INSTRUCTIONAL MANUALS

OF

KOM Lab

Dr. Vikas Gupta, CDLSIET, Panniwala Mota

CAM ANALYSIS APPARATUS

CONTENTS:

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CAM ANALYSIS APPARATUS

1.0 INTRODUCTION AND THEORY:

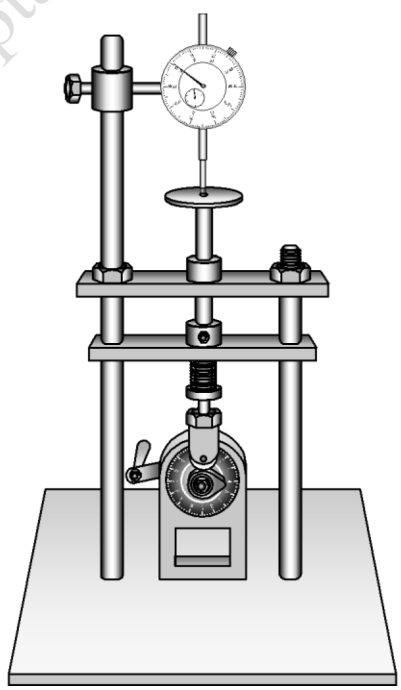
A cam may be defined as a rotating or a reciprocating element of a mechanism, which imparts a rotating, reciprocating or oscillating motion to another element termed as follower. In most of the cases the cam is connected to a frame, forming a turning pair and the follower is connected to the frame to form a sliding pair. The cam and the follower form a three-link mechanism of the higher pair type. The three links of the mechanism are (a) the cam which is the driving link and has a curved or a straight contact surface; (b) the follower which is the driven link and it gets motion by contact with the surface of the cam and (c) the frame which is used to support the cam and guide the follower. The cam mechanism is used in clocks, printing machines, automatic screw cutting machines, internal combustion engines for operating valves, shoe-making machinery etc. In fact all modern automatic machines require the help of a cam.

There are different types of cams as radial, cylindrical, reciprocating, tangent or circular cam. There are also different types of followers occurs viz. knife edge, roller, flat faced, spherical faced, offset, offset knife edge, offset mushroom etc.

2.0 OBJECTIVE:

To plot n v/s θ (follower displacement Vs. angle of cam rotation) curve for different cam follower pairs.

3.0 EXPERIMENTAL SET UP:



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The apparatus is designed to study the cam profile. At the free end of the camshaft, a cam (interchangeable) can be easily mounted. A push rod assembly is supported vertically and various types of followers (interchangeable) can be attached to this push rod. As the follower is properly guided in gunmetal bushes and the type of the follower can be changed to suit the cam under test. A graduated circular protractor is fitted coaxial with the shaft and a dial gauge can be fitted to note the follower displacement for the angle of cam rotation. A set of cams is provided consisting of as eccentric, tangent and circular arc type. A set of followers is also provided consisting of mushroom, roller and knife-edge type.

4.0 SUGGESTED EXPERIMENTAL WORK:

Step1: Select a suitable cam and follower combination.
Step2: Fix the cam on the shaft.
Step3: Fix the follower on push rod and properly tighten the check nut, such that knife-edge of follower (or axis of roller in case of roller follower) is parallel to axis of camshaft.
Step4: Attach the dial gauge on the push rod.

5.0 RESULTS & DISCUSSIONS:

1. The exact profile of the cam can be obtained by taking observations n V s θ. Where n = displacement of the follower from rotation initial position and θ = angle of cam rotation with reference from axis of symmetry chosen.
2. Plot n v/s θ (follower displacement Vs. Angle of cam rotation) curve for different cam follower pairs.

6.0 APPENNDIX-1: Critical data of experiment

Cams	: Circular arc cam
	: Eccentric cam
	: Tangent cam
Follower	: Mushroom follower
	: Roller follower
	: Knife-edge follower

7.0 PRECAUTIONS:

1. While assembling following precautions should be taken.
   (a) The horizontality of the upper and lower glands should be checked by a spirit level.
   (b) Lubrication
   The cam is to be lubricated by oil before starting.

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COMBINED COIL AND BELT FRICTION APPARATUS

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COMBINED COIL AND BELT FRICTION APPARATUS

1.0 THEORY

If a rope or a belt passes over a pulley with the angle of contact θ, then the two tensions T_1 and T_2 on the two sides of the rope or belt at the point of slipping from an equilibrium, is given by:

$$\frac{T_1}{T_2} = e^{\mu \theta}$$

Where,

T_1	= Tight side tension (driving side of the belt)
T_2	= Slack side tension (driven side of the belt)
θ	= Angle of lapping in radians
μ	= Coefficient of friction between the rope or belt with the pulley

From this μ can be determined by

$$\mu\theta = \log_e \left[\frac{T_1}{T_2}\right] \qquad \text{or,} \quad \mu = \frac{1}{\theta} \log_e \left[\frac{T_1}{T_2}\right]$$

2.0 OBJECTIVE:

1. To determine the coefficient of friction between a flat belt or rope and a pulley by the help of Combined Coil & Belt Friction Apparatus.

3.0 APPARATUS:

The apparatus consists of a vertical stand, on which a large wooden disc is mounted. At the centre there is a pulley, which is fixed to the disc and near the rim of the disc there is a free pulley. A handle is provided, which, when made loose, provides a free rotation of the disc as a whole, thereby varying the angle of contact. The disc can be fixed at any position by tightening the handle.

4.0 SUGGESTED EXPERIMENTAL WORK:

Step1: Note down the weights of the hangers. They can be treated as neglected as the weight of both the hangers is nearly same.

Step2: Place the belt/rope over the fixed pulley and over the free pulley. Suspend the hangers on the two ends of the belt.

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Step3: Make the handle loose and rotate the disc until the common tangent line of the belt of both the pulleys, become horizontal. Tighten the handle. At this position the angle of contact is 90^o. Note down the reading on the disc corresponding to the pointer.

Step4: Put some weights on both the hangers so that the belt remains in tension.

Step5: Increase weights on one of the hanger gradually, until the belt just slips over the fixed pulley. Note down the weights W put on the hanger.

Step6: By making the handle loose, rotate the disc so that the angle of contact increases. This will be indicated by the shift of the point on the graduated scale against the pointer. Fix the disc in this position, put more and more weights Δ W on the tight side of the belt gradually until the belt just slips over the fixed pulley.

Step7: Similarly for angles 120^o, 150^o, 180^o and the more angle and 60^o of contact below 90^o, collect sets of T_1 and T_2 readings.

5.0RESULTS AND DISCUSSIONS:

Determine the value of μ from above set of readings.

6.0 SAMPLE DATA SHEET:

Sl. No	Angle of Contact θ		Initial weight on pan, W (kg)	Additional Weights on tight side, W_1 (kg)	$T_1 = W+W_1$ (kg)	Additional Weights on slack side, W_2 (kg)	$T_2 = W+W_2$ (kg)	Co-efficient of friction μ
	Degree	Radian						

7.0 PRECAUTION:

1. Weights should be increased in steps.
2. Weights should be increased gradually without jerk.

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COMBINED COMPRESSION AND EXTENSION OF SPRING APPARATUS

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COMBINED COMPRESSION AND EXTENSION OF SPRING APPARATUS

1.0 THEORY:

According to Hook's law, "within elastic limit, the stress developed in a body is directly proportional to the strain produced",

i.e. Stress α strain

(1)

If a wire or a spring is stretched by hanging a weight, then

$$Stress = \frac{Weight\ hung}{area\ of\ cross\ section\ of\ the\ wire\ or\ spring}$$

and

$$Strain = \frac{increase\ in\ length}{original\ length}$$

In the case of the extensions of wires and springs, the cross sectional area remains practical constant. Hence in such a case Stress α Weight hung

It is quite obvious that, Stress α increase in length produced. Because original length is a constant quantity. Thus we have from relation (1)

Weight hung α increase in length.

Thus the extension produced in a spring is directly proportional to the weight hung from it. So a graph between the weights hung and the corresponding extension produced will be a straight line.

This straight-line graph can be used to determine the value of an unknown weight if we can measure the extension produced by it in the spring.

Similarly in compression the value of weight hung and compressed valued of spring is taken under consideration.

2.0 OBJECTIVE:

To establish graphically the relationship between stress and strain of helical spring under compression and extension.

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3.0 APPARATUS:

Apparatus consists of a C.I. bracket, which is provided with 4 holes for attaching it to the wall and is fitted with sliding vernier and scale arrangement. Apparatus is supplied complete with a set of helical spring with three springs for the compression and three for the extension.

4.0 SUGGESTED EXPERIMENTAL WORK:

Step1: Take two helical springs and place them between the apparatus.

Step2: Spring with hooks will be hanged and spring with flat surface will be placed in the apparatus.

Step3: With no weights on the hanger, read the position x_o of the pointer on the millimeter scale.

Step4: Increase weights on the lower hook in equal steps and note the corresponding positions of the pointer on the scale. The amount of increments in weights to be placed on the hanger is chosen according to the strength of the spring.

Step5: Draw a graph between the total weight W hung and the corresponding extension l produced.

Step6: Repeat above steps with other types of springs provided.

5.0 RESULTS AND DISCUSSIONS

1. Plot a graph between W and l. Comment.

6.0 SAMPLE DATA SHEET:

Position of the pointer on the scale with no weights on the hanger = X_O cm
Weight of the hanger = W_O cm
Table for compression and extension of springs at various loads

Sl. No.	Weight on the hanger W_1 (kg)	Total wt. Hung $W=W_1+W_O$ (kg)	Pointer position in loading X_1 (mm)	Extension/ compression $l = X-X_O$ (mm)

7.0 PRECAUTIONS:

- The support from where the spring is hung should be rigid and should not yield.
- After loading or unloading the hanger, the pointer's position should not be noted immediately. It should be done after a few minutes because the spring takes some time in occupying the new position or regaining its old one as the case may be.
- Loading should not be done beyond the elastic limit of the spring.

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COMBINED INCLINED PLANE AND FRICTION SLIDE APPARATUS

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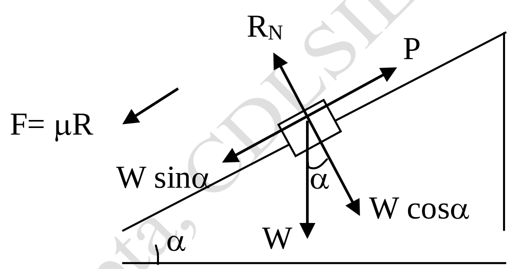
COMBINED INCLINED PLANE AND FRICTION SLIDE APPARATUS

1.0 THEORY:

It has been established since long that the surfaces of the bodies are never perfectly smooth. It has been observed that whenever, even a very smooth surface is viewed under a microscope, it is found to have some roughness and irregularities, which may not be detected by an ordinary touch. It has also been observed that if a block of one substance is placed over the level surface of the same or different material, a certain degree or interlocking of the minutely projecting particles takes place. This does not involve any force, so long as the block does not move or tends to move. But whenever one of the blocks moves or tends to move tangentially with respect to the surface, on which it rests, the interlocking property of the projecting particles opposes the motion. This opposing force, which acts in the opposite direction of the movement of the block, is called force of friction or simply friction.



Consider a body of weight W on a plane having an angle of inclination α i.e. resting on an inclined plane. Suppose it just tends to move up the inclined plane when a force of P is applied.

Since the body tends to move upwards, the frictional force F will be acting downwards.

The force on the body can be resolved into two components perpendicular and parallel to the plane. Resolving the forces parallel to the plane, we get

$$P = \mu R + W \sin\alpha \qquad (1)$$

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The component W cosα perpendicular to the plane balances the normal reaction R and the component W sinα parallel to the plane provides the necessary force for the body to move down the plane.

Substituting the value of R in equation (1), we get

$$P = \mu W \cos\alpha + W \sin\alpha$$

Or

$$\mu W \cos\alpha = P - W \sin\alpha$$

$$\therefore \mu = \frac{P - W \sin\alpha}{W \cos\alpha}$$

This μ is the coefficient of friction.

2.0 OBJECTIVE:

To determine the coefficient of friction between different pairs of given surfaces.

3.0 APPARATUS:

The apparatus consists of a wooden plane having adjustment for setting the required angle precisely with graduated arc and vertical scale is provided. A frictionless pulley is attached to the end by means of a clamp adjustable to any necessary position. Apparatus is supplied with a wheeled trolley and a set of slide draws having bottom of different materials, string and pan.

4.0 SUGGESTED EXPERIMENTAL WORK:

Step1: Note down the angle of inclination α after setting the inclined plane. The top surface of inclined plane is of wood.

Step2: Place the wooden block (slider) of known weight W, on the inclined plane. Tie the slider to the pan (of known weight) with the help of the thread passing over the frictionless pulley.

Step3: Put some weights in the pan till the slider just begins to slide upeards. Note down this weight in the pan.

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Step4: Repeat above procedure with other slides and with other angle of inclinations.

5.0 RESULTS AND DISCUSSIONS:

1. Find out the effort P i.e. Weight of Pan + Weights in the pan
2. Calculate the coefficient of friction μ for each pair of surfaces by using the equation

$$\therefore \mu = \frac{P - W \sin\alpha}{W \cos\alpha}$$

3. Find the average coefficient of friction for each surface.

6.0 SAMPLE DATA SHEET:

1. Weight of pan =

Sl. No.	Surface of slider (Material) With wood	Weight of Slider, W	Weight of pan + Weights in pan, P	Inclination of plane, α	Co-efficient of friction $\mu = \frac{P - W \sin\alpha}{W \cos\alpha}$

Mean value of coefficient of friction μ for a surface =

7.0 PRECAUTIONS:

- Pulley should be frictionless.
- There should not be any knot in the string.
- Weight should be placed in effort pan slowly.
- String should be parallel to the plane.
- The surface of the inclined plane should be smooth and clean.
- Proper lubrication of the pulley should be done to decrease friction.

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COMPOUND SCREW JACK APPARATUS

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COMPOUND SCREW JACK APPARATUS

1.0 OBJECTIVE:

To determine the mechanical advantage, velocity ratio and efficiency of compound screw jack.

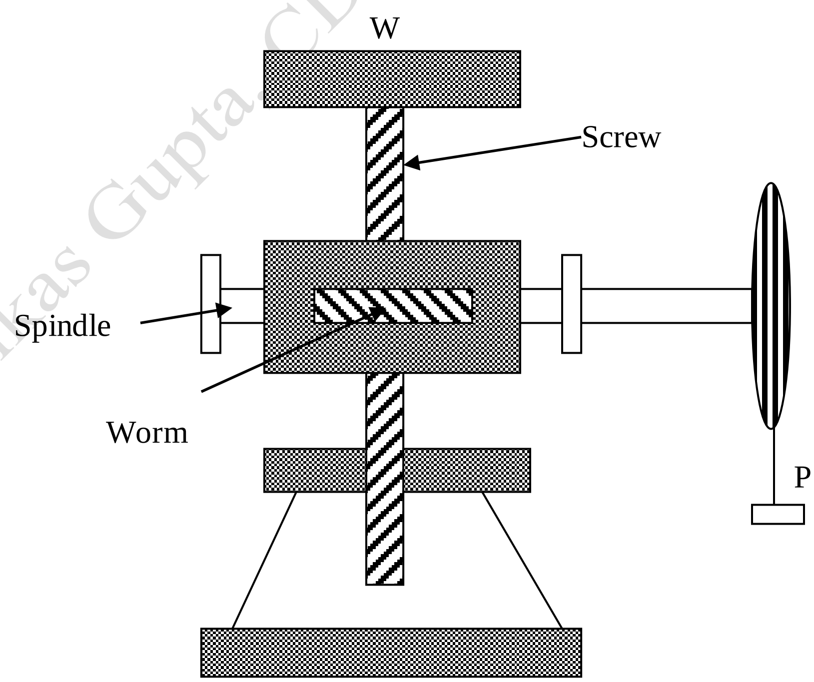
2.0 APPARATUS:

Apparatus consists of a jack having screw of 4 TPI and start carrying load platform. The nut of the screw is fitted on a pedestal bearing and is keyed to a worm gear of 40 teeth operated by a worm screw. The spindle of the worm gear is provided with an effort wheel of 15 cm diameter. Apparatus requires a string, pan, weight set and a meter scale or outside calliper.

3.0 THEORY:

For lifting heavy loads, a machine named compound screw jack is used. A compound screw jack consists of a jack with worm geared screw. It is an improved version of screw jack in which the screw is lifted with the help of worm and worm wheel, instead of effort at the end of a lever.

Now consider a worm-geared screw jack.



Compound screw jack

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Let D = Diameter of effort wheel
p = Pitch of the screw
T = Number of teeth on worm wheel
W = Load lifted and
P = Effort applied to lift the weight

For one revolution of the effort wheel, the distance moved by effort = πD

When worm is single threaded, then for one revolution of the effort wheel, the screw pushes the worm wheel through one tooth, then the worm wheel will move through 1/T revolution.

$$\therefore \text{ Distance moved by load} = \frac{p}{T}$$

$$V.R = \frac{\text{Distance moved by the effort}}{\text{Distance moved by the load}}$$

$$= \frac{\pi D}{p/T}$$

$$= \frac{\pi DT}{p}$$

When worm is n threaded, then $V.R. = \dfrac{\pi DT}{nP}$

Now Mechanical advantage $M.A. = \dfrac{W}{P}$

Efficiency $\eta = \dfrac{M.A.}{V.R.}$

4.0 EXPERIMENTAL PROCEDURE:

Step1: Note down the pitch ‘p’ of the screw.
Step2: Measure the Diameter of the effort wheel with an inextensible thread and meter scale or measure the diameter with the help of outside caliper.
Step3: Note down the number of teeth on the worm screw.
Step4: Wound one end of the string on the wheel in clockwise direction. And attach a pan in the opposite direction.

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Step5: Place a load 'W' on the top of the flanged table and start adding weights on to the effort pan gradually till the load starts lifting. P is the weight (effort) in the pan.

Step6: Calculate M.A, V.R. and % efficiency.

Step7: Repeat the above procedure by increasing the load 'W' on table and note down the corresponding efforts applied.

5.0 SAMPLE DATA SHEET:

1. Pitch of the screw, p, mm =
2. Diameter of the effort pulley, D, mm =
3. Number of teeth on the worm wheel, T =
4. Velocity ratio, V.R. =
5. Weight of the pan (if used), x, kg =

Sl. No.	Load on table, W (kg)	Total effort, $P = P_1 + x$ (if used) (kg)	$M.A. = \frac{W}{P}$	% efficiency η $= \frac{M.A}{V.R.} \times 100$

6.0 PRECAUTIONS:

1. There should not be any overlapping of the strings.
2. Weights in the pan should be placed very gently.
3. The pulley should be free from friction.
4. The screw should be well lubricated to reduce the friction.
5. The string should be free from knot.
6. See that the pan should move downwards.

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CRANK AND SLOTTED LEVER MECHANISM

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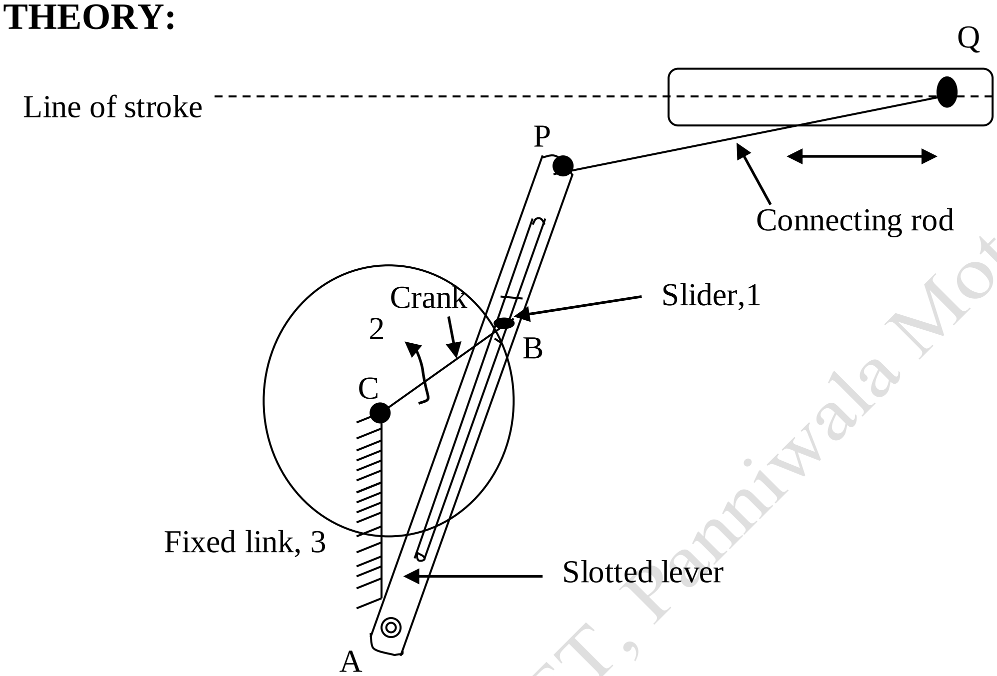
CRANK AND SLOTTED LEVER MECHANISM

1.0 THEORY:



Crank and Slotted lever quick return Mechanism

Crank and slotted lever mechanism is an inversion of single slider crank chain mechanism. This mechanism consists of four links, which consist of three turning pairs and one sliding pair. As shown in above figure in crank and slotted lever mechanism, the link AC (link 3) corresponding to the connecting rod is fixed. The driving crank CB (link 2) revolves about center C. A slider (link 1) attached to the crank pin at B slides along the slotted lever AP (link 4) and make the slotted lever oscillate about the pivoted point A. A short link PQ transmits the motion from AP to the arm, which reciprocates along the line of stroke. The line of stroke is perpendicular to the AC produced. This mechanism is used in shaping machines, slotting machines and rotary combustion engines etc.

2.0 OBJECTIVE:

To determine the ratio of maximum velocities during forward and backward stroke for the crank and slotted lever quick return mechanism.

3.0 APPARATUS:

Apparatus consists of a wooden board on which a crank and slotted lever mechanism is mounted. Provision is made for the measurement of crank rotation and actual slider displacement.

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4.0 EXPERIMENTAL PROCEFURE:

Step1: Bring the crank and the ram to zero positions.
Step2: For the given crank angle of rotation, note the displacement of the ram.
Step3: Plot a graph between crank rotation v/s displacement of the ram.
Step4: Assume the crank is rotating with a uniform angular speed of 1 rad/sec.
Step5: Determine the max. velocities during forward and backward stroke.
Step6: Determine the ratio of max. velocities at forward and backward stroke.

5.0 OBSERVATION AND COMPUTATION SHEET:

length of crank, r, mm=

Sl. No.	Crank rotation, θ (degree)	Displacement, X (cm)	Velocity, V cm/sec
During Forward stroke			
During backward stroke			

6.0 PRECAUTIONS:

01 The slider and slotted lever should be lubricated to decrease friction.
02 Displacement and crank rotation should be measured accurately.

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HOOKE'S JOINT APPARATUS

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HOOKE'S JOINT (UNIVERSAL COUPLING)

1.0 THEORY:

Hooke's joint is a device to connect two shafts whose axes are neither co-axial nor parallel but intersect at a point. It is used to transmit power from the engine to the rear axle of an automobile and similar other applications.

It consists of two forks connected by a center piece, having the shape of of a cross or square carrying four trunnions. The ends of the two shafts to be connected together are fitted to the forks.

Let

α = angle between the axes of two shafts.

β = angle turned through by the driving shaft.

ϕ = angle turned through by the driven shaft

ω_1 = angular velocity of driving shaft

ω_2 = angular velocity of driven shaft

Then, theoretically,

$$\frac{\omega_1}{\omega_2} = \frac{1 - \text{Cos}^2\theta\,\text{Sin}^2\alpha}{\text{Cos}\,\alpha}$$

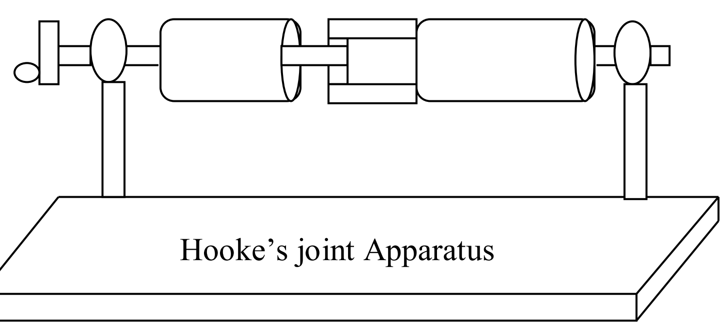
Also Experimentally

$$\frac{\omega_1}{\omega_2} = \frac{\Delta\theta}{\Delta\phi}$$

2.0 OBJECTIVE:

To determine the ratio of angular speed of shafts of a Hooke's Universal joint.

3.0 APPARATUS:



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Hooke's Joint apparatus is shown in above fig. This joint has the provision for measuring the angle of rotation of the driving and driven shafts. The angle between the driving and driven shafts can also be varied and measured.

4.0 EXPERIMENTAL PROCEDURE:

Step1: Adjust the angle between the shafts to be 15°

Step2: Set the angles of driving and driven shaft to be equal to zero degree.

Step3: Rotate the driving shaft through equal intervals of 30° and note down the corresponding angles of the driven shaft.

Step4: Change the angle between the shafts to 30°, 45°, 60° and 90° etc. and repeat the experiment.

Step5: Calculate the ratio of incremental angles turned through by the driving and driven shafts.

Step6: Calculate the theoretical values and compare.

5.0 OBSERVATION AND COMPUTATION SHEET:

Sl. No.	For $\alpha = 15^o$				For $\alpha = 30^o$			
	θ	ϕ	ω_1/ω_2		θ	ϕ	ω_1/ω_2	
			Exp.	Theor.			Exp.	Theor.

6.0 PRECAUTIONS:

01 Lubricate all moving parts to minimize friction.

02 All angles should be measured carefully.

03 Clearance in joints should be minimize.

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SIMPLE SCREW JACK APPARATUS

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SIMPLE SCREW JACK APPARATUS

1.0 OBJECTIVE:

To determine the mechanical advantage, velocity ratio and efficiency of a simple screw jack.

2.0 APPARATUS:

Simple screw jack apparatus complete with two strings, pans, weight set and a meter scale or outside calliper.

3.0 THEORY:

For lifting heavy loads, a machine named simple screw jack is used. It consists of a screw, fitted in a nut, which forms the body of the jack. It works on the principle of screw and nut. A simple screw jack is rotated by the application of an effort, at the end of the lever, for lifting the load.

Let D = Diameter of the flanged table
W = Load to be lifted
P = Effort required to lift the load
p = Pitch of the screw (Pitch is the axial distance between any two corresponding points

Suppose the flanged table be turned by one revolution.
Therefore, the distance moved by the load in one revolution = p

Distance moved by the effort in one revolution = πD

Therefore, Velocity ratio is

$$V.R. = \frac{\text{Distance moved by the effort}}{\text{Distance moved by the load}}$$

$$= \frac{\pi D}{p}$$

Now Mechanical advantage $M.A. = \frac{W}{P}$

Efficiency $\eta = \frac{M.A.}{V.R.}$

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4.0 SUGGESTED EXPERIMENTAL WORK:

1. Note down the pitch ‘p’ of the screw.
2. Measure the circumference of the flanged table with an inextensible thread and meter scale or measure the diameter of flanged table with the help of outside calliper
3. Wrap the string round the circumference of the flanged table and pass it over one pulley. Similarly wrap another string over the circumference of flanged table and take it over the second pulley. The free ends of both the strings be tied to two pans/hanger in which the weights are to placed/hanged.
4. Place a load ‘W’ on the top of the flanged table and start adding weights on to the pans gradually till the load starts lifting. P_1 and P_2 are the weights (effort) in the pans.
5. Calculate M.A, V.R. and % efficiency.
6. Repeat the above procedure by increasing the load on flanged table and note down the corresponding efforts applied.

5.0 SAMPLE DATA SHEET:

1. Pitch of the screw, p, mm =
2. Diameter of the flanged table, D, mm =
3. Circumference of the flanged table, πD, mm =
4. Velocity ratio, V.R. =
5. Weight of the pan (if used), x, kg =

Sl. No.	Load on flanged table, W (kg)	Total effort, $P = P_1+P_2 + x$ (if used) (kg)	$M.A. = \frac{W}{P}$	% efficiency η $= \frac{M.A}{V.R.} \times 100$

6.0 PRECAUTIONS:

7. There should not be any overlapping of the strings.
8. Weights in the pan should be placed very gently.
9. The guide pulleys should be free from friction.
10. The screw should be well lubricated to reduce the friction.
11. The string should be free from knot.
12. See that both the pans/hanger should move downwards.

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SIMPLE SCREW JACK APPARATUS

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1.0 OBJECTIVE:

To determine the mechanical advantage, velocity ratio and efficiency of a simple screw jack.

2.0 APPARATUS:

Simple screw jack apparatus complete with two strings, pans, weight set and a meter scale or outside calliper.

3.0 THEORY:

For lifting heavy loads, a machine named simple screw jack is used. It consists of a screw, fitted in a nut, which forms the body of the jack. It works on the principle of screw and nut. A simple screw jack is rotated by the application of an effort, at the end of the lever, for lifting the load.

Let D = Diameter of the flanged table
W = Load to be lifted
P = Effort required to lift the load
p = Pitch of the screw (Pitch is the axial distance between any two corresponding points

Suppose the flanged table be turned by one revolution.
Therefore, the distance moved by the load in one revolution = p

Distance moved by the effort in one revolution = πD

Therefore, Velocity ratio is

$$V.R. = \frac{\text{Distance moved by the effort}}{\text{Distance moved by the load}}$$

$$= \frac{\pi D}{p}$$

Now Mechanical advantage $M.A. = \frac{W}{P}$

Efficiency $\eta = \frac{M.A.}{V.R.}$

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4.0 SUGGESTED EXPERIMENTAL WORK:

7. Note down the pitch ‘p’ of the screw.
8. Measure the circumference of the flanged table with an inextensible thread and meter scale or measure the diameter of flanged table with the help of outside calliper
9. Wrap the string round the circumference of the flanged table and pass it over one pulley. Similarly wrap another string over the circumference of flanged table and take it over the second pulley. The free ends of both the strings be tied to two pans/hanger in which the weights are to placed/hanged.
10. Place a load ‘W’ on the top of the flanged table and start adding weights on to the pans gradually till the load starts lifting. P_1 and P_2 are the weights (effort) in the pans.
11. Calculate M.A, V.R. and % efficiency.
12. Repeat the above procedure by increasing the load on flanged table and note down the corresponding efforts applied.

5.0 SAMPLE DATA SHEET:

1. Pitch of the screw, p, mm =
2. Diameter of the flanged table, D, mm =
3. Circumference of the flanged table, πD, mm =
4. Velocity ratio, V.R. =
5. Weight of the pan (if used), x, kg =

Sl. No.	Load on flanged table, W (kg)	Total effort, $P = P_1 + P_2 + x$ (if used) (kg)	$M.A. = \frac{W}{P}$	% efficiency η $= \frac{M.A}{V.R.} \times 100$

6.0 PRECAUTIONS:

13. There should not be any overlapping of the strings.
14. Weights in the pan should be placed very gently.
15. The guide pulleys should be free from friction.
16. The screw should be well lubricated to reduce the friction.
17. The string should be free from knot.
18. See that both the pans/hanger should move downwards.

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Whitworth Quick Return Mechanism

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1.0 INTRODUCTION:

The Whitworth quick return motion also has a slotted link and sliding block as shown in figure . This mechanism is used on planing machine, which is quite large and on slotting machine which are small. With the slotting machines a single point tool is fixed to the front of the slider and is used for cutting fine grooves and key-ways. With planning machines the slider is the worktable on which the workpiece is secured. This moves with slow forward and quick return motion beneath a stationary single point cutting tool.

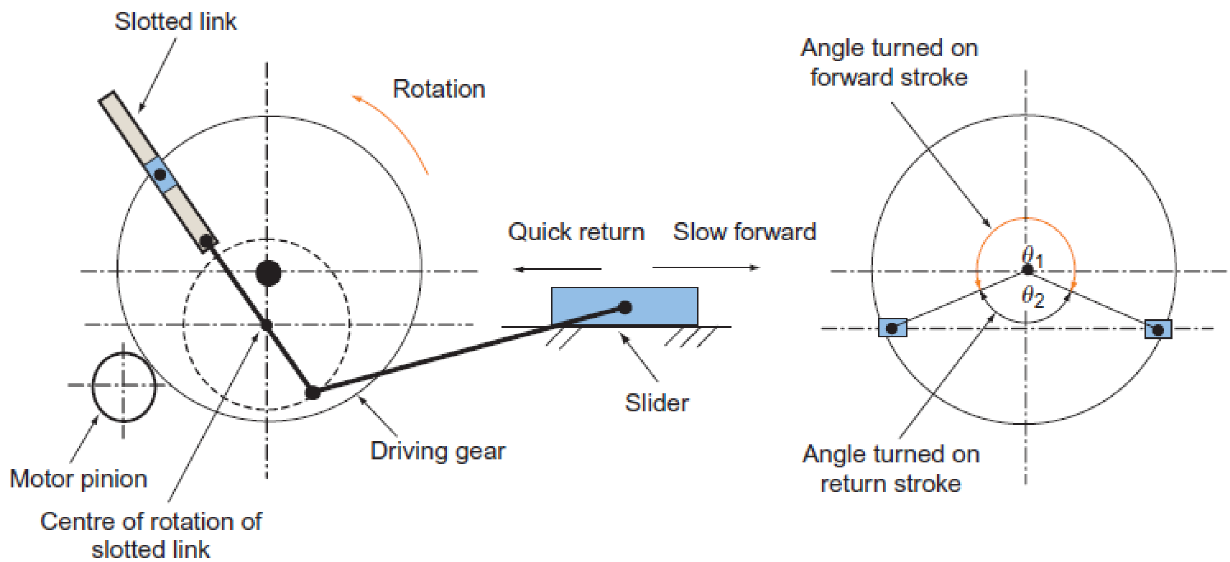

Figure 2: Whitworth quick return mechanism

1.0 OBJECTIVE:

To study Withworth quick return mechanism.

2.0 APPARATUS:

Apparatus consists of a wooden board on which Withworth quick return Mechanism is mounted. Provision is made for the measurement of crank rotation and actual slider displacement.

3.0 **EXPERIMENTAL PROCEDURE:**

Step1: Bring the crank to the inner dead center position (I.D.C.).
Step2: Measure total degree for forward stroke.
Step2: Measure total degree for return stroke.

4.0 OBSERVATIONS TABLE:

Sl. No.	Crank rotation θ (deg)		Displacement, mm	
	Forward Stroke	Return Stroke	Forward Stroke	Return Stroke

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DETERMINATION OF YOUNG'S MODULUS BY SEARLE'S METHOD

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Description:

In this method a sensitive spirit level and a micro-meter screw is used for measuring the increase in length. Searle's apparatus is shown in fig. (a) and (b).

Searle's apparatus consists of a pair of frames, hinged together by cross pieces EF and GH in such a way, that they are free to move up and down with respect to each other. A strip mounted in the frame I rests on the tip o0f micro-meter screw M which passes through the cross piece of the frame II. A sensitive level S is mounted on a strip which is pivoted at P in frame I.

The wires A and B are identical in length, material and diameter and are suspended from a rigid support C. At the lower end of these wires two frames are connected. The wires a which is used for comparison is kept tight by suspending from its frame I a constant load D. Form the frame II of the experimental wire B, is suspended a hook to carry a load which can be changed at w111.

To remove the kinks if any in the wire load and unload the wire B, a number of times and then stretch the wire by placing a load W_0. Measure its length from the top of the frame to the point of suspension. Let this original length be L_m.

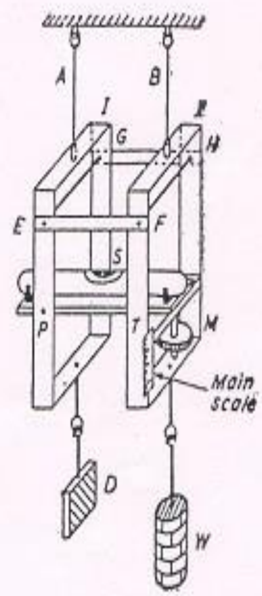
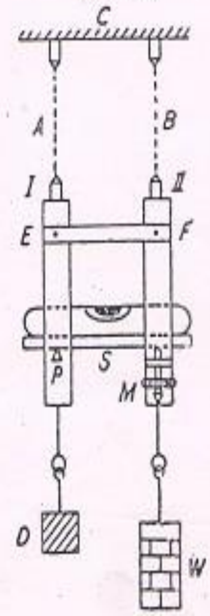


Fig. 7·9 (a)



Measure the diameter of the wire at different places along its length, taking two readings at right angles to each other at each position. Determine the mean diameter of the wire from these measurements and calculate with this value the area of cross-section πr^2 in m^2.

With the dead load W_0, adjust the micro-meter screw, until the air bubble of the spirit level is in its centre. Record the readings of the linear millimetre scale and the corresponding reading of the circular scale of the micro-meter screw against the former. Take it as the zero reading.

Increase load on the experimental wire by placing a weight on the hook. The wire B is stretched and gets increase in length and the frame II moves down relative to frame I. Now raise the lowered side of the strip by adjusting the micro-meter screw upward till the air bubble again comes back in the central position. Record the reading of the micro-meter with respect to the linear scale. The difference of the reading for load W_0 and this gives the increase in length of wire due to weight. Repeat the observations by increasing the load and adjusting the spirit level for each load. In this way determine the successive extensions corresponding to each additional load.

Now the weight on the hanger is decreased in stages and the readings of the micro-meter screw are recorded. The mean of the two readings corresponding to equal weight while loading and unloading is found out for each step. Plot a graph between the load in kg and extension in m. a straight line graph is obtained. From this graph h the ratio F/l in N/m^2 is found out.

If L is the length of the wire, then

Young's modulus $Y = \frac{F/a}{\frac{l}{L}} = \frac{F \times L}{a \times l}$

If M is the mass of the weight and r mean radius, then

1. $Y = \frac{Mg\ L}{\pi r^2}$ N/m^2

COMMENT:

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