SNS COLLEGE OF TECHNOLOGY

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COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING

19CET204 – MECHANICS OF MATERIALS

II YEAR / IV SEMESTER

Unit 4: STATE OF STRESS IN THREE DIMENSION

Topic 1 : THEORIES OF FAILURE

PRINCIPAL PLANES AND PRINCIPAL STRESSES

PRINCIPAL PLANES

The plane in which the shear stress is zero is called principal planes

PRINCIPAL STRESS

The normal stress acting on the principal planes is called principal stress

VOLUMETRIC STRAIN

The ratio of change in volume to the original volume is known as volumetric strain.

$$\Sigma V = \frac{\Delta V}{V}$$

ΔV= Change in volume by original volume

V= original volume

PRINCIPAL THEORIES OF FAILURE

1. Maximum principal stress theory (Rankine's theory)
2. Maximum shear stress theory (St. Venant's theory)
3. Maximum principal strain theory (Tresca's and Guest theory)
4. Maximum strain energy theory (Von-Mires-Henky or Distortion theory)
5. Maximum distortion energy theory (Heigh's theory)
6. Mohr's theory

PRINCIPAL STRESS THEORY OR RANKINE'S THEORY

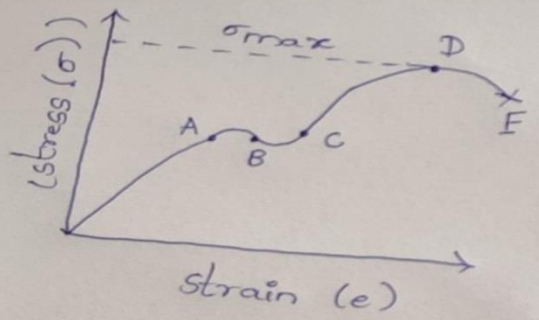
Maximum principal stress theory (Rankine's theory)

According to this theory , failure will occur when the maximum principal tensile stress in the complex state reaches the value of the maximum stress at the elastic limit in simple tension or the minimum principal stress reaches the elastic limit in simple compression.

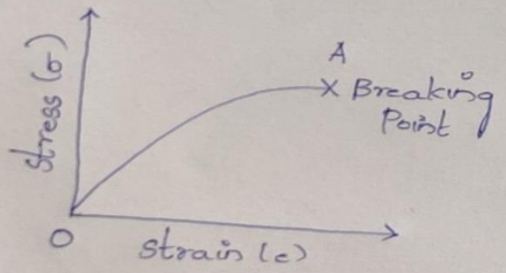
PRINCIPAL STRESS THEORY OR RANKINE'S THEORY

Maximum Principal stress theory:

It states that "The failure of a material or component will takes place when the maximum value of stress exceeds the Limiting Values of stress".



(Ductile Materials)



(Brittle Materials)

UNDERSTANDING THEORY OF FAILURE

https://youtu.be/xkbQnBAOFEg

MAXIMUM SHEAR STRESS THEORY OR ST.VENANT'S THEORY

Maximum shear stress theory.

It states that "the failure or yielding of component occurs when the working stress value reaches the limiting stress value in the Material."

$$\tau_{per} = \frac{\tau_{max}}{\text{Factor of Safety}}$$

$$\tau_{per} = \frac{\sigma_y}{2 \times FOS} \qquad \tau = \frac{\sigma_y}{2}$$

This is for Ductile Materials.

Thank you