STRUCTURAL ANALYSIS III
LABORATORY MANUAL

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ROLL NO: _____

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Certificate

This is to certify that Mr. / Ms. _____

bearing roll no _____of B. Tech _____semester_____

_____ Branch has satisfactorily completed _____

_____ laboratory during the academic year ____.

Signature of Coordinator **Signature of Faculty**

Signature of Internal Examiner **Signature of External Examiner**

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EXPERIMENT 1: THREE HINGED ARCH

OBJECTIVE: Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.

APPARATUS: Three Hinged Arch Apparatus, Weight's, Hanger, Dial Gauge, Scale, Vernier Caliper.

THEORY: A three hinged arch is statically determined with the axial thrust assisting in maintaining the stability. The model has a span of 100cm and rise of 25cm with hinges at supports and crown. One of the ends rests on rollers along the horizontal span of the applications of load. This marked at the equidistant for the application of load. This being a statically determined structure, the horizontal thrust developed under the action of any load system can be theoretically calculated and will also be measured directly by neutralization of the outward movement of the roller end.

Taking moment about A

$$R_B \times L = W_1a_1 + W_2a_2 + W_3a_3$$

$$R_B = \frac{W_1a_1 + W_2a_2 + W_3a_3}{L}$$

Taking moment about B

$$R_A \times L = W_1(L-a_1) + W_2(L-a_2) + W_3(L-a_3)$$

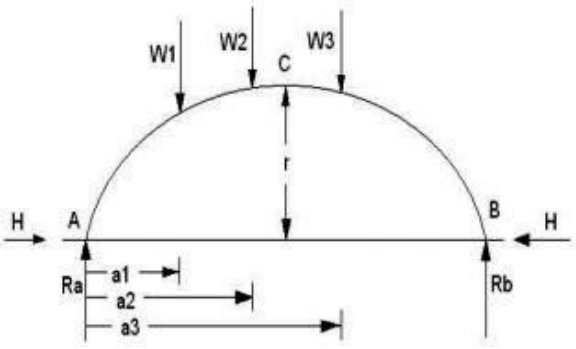
$$R_A = \frac{W_1(L-a_1) + W_2(L-a_2) + W_3(L-a_3)}{L}$$

Taking the moment of all the forces on left hand side about C. we get,

$$H \times r + W_1 \left(\frac{L}{2} - a_1\right) + W_2 \left(\frac{L}{2} - a_2\right) = R_A \times \frac{L}{2}$$

$$H = \frac{1}{r}\frac{1}{2}[W_1(L-a_1) + W_2(L-a_2) + W_3(L-a_3)] - W_1\left(\frac{L}{2} - a_1\right) - W_2\left(\frac{L}{2} - a_2\right)$$

DIAGRAM AND SETUP:



PROCEDURE:

i. Balance the self-weight of the arch by putting load on the thrust hanger till the

appropriate equilibrium conditions are obtained. The moveable end of the arch is positioned such that it shows a tendency to move inside on tapping the supporting table.

ii. Place a few loads on the arch in any chosen positions. Balance these by placing additional weights on the hanger for horizontal thrust. The additional weights on the thrust hanger give the experimental value of the horizontal thrust.

iii. Measure the distances a1, a2 and a3 from A with respect to the loads applied, W1, W2 and W3

OBSERVATION TABLE:

S. No.	Loads on hanger members from the roller end	Distance from left hand support (cm)	Additional load on the thrust hanger, H (Kg)
	Set No.	Load (Kg)	
1.	W_1	a_1 =	
2.	W_2	a_2 =	
3.	W_3	a_3 =	

OBSERVATIONS:

Span of the arch, L =

Central rise, r =

Initial load on the thrust hanger for balancing=

Result: Compare the horizontal thrust obtained theoretically with the values obtained experimentally.

PRECAUTIONS:

i. Apply the loads without any jerk.

ii. Perform the experiment at a location, which is away from any external disturbance.

iii. Ensure that the supports are rigid.

iv. The load applied should be within the allowed limits for the apparatus.

EXPERIMENT: 2 TWO HINGED ARCH

OBJECTIVE: To study two hinged arch for the horizontal displacement of the roller end for a given system of loading and to compare the same with those obtained analytically.

APPARATUS: Two Hinged Arch Apparatus, Weight's, Hanger, Dial Gauge, Scale, Vernier Caliper.

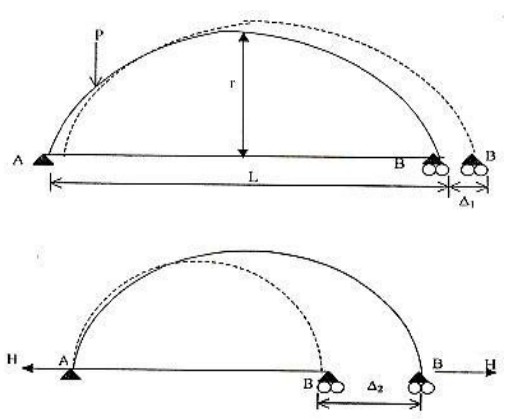
FORMULA: $H = \frac{5WL}{8r}(a - 2a^3 + a^4)$

Where,

W= Weight applied at end support. L= Span of two hinged arch.

r= rise of two hinged arch. a = dial gauge reading.

DIAGRAM AND SETUP:



THEORY: The two hinged arch is a statically indeterminate structure of the first degree. The horizontal thrust is the redundant reaction and is obtained y the use of strain energy methods. Two hinged arch is made determinate by treating it as a simply supported curved beam and horizontal thrust as a redundant reaction. The arch spreads out under external load. Horizontal thrust is the redundant reaction is obtained by the use of strain energy method.

PROCEDURE:

i) Fix the dial gauge to measure the movement of the roller end of the model and keep the lever out of contact.

ii) Place a load of 0.5kg on the central hanger of the arch to remove any slackness and taking this as the initial position, set the reading on the dial gauge to zero.

iii) Now add 1 kg weights to the hanger and tabulated the horizontal movement of the

roller end with increase in the load in steps of 1 kg. Take the reading up to 5 kg load. Dial gauge reading should be noted at the time of unloading also.

iv) Plot a graph between the load and displacement (Theoretical and Experimental) compare. Theoretical values should be computed by using horizontal displacement formula.

v) Now move the lever in contact with 200gm hanger on ratio 4/1 position with a 1kg load on the first hanger. Set the initial reading of the dial gauge to zero.

vi) Place additional 5 kg load on the first hanger without shock and observe the dial gauge reading.

vii) Restore the dial gauge reading to zero by adding loads to the lever hanger, say the load is w kg.

viii) The experimental values of the influence line ordinate at the first hanger position shall be 4w.

ix) Repeat the steps 5 to 8 for all other hanger loading positions and tabulate. Plot the influence line ordinates.

x) Compare the experimental values with those obtained theoretically by using equation (5).

OBSERVATION TABLE: Horizontal displacement

Sl. No.	Central load (kg)	0.0	1.0	2.0	3.0	4.0	5.0	6.0
	Observed horizontal Displacement (mm)							
	Calculated horizontal Displacement Eq. (4)							

SAMPLE CALCULATION: Central load (kg) =……..

Observed horizontal Displacement (mm). =

Calculated horizontal Displacement =

$$H = \frac{5WL}{8r}(a - 2a^3 + a^4) = \ldots\ldots\ldots\ldots \quad (5)$$

RESULT: The observed and horizontal displacement is nearly same.

PRECAUTION: Apply the loads without jerk.

Perform the experiment away from vibration and other disturbances.

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