OUTLINE:

I. Axial Loads — Stress and Strain

EQUILIBRIUM OF THE PARTS TO EITHER SIDE OF THE SECTION. THE FIGURE BELOW ILLUSTRATES THIS PRINCIPAL WITH THE FORCE SYSTEM SHOWN IN TERMS OF COMPONENTS AT THE CENTROID OF THE SECTION. IF THE

[redacted]

AXIAL FORCE EXAMPLE

A STEEL CYLINDER 12 IN. OUTSIDE DIAMETER AND A WALL THICKNESS [illegible] CONCRETE AND USED [illegible] AN AXIAL LOAD [illegible] THE ALLOWABLE [illegible] STRESSES ARE [illegible] PSI FOR STEEL AND [illegible] YOUNG'S MODULUS FOR THE STEEL [illegible] CONCRETE [illegible] THE PIER [illegible] THE ALLOWABLE [illegible]

[illegible]

STEEL AND CONCRETE MUST DEFORM THE SAME AMOUNT UNDER [illegible]

$\Delta_s = \Delta_c$

P_s [illegible] P_c

A_s [illegible] A_c

σ_s [illegible] σ_c [illegible]

$\frac{\sigma_s}{30 \times 10^6} = \frac{\sigma_c}{2.8 \times 10^6}$ [illegible] $\sigma_s = \frac{30}{2.8}\sigma_c$

[illegible]

STEEL IS NOT STRESSED TO ITS MAXIMUM [illegible] AND THE [illegible]

[illegible]

[redacted]

[redacted]

PRESSURE VESSEL & HOOKE'S LAW PROBLEM — CYLINDRICAL

EIT EXAM SPRING 1978

PRESSURE VESSEL IS 24" O.D. WITH A 1/2" WALL ... A STEEL

... INTERNAL PRESSURE ...

BIAXIAL HOOKE'S LAW

SOLVE SIMULTANEOUSLY FOR σ_x, σ_y

INTERNAL PRESSURE

CIRCUMFERENTIAL STRESS

PRESSURE
RADIUS
INCHES

P = INTERNAL ...
r = AVERAGE ...
t = WALL THK ...

[redacted]

TORSION EXAMPLE

THE HOLLOW STEEL SHAFT ($G = 12 \times 10^6$ PSI) MUST TRANSMIT

TORSION EXAMPLE

[redacted]

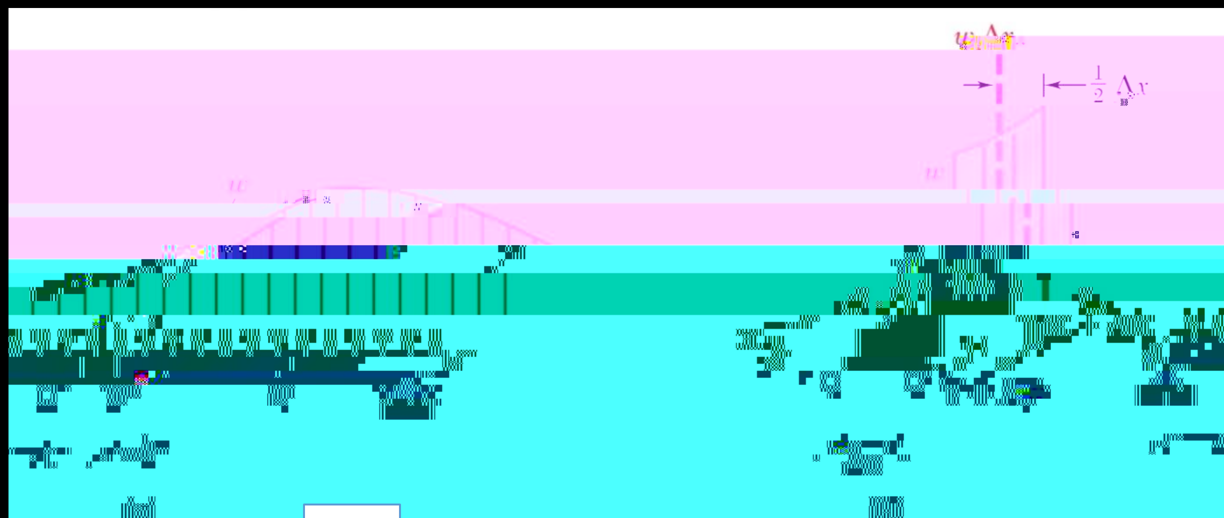
[redacted]

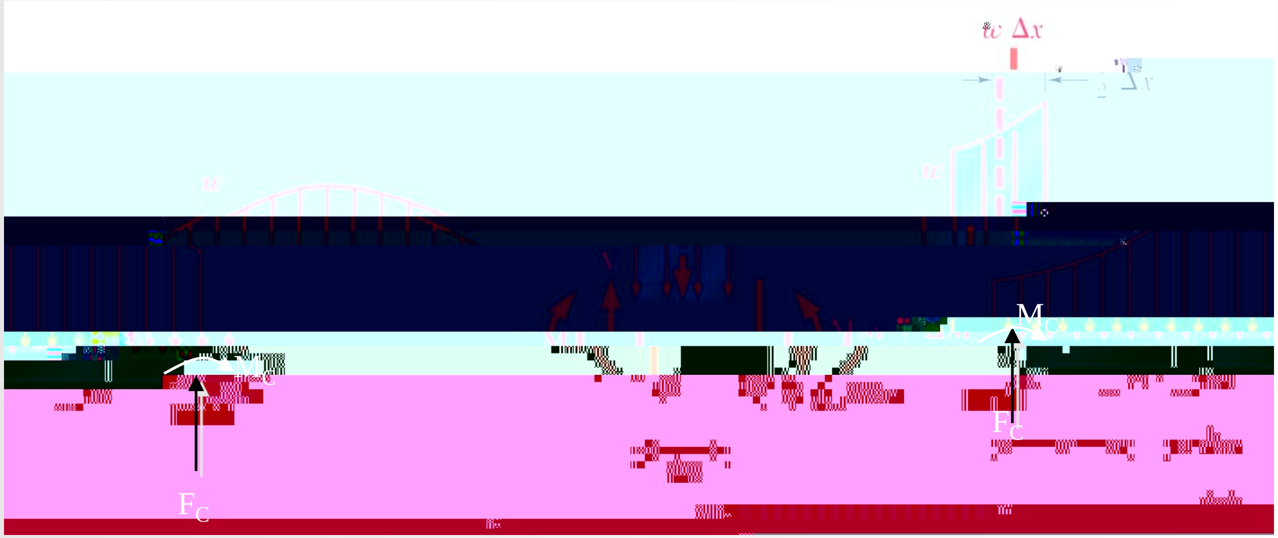
TORSION PROBLEM FROM EIT EXAM - SPRING, 1972

A HOLLOW STEEL SHAFT HAS AN EXTERNAL DIAMETER OF

[redacted]

IV. SHEAR AND BENDING MOMENT IN BEAMS





IF THERE ARE CONCENTERATED FORCES/MOMENTS ACTING AT A POINT,

$$+\Delta \quad = \quad + \quad (\uparrow)$$
$$+\Delta \quad = \quad + \quad (\curvearrowright)$$

SHEAR & MOMENT IN BEAMS

A 16 FT. BEAM HAS SIMPLE SUPPORTS AT THE ENDS AND CARRIES A LOAD AS INDICATED IN THE FIGURE.

(a) SKETCH NEATLY TO AN APPROXIMATE SCALE THE LOAD, SHEAR AND BENDING MOMENT DIAGRAMS. WRITE IN THE MAGNITUDES OF THE ESSENTIAL VALUES ADJACENT TO [illegible] ... WHERE THESE VALUES [illegible]

(b) EVALUATE THE SECTION MODULUS [illegible] BENDING [illegible]

LOAD DIAGRAM — 600 #, 200 #/FT

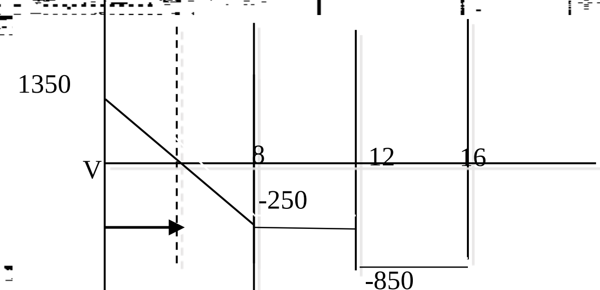
SUPPORT REACTIONS

$\Sigma M_L = 0 = 200(8)(8/2) + 600(12) - R_R(16)$

$R_R = 850$

$\Sigma M_R = 0 = 600(4) + 200(8)(8/2+8) - R_L(16)$

$R_L = 1350$



M: 4560, 4400 #, 3400 # FT

M = MAXIMUM MOMENT

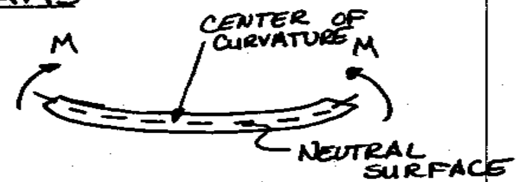
I/C = SECTION MODULUS

f = ALLOWABLE STRESS

$\frac{(4560 \text{ \#FT})(12 \text{ IN/FT})}{30{,}000} = 1.82 \text{ IN}^3$

V. FLEXURAL STRESSES IN BEAMS

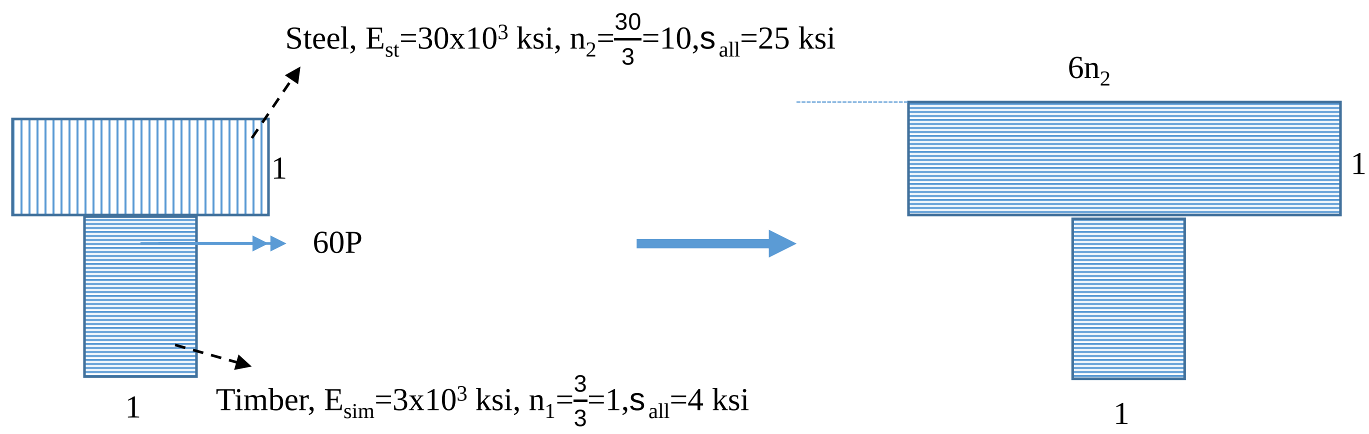
BENDING MOMENTS, M, ON A BEAM SEGMENT CAUSE DEFORMATIONS AS SHOWN AND THE RADIUS OF CURVATURE, ρ, AND M ARE RELATED BY:



[illegible]

FLEXURE EXAMPLE

GIVEN THE BEAM SHOWN BELOW. THE ALLOWABLE TENSILE UNIT STRESS IS 3000 PSI ; THE ALLOWABLE COMPRESSIVE UNIT STRESS IS 16,000 PSI. NEGLECTING THE WEIGHT OF THE BEAM, WHAT IS THE MAXIMUM [illegible] ... ENDS OF THE BEAM [illegible]



Original X-section

Transformed X-section

[redacted]

SUMMARY OF BEAM LOADINGS

[redacted]

(2

[redacted]

IX. EULER COLUMN EQUATION

WHEN THE LENGTH OF A COMPRESSION MEMBER IS LARGE IN COMPARISON WITH ITS TRANSVERSE DIMENSIONS FAILURE TENDS TO OCCUR BY BUCKLING OR LATERAL

EULER COLUMN EQUATION

A 2-INCH DIAMETER STEEL ROD AB 10 FT LONG IS ... AT 100°F ... PINNED AT BOTH ENDS AND IS UNSTRESSED ... TEMPERATURE ... DETERMINE THE ... BEFORE IT WILL BUCKLE ... THE BAR MAY ... OF THE BAR ... NEGLECT THE WEIGHT ...

... CRITICAL STRESS ...

... DUE TO HEATING ... HOOKE'S LAW FOR AXIAL ... THERMAL STRAIN ...

STRESS ... EQUAL TO CRITICAL ...

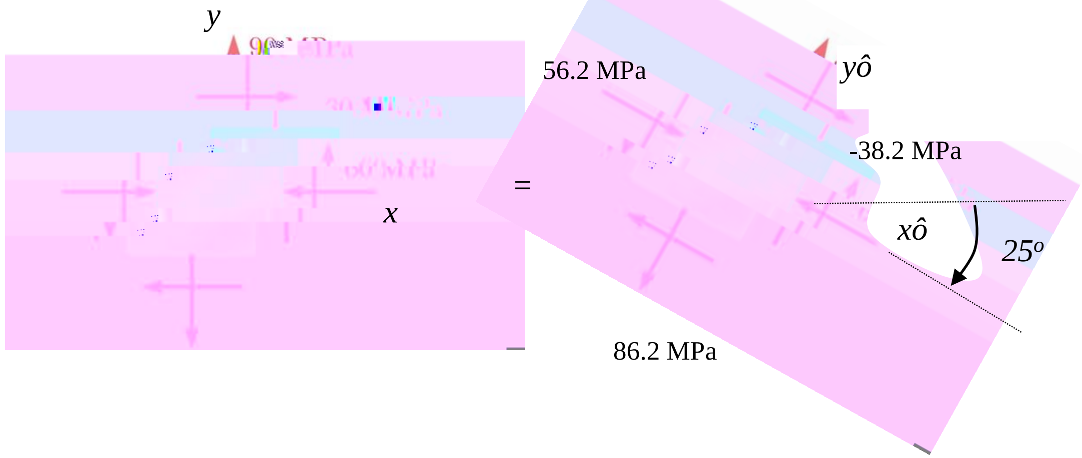
... 85.67°F ...

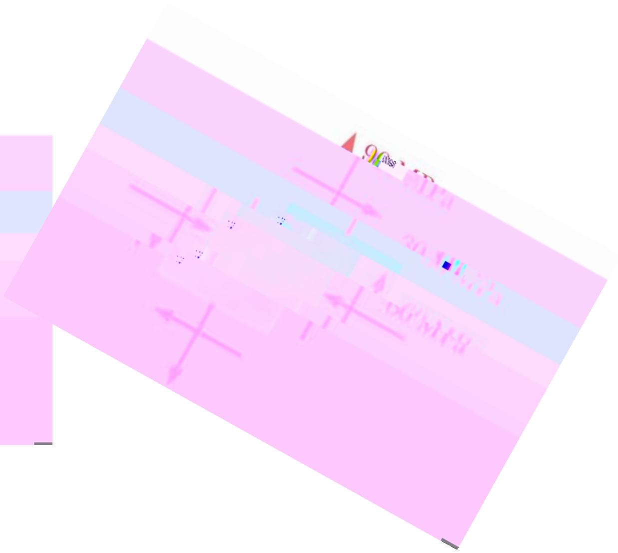
$\Delta T = \dots (4\times10^{-6}) (120/\dots)$

MAX TEMP ... $= 85.7 + 60 = 145.7°F$

STRESS TRANSFORMATION

$$= \left(\frac{+}{2}\right) + \left(\frac{-}{2}\right)\cos(2\ \ ) + \quad \sin(2\ \ ), \quad = -\left(\frac{-}{2}\right)\sin$$





The End