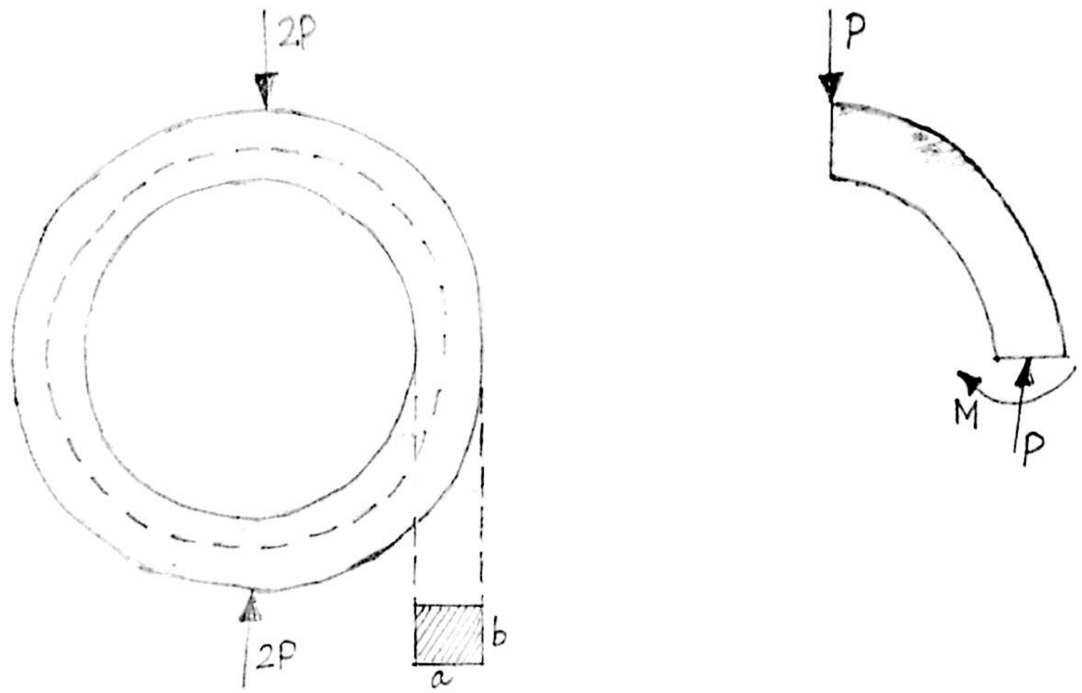

FORCES AND MOMENTS ON A PROVING RING

DATE
8/09/16

EXPT. NO.
11

CALIBRATION OF PROVING RING

- **Aim of the Experiment:** To calibrate the given proven ring by applying compressive force by U.T.M (universal testing machine)

- **Experimental Apparatus:**
  a) Proving Ring
  b) Dial gauge
  c) Universal Testing Machine
  d) Scale.

- **Theory:** Deflection: $\delta = \frac{PR\pi}{2EA} + \frac{PR\pi}{2GA} + \frac{0.3PR^3}{EI}$

  P = Load
  R = Mean Radius
  E = Young's Modulus of elasticity
  A = Area of Cross-Section
  I = Inertia of area of cross-section
  G = Modulus of rigidity.

- **Applications:**
  - Proving ring is used in sensing applications.
  - It can be also used as a device for caliberation of force measuring dial gauges.

• Observations :

$a = \frac{8.68 + 8.72 + 9.08}{3}$ mm $= \underline{8.83\ mm}$; $b = \frac{28.24 + 28.30 + 28.34}{3}$ mm $= \underline{28.29\ mm}$

least count of dial gauge = $\underline{0.001\ mm}$

Sr. No.	LOAD 2P (in kgs)	LOAD 2P (in N)	DEFLECTION (div)		DEFLECTION (m) $\times 10^{-6}$		DEFLECTION THEORETICAL (in µm)
			loading	Unloading	loading	Unloading	
1.	2.2	21.56	6	0	6	0	5.844
2.	3.0	29.40	8	0	8	0	7.9690
3.	3.3	32.34	9.2	0	9.2	0	8.766
4.	4.3	42.14	11.5	11.5	11.5	11.5	11.420
5.	5.5	53.90	16	16	16	16	14.610
6.	6.1	59.78	18	0	18	0	16.200

$R = \frac{16.4 + 16.3 + 18.0 + 17.9}{4} = \underline{17.15\ cm}$

E for stainless steel = $\underline{180\ GPa}$

G for stainless steel = $\underline{77.2\ GPa}$

$A = a \times b = \underline{249.8 \times 10^{-6}\ m^2}$

$\therefore I = \frac{1}{12} a^3 b = \frac{1}{12} \times (8.83)^3 \times (28.29) \times 10^{-12} m^4 = \underline{1.623 \times 10^{-9}\ mm^4}$

• Calculations :

$$\boxed{\delta = \frac{PR\pi}{2EA} + \frac{PR\pi}{2GA} + \frac{0.3PR^3}{EI}}$$

For $P = 29.4/2\ N = 14.7\ N$, (Reading number 2)

$$\delta = 14.7 \times \left(\frac{171.5\pi}{2 \times 180 \times 249.8 \times 10^{-6}} + \frac{171.5\pi}{2 \times 77.2 \times 249.8 \times 10^{-6}} + \frac{0.3 \times (171.5)^3}{180 \times 1.623 \times 10^{-9}} \right) \mu m$$

$\Rightarrow \boxed{\delta = 7.969\ \mu m}$

Similarly, δ is calculated for other values.

$P = K\delta$

$\Rightarrow \boxed{K = 3.034 \times 10^{+6}\ \frac{N}{m}}$

DATE 8/09/16

EXPT. NO. 11

Results:

- From the graph between load and deflection, the slope is found to be 3.103 N/um (3.103 ~~x~~ 10^6 N/m) which is very close to the calculated value of 3.034 X 10^6 N/m

Discussion:

- The observed values of deflection for the loads came very close to real /calculated values.
- The slope from graph comes very near to calculated factor
- calibration factor shows the sensivity of proving ring.
- This experiment shows us the sensing applications of proving ring.
- As we deform the ring in elastic region, our graph comes to be linear.
- The slope of the graph is called the calibration factor.

Relevant graphs on next page

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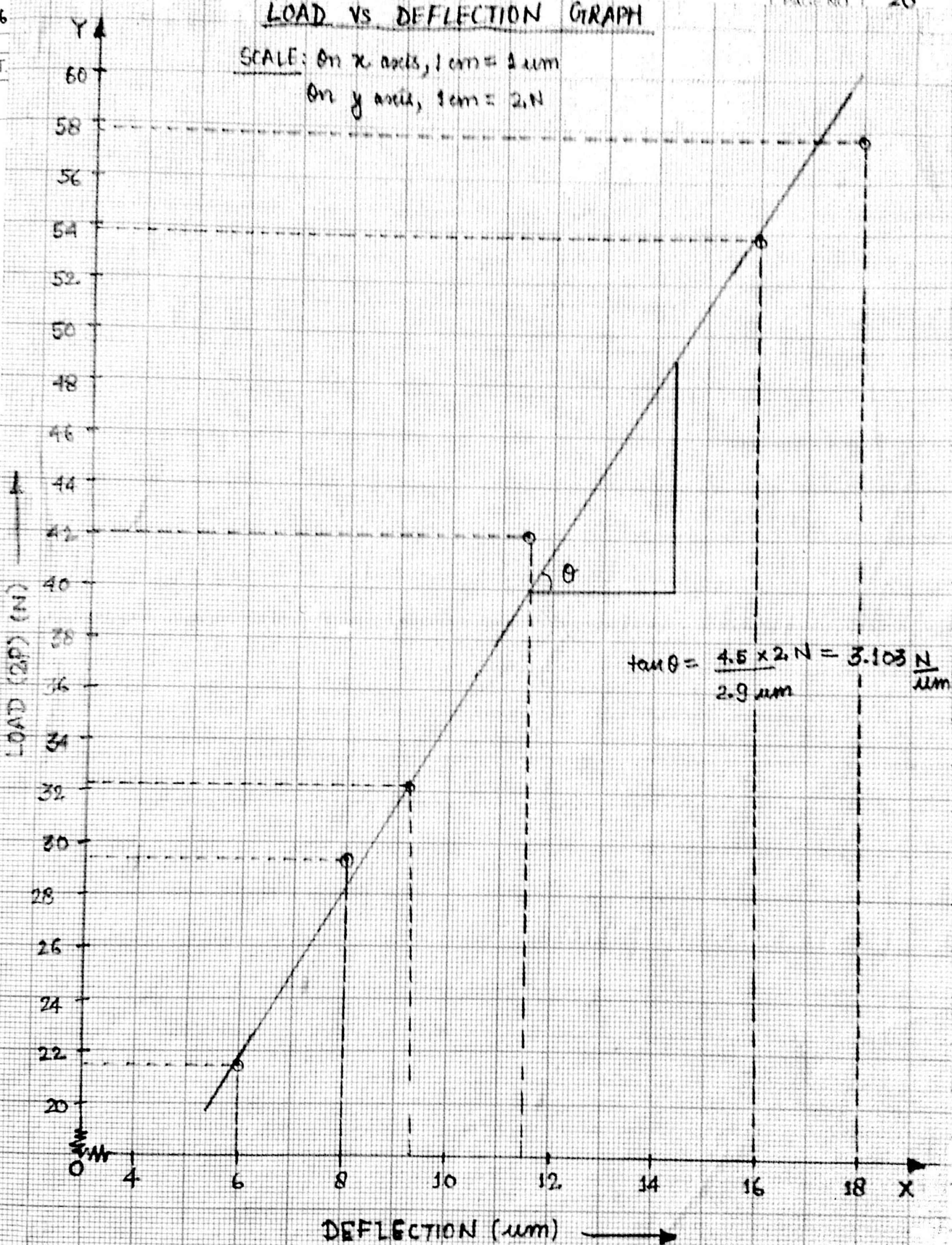
DATE 8/9/16

EXPT. 11

LOAD VS DEFLECTION GRAPH

SCALE: On x axis, 1 cm = 1 um

On y axis, 1 cm = 2 N



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