Trapezoidal Method: Demonstration Model

Course: Engineering Drawing

Topic: Projections of Straight Lines

Class: B.E. I-Semester

Objective: To understand the

- Projections of straight line (AB) inclined to both the principal planes
- Traces of the Line (HT & VT)
- Collinearity of Front View Projections, h & VT (a’ b’ h VT)
- Collinearity of Top View Projections, v & HT (a b v HT)
- Determination of true length of the line given the projections
- Determination of true inclinations of line with the principal planes

Method: Demonstration

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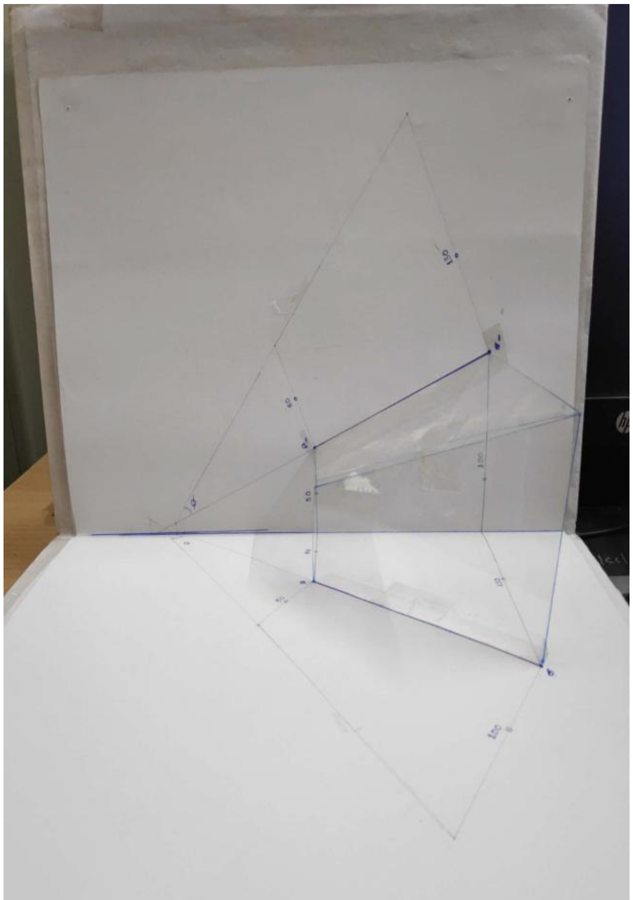
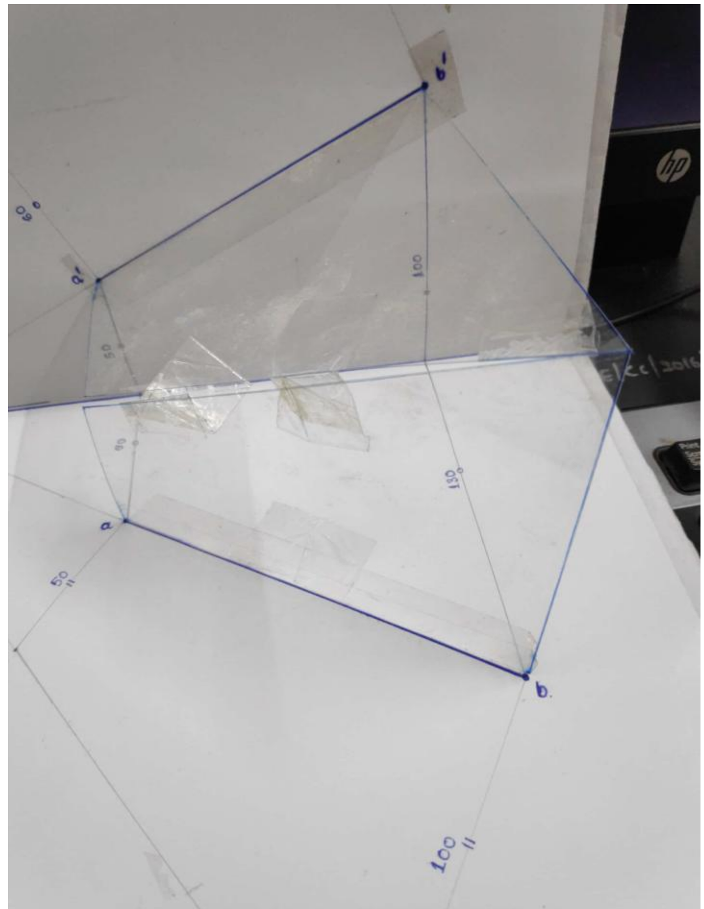
Description: Drawing the projections of straight lines inclined to both the principal planes of projections can be challenging in some cases with the tricky combination of the given data. In this context the Trapezoidal Method is very useful in completing the solution. The method involves identifying the two trapezoidal planes each containing the given straight line in 3-dimensional space and the top view projection of the line and the front view projection of the line, respectively. The trapezoids are then opened up and are made to lie on the VP and the HP. The vertical trace (VT) of the line is identified as the intersection of the extensions of the true line and the front view projection and the angle included is the true inclination of the line with the VP. Similarly, the horizontal trace (HT) is located as the intersection of the extensions of the true line and the top view projection and the angle included is the true inclination of the line with the HP. The collinearity of the front view projections a’ b’, h & VT and the top view projections a b, v & HT can also be clearly demonstrated from this method.

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a
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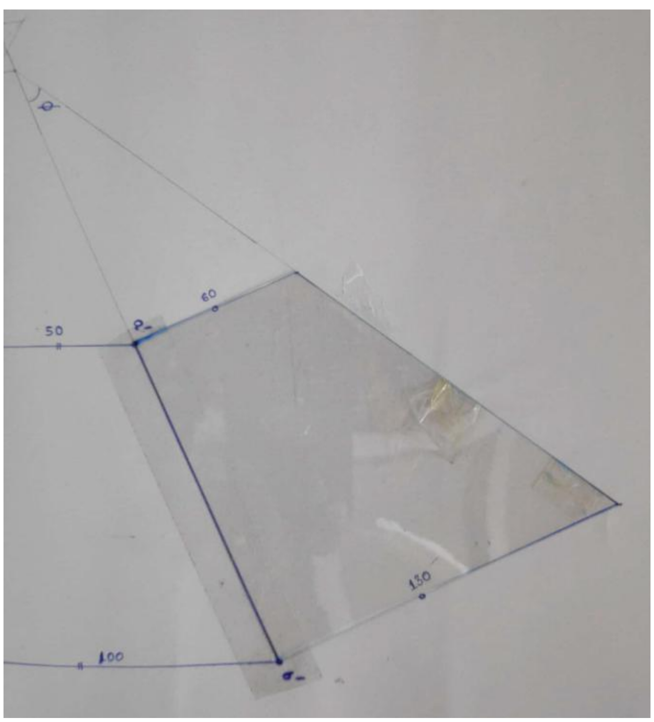
b.
100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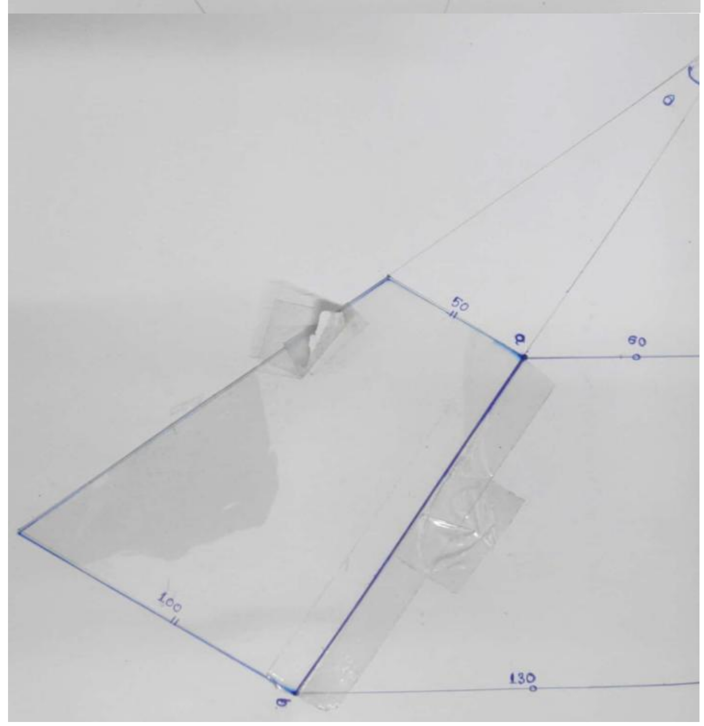
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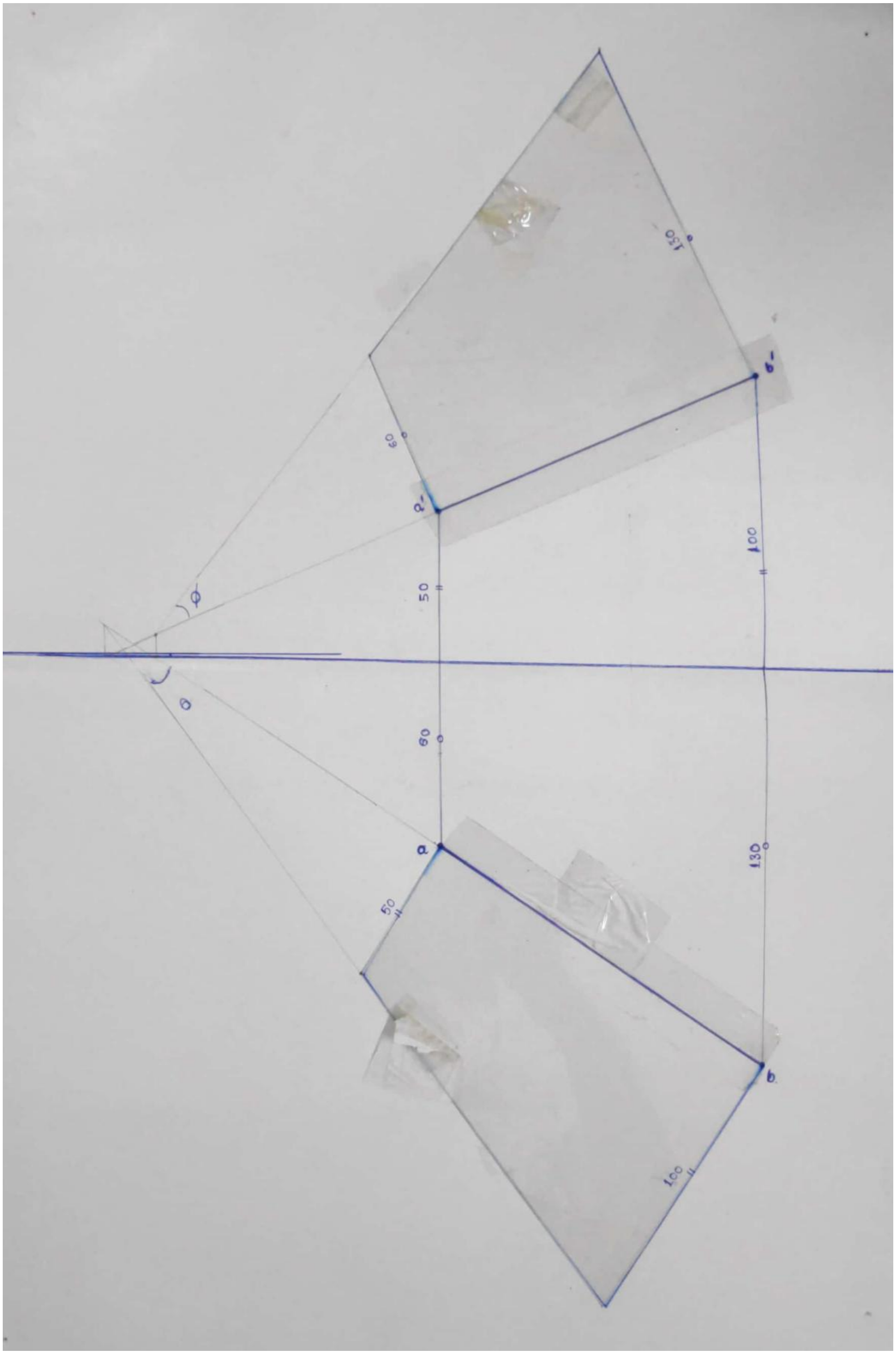

a
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b'
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130
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KINEMATICS OF MACHINES

INTRODUCTION

kinematics:

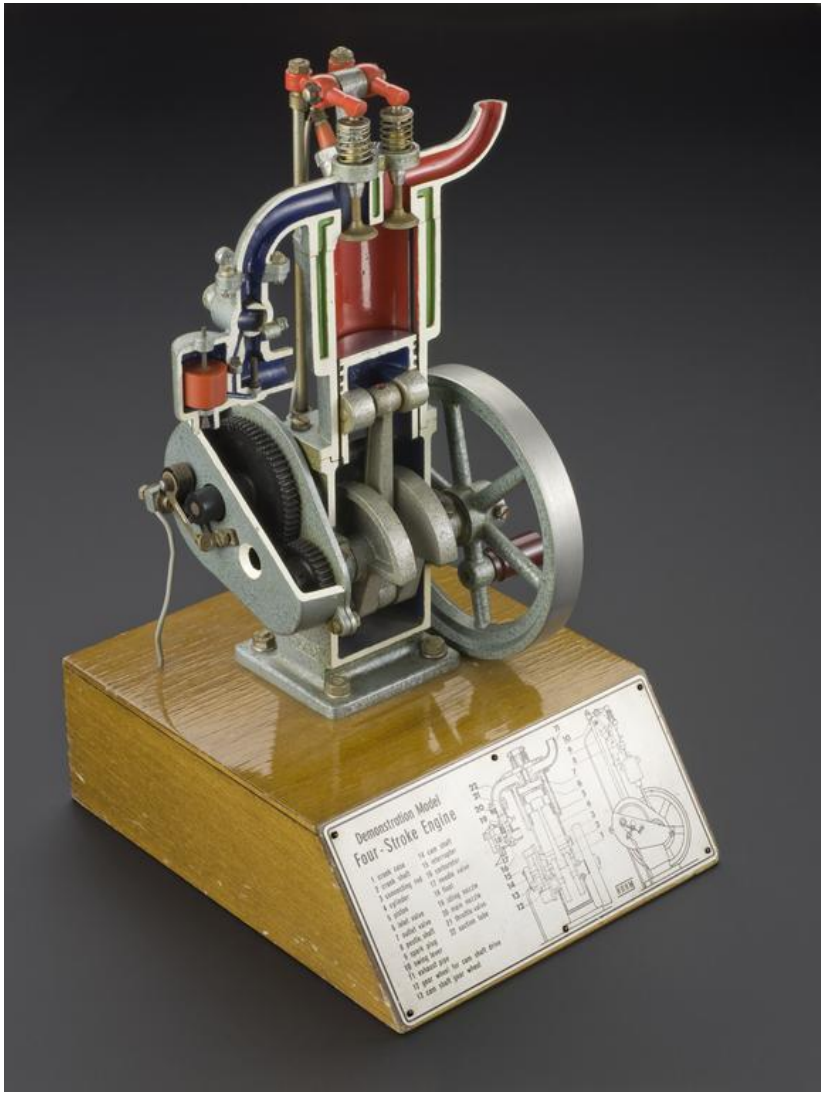
The branch of mechanics concerned with the motion of objects without reference to the forces which cause the motion.

Kinematic link:

Kinematic link: Each part of a machine, which moves relative to some other part, is known as a kinematic link (or simply link) or element.

Kinematic links help in the transmission of motion, from one machine part to another.

Example: piston, connecting rod, crank of a internal combustion engine

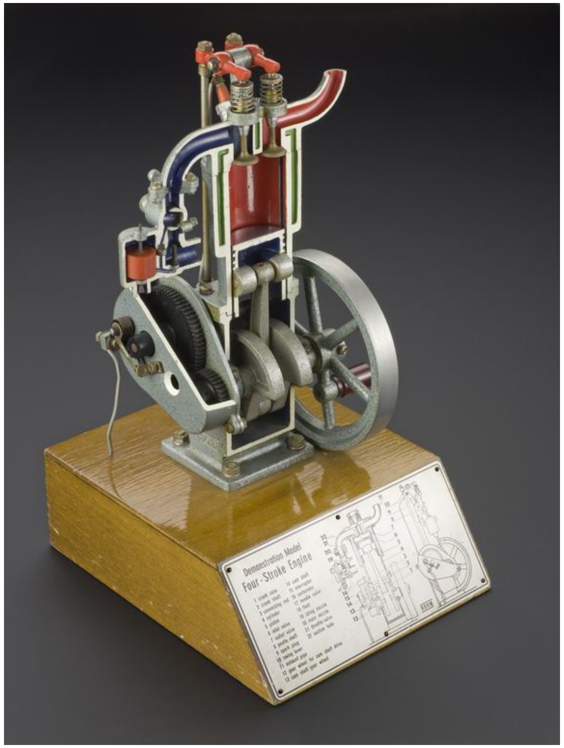


https://www.youtube.com/watch?v=emSXIJwGfQU

Kinematic pair:

A pair of links, having relative motion between them is called a kinematic pair.

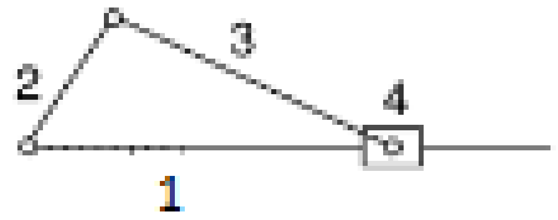
Examples: piston and cylinder , piston and connecting rod, connecting rod and crank



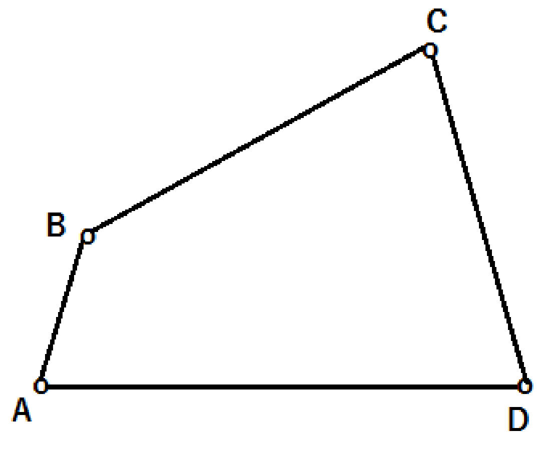
Kinematic chain:

It is an assembly of links in which the relative motions of the links is possible and the motion of each relative to the other is constrained.

Examples: 1) slider – crank kinematic chain



2) Four bar kinematic chain



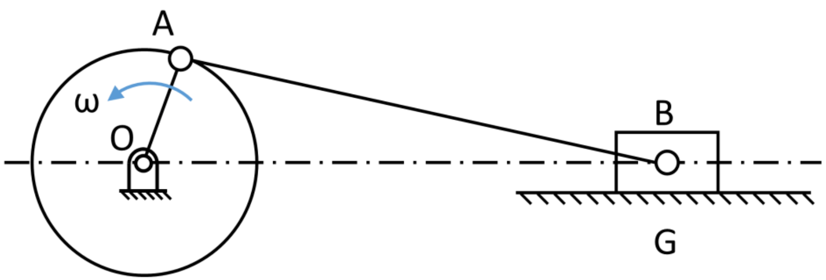
Mechanism:

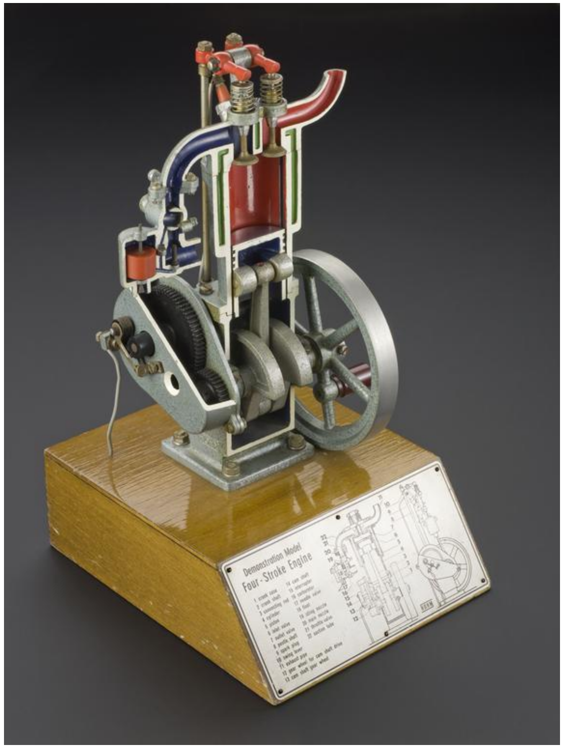
An assembly of links in which the motion of one causes constrained and predictable motion to the others is known as a mechanism.

Note: A mechanism is formed by fixing any one of the links of a kinematic chain.

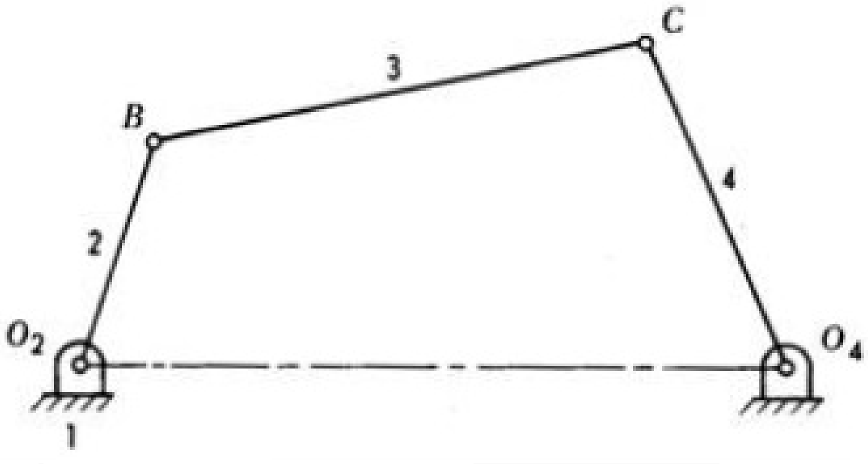
The function of a mechanism is to transmit and modify the motion.

Example: 1) slider – crank mechanism





Example: 2) Four bar mechanism



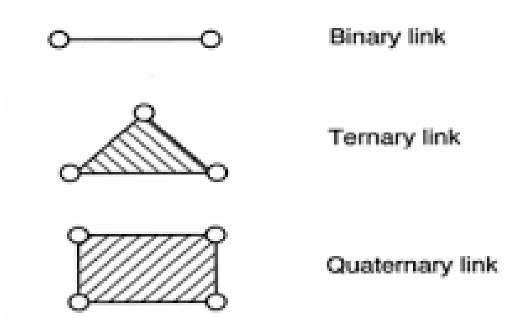
Machine:

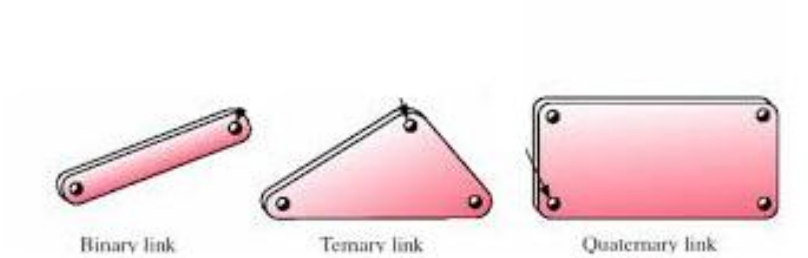
It is a mechanism or a combination of mechanisms which, a part from imparting constrained motion to the other parts, also transmits and modifies the available mechanical energy into some kind of desired work.

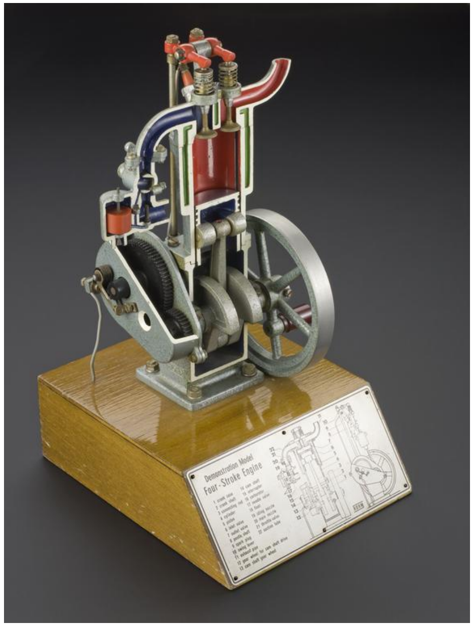
Example: all automobile vehicles, lathe machine, milling machine, drilling machine etc…

Types of kinematic links:

1. Binary link
2. Ternary link
3. Quaternary link

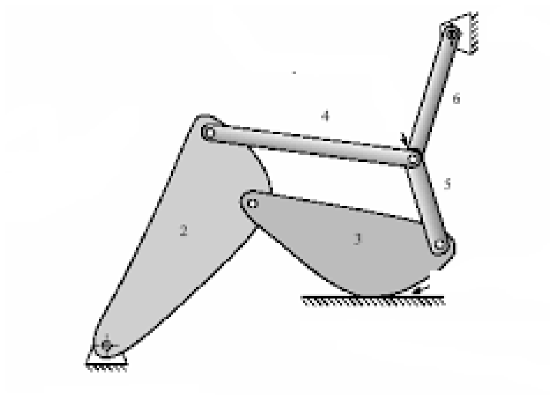




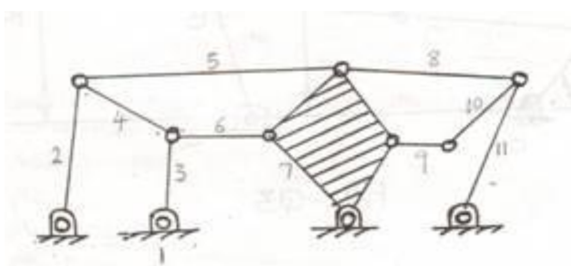


Piston, connecting rod , crank are binary links.

Ternary link mechanism:

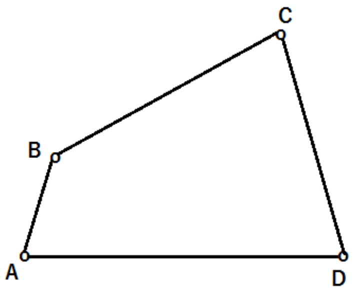


quaternary link mechanism:

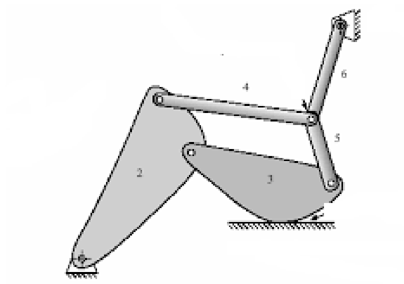


Types of kinematic joints:

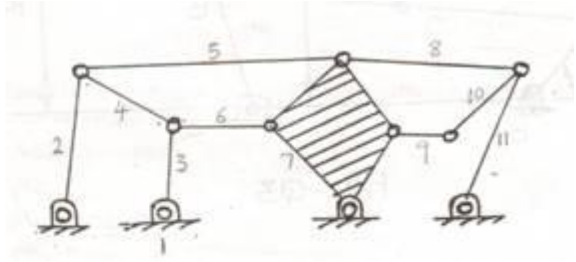
1. Binary joint: If two links are joined at the same connection, it is known as binary joint



2. Ternary joint: If three links are joined at the same connection, it is known as ternary joint. It is equivalent to two binary joints.



3. Quaternary joint: If four links are joined at the same connection, it is known as quaternary joint. It is equivalent to three binary joints.



Types of kinematic pairs:

Classified into three categories.

Based on

1. nature of contact
2. nature of mechanical constraint
3. nature of relative motion

Nature of contact: There are two types.

1. Lower pair
2. Higher pair

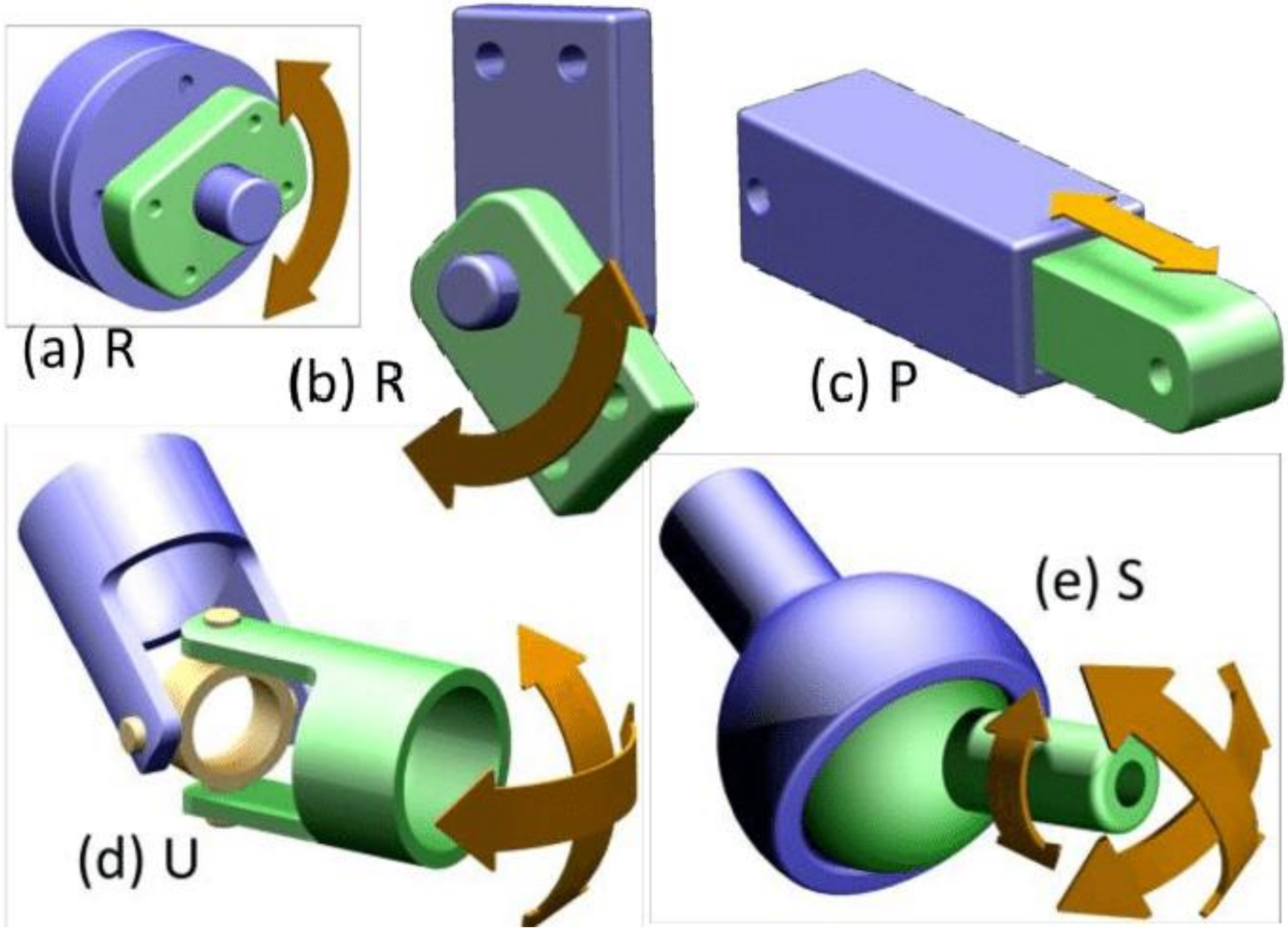
Lower pair:

A pair of links having surface or area contact between the members is known as a lower pair. The contact surfaces of two links are similar.

Examples:

- Shaft rotating in a bearing
- Nut turning on a screw
- All pairs of slider crank mechanism

Some of the lower pairs

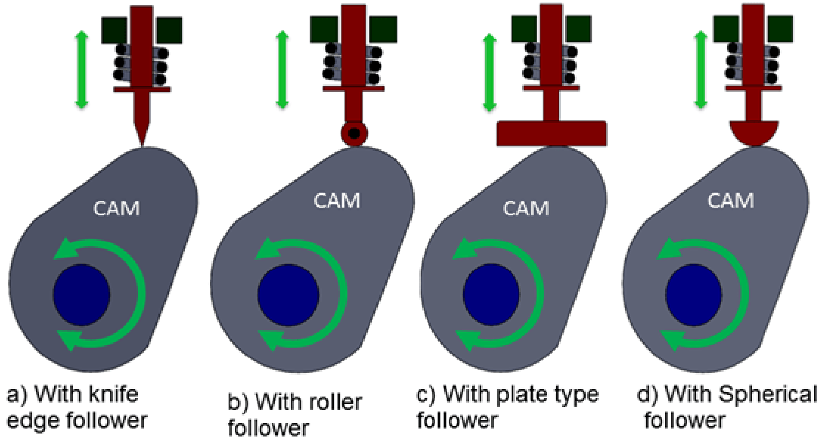


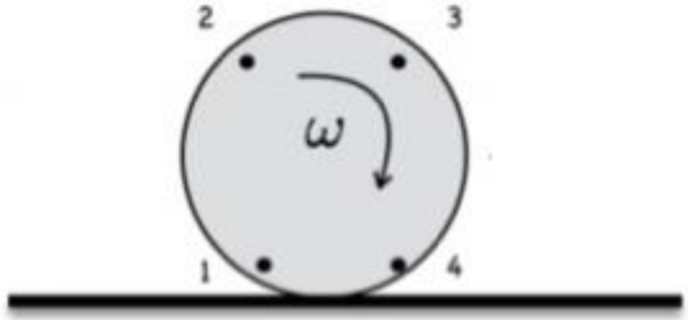
higher pair:

when a pair has a point or line contact between the links , it is known as higher pair. The contact surfaces of the two links are dissimilar.

Examples:

- Wheel rolling on a surface
- Ball bearing
- Roller bearing
- Tooth gears
- Cam and follower pair





2
3
ω
1
4

Nature of mechanical constraint: There are two types.

1. closed pair
2. unclosed pair

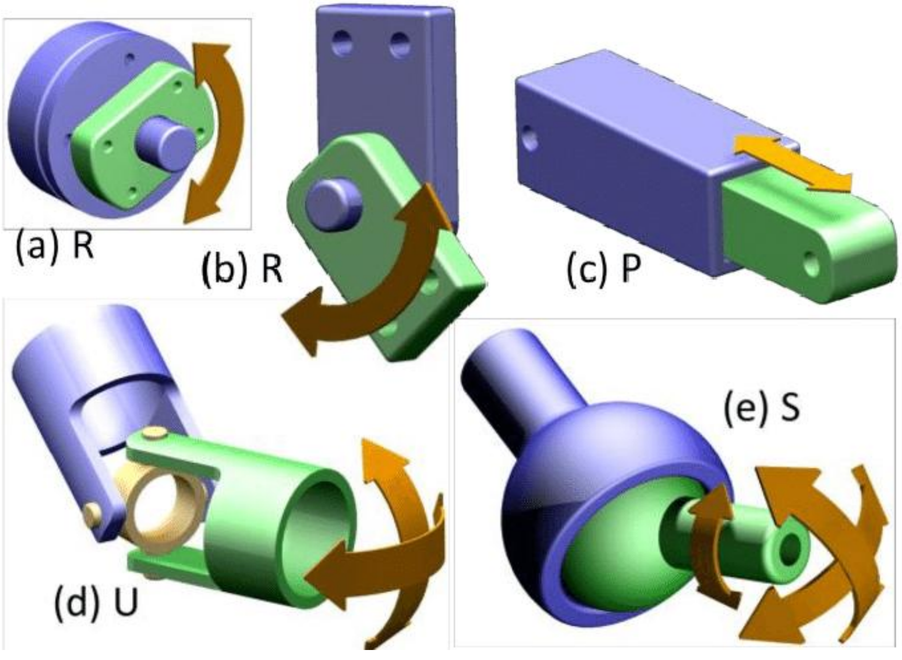
Closed pair(or self closed or form closed):

When the links of a pair are held together mechanicallly, it is known as a closed pair.

The two links are geometrically identical, one is solid and full and the other is hollow or open. The latter not only envelops the former but also enclosed.

Example:

- All the lower pairs
- Some of the higher pairs

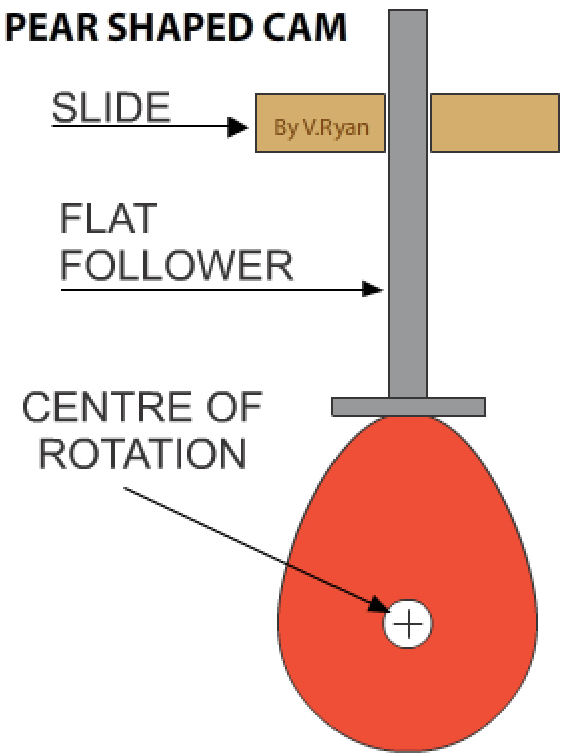


Unlosed pair(or force closed pair):

when two links of a pair are in contact either due to force of gravity or some spring action, they constitute an unclosed pair.

Example:

- Cam and follower mechanism



Demonstration

Topic: Pascal's Law

According to Pascal's Law, "Pressure or intensity of pressure at a point in a static fluid will be equal in all directions and pointing towards the point".

To prove Pascal's law, Consider a stationary fluid element of **tetrahedral** shape with three of its faces coinciding with the coordinate planes x, y and z as shown in the figure. To give more clarity to the students, **tetrahedral** element is prepared with card board.