iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** V **Month of publication:** May 2021

DOI: https://doi.org/10.22214/ijraset.2021.34270

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Stair Climbing Material Handling Equipment

Kohini Saini[1], Prachit Churi[2], Yash Churi[3], Medhaj Joshi[4], Mr. M. A. Gulbarga[5]
[1, 2, 3, 4]*Student, Department of Mechanical Engineering, Theem College of Engineering, Boisar*
[5]*Head of Department, Department of Mechanical Engineering, Theem College of Engineering, Boisar*

Abstract: Equipment is generally use for the carrying heavy weights with the help of less human effort. The manufacturing of the equipment deals with proper design, accurate fabrication and prescribed analysis using finite element software gives better motion which resist to high load by applying less effort this paper deals with manufacturing of such stair climbing equipment (trolley) with simple mechanism(i.e. ratchet mechanism) initially the model is sketched using solid works and imported into ANSYS software for structural analysis used to find von-mises stresses under load which deals to fabricate trolley with better performance under heavy duty with less effort.
For this we used three-star planetary wheel frame.
Keywords: Material Handling, Trolley, Three-star Planetary, wheel Frame.

I. INTRODUCTION

It requires much effort, time to lift a heavy weight component and to transport them to different locations. This type of problems raises in industrial sector, factory, manufacturing units and production sector where heavy mechanical components are to be transported from one place to another place and also from one floor to another floor using simple mechanism in involved in such operation it becomes very much difficult to move heavy components to different locations. This stair climbing trolley is one of the simplest operating vehicles which require less human effort without any external electrical power input to operate the trolley and move on the ground even though the path is uneven. The wheel mechanism adjusts itself to stair to climb different floors by vehicle and also on rough ground. Even though main researchers investigated on fabrication and design of stair climbing trolley less effort where implemented to perform analysis on cabin structure and wheel alignment. In this paper the efforts are insisted to carry analysis on entire trolley structure is including wheels and fabricated with optimal measurements with suitable materials.

II. LITERATURE REVIEW

Pratik H. Rathod et al. [1] designed and fabricated a hand truck which climb stair with less effort which is useful for library, hospital, regular goods carrier etc. the main modification in this truck where made at wheels using plat surface roller plat attached instead of traditional wheel frame. The mechanism based on retched arrangement mechanism. The maximum bending moment was calculated. The inclination of 44 degrees plays a major role which covers more than 90% of all stairways within this limit. There is an optional maximum inclination warning alarm that alerts the operator of an inclination of more than 44 degrees. When truck operated with exceeding the limit there should be taken the necessary safety precautions.

Md. A. Hussain et al. [2] designed and manufactured a stair climbing vehicle using modified form of frame arrangement i.e. a curved wheel frame which move on rough surface. To address several technical issues in designing this vehicle is stability and maintain high speed at vehicle wheel arrangement while climbing stairs. The frame arrangement consists of sun, planetary, idler wheel which are assembled to the shaft which reduces application of load. However, the steepness of the stairs is also the important concern of this study. The vehicle has four set of wheels arrangement to support its weight when it moves over the flat terrain. Each wheel frame consists of three sub-wheels attached with the sun wheel through three idler gears.

P. P. Gondole et al. [3] fabricated a stair climbing hand trolley with proper dimensions of Height 4 feet, Lower frame 38 X 38 cm, Length of each arm of trigonal wheel axial geometry 15 cm, Diameter of shaft 15 mm. The major components used to fabrication process are square bar cast iron pipe, Round bar shaft of SAE 1030, rubber rest, caster wheels (industrial rubber), iron plate, long guzzon pin. Mathematical calculations are made to this work to exhibits expected results and carried load across the stair very easily thus climbing across stairs transportation of goods very easily.

P. Jey Praveen Raj et al. [4] designed device such as hand trolley used to relieve the stresses of lifting while on flat ground. However, these devices usually fail when it comes to carrying the load over short fleet to carry heavy objects up the stairs with less effort compared to carrying them manually. The main objective of the project is to find an efficient and user-friendly method of carrying various objects through stairs using minimum effort from the user and to also provide a smooth movement while climbing the stair.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Under this project we have manufactured a stair climber with tri lobed wheel frames at both sides of the climber and three wheels on each side are used in the tri lobed frame. The wheel assembly is rotated by a gear- motor mechanism where a DC gear motor is used to provide the necessary power for rotation and a pinion-gear mesh is used for reducing the rotating speed of the wheel. The motor is connected to a lead acid battery of similar ratings and they are in turn connected to DPDT switch.

III. PROBLEM STATEMENT

A. It is difficult to carry 100 kg load on stairs manually.
B. The material handling equipment are costly in the market.

IV. METHODOLOGY

As a trolley using wheel additional setup three in number forming an equilateral shape on both ends of the trolley. The fabrication is made using design and modelling sketched in SOLIDWORKS software. Analysis is done on the trolley to find Von-misses stresses and deformation to find out the failure criteria on entire trolley setup. The number of nodes and elements formed by meshing component gives the fine analysis requirement.

A. Modification Of Straight To Curved Wheel Frame

The straight wheel frame shown in the figure 2a takes more thrust to tilt the wheel frame to engage next planetary wheel. The length of each arm is high and thus creates vibration and the vehicle would be unstable. In the present design, the wheel frame was made curve so that the front surface of the arm could not collide with the edge of the stair. The optimization of the curvature was done to eliminate above problem. The curve wheel frame (fig. 4.1.1) also requires less power to tilt compare to straight frame (fig. 4.1.2).

Modification of Wheel

Fig: 4.1.1: Initial Design

Fig: 4.1.2: Final Design

B. Standard Staircase Width

Type of Building	Minimum Width
Residential	1.00 - 1.25 m
Residential hotel	1.5 m
Assembly	2.00m
Educational	1.50 m
Institutional	2.00 m
Industrial	1.8 – 2.00 m

Table No.: - 4.2 From the above table main shaft length is 1m

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

V. FABRICATION

A. *Fabrication Processes Used For Various Components*

Fabrication process for trolley components S.NO	COMPONENT	FABRICATION PROCESS
1	Main Body	Cutting, Welding
2	Main Shaft	Polishing
3	Wheel Axel	Turning, Drilling, Tapping
4	Bushes	Boring, Drilling, Tapping
5	Bearings	Standard (25 mm)
6	Three-Star Planetary Plate	cutting, Drilling
7	Pulley	Boring

Table No.: - 5.1.1

B. *Various Tools and Machinery Used*

SR. NO.		Tool Used	M/C USED
1		Turning Tool	Lathe
2		Drill Bit	Drill m/c
3		Tap	-----
4	Cutting Wheel	Grinding m/c	
5	Welding Electrode	Welding m/c (arc welding)	

Table NO.: - 5.2.1

VI. MAIN PARTS

1) Main Body: This is the main body made of Mild Steel rectangular pipe having 2.2mm thickness. Total Height of project is 1400mm.

Fig No.: 6.1

2) Shaft: The shaft is made of mild steel of total length 1000mm &diameter 25mm.

Fig No. 6.2

3) Wheel and Wheel Frame: Wheel is made up of rubber wheel and it has diameter of 110mm.
Wheel Frame is made of Mild Steel having 5mm thickness & radius is 180 mm (From centre of the shaft to end of the wheel frame).

Fig No. 6.3

4) Bearing: It is standard bearing having diameter of 25mm. Company of bearing is Kyosho DBX. Bearing is used to support the main shaft.

Fig No. 6.4

5) Motor: Motor having 0.25 hp and having 50mm diameter of pulley.
Motor RPM is 30mm.

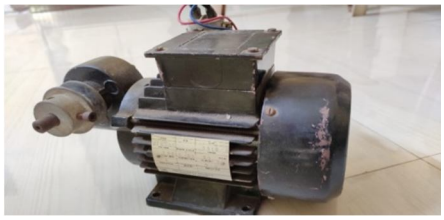


Fig No. 6.5

6) V-Belt: Power transmission from motor pulley to main shaft pulley. 'A' type of V-Belt of dimension 13mm*8mm.

Fig No. 6.6

7) *Pulley:* A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. Bore diameter of pulley is 25mm.

Fig No. 6.7

8) *Nut & Bolt:* They used to fix bearing to main body and to fix other components like Motor to main body. Size used is M06, M08.

Fig No. 6.8

9) *Assembly:* Final Assembly

Fig No. 6.9

VII. COSTING

Costing of parts

Sr. no.	Parts	Quantity	Price (Rs.)
1.	Square pipe	20 feet	650
2.	Wheel	6	1,440
3.	AC Motor	1	3,000
4.	Plummer Block bearing	2	280
5.	Pulley	1	300
6.	Pulley Belt	1	120
7.	Grinding wheel	3	200
8.	MS-wheel frame	4	1,800
9.	MS Shaft	1 meter	250
10.	MS Axle	0.7 meter	260
11.	Frame welding	1	400
12.	Nut & Bolt (M06, M08)	15	120
13.	Allen Key Bolt (M05)	8	50
		Total	8,870

Table No. 7.1

A. Observation Table

One revolution of manual reading = 8 Sec
One revolution with motor reading= 6 Sec
One revolution = π*D= 923.63 mm
Motor RPM= 30rpm
No. of steps= 12

Observation Table

Sr. No.	Load (Kg)	Manually Reading (Sec)	With Motor Reading (Sec)
1	0	32.05	26.8
2	25	44.30	26.4
3	50	56.75	26.6
4	100	80.04	26.5

Table No. 7.1.1

B. Result

1) The design of trolley is compact and hence is able to move about in almost all the stairs.
2) The main benefit of this project is carrying load on stairs with less effort.
3) This equipment carries 100kg of load.

C. Conclusion

1) We observed that time required for manual reading increasing as per the load whereas motor reading is to be constant.
2) we found some vibration problem and to overcome this we have planned to install springs and braking system, so that trolley will be in a good control.

D. Future Scope

1) Adjustable nut can be added in future for easy operation with uneven surface or any obstacle.

2) Base of the project can be lifted by means of fork lifter

REFERENCES

[1] Mulik Shriniwas, Salunkhe Rohit, Shaikh Shahrukh, Waghmode Dada, and Swipnil Gaikwad, Advance material handling trolley using tri-wheel mechanism, International Journal of Recent Research in Civil and Mechanical Engineering, (2016).

[2] Sonukumar Krishnaprasad Singh, Jaydev Harish Kumar Lad, Hoosen P. Kuranjekar, Virendra J. Tekade, and Swapnil Srivastav, Design and Fabrication of Semi-Automatic Stair Climbing Trolley, International Journal of Engineering Science and Computing, Elissa, "Title of paper if known," unpublished, (2017).

[3] Roshan Alas pure, Chaitali Barmase, Snehal Chambhare, Manish Mandhre, and Prof. Yogesh G. Joshi, Fabrication of Stair Climbing Wheel Mechanism: Alternate for lifting goods, International Research Journal of Engineering and Technology, e-ISSN: 2395 -0056, (2016).

[4] Pedy Praveen Raj, P.M. Mohamed Fuge, R. Paul Caleb, and G. Natarajan, Design and Fabrication of Stair Climbing Trolley, International journal of Advancement in Engineering Technology, ISSN NO: 2349-3224, (2016).

[5] Pratik R. Baviskar, Aniket V. Naik, Ganesh B. Payghan, Abhijit P. Sarkar, and Santosh P. Joshi, Design, Analysis and Fabrication of Automated Staircase Climbing Load Carriage, Engineering Research, ISSN 2229-5518, (2017).

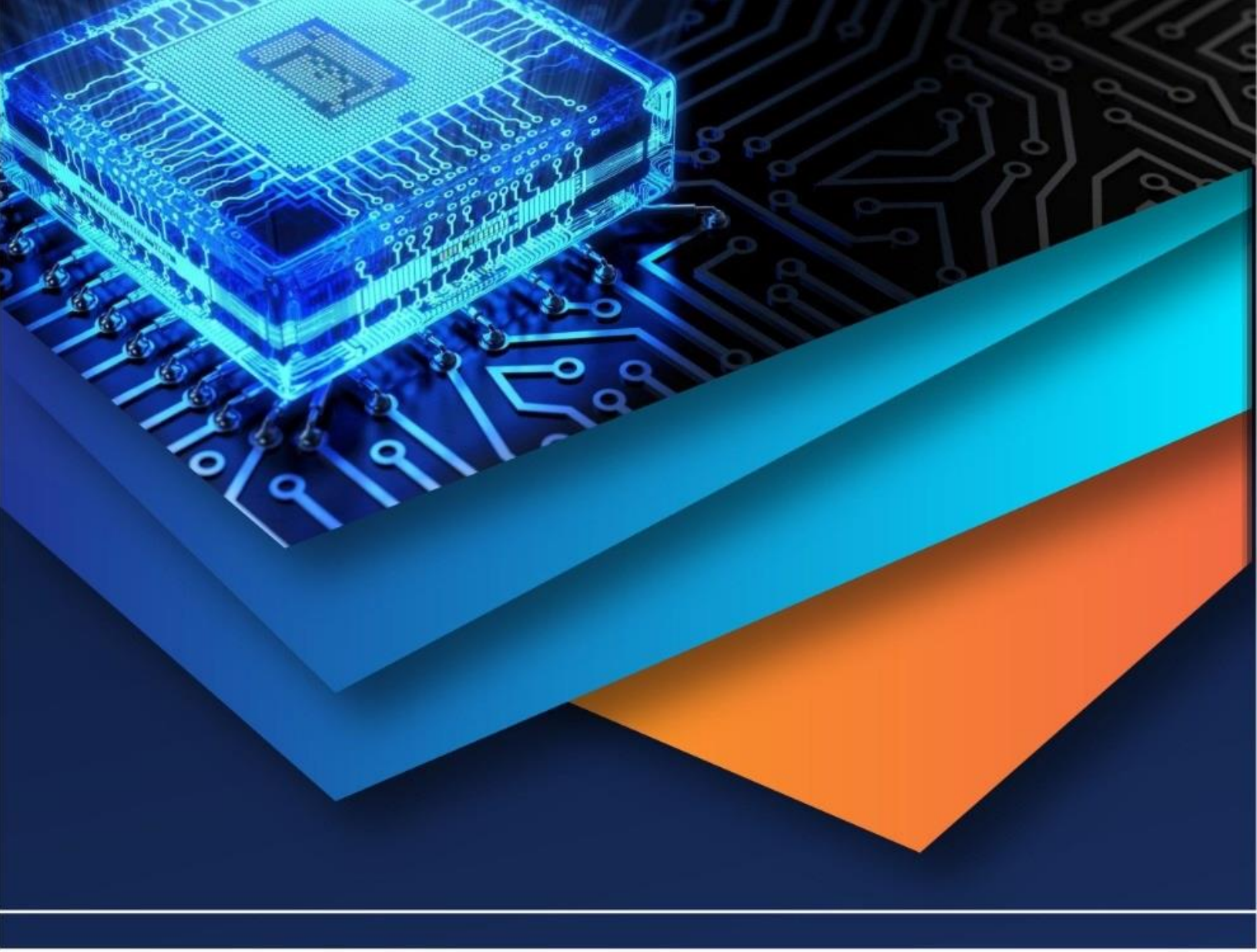
[6] A Review On: Stair Climber Material Handling system, National Conference on Quality Up-gradation in Engineering, Science and Technology (NC-QUEST018) Organized by College Engineering and Technology, Hannagan Rly-444709 International Journal of Innovations in Engineering and Science, Vol. 3, No.6, (2018).

[7] DESIGN AND FABRICATION OF STAIR CLIMBING TROLLEY, Mechanical Engineering Department, Nageswara College of Engineering, karimnagar, Telangana, India, JETIR September 2018, Volume 5, Issue 9, (2018).

[8] R.S. Khurmi, J.K. Guptha, A text book of Machine design, S. Chand publishing house (P) Ltd.

[9] Dr.R.K. Bansal, A text book of Strength of materials, Laxmi Publications(P) Ltd.

[10] National building code of India 2016 volume 1 by BIS.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY