# EXPERIMENT NO 04

## DIFFERENTIAL AXLE AND WHEEL

**Aim:** To study the performance of differential axle and wheel and find its velocity ratio, efficiency and law of machine etc…

**Apparatus:** Differential axle and wheel consisting of effort wheel, larger axle, smaller axle, thread, pan, weights.

**Theory:**

The simplest machine which is in use, since ages is the simple wheel and axle used for drawing up water from well. It is used on the village wells even till date. Simple wheel and axle are used to lift loads.

Simple wheel and axle consist of an effort wheel and an axle of different diameters which are keyed to same spindle. The diameter of the wheel is greater than the diameter of the axle to reduce the frictional resistance.

A sting is wound on the axle, with one end fixed to it. The other end of this rope carries the load W, which is to be lifted. A second string is wound around the wheel, in a direction opposite to that of the rope on axle. One end of this rope is fixed to the wheel while to the other end effort P is applied.

Since the two strings are wound in opposite directions, therefore, a downward motion of P will lift the load W.

**Let D = Diameter of the effort wheel,**

**d = Diameter of axle,**

**W = Load lifted and**

**P = Effort applied to lift the weight**

Since the wheel and axle are mounted on the same spindle. In one revolution of the wheel, the axle will also make one revolution.

**Distance moved by load in one revolution = π d**

**Distance moved by effort in one revolution = π D**

**V.R= Distance moved by Effort/Distance moved by Load**

**V.R= π D/ π d**

**Now Mechanical Advantage=M.A=W/P**

**Efdiciency=Π=M.A/V.R**

**=(W/P)/(D/d)*100**

**=Wd/PD*100**

**I. Parts of machine:** Differential axle and wheel consisting of effort wheel, larger axle and smaller axle.

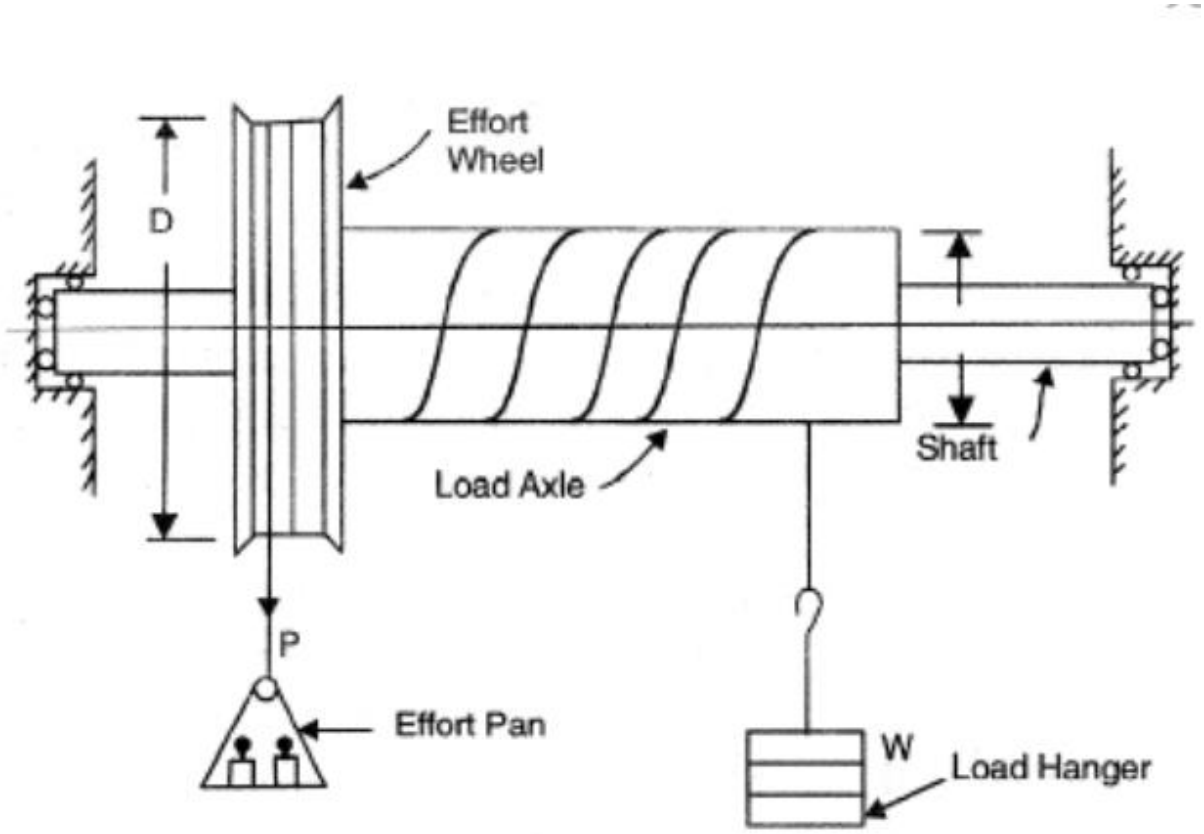
**II. Working of machine**: The load axle is made up of two parts to the same shaft which is mounted on the shaft ball bearing in order to reduce the frictional resistance. The effort string is wound around the axle to which the effort pan is attached.

**III. Velocity Ratio:** In one revolution of effort wheel,

**Displacement of effort wheel is = $\pi D$**

**Distance travelled by load =$\pi d$**

**V.R. = D / d**




**Procedure:**

1. Measure the diameter of the wheel as D by the help of outside caliper.
2. Measure the diameter of the axle as d by the help of outside caliper.
3. Wind one string on the effort wheel and attach scale pan to carry effort P.
4. Wind other string on the axle to hang load.
5. Put the weight in the load pan.
6. Now place the weight slowly in the effort pan unless and until the load Pan just starts to lift up.

7. Note the weight placed in the effort Pan.

8. Calculate M.A., V.R. and efficiency.

9. Repeat the above procedure by increasing the load in the load pan and note down the corresponding effort.

**Observations:**

1. Circumference of Effort wheel: **πD**

2. Circumference of axle: **πd**

3. Distance travelled by effort: = **πD1**

4. Velocity Ratio **= (πD) /(πd )**

**SAMPLE DATA SHEET:**

Diameter of wheel, D in cm =

Diameter of axle, d in cm =

V.R. =

Weight of load pan/hanger = **a gm =**

Weight of effort pan/hanger **= b gm =**

| **Sr.No** | **Load (W)Newton** | | **Effort (Pa)Newton** | | **M.A=W/Pa** | **ή%=M.A/V.R *100** | **Pi=W/V. R** | **Pf=Pa-Pi** |
|---|---|---|---|---|---|---|---|---|
| | **Wt. in Pan w1 (gm)** | **Total wt. W=w1+a** | **Wt. in Pan w2(gm)** | **Total effort P= w2+b** | | | | |
| 01 | | | | | | | | |
| 02 | | | | | | | | |
| 03 | | | | | | | | |
| 04 | | | | | | | | |

**Result:**

i. V.R. of machine =

ii. Efficiency of machine =

iii. Percentage of efficiency of machine =

iv. Law of machine is given as P = mW+C

**Conclusion:**

i. As the efficiency is greater than 50%, machine is reversible.

ii. Velocity ratio remains constant.

iii. Effort of machine increases with load.

iv. Graph of effort against load is a straight line represents linear motion.