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Civilittee Hashemite

Deflection of Beams

Student Name: RUBA TAHA **ID#: 1933772**

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9p,Result and calculations:

Rod material	Steel	**Modulus of Elasticity**	210 GPa
Length	1000 mm	**Cross section dimension**	(20 x 6) mm
Cross section type	Rectangle	**Ends condition**	Simply supported

Experiment parameters

Part (1): Measurement of the reaction forces: The load = 10N

Distance X from support A (mm)	**Experimental**		**Theoretical**		**Percentage Error (%)**	
	Reaction force A (N)	**Reaction force B (N)**	**Reaction force A (N)**	**Reaction force B (N)**	**Reaction force A**	**Reaction force B**
100	8.4	0.9	9	1	6.66%	10%
200	7.4	1.9	8	2	7.5%	5%
300	6.5	3.1	7	3	7.142%	3.33%
400	5.5	4.05	6	4	8.33%	1.25%
500	4.3	5	5	5	14%	0

Experiment data and result

Sample of calculation:

▶ Subject : / /

* sample of calculation

$\sum F_y = zero$

$RA + RB - F = zero$

$RA = -RB + F \Rightarrow F - RB$

$F - \frac{Fx}{L}$

$F\left(1 - \frac{x}{L}\right)$

$\sum M = zero \Rightarrow Fx = RBL$

$RB = F\frac{x}{L}$

Load = 10 N

L = 1000 mm

at $x = 100$

$RA = F\left(1 - \frac{x}{L}\right) \Rightarrow 10\left(1 - \frac{100}{1000}\right)$

$= 9\ N$

* Percentage error %

$= \left|\frac{Theo(A) - Exp(A)}{Theo(A)}\right| \times 100\%$

$\left|\frac{9 - 8.4}{9}\right| \times 100\%$

$= 6.66\%$

$error\ \% = \left|\frac{Theo(B) - Exp(B)}{Theo(B)}\right| \times 100\%$

$= \left|\frac{1 - 0.9}{1}\right| \times 100\%$

$= 10\%$

Part (2): Deflection of simply supported beam: The load = 10N

Distance X from support A (mm)	**Deflection W (Experimental) mm**	**Deflection W (Theoretical) mm**	**Percentage Error (%)**
100	0.8	0.81	1.23%
200	1.75	1.56	12.17%
300	2.45	2.18	12.38%
400	2.8	2.60	7.69%
500	2.9	2.755	5.26%

Experiment data and result

Sample of calculation:

Subject :

Sample of calculation

$E = 210$ GPa

$L = 1000$ mm

Load $= 10$ N

cross dimension $= (20 * 6)$ mm

$$I = \frac{1}{12} * b * h^3 = \frac{1}{12} * 20 * 6^3 = 360 \text{ mm}^4$$

العرض

at $x = 100$ mm

$$w(x) = \frac{F * L^3}{48 * E * I} * \left(\frac{3x}{L} - \frac{4x^3}{L^3} \right)$$

$$\text{so} \quad \frac{10 * 1000^3}{48 * 210 * 10^3 * 360} * \left(\frac{3 * 100}{1000} - \frac{4 * (100)^3}{1000^3} \right)$$

$$= 0.815$$

$$\text{error \%} = \left| \frac{\text{Theo} - \text{exp}}{\text{Theo}} \right| * 100\%$$

$$\left| \frac{0.81 - 0.8}{0.81} \right| * 100\%$$

$$= 1.23\%$$

STARS NOTEBOOK

Part (3): Cantilever beam Deflection: The load = 10N

Length L from clamp (mm)	Deflection W (Experimental) mm	Deflection W (Theoretical) mm	Percentage Error (%)
200	0.4	0.35	14.28%
300	1.3	1.19	9.24%
400	2.8	2.82	0.70%

Experiment data and result

* Sample of calculation   * Load = 10N   * E = 210 GPa

at $x = 200$ * $I = 360$ *

$$w(x) = \frac{F \times L^3}{3 \times E \times I} = \frac{10 * 200^3}{3 \times 210 \times 10^3 \times 360} = 0.3527 \text{ mm}$$

$$\% \text{ Error} = \left[\frac{0.35 - 0.4}{0.35}\right] * 100\% = 14.28\%$$

exp

Theo

Theo

S T A R S N O T E B O O K

State the sources of error?

1-personal error in reading the dynamometer (because the difference in angle of view).

2-Beam is not completely straight.

3-Already plastic deformation before the experiment in the beam .

4-The dynamometers experience spring excursion under load.

Comment on your results in each case:

Part 1:

when ever the distance x is closer to the support , the reaction value will be high

Part 2 :

The deflection is increased by increasing the distance , until it reaches the midelte at it

Part 3:

In the cantilever with increasing distance the deflection increses and the largest deflection is at freeend .

I= Area moment of intiria .

Direct relationship between the deflection and the beam length.

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Strength Of Materials Lab

stability of columns

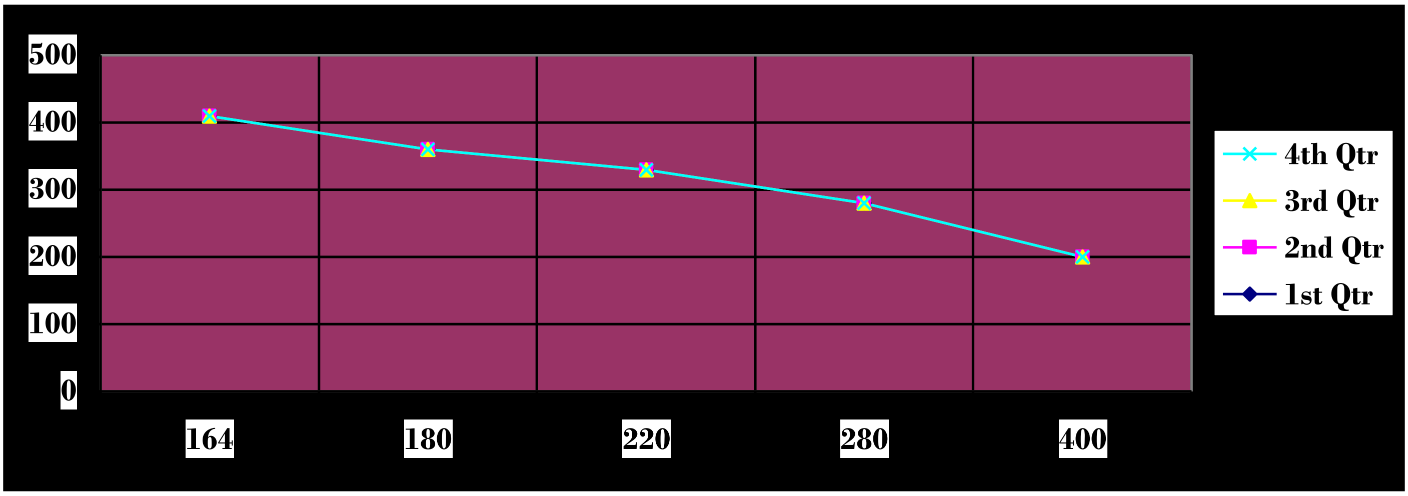
Student Name: RUBA TAHA ID # : 1933772

Result and calculations:

Rod material	Steel	Cross section dimension	(20 x 4) mm^2
Length	700 mm	Modulus of elasticity	210 Gpa
Cross section type	Rectangle	Ends condition	Pin –pin (K=1)

Experiment parameters

Deflection y [mm]	0.5	1.0	1.5	2.0	2.5
Load (P) N	200	280	330	360	410
P/y (N/mm)	400	280	220	180	164



pcr(exp)= 500(تقريبا) ** عند وصل المنحنى ب محور واي **

#yaxis= load(p)

#x axis=p/y

موضوع الدرس اليوم التاريخ / /

Length = 700

E = 210 Gpa

crossectio = $(20 * 4)\ mm^2$

$$I = \frac{1}{12} * 20 * 4^3 = 106.67\ mm^4$$

$$P_{cr} = \frac{\pi^2 * E * I}{(L * e)^2}$$

$e \rightarrow K * L$

$$= \frac{\pi^2 * 210 * 10^9 * 106.67 * 10^{-12}}{(700 * 10^{-3} * 1)^2}$$

$$= 451.1960\ N$$

$$error\% = \left| \frac{451.1960 - 500}{451.1960} \right| * 100\%$$

$$= 10.822\ \%$$

Discussion and conclusion:

We use this measurement to find the minimum load we will do to the design it would bk less , the critical load in pin-pin exp we need is more critical than that in pin-fixed exp.

Errors:

1.peronal error.

2.Error in reading value .

3.Machine error.

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Fatigue test

Student Name: Ruba Taha **ID#:1933772**

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Results and Analysis:

# of load cycles for test bar under different loads			
Trial No.	**Load F_a (N)**	**Endurance N (cycles)**	**Stress σ_a (N/mm^2)**
1	195	14030	389.879
2	172	48800	343.894
3	147	167000	293.909
4	128	455000	255.92
5	118	1280800	235.927
L = 100. 5 mm	d = 8 mm		

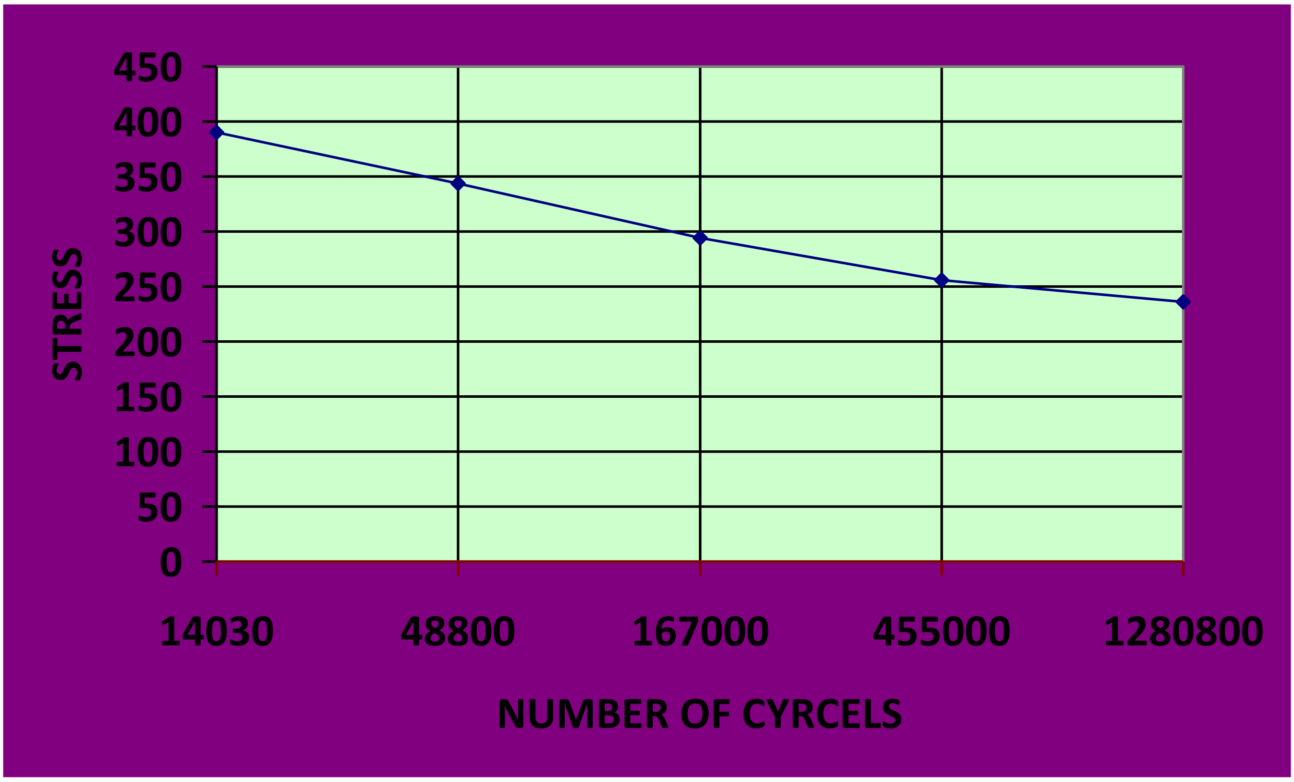
1. calculate the bending stress

$$* \; I = \frac{\pi}{64} \times d^4 = \frac{\pi}{64} \times 8^4 = 64\pi \; mm^4$$

$$* \; \sigma = \frac{M \times c}{I} \Rightarrow \frac{F \times L \times \frac{d}{2}}{I} = \frac{200 \times 100.5 \times 4}{64\pi}$$

$$= 399.879 \; N/mm^2$$

2. plot stress against number of cycles .



3. find the endurance limit :

235.927.

4.Estimate the fatigue strength corresponding to $4*10^5$ cycles.

269 تقريبا.

5. estimate the expected fatigue life corresponding to a bending stress of 250 Mpa

755000تقريبا.

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Impact Test

Student Name: Ruba Taha **ID#:**1933772

Apply the ***impact test*** on the following ***Specimens:***

Material	Notch Type	Total Absorbed Energy (N.m)		Absorbed Energy by specimen only (N.m)	
Mild Steel	V,U	26	35	22	31
Brass	V,U	14	21	10	17
Aluminum	V,U	-------	-------	--------	-----------

Absorbed Energy by friction only is : **4 N.m.**

Q1: State the main ***Material Property*** obtained from this test.

RELATIVE TOUGHNESS

Q2: In order to perform an impact test, we need high strain rate, in other words a ***shock load***. What is the constrain (condition) of applying a ***shock load***?

T<1/3Wn Wn: natural period of vibration "natural frequency"

Q3: According to the above table, answer the following questions:

A. Why we use ***notched specimens***?
.To decrease the energy needed to break specimens
.To facilitate the breakage

B. Which specimens from the ***same material*** absorb ***higher*** amount of energy and why?
Material with (v)natch absorb higher energy because it give less stress concentration than (v)natch

C. Which specimen absorbed higher energy (Mild Steel or Brass), and why?
Mid steel because it is aductile material “ductility of mild steel is higher than ductility of brass”

Q4: If we apply ***the same impact load*** on ***the same specimens*** but at ***different temperature***, what you think will happen? Explain.

As temperature increase the ductility of materials will increase and the toughness will also increase, so the material which have higher temperature will absorb more energy than other material

Q5: Compare between impact test and tensile test.

	Impact Test	**Tensile Test**
Type of Load	**shock**	**Static**
Strain Rate	**Higher**	**Lower**
Specimen's Notch	**There is a notch**	**There is no notch**

Q6: state two differences between **Charpy** and **Izod** test ?

Charpy Test	**Izod Test**
Notch opposes the hammer	Notch faces the hammer
Specimen is simply supported	Cantilever type specimen
Two shearing Area	One shear Area
E Charpy = 2 E Izod	E Izod= ½ E Charpy

Thin Wall Cylinder

Student Name: Ruba Taha ID # :1933772

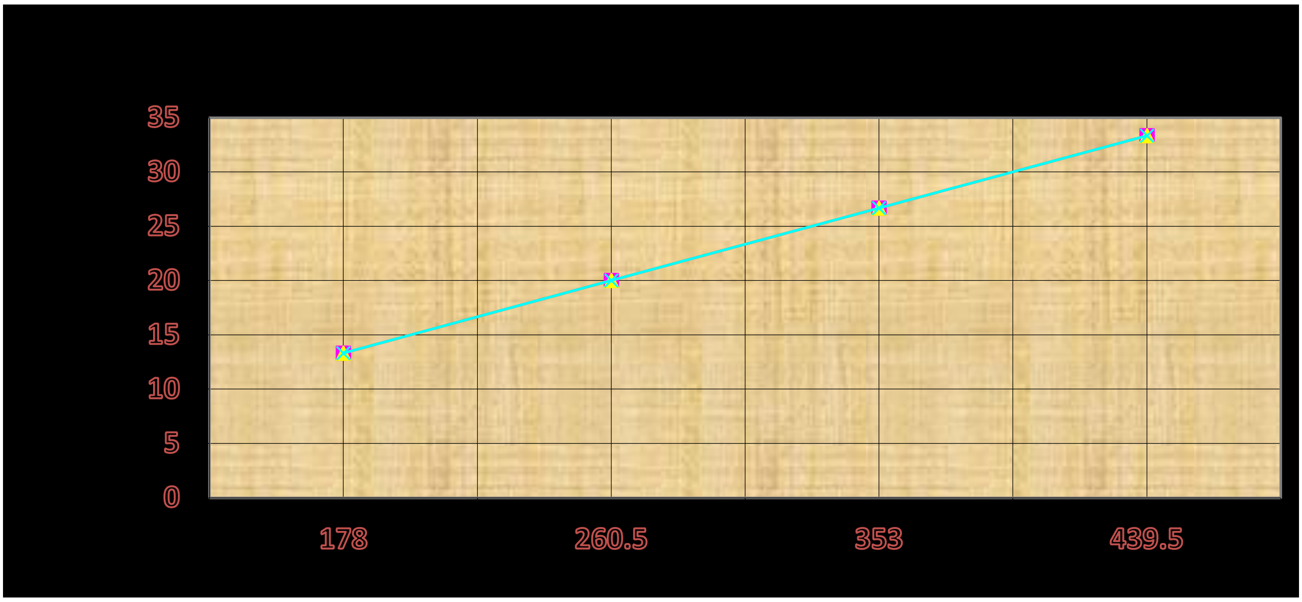
Results and Analysis:

- Fill the experiment results for all parts and compare with theoretical value:

Trial No. #	Cylinder Pressure P (Mpa)	Hoop Strain ε_H Gauge 1	Hoop Strain ε_H Gauge 6	Average Hoop Strain ε_H	Hoop stress σ_H (Mpa)
1	0.5	76	96	86	6.67
2	1	162	194	178	13.33
3	1.5	243	278	260.5	20
4	2	334	372	353	26.67
5	2.5	421	458	439.5	33.33
d = 80 mm t = 3.00 mm L = 358mm Theoretical modulus of elasticity (E) =69 Gpa					

- Plot σ_{Hoop} versus ϵ_{Hoop} then find E and compare with theoretical values.

σ_{Hoop}(mpa)



ϵ_{Hoop}

- Sample of calculation:

ع الرسم البياني

$Slope = E = \dfrac{(27-20)*10^{6}}{(353-260.5)*10^{-6}} = 75.67\ Gpa$

$error = \left| \dfrac{75.67-69}{69} \right| * 100\% = 9.67\ \%$

ع الجدول

Trail NO. #1 $\Rightarrow$

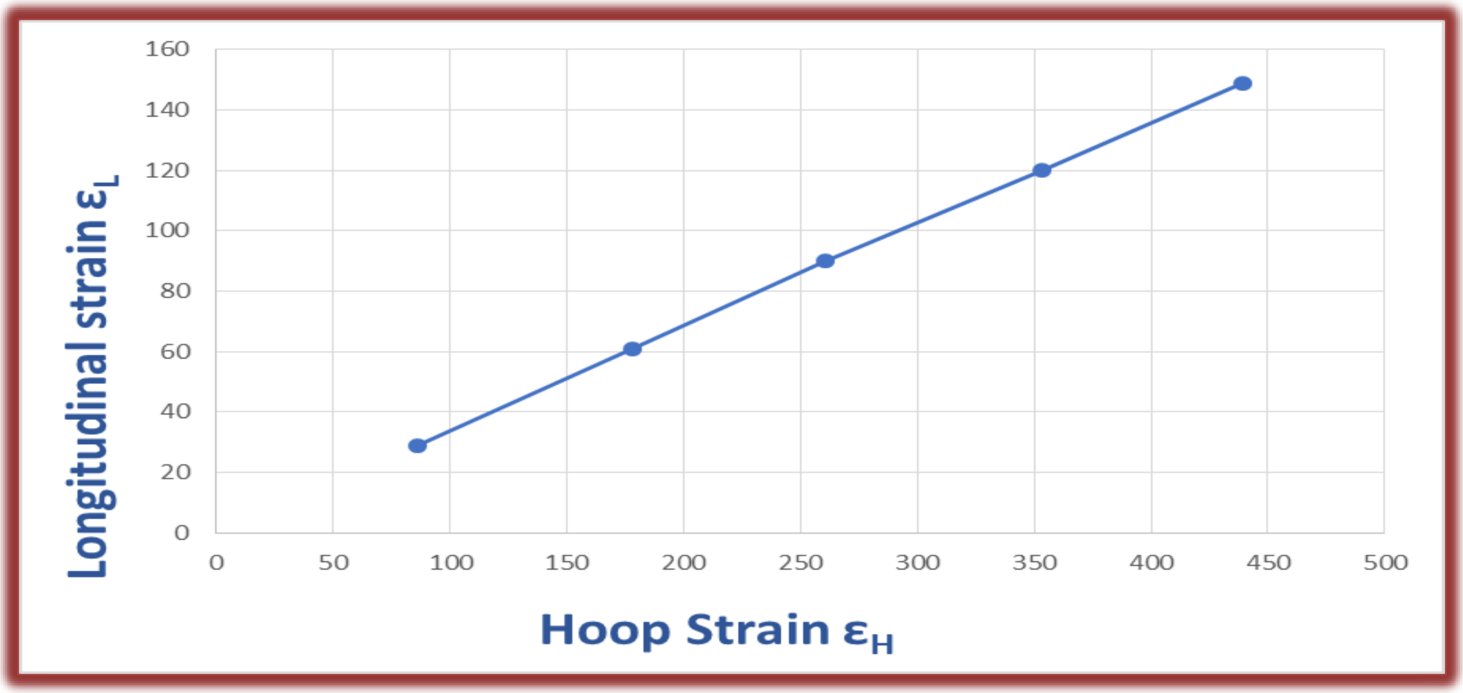
* $Avegage\ Hoopstrain = \dfrac{76+96}{2} = 86$

* $Hoop\ stress = \dfrac{P*D}{2*t} = \dfrac{0.5*80}{2*3} = 6.67\ Mpa$

- Fill table below and find the Poisson's ratio (v):

Trial No. #	Hoop Strain ε_H Gauge 1	Hoop Strain ε_H Gauge 6	Longitudinal strain ε_L Gauge 2	Average Hoop Strain ε_H
1	76	96	-29	86
2	162	194	-61	178
3	243	278	-90	260.5
4	334	372	-120	353
5	421	458	-149	439.5
Theoretical Poisson's ratio (v) =0.33				

- Plot ϵ_{Hoop} versus $\epsilon_{Longitudinal}$, then find Poisson's ratio (v) and compare with theoretical value



Calculate the theoretical principal hoop and longitudinal strains for poisson`s experiment and compare your results with the experimental values?? (first trial only)

▶ Subject :

* Trial NO#7 ⇒ longitudinal strain = −29

$\varepsilon H = 86$

* Poisson's ratio (V) = $-\frac{\varepsilon L}{\varepsilon H} = -\frac{-29}{86} = 0.337$

(V) exp

error% = $\left[\frac{0.33 - 0.3372}{0.33}\right] * 100\% = 2.18\%$

AT P = 2.5 Mpa

$\sigma H = \frac{2.5 * 80 * 10^{-3}}{2 * 3 * 10^{-3}} = 33.33$ Mpa.

$\varepsilon H\ Tho = \frac{\sigma H}{E} = \frac{33.33 * 10^{6}}{69 * 10^{9}} = 4.83 * 10^{-4}$

$\varepsilon L\ Tho = -V * \left(\frac{\sigma H}{E}\right) = -0.33 \left(\frac{33.33 * 10^{6}}{69 * 10^{9}}\right)$

$= -1.594 * 10^{-4}$

$\varepsilon L\ exp = -149$

error $= \left|\frac{-159.4 + 149}{-159.4}\right| * 100\% = 6.5$

εH error% $= \left|\frac{483.04 - 439.5}{483.04}\right| * 100\%$

$= 9\%$

S T A R S N O T E B O O K

- Calculate the theoretical longitudinal stress ?

  $\sigma L = 0$ (free end condition) in open cylinder

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Strain Measurement with Strain Gauges

Student Name: RUBA TAHA

ID #: 1933772

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Result and calculations:

Rod material	Steel	**Cross section dimension**	(20 x 4) mm
Length	800 mm	**Distance of W from center**	200 mm
Cross section type	Rectangle	**Ends condition**	Simply supported

Experiment parameters

#	**W1 (N)**	**W2 (N)**	**Channel 1 Reading µ**	**Channel 2 reading µ**	**$\epsilon_{lateral}$**	**ϵ_{axial}**	**Bending moment (M)**	**Stress (σ) Mpa**
1	**0**	**2.5**	**10**	**32**	**5**	**16**	**250**	**4.69**
2	**2.5**	**2.5**	**26**	**86**	**13**	**43**	**500**	**9.38**
3	**2.5**	**5**	**46**	**158**	**23**	**79**	**750**	**14.07**
4	**5**	**5**	**62**	**188**	**31**	**94**	**1000**	**18.07**
5	**5**	**7.5**	**80**	**260**	**40**	**130**	**1250**	**23.45**
6	**7.5**	**7.5**	**100**	**332**	**50**	**166**	**1500**	**28.1**

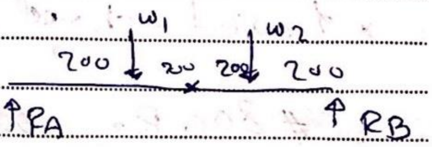
Experiment data and result

Sample of calculation:

Subject: at $w_1 = zero$, $w_2 = 2.5$

ϵ lateral $\Rightarrow \frac{10}{2} = 5$

ϵ axial $\Rightarrow \frac{32}{2} = 16$



$\Sigma F_y = zero$

$RA + RB - w_1 - w_2 = zero$

$RA + RB = w_1 + w_2$

$\Sigma M_A = zero$

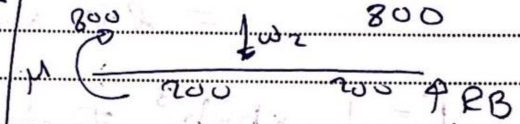
$200 w_1 + 600 w_2 - 800 RB = zero$

$800 RB = 200 w_1 + 600 w_2$

$\Rightarrow RB = \frac{200 w_1 + 600 w_2}{800}$

$RB = \frac{200 \times zero + 600(2.5)}{800}$

$RB = 1.875$



$M = 400 RB - 200 w_2$

$M = 400(1.875) - (200 \times 2.5)$

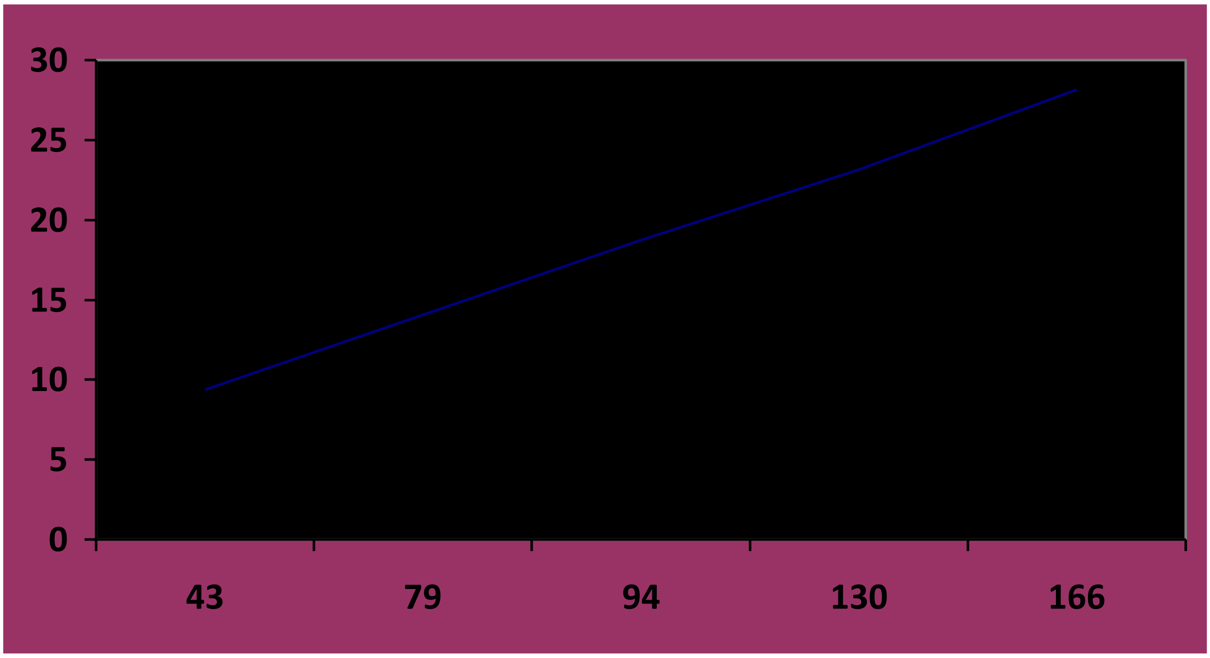
$M = 250$ N.mm

$* I = \frac{1}{12} b h^3 \Rightarrow \frac{1}{12} \times 0.02 \times (0.004)^3 = 106.6 \times 10^{-12}\ mm^4$

$* \sigma = \frac{M c}{I}$; $\boxed{C = 2}$ at $M = 250$

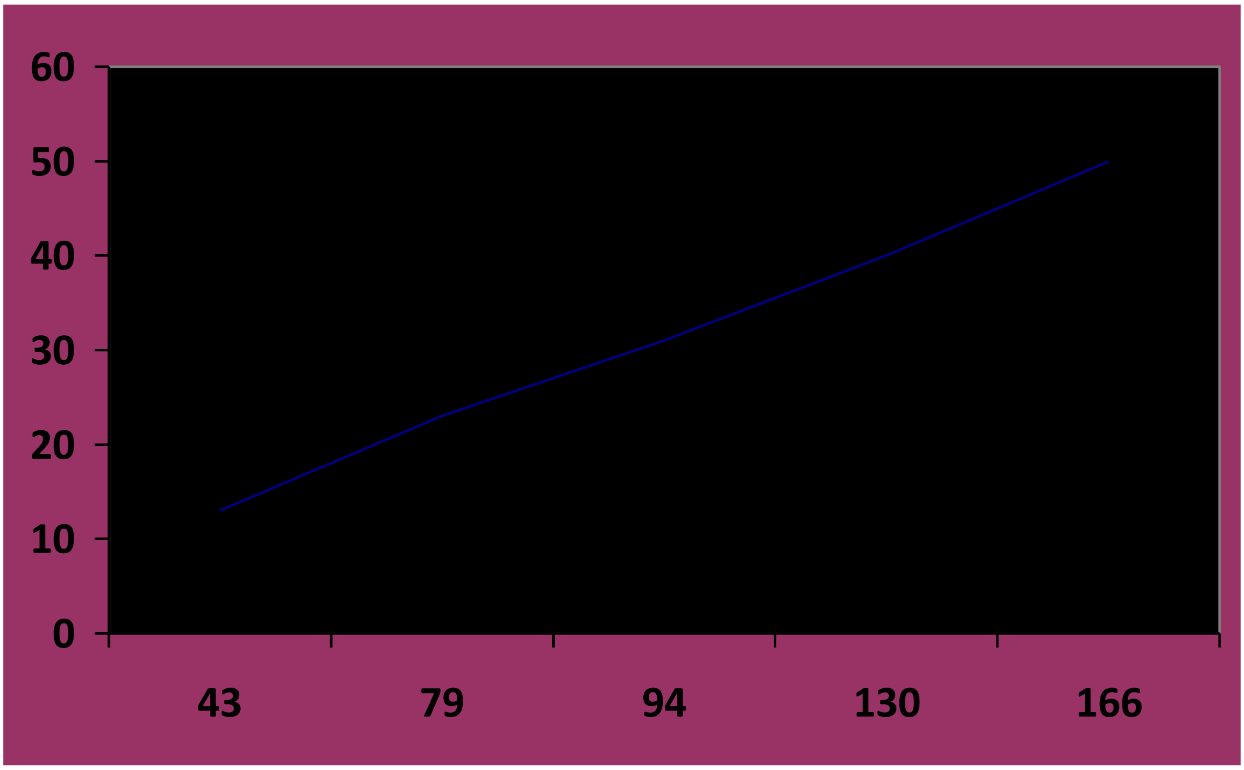
$\sigma = \frac{250 \times 2}{106.66} = 4.69$ MPa.

Plot **σ** versus ϵ_{axial} then find E and compare with theoretical values



E=slope=126
Ethr=210 GPA
Error=((210-126)/210)*100%=40%

Plot ϵ_{axial} versus $\epsilon_{lateral}$ then find **V** and compare with theoretical values



slope=Uexp=0.285
U=thr=0.34
Error=((0.34-0.285)/0.34)*100%=16.17%

State 3 applications of strain measurement using strain gauges.

1-CAR SPRING .

2-CUTRING MACHINE AND VESSEL SUPPORT STRUCTURE .

3-IN NUCLEAR REACTORS .

Discussion and conclusion:

IN THIS EXPERIMENT WE SHOW HOW TO FIND THE AXIAL ANA LATERAL STRAIN ON THE BEAM BY USE STRAIN GAUGE WE DETERMAIN VALUE OF Є AXIAL ,LATERAL ,, (σ) , M.

Discussion

-Vibration Error because the strain gauges are very sensitive for vibration.

-Heat because the gauges the material deforms by the heat for long terms of time.

-The low efficiency of the circuit because its not brand new.

-Error in fitting the gauge on the rod.

-The rod is already deformed my many factors.

:Conclusions

-Proving hooks law

.-Proving Wheatstone bridge theory

-Getting to know the components of a scale

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Strength Of Materials

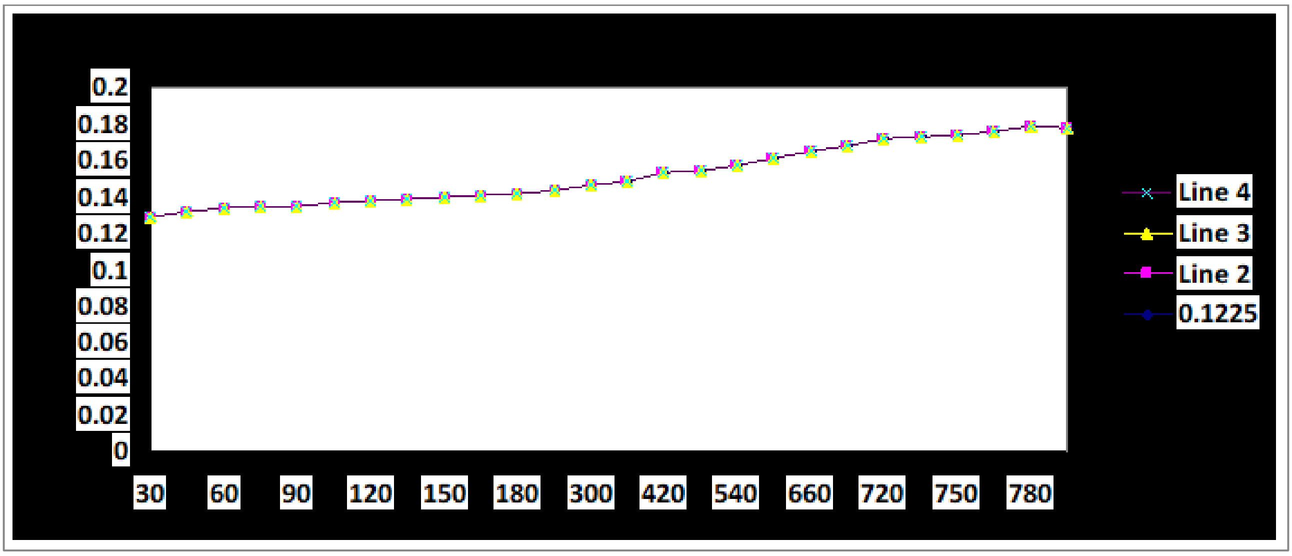
Creep Test

NAME:RUBA TAHA ID#:1933772

Specimen specifications: - made of Lead. - Dimensions: (2*5mm –Section), 20mm Length.
- Applied mass: 1.5 Kg. - Ambient temperature: 14º

Time (Sec.)	Dial Gauge Extension mm (Ext.1)	Extension (2)	STRAIN
15	4.90	2.45	0.1225
30	5.17	2.585	0.12925
45	5.27	2.635	0.13175
60	5.36	2.68	0.134
75	5.39	2.685	0.13475
90	5.40	2.7	0.135
105	5.48	2.74	0.137
120	5.52	2.76	0.138
135	5.56	2.78	0.139
150	5.58	2.79	0.1395
165	5.62	2.81	0.1405
180	5.64	2.82	0.141
240	5.74	2.87	0.1435
300	5.85	2.925	0.14625
360	5.95	2.975	0.14875
420	6.11	3.055	0.15275
480	6.18	3.09	0.1545
540	6.27	3.135	0.15675
600	6.45	3.225	0.16125
660	6.60	3.3	0.165
690	6.71	3.355	0.16775
720	6.86	3.43	0.1715
735	6.92	3.46	0.173
750	6.94	3.47	0.1735
765	7.01	3.505	0.17525
780	7.15	3.575	0.17875
795	7.10	3.55	0.1775

- Plot Strain against Time(s), the slope of the curve at the secondary region is the creep rate **έ.**



$L = 20\,mm$ applied mass $= 1.5\,Kg$ ambient Temp $= 14^{o}$

at $t = 15\,s$ $\Rightarrow Ext(2) = \frac{Ext(1)}{2} = \frac{4.9}{2}$

$= 2.45$

$$\varepsilon = \frac{Ext(2)}{L_o} = \frac{2.45}{20} = 0.1225$$

$$\text{slope} \quad \frac{0.15275 - 0.14625}{420 - 300} = 5.42 \times 10^{-5}$$

$R = 8.31\ J/mole.K$ $\quad E = 120\,kg/mol$

$\alpha = 0.85$

$P = (2.84 + 8 * M) * g$ $\quad m = 1.5\,kg$

$= (2.84 + 8 \times 1.5) \times 9.81$

$P = 145.5804\ N$

So $\sigma = \frac{P}{A} = \frac{145.5804}{10 \times 10^{-6}}$

Area

$= 14558040\,pa = 14.558\,Mpa$

- 2-Find the time required for each stage.
- 3-Calculate the constant B.

② Time required

* Primary ⇒ $15_s - 90_s$
* Secondary ⇒ $90_s - 540_s$
* tertiary ⇒ $540_s - 795_s$

③ calculate The constant B

$$\varepsilon = B e^{\alpha\sigma} \times e^{(-E/RT)}$$

$$B = \frac{\dot{\varepsilon}}{e^{\alpha\sigma} \quad e^{-E/Rt}}$$

$$B = \frac{5.42 * 10^{-5}}{e^{12,376} * e^{(-170/\,8.31 * 287)}}$$

$$= 2.40448 * 10^{-10}$$

- 4-State 2 applications where the creep test is essential in elements and members design.

  - In the bridges
  - In cars

Hardness Test

Student Name: Ruba Taha ID # : 1933772

Results and Analysis:

Test / Setting	Brinell Hardness Test (HB)	Vickers Hardness Test (HV)		Rockwell Hardness Test (HRC)	Rockwell Hardness Test (HRB)
		10	30		
Indenter	Steel ball 2.5 mm.	Diamond pyramid	Diamond pyramid	Diamond cone	Steel ball (1/16'')
Preload	3	3	3	10	10
Main load	187.5	10	30	150	100

Experiment parameters

Test / Materials	Brinell Hardness Test (HB)	Vickers Hardness Test (HV)		Rockwell Hardness Test (HRC)	Rockwell Hardness Test (HRB)
		10	30		
Mild steel	173	208	X	X	85.9
High speed steel	X	X	619	64.2	X
Aluminum	100	105	X	X	50.6
Brass	102	97	X	X	56.2

Experiment data and results

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Strength Of Materials

1-What is the reason or for using a minor load in the case of Rockwell hardness test method?

1. To make contact between specimen and indentor.
2. To overcome the roughness on the surface of specimen

2-A 10 mm diameter Brinell hardness indenter produced an indentation 2.5 mm in diameter in a steel alloy when a load of 100 kg was used. Compute the HBN of this material?

……………………………………………………………………………………………

3- Find the Ultimate tensile strength for the mild steel based on the hardness test?

……………………………………………………………………………………………

الفرع الثاني

2.

$D = 10$ mm

$d = 2.5$ mm

$P = 100$ Kg

$$HBN = \frac{P}{0.5 * \pi * D\left(D - \sqrt{D^2 - d^2}\right)}$$

$$= \frac{100}{0.5 * \pi * 10\left(10 - \sqrt{100 - 6.25}\right)}$$

$$= \frac{100}{4.987} = \boxed{20.0521}$$

الفرع الثالث.

3.

$$\sigma_{ult} = 3.4 * BHN$$

$$= 3.4 * 173$$

$$= \boxed{588.2 \text{ MPa}}$$