

TA-201

ME-LAB

PROJECT REPORT

**“Multi-Purpose
Ladder”**

INSTRUCTOR:- Dr. J. Ramkumar

TUTOR:- Prof. Pankaj Wahi

GROUP NO. 5

Section M6 & M10

Shubham Gupta Y9569

Ashok Kumar Meena Y9148

Gaurav Solanki Y9231

Shiv Prakash Y9551

Shouvik Ganguly Y9558

CONTENTS

- Acknowledgements
- General Overview
 - 1. Motivation
- Components Used
- Processes Used in Making Various Parts
- Cost Estimation
- Difficulties Faced
- Modifications for Improvement
- Innovation
- A special word of Thanks



ACKNOWLEDGEMENTS

We would like to thank our instructor **Dr. J. Ramkumar** for giving us the opportunity of a project.

We are also thankful to our Project Guide, **Mr. Mahesh**, for his contributions in the lab.

Last but not the least, we are very much thankful to all the staff and guides, especially **Dr. P. C. Gond**, who not only helped us in the project but also trained us in various skills and supported us in various types of experiments. Without them, it would be impossible to complete the project.

GENERAL OVERVIEW

Multi-purpose Ladder has an innovative design, allowing more degrees of freedom than the conventional fire-ladder.

MOTIVATION

Fire-ladder is an indispensable part of a fireman's kit. So we decided to make an innovative version of a fire-ladder which allows three kinds of motion. Besides, it nicely illustrates the use of different types of

gears. Finally, the consent of respected tutor and guides motivated us to proceed for this particular project.

COMPONENTS USED

SL No	Component	Quantity
1	Lower Platform	1
2	Upper Platform	1
3	Worm and Worm Wheel	2
4	Angles	8
5	Plates	6
6	Ladder	1
7	Rack and Pinion	2
8	Support for Base Rod	2
9	Handle	3

PROCESSES USED IN MAKING

VARIOUS PARTS

Lower Platform:

Available in the lab.

Support for Base Rod:

Material: Mild steel

Quantity: 2

Process: Cutting

Rack and Pinion:

Material: Mild steel

Quantity: 2

Process: Cutting

For pinion,

Module (m) = 1.5 mm

No. of teeth (N) = 28

Outer diameter = $m(N+2)$ = 45 mm

Depth of cut = $2.157 \times m$ = 3.2355 mm (done on milling machine)

Tap hole = 5.2 mm drill & (1/4)" tap

Length = $4.7 \times N + 25$ = 166 mm

Rod diameter = $(1/2)''$

Upper Platform:

Diameter = 126 mm

It has a hole of diameter 12.7 mm at the centre.

Worm and Worm Wheel:

d_o = outer diameter of worm = 27 mm

Pitch of the worm = 4.7 mm

Ratio of worm and worm wheel = 40:1

Depth of the worm = 3.23 mm

Diameter over sharp corner = $D_o' = 2r(1 - \cos(\theta/2)) + D_o$

= $16(1 - 0.86) + 32.92 = 35.16$ mm

Pitch diameter = $D = NP/\pi = 59.84$ mm

Material: Mild steel

Process: Cutting

Gashing angle = $\alpha_g = 90^\circ - \alpha_w$

$\tan \alpha_w = \pi d / \text{lead} = \tan 85.925^\circ$

Handle:

Material: Mild steel

Process: Cutting

COST ESTIMATION

ITEM	RATE	QUANTITY/ TIME	AMOUNT
Mild steel	Rs. 50/kg	2.3 kg	Rs.115.00/-
Nuts and Bolts	Rs. 75/kg	0.1 kg	Rs 7.50/-
Lathe M/c	Rs. 65/ hr	21 hrs	Rs. 1365.00/-
Milling	Rs. 85/hr	4 hrs.	Rs. 340.00/-
Drilling	Rs. 50/hr	3.5 hrs	Rs. 175.00/-
Skilled Labour	Rs. 250/8hrs	21 hrs	Rs.656.25 /=
Total			Rs. 2658.75

Hence, total cost = Rs. 2658.75

DIFFICULTIES FACED

- The slots made in the racks should have been parallel to each other but weren't so exactly, so the ladder faced a lot of friction while moving forward.
 - **Solution:** The friction was reduced by filing.
- It was extremely difficult to place the pinion at the exact position in the rack.
- The worm was short, so the rotation of the handle attached to it was obstructed by the circular plate.

- **Solution:** The diameter of the worm was reduced to 8 mm upto a length of 25 mm and a hole of 8mm diameter was drilled in another rod and they were fitted together.

MODIFICATIONS FOR IMPROVEMENT

- The handle attached to the pinion of the ladder could have been replaced by a chain and sprocket mechanism so that it could be operated from the ground.
- The edges of the handle should have been filed, but it was not possible due to time constraints.

INNOVATION

The rack itself has been used as ladder, so the material used is less, reducing the total weight and cost.

A SPECIAL WORD OF THANKS

Finally, we must admit that it's great to see one's hard work come to fruition. We gave our hundred percent to the project. In spite of our utmost efforts, the project couldn't have seen the light of day, had it not been for the help and guidance of everyone at the TA Lab. Thank you all...