Experiment No. : 5

Title of Experiment : Verification of Lami's Theorem using Jib Crane

Student's Name : Ayush Shailesh Jain

SAP No. : 60004200132

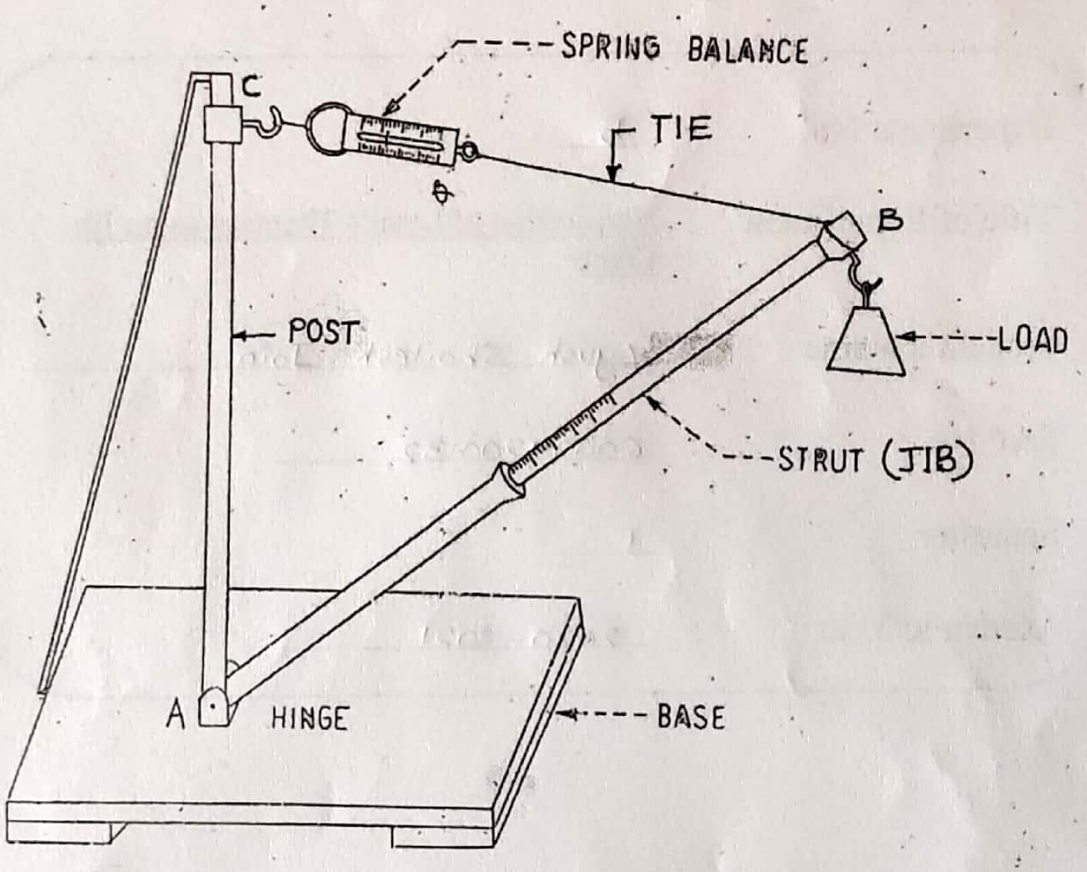
Semester : 1

Academic Year : 2020-2021

Punctuality	Reading & Understanding	Application	Total	Signature & Date
02	04	04	**10**	

DJ19FEC104.01	*Illustrate the effect of force and moment and apply the same along with the concept of equilibrium systems with the help of FBD.*
DJ19FEC104.02	*Demonstrate the understanding of Centroid and its significance and locate the same.*
DJ19FEC104.03	*Correlate real life application to specific type of friction and estimate required force to overcome friction.*
DJ19FEC104.04	*Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation.*
DJ19FEC104.05	*Analyze general plane motion of rigid bodies using Instantaneous centre.*
DJ19FEC104.06	*Analyze particles in motion using force and acceleration, work-energy and impulse-momentum principles.*

Set-up Diagram



JIB CRANE APPARATUS

Experiment No: 05 **Date:** 01/04/2021

Title : **Verification of Lami's Theorem using Jib Crane**

Aim: To determine the forces in Jib and tie of Jib Crane experimentally and verify the same analytically [Verification of Coplanar Concurrent Forces]

Apparatus :

Jib Crane equipment, load hanger, weights and angle measuring instrument, etc.

Theory :

Very often bodies are subjected to forces whose lines of action are situated in one plane. Such forces are termed as coplanar forces. In addition, if lines of action of all the forces pass through one point, then such forces are termed as coplanar concurrent force system.

If the F.B.D. of the joint at which load is applied on jib crane, is drawn, it forms an example of coplanar concurrent force system in equilibrium.

In general, equilibrium conditions for coplanar concurrent force system are as follows:

i) $\sum F_x = 0$ ii) $\sum F_y = 0$

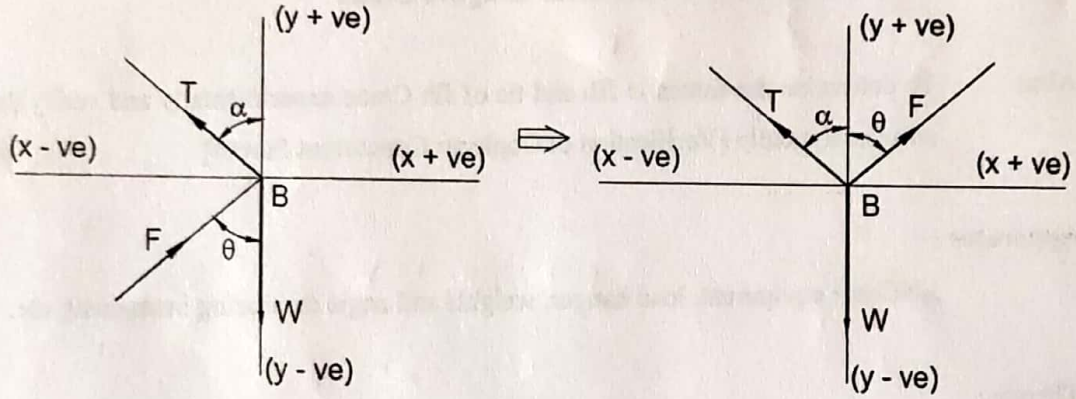
where, $\sum F_x$ = Algebraic sum of components of all forces in x direction.

$\sum F_y$ =, Algebraic sum of components of all forces in y direction.

If three concurrent coplanar forces acting on a body or particle are in equilibrium, then Lami's theorem can also be used to find the unknowns instead of using equilibrium conditions.

Lami's Theorem states "If three forces acting at a point are in equilibrium, the ratio of any of the forces to the sine of the angle between the remaining two forces is same".

Free Body Diagram



F B D OF JOINT B

Observation Table:

Sr. No.	W (N)	θ (degree)	α (degree)	Experimental		Analytical	
				Force in Jib (F) N	Force in Tie (T) N	Force in Jib (F) N	Force in Tie (T) N
1.	24.9	59	76	30	31	34.17	30.18
2.	35.2	61	73	46	45	46.8	42.8
3.	44.58	62	72	56	53	59.26	54.72

Sample Calculations:

By Lami's Theorem,

$$\frac{W}{\sin(\alpha+\theta)} = \frac{F}{\sin(180-\alpha)} = \frac{T}{\sin(180-\theta)}$$

$$\therefore \frac{24.9}{\sin(59+76)} = \frac{F}{\sin(180-76)} \qquad \therefore F = 34.17\ N$$

$$\therefore \frac{24.9}{\sin(59+76)} = \frac{T}{\sin(180-59)} \qquad \therefore T = 30.18\ N$$

Result:

The forces in jib and tie by observation are equal to the calculated values within the limits of experimental errors.

Precautions:

1. Always keep anchor weight on the base-plate of the setup.
2. Do not attach/apply a weight more than that of half the anchor weight on joint B to avoid overturning of the setup.
3. Do not stand below joint B, keep safe distance.