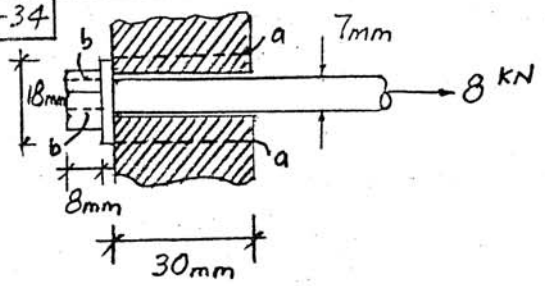
1-34

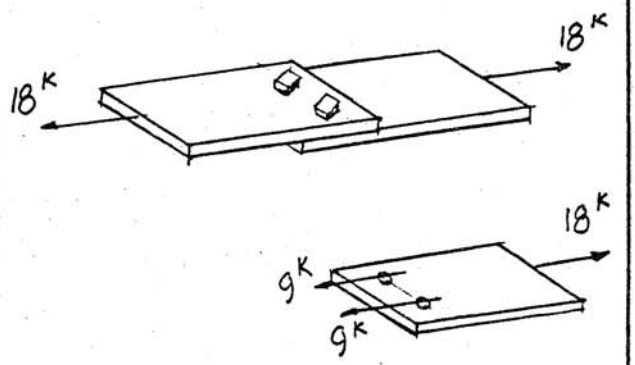


$$\sigma_s = \frac{8(10^3)}{\frac{\pi}{4}\left(\frac{7}{1000}\right)^2} = \underline{208\ MPa}$$

$$(\tau_{avg})_a = \frac{8(10^3)}{\pi\left(\frac{18}{1000}\right)\left(\frac{30}{1000}\right)} = \underline{4.72\ MPa}$$

$$(\tau_{avg})_b = \frac{8(10^3)}{\pi\left(\frac{7}{1000}\right)\left(\frac{8}{1000}\right)} = \underline{45.5\ MPa}$$

1-43



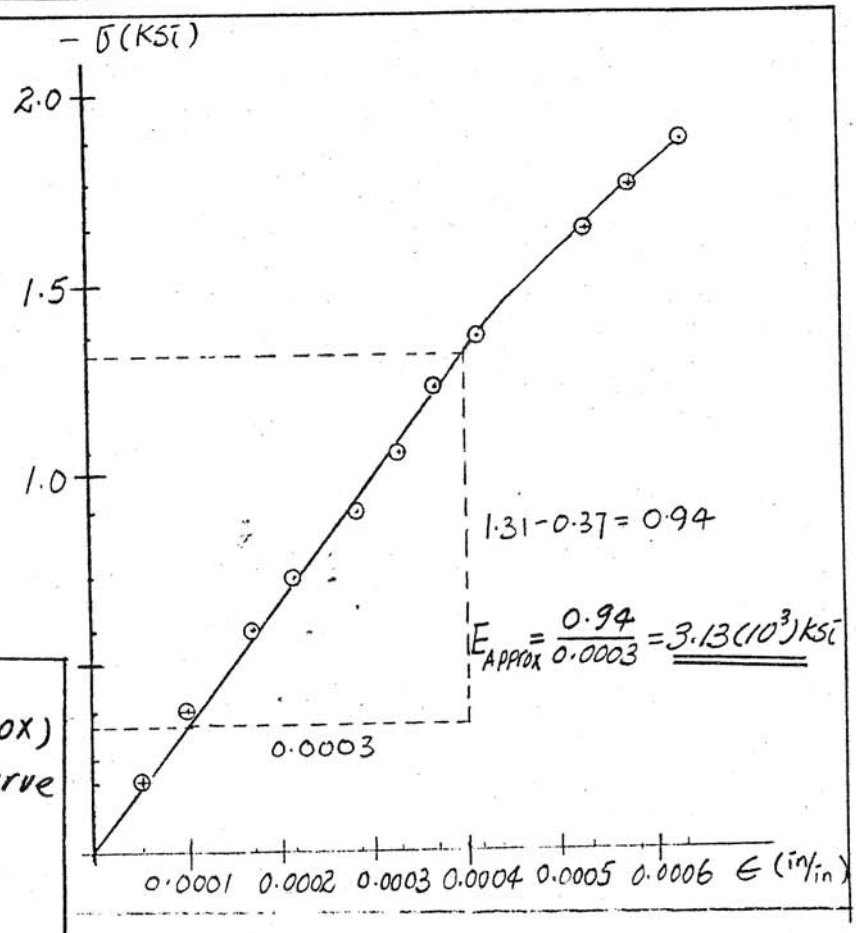
$$\tau_{allow} = 12(10^3) = \frac{9(10^3)}{\frac{\pi}{4}d^2}$$

$$d = 0.977''$$

use $d = \underline{1''}$

3-3

$\sigma = \frac{P}{A}$ (KSI)	$\epsilon = \frac{\Delta L}{L}$ (in/in)
0	0
0.177	0.00005
0.336	0.0001
0.584	0.000167
0.725	0.000211
0.902	0.000283
1.061	0.000333
1.220	0.000375
1.362	0.000417
1.643	0.000517
1.768	0.000583
1.972	0.000625



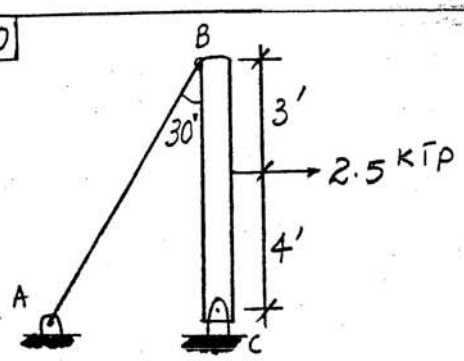
$$E_{APPROX} = \frac{0.94}{0.0003} = \underline{3.13(10^3)\ KSI}$$

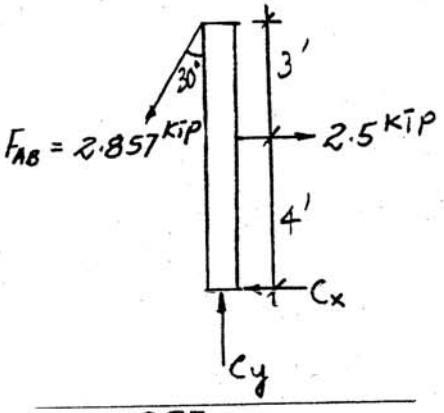
3-5

modulus of toughness (APPROX)
= total area under the curve
= (87) (7.5) (0.025)
= 16.3 $\frac{in\text{-}kip}{in^3}$

number of squares under the curve

3-10





$$\sigma = \frac{2.857}{\frac{\pi}{4}(0.2^2)} = 90.94 \text{ KSI}$$

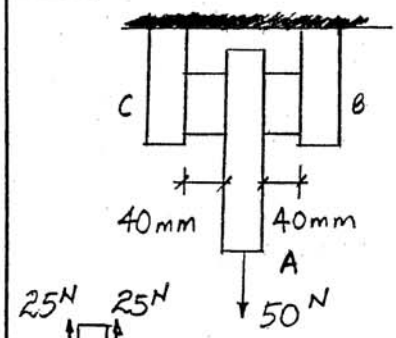
$$\epsilon = \frac{\sigma}{E} = \frac{90.94}{29(10^3)} = 0.003136$$

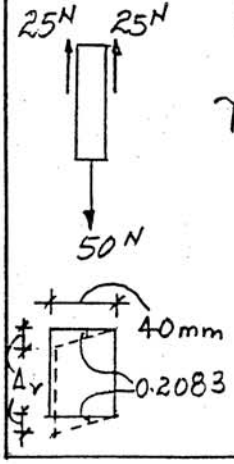
$$\Delta L = \epsilon L = 0.003136\left(\frac{7}{\cos 30°}\right)$$

$$= 0.0253 \text{ ft}$$

$$= \underline{0.304 \text{ in.}}$$

3-21





$$\tau_{avg} = \frac{25}{(0.03)(0.02)}$$

$$= 41666.67 \text{ Pa}$$

$$\gamma = \frac{\tau}{G} = \frac{41666.67}{0.2(10^6)}$$

$$= 0.2083 \text{ rad}$$

$$\Delta_\gamma = 40(0.2083) = \underline{8.33 \text{ mm}}$$

1.6

Bolts: $A_b = \frac{\pi}{4} d_b^2 = \frac{\pi}{4}(0.012 \text{ m})^2$

$= 113.10 \times 10^{-6} \text{ m}^2$

Washers: $A_w = \frac{\pi}{4}\left[(0.030 \text{ m})^2 - (0.015 \text{ m})^2\right]$

$= 530.14 \times 10^{-6} \text{ m}^2$

Max. bearing stress between washers and planks:

$\sigma_w = 5 \text{ MPa}$ But $\sigma_w = \frac{P}{A_w}$

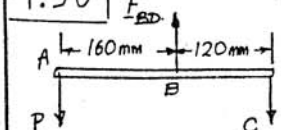
$P = \sigma_w A_w = (5 \times 10^6 \text{ Pa})(530.14 \times 10^{-6} \text{ m}^2) = 2651 \text{ N}$

Maximum allowable stress in bolts:

$$\sigma_b = \frac{P}{A_b} = \frac{2651 \text{ N}}{113.10 \times 10^{-6} \text{ m}^2} = 23.44 \times 10^6 \text{ Pa}$$

$$\sigma_b = 23.4 \text{ MPa}$$ ◀

1.50



Free Body: Member ABC

+↻ $\Sigma M_C = 0$: $280P - 120 F_{BD} = 0$

$P = \frac{3}{7} F_{BD}$ (1)

+↻ $\Sigma M_B = 0$: $160P - 120C = 0$

$P = \frac{3}{4} C$ (2)

A. For failure of link BD in tension: $\sigma_U = 400 \text{ MPa}$

$F_{BD} = \sigma_U A_{net} = (400 \text{ MPa})(6 \text{ mm})(18 \text{ mm} - 10 \text{ mm}) = 19.2 \text{ kN}$

From (1): $P_U = \frac{3}{7}(19.2 \text{ kN}) = 8.229 \text{ kN}$, $P_{all} = \frac{P_U}{F.S.} = \frac{8.229}{3} = 2.74 \text{ kN}$ ◁

B. For failure of pin B or D in single shear: $\tau_U = 150 \text{ MPa}$

$F_{BD} = \tau_U A = (150 \text{ MPa})\frac{\pi}{4}(10 \text{ mm})^2 = 11.781 \text{ kN}$

From (1): $P_U = \frac{3}{7}(11.781) = 5.049 \text{ kN}$, $P_{all} = \frac{P_U}{F.S.} = \frac{5.049}{3} = 1.683 \text{ kN}$ ◁

C. For failure of pin C in double shear: $\tau_U = 150 \text{ MPa}$

$C = 2(\tau_U A) = 2(150 \text{ MPa})\frac{\pi}{4}(6 \text{ mm})^2 = 8.482 \text{ kN}$

From (2): $P_U = \frac{3}{4}(8.482 \text{ kN}) = 6.362 \text{ kN}$, $P_{all} = \frac{P_U}{F.S.} = \frac{6.362}{3} = 2.12 \text{ kN}$ ◁

Shear in pins B and D is critical: $P = 1.683 \text{ kN}$ ↓ ◀

Problem Set # 2A problem 3.5

	A	B	C	D	E	F	G	H	I
1	Load (ip)	Elongation (in)	**Engineering Stress**	**Engineering Strain**		Area (trap)			
2	0	0	0	0	0	0.000000			
3	2500	0.0009	12581.34194	0.00045	12581.34	2.831			
4	6500	0.0025	32711.48904	0.00125	32711.49	20.948			
5	8500	0.004	42776.56259	0.002	42776.56	49.256	< MR		
6	9200	0.0065	46299.33833	0.00325	46299.34	104.928			
7	9800	0.0098	49318.8604	0.0049	49318.86	183.813			
8	12000	0.04	60390.4413	0.02	60390.44	1012.119			
9	14000	0.12	70455.51485	0.06	70455.51	3629.038			
10	14500	0.25	72971.78324	0.125	72971.78	8290.425			
11	14000	0.35	70455.51485	0.175	70455.51	11876.107			
12	13200	0.47	66429.48543	0.235	66429.49	15982.657			
13						41152.122624	< MT		
14	Area	Length							
15	0.198706943	2							
16									
17									
18									
19									
20									
21									
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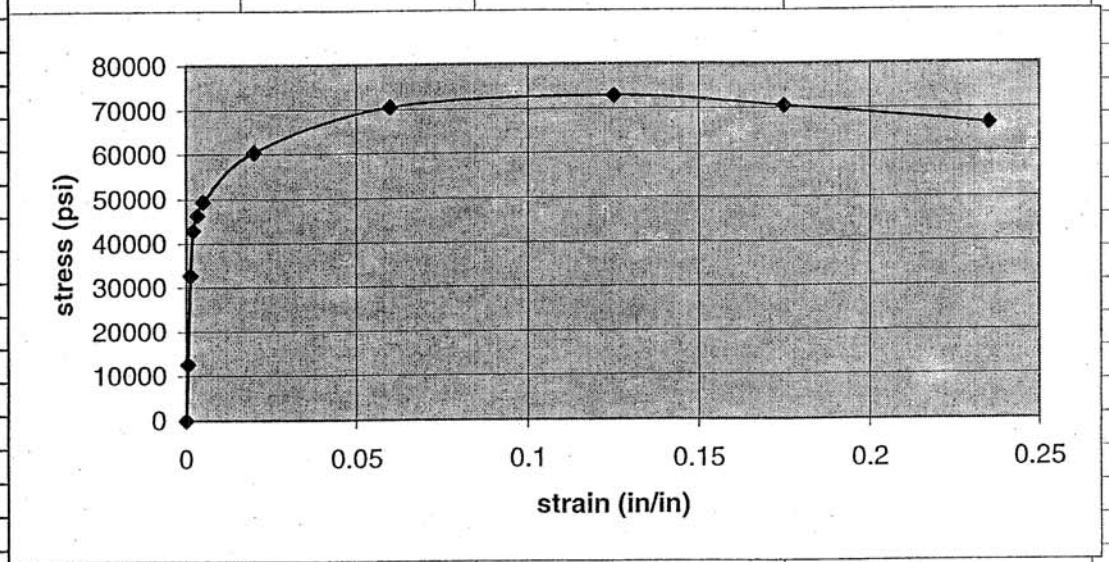
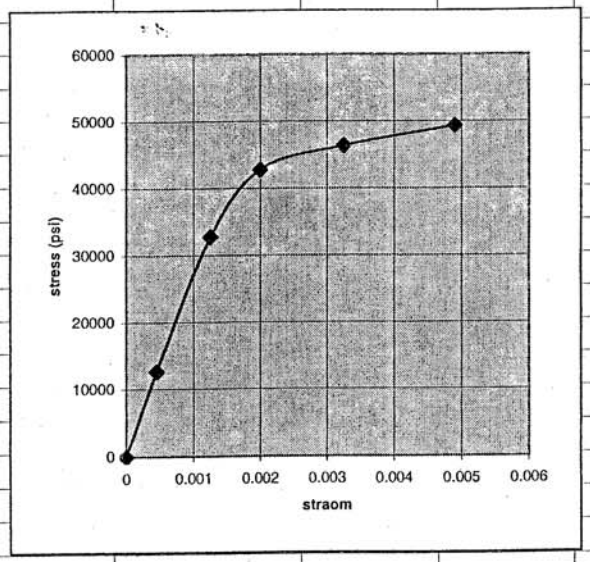
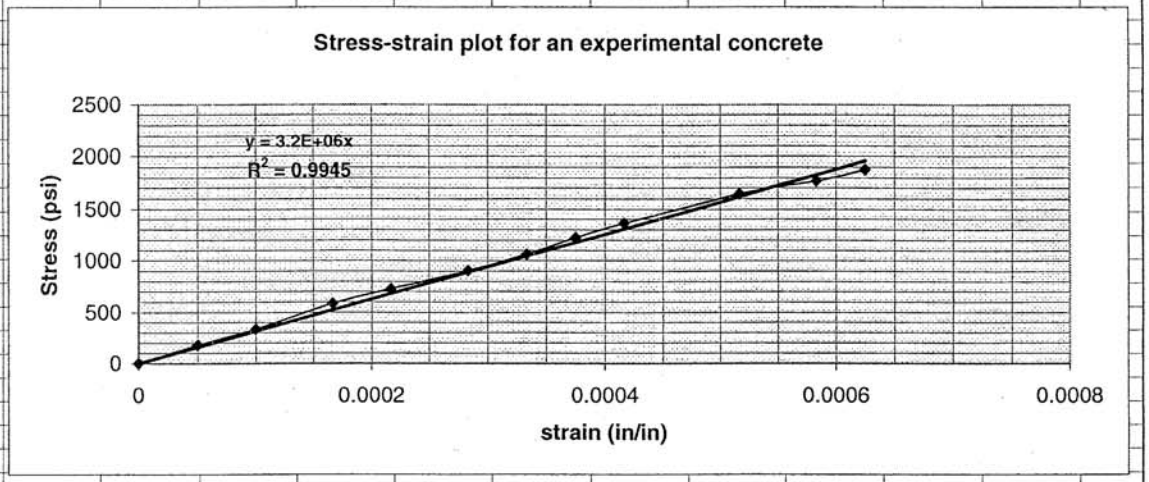




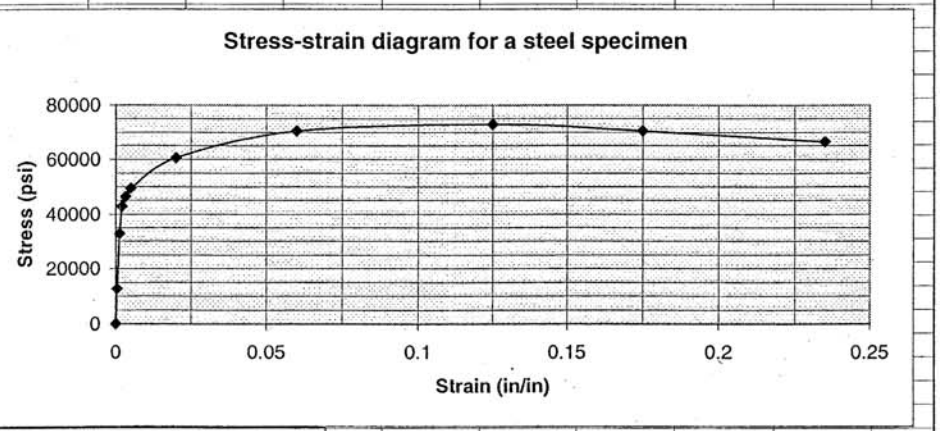
	A	B	C	D	E	F	G
1	Load (ip)	Elongation (in)	**Engineering Stress**	**Engineering Strain**		Area (trap)	
2	0	0	=A2/$A$15	=B2/2	0	0	
3	2500	0.0009	=A3/$A$15	=B3/2	12581.3419377198	=F2+((E3+E2)/2)*(D3-D2)	
4	6500	0.0025	=A4/$A$15	=B4/2	32711.4890380715	=F3+((E4+E3)/2)*(D4-D3)	
5	8	0.004	=A5/$A$15	=B5/2	42776.5625882473	=F4+((E5+E4)/2)*(D5-D4)	< MR
6	9.	0.0065	=A6/$A$15	=B6/2	46299.3383308088	=F5+((E6+E5)/2)*(D6-D5)	

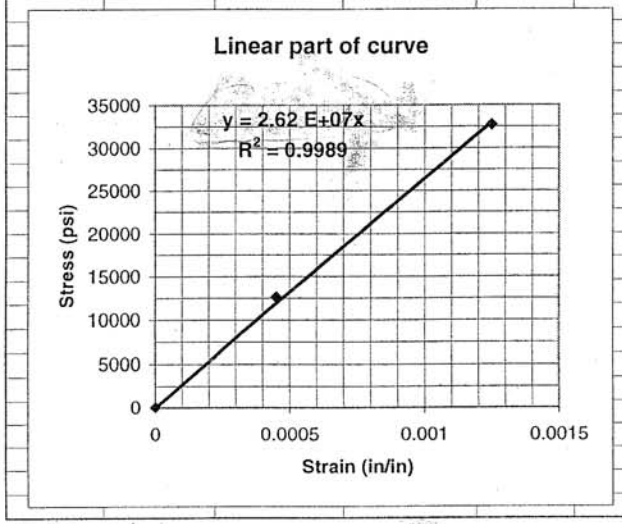
ME 3300	Computer problems	3.3* & 3.5*		
	Load (kip)	Shortening (in)	Strain	Stress (psi)
Prob 3.3 ->>>	0	0	0	0
	5	0.0006	0.00005	176.8388
	9.5	0.0012	0.0001	335.9938
	16.5	0.002	0.000167	583.5681
	20.5	0.0026	0.000217	725.0392
	25.5	0.0034	0.000283	901.878
	30	0.004	0.000333	1061.033
	34.5	0.0045	0.000375	1220.188
	38.5	0.005	0.000417	1361.659
	46.5	0.0062	0.000517	1644.601
	50	0.007	0.000583	1768.388
	53	0.0075	0.000625	1874.492

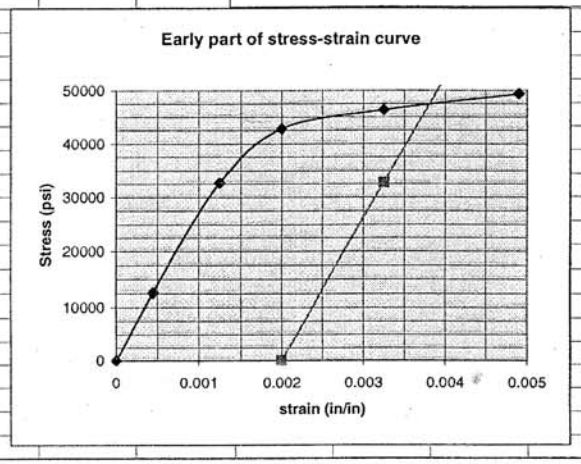
$E = 3.2 \times 10^6$ psi



Prob. 3.5 ->>>	elongation (in)	stain (in/in)	stress (psi)		Area under curve trap rule	
0	0	0	0		0	
2.5	0.0009	0.00045	12581		2.830718	
6.5	0.0025	0.00125	32711		20.94732	
8.5	0.004	0.002	42775	0	49.2545	Mod of R
9.2	0.0065	0.00325	46298	32750	104.9253	
9.8	0.0098	0.0049	49317	75980	183.808	
12	0.04	0.02	60389	471600	1012.089	
14	0.12	0.06	70453		3628.931	
14.5	0.25	0.125	72970		8290.18	
14	0.35	0.175	70453		11875.76	
13.2	0.47	0.235	66428		15982.19	Mod of T







Mod of Resilience = 49 in-lb/in³

0.2% offset yield = 47,520 psi

Ult tensile strength = 72,000 psi

Modulus of toughness = (0.235+.002)100 = 23.70 in-lb/in³

To get Poisson's ratio need to determine (measure) lateral strain ($\mu = \varepsilon_{lat}/\varepsilon_{long}$)

For area reduction need to measure X-Section Area after failure → $\frac{A_i - A_f}{A_i}(100)$