Principal Stress

Objective:

- How to calculate principal stress at a point P ?
- At any point P there is always three principal planes at which shear stress are zero.
- Eigen value of stress matrix.

State of stress at a point:

$$\sigma = \begin{bmatrix} \sigma_{xx} & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_{yy} & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_{zz} \end{bmatrix}$$

Step to calculate Eigen value of square matrix.

[A] – λ [I]

$$\begin{bmatrix} \sigma_{xx} - \lambda & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_{yy} - \lambda & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_{zz} - \lambda \end{bmatrix}$$

Det ([A] – λ [I]) = 0

$$\begin{vmatrix} \sigma_{xx} - \lambda & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_{yy} - \lambda & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_{zz} - \lambda \end{vmatrix} = 0$$

$$a\lambda^3 + b\lambda^2 + c\lambda + d = 0$$

After solving this equation you will get three values of lamda which corresponds to principal stresses at that point.