mean\ stress:\ \sigma_m = 0$$

$$Reversed\ or\ alternative\ or\ variable\ stress \sigma_v = \frac{\sigma_{max} - \sigma_{min}}{2}$$

Alternating Fatigue Stress

The stresses which vary from a minimum value to a maximum value of the opposite nature (i.e. from a certain minimum compressive to a certain maximum tensile or from a minimum tensile to a maximum compressive) are called alternating fatigue stresses.



• Means stress,	$\sigma_m = \frac{\sigma_{max} + \sigma_{min}}{2}$
• Stress amplitude,	$\sigma_a = \frac{\sigma_{max} - \sigma_{min}}{2}$
• Stress range,	$\sigma_r = \sigma_{max} - \sigma_{min}$
• Stress ratio,	$R = \frac{\sigma_{max}}{\sigma_{min}}$
• Amplitude ratio,	$A = \frac{\sigma_a}{\sigma_m}$

here σ_{max} = Maximum stress value during complete cycle

σ_{min} = Minimum stress value during complete cycle