USE STRESSES CALCULATED FROM 5-33

COMPUTE PRINCIPLE STRESSES

\[ \sigma_{1,3} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \]

\[ \sigma_2 = 0 \quad (2\text{-DIMENSIONAL STRESS STATE}) \]

(CAN ALSO USE MOHR'S CIRCLE)

CONSIDER FAILURE ENVELOPES SHOWN BELOW... FIG 5-9 TEXT

POINT C IS APPLIED STATE OF STRESS.

THE FACTOR OF SAFETY IS FOUND AS FOLLOWS...

\[ N = \frac{\text{DISTANCE FROM ORIGIN TO FAILURE ENVELOPE ALONG LOAD LINE}}{\text{DISTANCE TO POINT C FROM ORIGIN ALONG LOAD LINE}} \]

NOTE: ALL APPLIED STATES OF STRESS FOR POINTS A & B

LIE IN 4TH QUADRANT AS SHOWN. (TORSION)

USING GEOMETRY,

LOAD LINE EQN IS

\[ y = \frac{\sigma_3}{\sigma_1} - x \]

COULOMB-MOHR ENVELOPE LINE (FOURTH QUADRANT) IS

\[ y = \frac{S_{uc} - S_{ut}}{S_{uc} - \frac{\sigma_3}{\sigma_1}} \cdot x - S_{uc} \]

X INTERSECTION AT

\[ x = \frac{S_{uc}}{\frac{S_{uc} - \sigma_3}{\sigma_1}} \]

FOS IS THE RATIO OF X AT INTERSECTION AND \( \sigma_1 \)

\[ N = \frac{1}{\frac{\sigma_1}{S_{ut}} - \frac{\sigma_3}{S_{uc}}} \]

SIMILAR CALCULATIONS CAN BE MADE FOR THE MODIFIED MOHR CASE. SEE ALSO P 305 EQN 5.12 a & b.
HAND CALCULATIONS FOR ROW A: (POINT A)

USE STRESSES CALCULATED FROM 5-33

\[ \sigma_{1,3} = \frac{8.38 + 0}{2} \pm \sqrt{\left(\frac{8.38 + 0}{2}\right)^2 + 16.76^2} = 4.19 \pm 17.28 \]

\( \sigma_1 = 21.5 \text{ MPa} \)

\( \sigma_3 = -13.1 \text{ MPa} \)

COULOMB-MOHRC:

\[ N = \frac{1}{\frac{\sigma_1 - \sigma_3}{S_{ut} - S_{uc}}} = \frac{1}{\frac{21.5 + 13.1}{350 + 1000}} = 13.4 \]

MODIFIED-MOHRS:

\[ N_1 = \frac{S_{uc} S_{uc}}{S_{uc} \sigma_1 - S_{uc} (\sigma_1 + \sigma_3)} = \frac{350 (1000)}{1000 (21.5) - 350 (21.5 - 13.1)} = 18.9 \]

\[ N_2 = \frac{350}{21.5} = 16.3 \]

(USE SMALLER)

SEE SPREADSHEET (PG3) FOR ADDITIONAL ROWS