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Design, Analysis and Fabrication of Load Carrier Bogie for Shop Floor Application

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Abstract: We are presenting paper on "Design and Fabrication of bogie to carry the load around shop floor" which is creating a bogie that will minimize the effort required to push or pull load on it. Motor is used in this system to help to push or pull load. A bogie system is the key equipment in industrial applications. To carry large weighted material without effort is important to avoid accidents, waste of material and time delay. Rigorous practical evaluation of bogies is still a challenge. Presently, there is overreliance on part-specific experiments in practice. In the present work, a risk evaluation index system of a bogie system has been established based on the inspection data and experts' evaluation. Then, considering quantitative and qualitative aspects, the risk state of a bogie system has been evaluated using an extension theory and an entropy weight method.

We are still accustomed to the age-old industrial methods despite the rapid developments in this area. Numerous factors contribute to this, including inertia, rejection of new technology, and a lack of engineering aptitude, a lack of ability and technical knowledge, and most critically, concern over job possibilities being lost. The goal of this project is to create a mechanism that will make it simple to move large objects over flat surfaces with little effort. Our civilization has daily needs that call for such a system. On level ground, devices like hand bogies are used to decrease the strain of lifting, but the motorized hand bogies reduce user effort and eliminate stress. In light of this, the project aims to create a motorized hand cart that can transport heavy goods on a plane's surface with less effort than doing so by hand. The bogie in the current project has motorized wheels that make it easier to move the bogie on a surface and allow us to carry loads. The design and construction of an industrial bogie that can be used to transport luggage or other objects from one location to another are the topics of the current study. Depending on the need, a bogie has been built using CATIA V5 and is currently essential for moving various goods from one location to another in our daily lives or even at work.

Keywords: Cluster, Hybrid Motors, Belts

I. INTRODUCTION:

The load carrier is a recent technology that enables workers to work comfortably without experiencing any difficulties or danger to their health. It may be utilized in settings like factories, ports, construction sites, etc., or almost anywhere big loads need to be lifted and carried by hands, shoulders, or heads. The ergonomic design of this carrier lowers the danger of head, shoulder, hand, and other body injury while also improving the working environment for workers. The major goal is to enable the workers to carry the loads in three simple ways: over the head, at the back, and by pushing or pulling. Easy to prepare and inexpensive. Making it also doesn't take a lot of expert labour. The many tools and load carriers that are presented here are the latest and best inventions for transporting things simply and safely without causing any harm to the head, neck, shoulder, legs, or hands, among other body parts. These new load carriers are made to be lightweight, simple to use, and work without putting undue strain on the body's muscles or other organs. The primary goal of all devices, regardless of their intended function, is to minimize bodily strain and injury levels in any

way that is possible. Some are employed in industry, while others are employed in domestic settings, such as gardening. Each of the devices listed below has a specific use and mode of usage, as well as a variety of advantages over earlier iterations and contemporary devices.

We are going to create a bogie, or carrier, that can move forward and backward while also allowing us to adjust the motor's speed. The bogie can carry a load of approximately 100 kg. We'll utilize an Arduino motor control circuit to perform this operation, and we'll modify the variable speed accordingly.

Many times in daily life, heavy objects like books, travel suitcases, etc., will need to be transported between two sites. Moreover lacks lifts and escalators in the majority of buildings around the world. Human labor is regarded as the sole option in this situation. In wealthy nations, labor is growing more time- and money-consuming. A compact transport tool used to move big items from one location to another is called a motored hand bogie. Many different sectors that convey physical goods use it as a relatively common tool.

The objective of this project is to create an easy-to-use method for moving such weights. Bogies reduces the strains that come with lifting objects from one place to another over flat surfaces. It is created a stair climbing bogie1 that can transport large objects up the stairs with far less effort than carrying them manually. When applied correctly. Bogies can shield users from the health issues that come with lifting large objects, such as back ailments. It is obvious that mechanical designs help humans perform their activities more efficiently. One of the most frequent mobility problems for robotic applications is climbing stairs. Our group has been working on a project to design and construct a mechanical STAIR-CLIMBER that can ascend stairs safely and step-by-step with the help of the Industrial Centre of the Hong Kong Polytechnic University.

After considering several solutions, it was decided to construct a bogie that could carry a load across stairs and to manually power it in order to keep it within reach of a large number of people. This made it possible to move products across stairs effectively while using less human energy.

AREA OF USE – Local society, Hospitals, Hotel, Malls, Small work area like construction, Can be used by individuals for own purpose, Airports and Railways station etc, Houses (On stairs, rough surface)

II. PROBLEM STATEMENT:

The bogie which is being utilized for has such a lot of weight to convey so it isn't so natural to move the bogie by the human exertion, which will make the work drearier and less productive. To that end we are making a system which can work the bogie and control the speed of the bogie as well.

III. OBJECTIVES:

1. Creating a bogie that will minimize the effort expected to push or pull load on it.
2. Creating a mechanism on the bogie which will make the bogie to move at a controlled speed.
3. Creating a system for transmission movement which can carry the load of 200 kg.

4. Walk on plane surface easily with different-different speed.
5. Lifting heavy objects especially where there are no lifting facilities.

This project aims to develop a simple mechanism to transport such weights with easily bogie help to reduce the stresses a human being experiences while lifting loads from one place to another over flat surfaces or on stairs.

Fig. No.1 - Objective of Work

When used properly, bogies can protect people from back injuries and other health problems
that can result from lifting heavy loads and also by minimizing the time period of carrying the goods as compared to human powered bogie also reducing the problem of slipping and toppling and attaining variable speed as per requirement of users and also make the life easy for small level and also make the life more comfortable and luxuries.

IV. NEED AND IMPORTANCE:

The significance of this venture is to make the existence of individuals more agreeable and extravagances. This venture is important for feeble individuals who can't convey or move around the manual bogie and it will likewise be utilized as a standard use while shopping and save an individual to convey the weighty great's which save the with the different wounds, for example, (Muscle pull and strain, Hyper-extended lower leg, Shoulder wounds, Knee wounds and so on.). It is likewise significant in light of the fact that it will convey more burden as contrast with human. It decreases the work of human and furthermore it will work impeccably. It likewise help to set aside the cash which was given to others on Air terminals, Rail line station and it might likewise use in the ventures and medical clinics to decrease the human exertion and furthermore because of low upkeep it will lessen the expense of conveying a products starting with one spot then onto the next it might likewise say it onetime speculation after that it's a free.

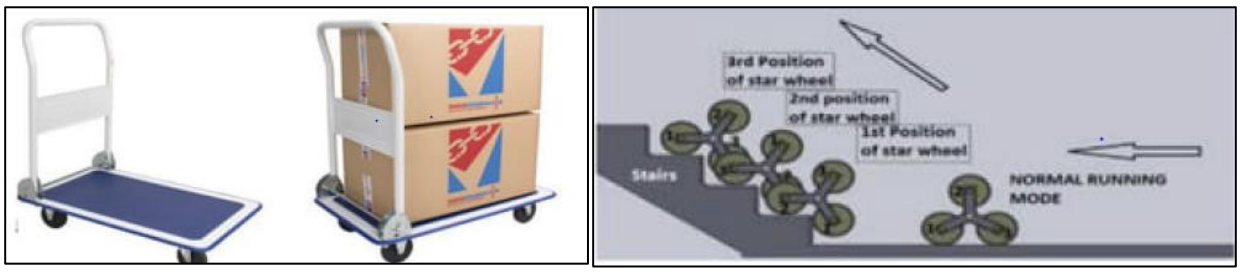
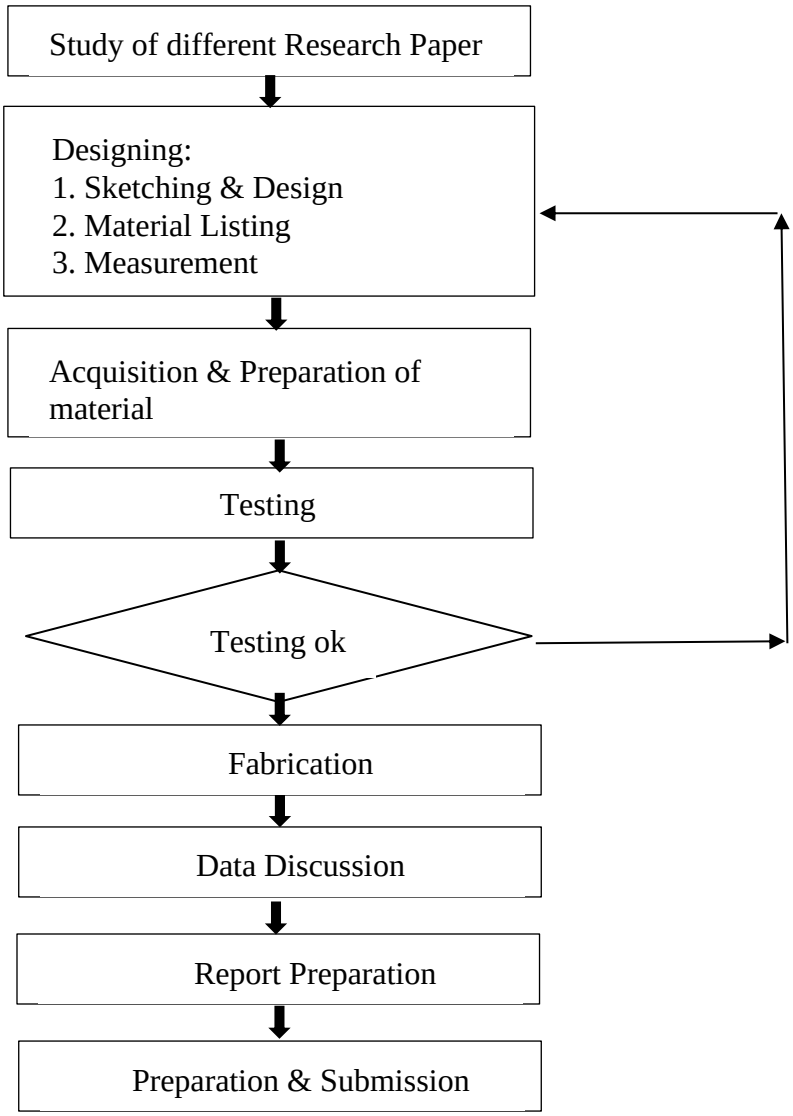


Fig. No.2 - Objective of Work

V. METHODOLOGY:



The bogie is a component that permitted man to move their weighty things like PCs, Documents and so on to different spots. I's assist with monitoring to take care of their responsibilities without having an issue because

of the weighty stacking. In's likewise assists with decreasing agony in abdomen, back, hand and feet. Regardless of how light the stacking is, individuals as a rule will choke out a huge torment in their body if lifting the things in commonly. Thus, this is the point at which individuals depend upon a bogie that can do things moving commonly with a tiny bit of exertion. From the assertion above reason that the bogie assuming a significant part as a things moving component for individuals without having an issue of doing that. A bogie likewise worked as a partner to individuals to hold things organized while moving between harsh surfaces.

VI. CONCEPTUAL DIAGRAM:

It is creating a bogie that will minimize the effort required to push or pull load on it. A bogie system is the key equipment in industrial applications. To carry large weighted material without effort is important to avoid accidents, waste of material and time delay. Rigorous practical evaluation of bogies is still a challenge. Presently, there is overreliance on part-specific experiments in practice. In the present work, a risk evaluation index system of a bogie system has been established based on the inspection data and experts' evaluation. Then, considering quantitative and qualitative aspects, the risk state of a bogie system has been evaluated using an extension theory and an entropy weight method.
It consist of Motor, Battery, chain drives and MS square tubes for fabrication.

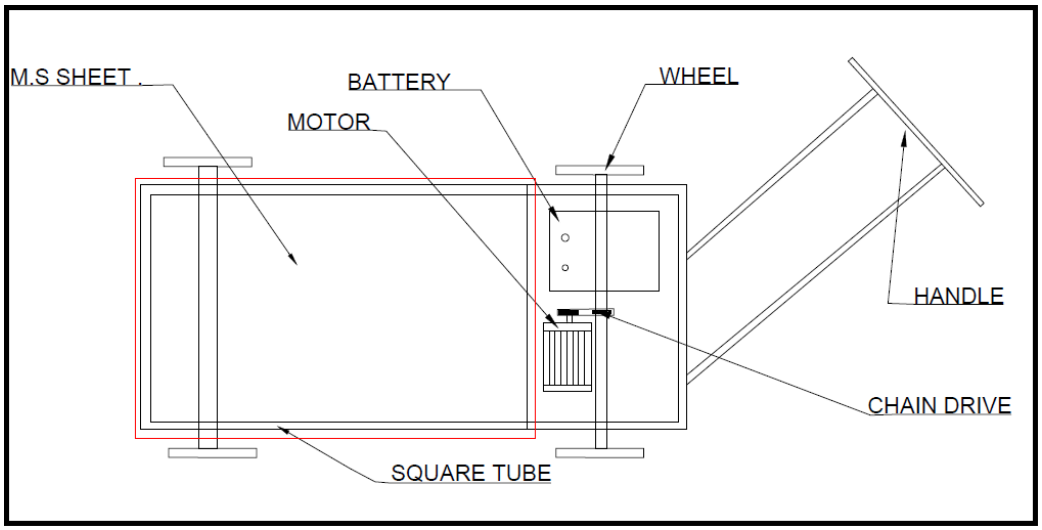


Fig. No.3 - Conceptual block diagram

Component Specification –
Following are the Components used in motor bogie are:

1. Frame and material
2. Motor (drive system)
3. Battery
4. Charger

5. Wheels
6. Belt drive
7. Arduino Unit

1. Frame and material –

Frame is fundamental gathering of bogie mounted on hub .Intend to kept material that should be moved. A casing is normally a primary framework that upholds various pieces of an actual development as well as gentle steel frame that restricts the development's degree. Framing, in development. They fitting together of things to give a design backing and shape. Framing materials are generally wood, constructed wood, or steel. Handle is to hold by mover and simple development of bogie from one spot to various to hold weighty burden bogie are a typical type of transport in dissemination conditions. For moving mass burdens. An extremely straightforward plan offers an essential level stage with two casters, two haggles fixed handle which is utilized to one or the other push or pull the plat structure with the heap on the stage.

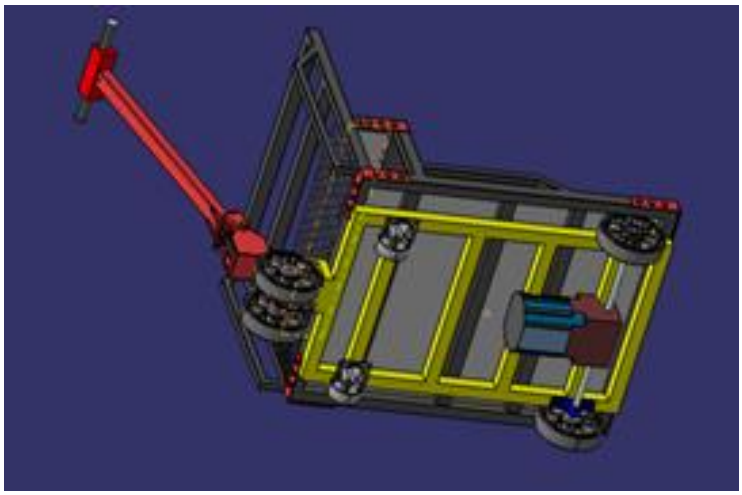


Fig. No.4 - Motors bogie frame

The axles are fixed the skeleton, and the wheels are connected to the handle that permits the bogie to be turned when moved. Fundamentally in the event that we are discussing bogie outline as displayed in fig. it is comprised of gentle steel square lines. (iron containing a little level of, serious areas of strength for carbon intense however not promptly tempered), otherwise called plain-carbon steel and low-carbon steel, is currently the most widely recognized type of steel on the grounds that its cost is somewhat low while it gives material properties that are OK for some applications. Gentle steel contains around 0.05-0.30% carbon making it pliant and malleable. Gentle steel has a somewhat low rigidity, however it is modest and simple to shape surface hardness can expanded through carburize.

Fig. No.5 - Mild steel square pipes

Low-carbon prepares show yield-call attention to run where the material has two yield focuses. The principal yield point (or upper yield point) is higher than the second and the yield drops decisively after the upper yield point. If low-carbon steel is simply anxious to a few point between the upper and lower yield point then the surface creates stronger groups. Low-carbon prepares contain less carbon than different prepares and are more straightforward to cold-structure, making them simpler to deal with. By these two lines we make the entire casing of the bogie. This material is utilized by us since it is less expensive and having great strength and furthermore simple to do different cycle for making bogie like cutting, welding. Crushing and so on. In the casing we additionally utilize four treated steel butt pivots as displayed in fig.

The edge of the bogie is joint with different stray pieces. It will be used to make the bogie.

Dismantle on the off chance that no utilization of its which is effectively dismantle and furthermore effectively collect. The edge is plan so that it will effortlessly be gather and dismantle and furthermore simple to make as indicated by use it is flexible and use as multipurpose such has it will use while movement. Housework, shopping and so forth. It is plan such a way that it doesn't require more space to store.

Fig. No.6 - Stainless steel butts' hinges

Fig. No.7 - Nuts and Bolts

2. DC motor –

A direct current (DC) motor is a type of electric machine that coverts electrical energy into mechanical energy. DC motors take electrical power through direct flow, and convert this energy into mechanical turn. The stock voltage range is 12-48V with the extremity markers at the base of the motor. With the assistance of electric bike engine, we play out the genuine work at the farm.

Motor Specifications:

- Rated Operating Voltage: 48V
- Rated Power: 800W
- No Load Current: 4.0A
- No Load Speed: 450 RPM
- Rated Torque: 102Kg-cm
- Rated Speed: 350 RPM
- Rated Current: 15.6A
- Efficiency: 80%
- Gear Ratio: 6:1
- Wight (approx.) = 5 kg

Fig. No.8 - DC Motor

kW	HP	220V	240V	kW	HP	220V	240V
0.37	0.5	3.9	3.6	4	5	29.6	27.1
0.55	0.75	5.2	4.8	4.4	6	34.7	31.8
0.75	1	6.6	6.1	5.2	7	39.8	36.5
1.1	1.5	9.6	8.8	5.5	7.5	42.2	38.7
1.5	2	12.7	11.7	6	8	44.5	40.8
1.8	2.5	15.7	14.4	7	9	49.5	45.4
2.2	3	18.6	17.1	7.5	10	54.4	50
3	4	24.3	22.2				

3. Battery –

A twelve-volt battery has six single cells in series creating a completely energized yield voltage of 12.6 volts. A battery cell comprises of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with a protecting material (separator) in the middle. It is utilized to run the DC engine.

Battery Specifications:

Capacity = 12V 12Ah
Battery type = Acid lead battery
Weight (approx.) = 2 kgs

Fig. No.9 - Battery

4. Charger –

A battery charger or recharger is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. The charging protocol (how much voltage or current for how long. and what to do when charging is complete. for instance) depends on the size and type of the battery being charged.

Fig. No.10 - Charger

Charger specification:

- This Charger is for Lithium ion 24V battery.
- The charger is based on the modern high-frequency switching power supply structure,
  Built-in microcomputer control, to achieve fast, balanced. Turbulent, floating charge
  Automatic control charging, charging speed, accurate and reliable.
- Current rating: 1.2A to 2A

5. Wheels –

A wheel is a roundabout part that is intended to pivot on a crapped bearing. The wheel is one among the critical pieces of the haggle that is one of the simple machines. Wheels, related to axles. license weighty items to be moved essentially working with development or transportation though supporting a heap, or performing work in machines. Wheels are likewise utilized for various purposes, similar to a boat's wheel, hand wheel, haggle.

Material: Polyurethane (PUR and PU)It might be a compound made out of natural units joined via carbonate (urethane) joins. Though most polyurethanes region unit bottles polymers that don't mellow once warmed, thermoplastic polyurethanes likewise are available.

Fig. No.11 - Wheels (Casters)

Fig. No.12 - Tri star Wheel

A Tri Star wheel capabilities as a standard wheel on level ground, but has the capacity to climb consequently once an obstruction to rolling is experienced . This wheel configuration comprises of three tires. They will conjointly permit a vehicle to move over little deterrents like rocks, openings and steps.

Fig. No.13 - Use of Tri Star Wheel

The unnecessary extra person sits at the top till the lower front wheel hits a block. The block forestalls the lower front wheel from pushing ahead anyway doesn't significantly affect the movement of the live pivot. This makes the top wheel move onward into position. Assuming we are discussing how to utilize attempt star-wheel on level surface as well as on steps then, at that point, it's another ideas in our task before that nobody utilize this ideas on bogie this will utilize just on a little robot or in a weighty vehicles as displayed in fig. I's a first opportunity to utilize give wheel with engine a shot both for step as well as plane surface. We utilize two tri star wheels on the lower segment which is associated with one another with a shaft and the whole tri wheel are in a reached with one another with stick gear as displayed in fig.

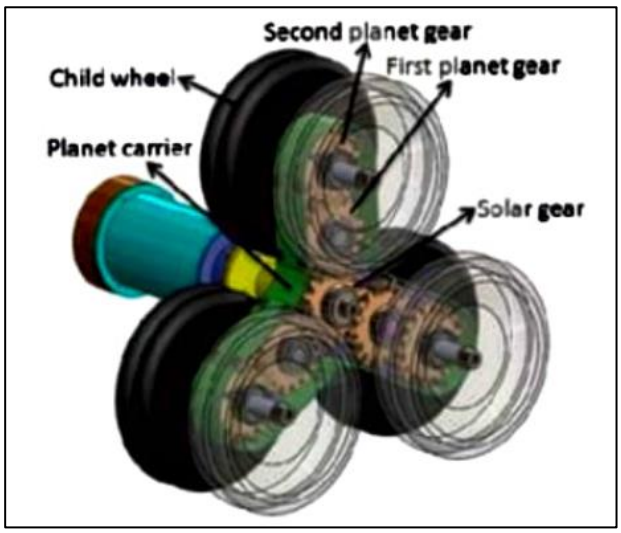


Fig. No.14 - Mechanism of Tri- Star Wheel

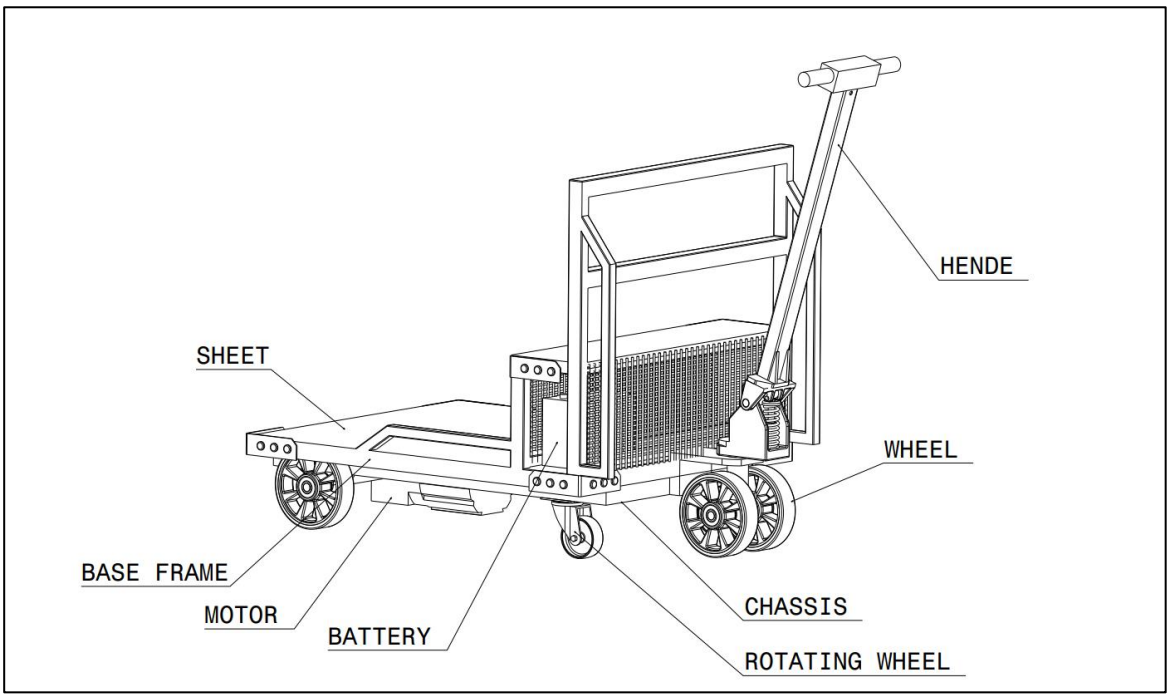
6. Plummer Block Bearing (P204) –

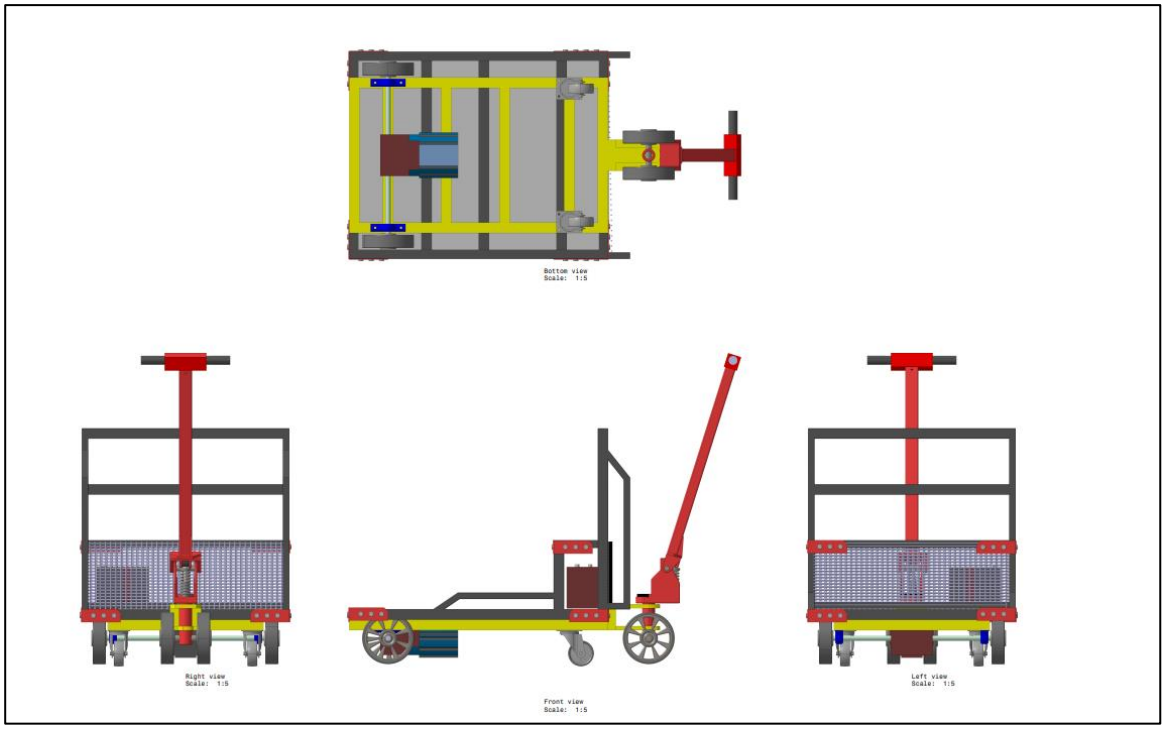
A cushion block bearing (or Plummer block) is a platform used to offer help for an alternating shaft with the assistance of viable course and different embellishments. The gathering comprises of a mounting block which houses a direction. The square is mounted to an establishment and a shaft is embedded permitting the internal piece of the bearing/shaft to pivot.

Fig. No.15 - Plummer Block Bearing (P204)

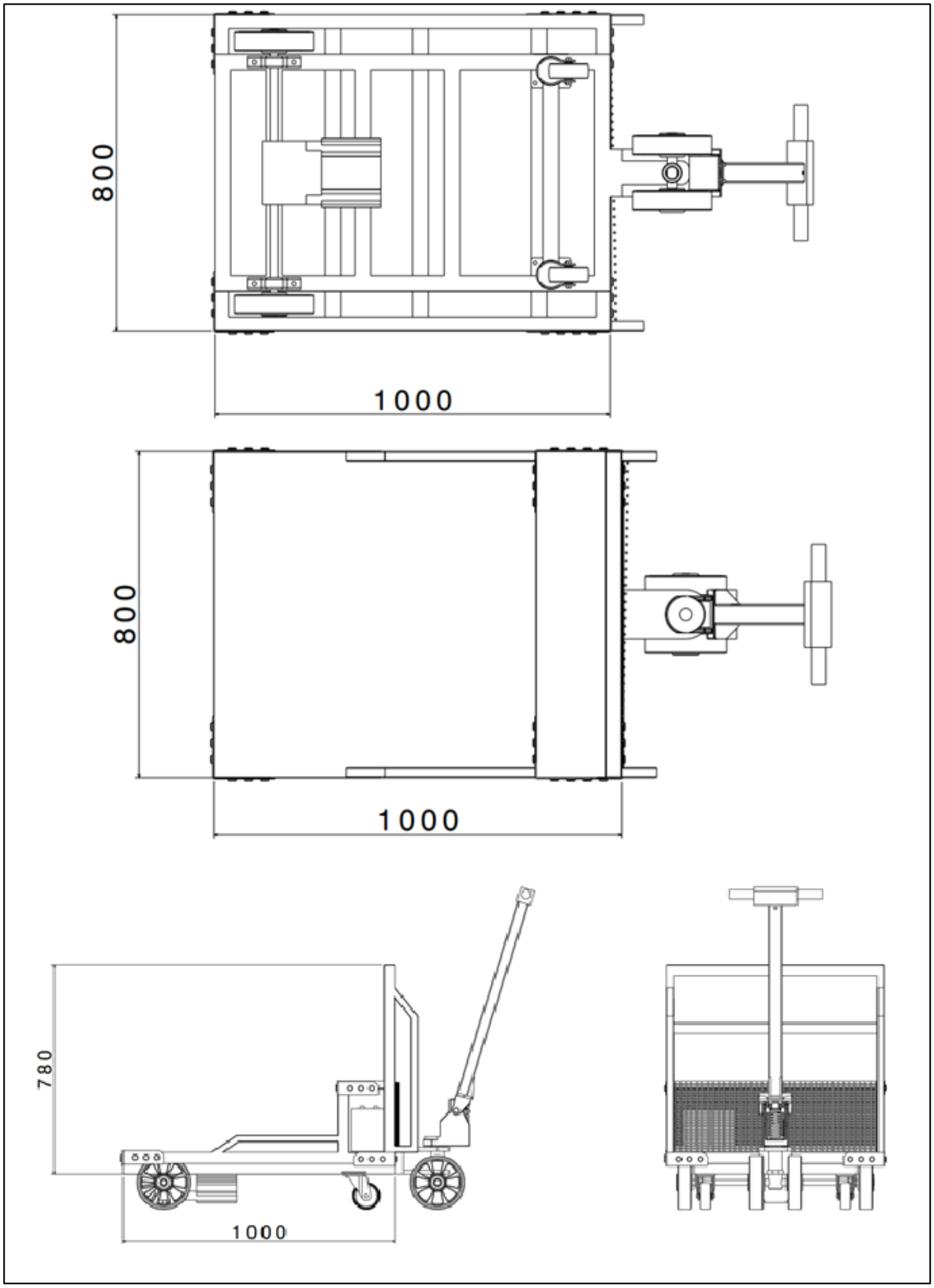
VII. DESIGN OF MACHINE:

Layout of Project –

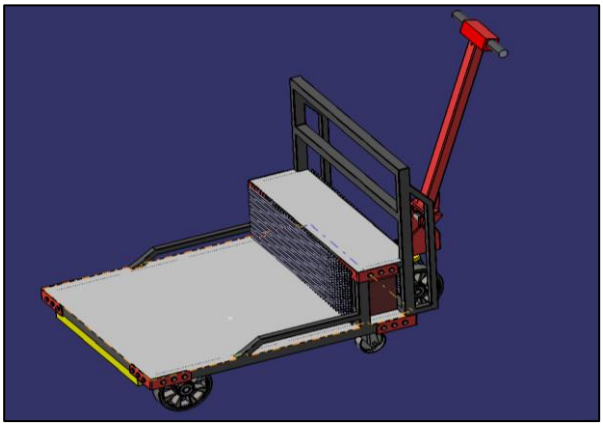




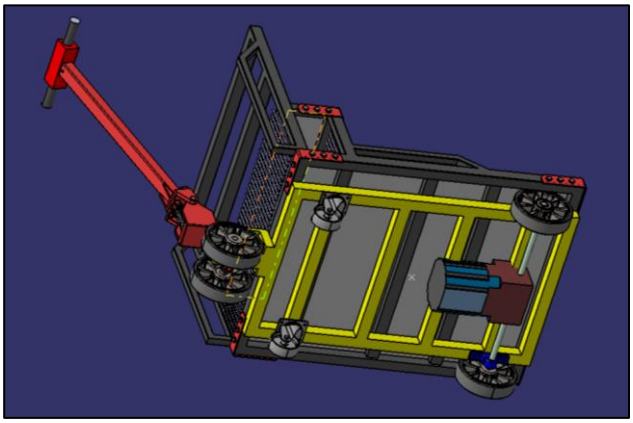
AutoCAD Drafting sheet –


800
1000
800
1000
780
1000

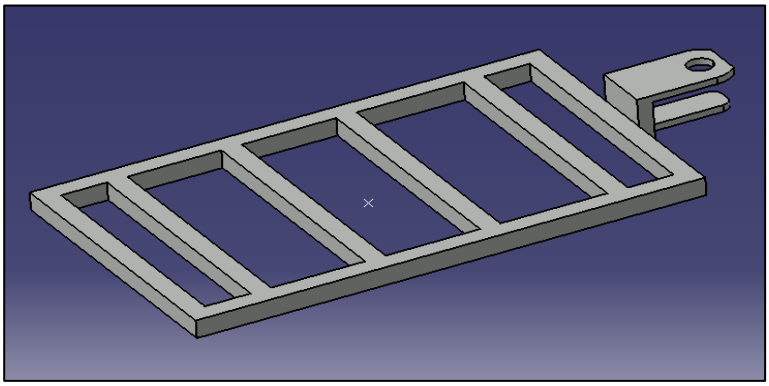
3D CAD Design of System –



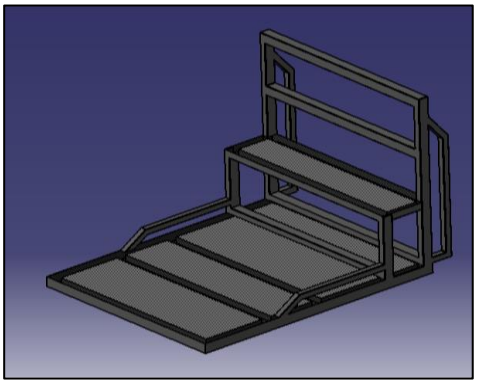
Top side view



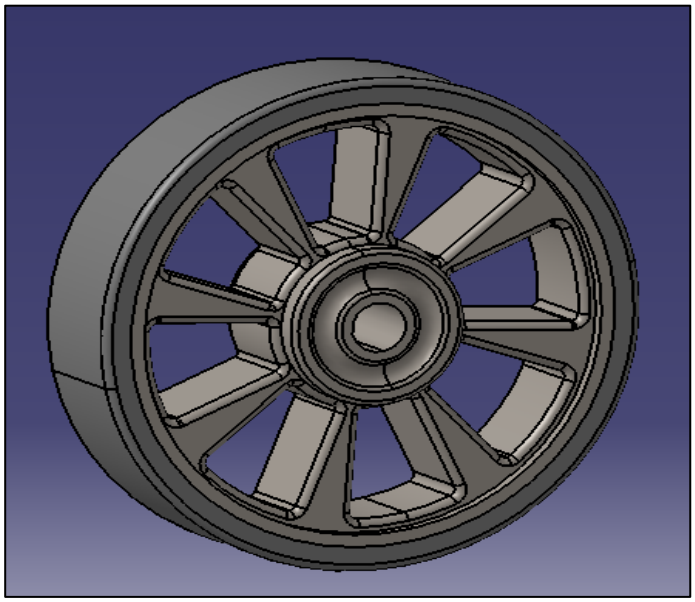
Bottom side view

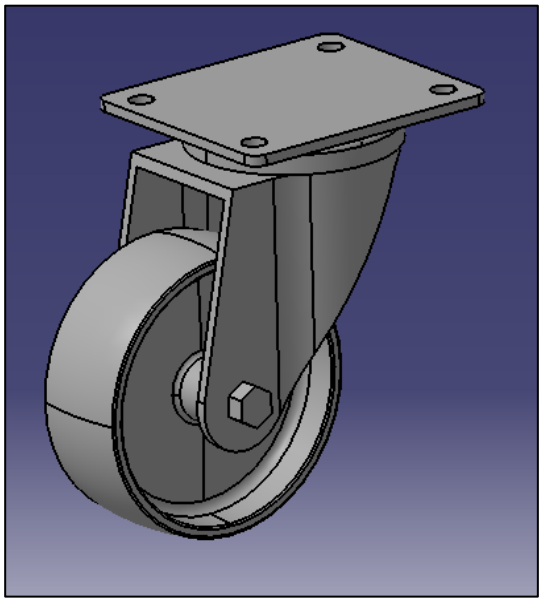


Chassis

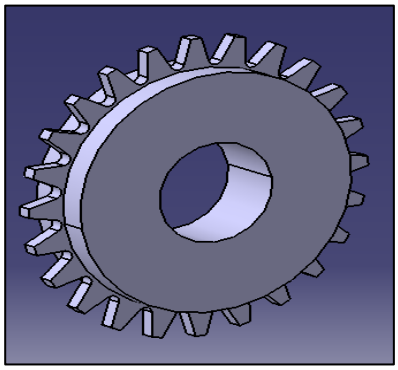


Base Frame



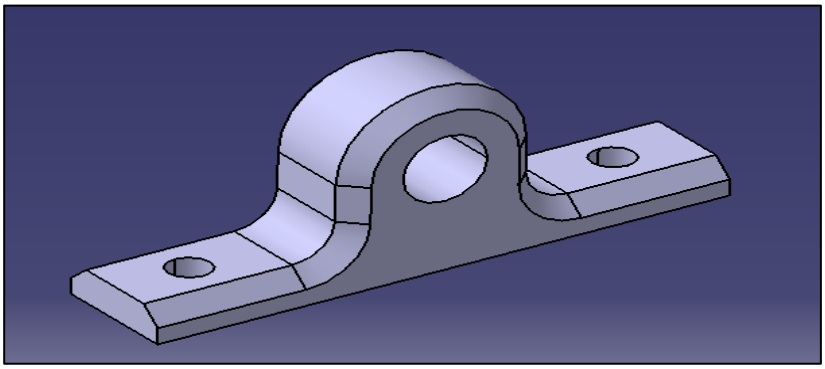


Wheel

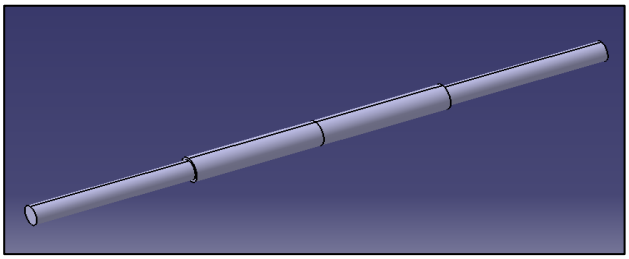


Sprocket gear

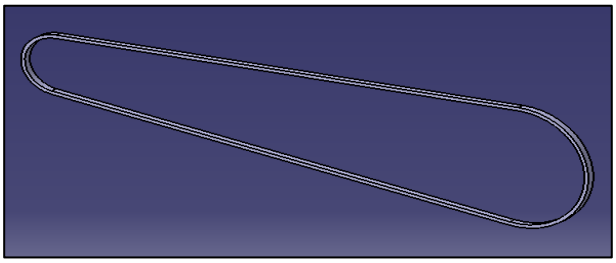
Rotating wheel



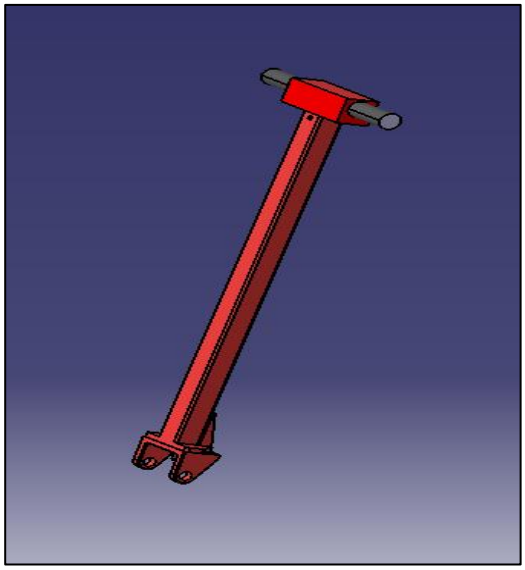
Bearing housing



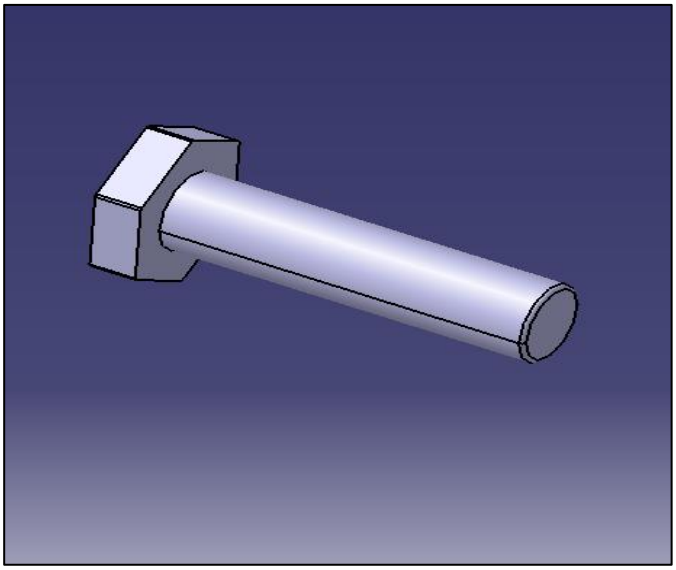
Main shaft



Chain



Handle



Hex bolt

VIII. CALCULATION:

1. Frame Design –

The Frame fabricated for our project which is made up of M.S. It is welded accordingly for arrangement of the system components. The Frame along with dimension is shown in figure below:

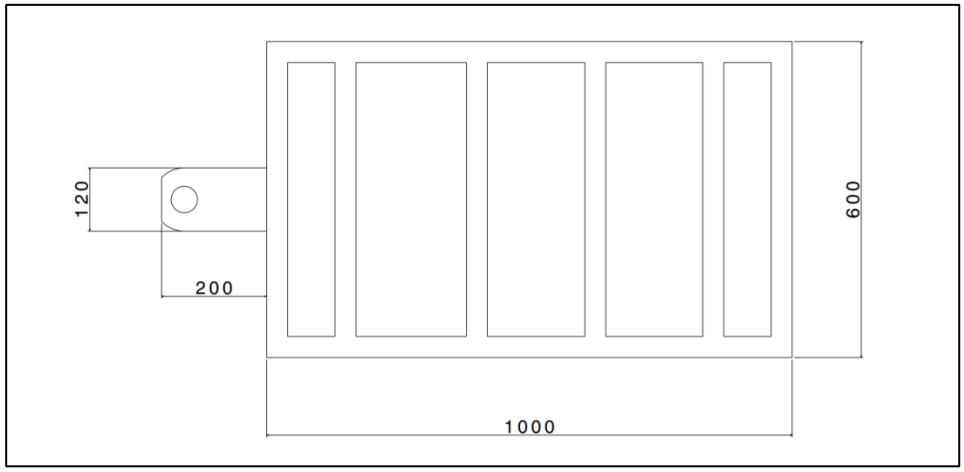


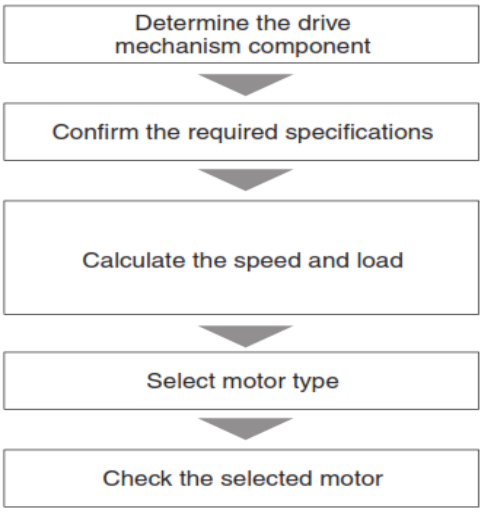
Fig. No.16 - Frame design

Frame Specification:

- Size of Frame: 600*1000 mm
- Material of Frame: Mild Steel
- Expected Loaded weight of frame: 150 Kgs

2. Motor Selection –

This segment depicts specific things that should be determined to track down the ideal engine for a specific application. Choice strategies and examples are given.



1. To start with, choose explicit components of the arrangement, for instance, drive part, harsh aspects, distances moved, and arranging period.
2. Affirm the essential conclusions for the drive system and stuff (stop accuracy, position holding, speed range, working voltage, objective, sturdiness, etc.).
3. Ascertain the motivation for load force, load dormancy, speed, etc. at the motor drive shaft of the part. Imply page 3 for determining the speed, load power and weight inactivity for various frameworks.
4. Select a motor sort from AC Engines, Brushless DC Engines or Venturing Engines considering the normal conclusions.
5. Make a last confirmation of the motor ensuing to insisting that the points of interest of the picked motor/gearhead satisfy the essentials overall (mechanical strength, speed increment time, speed increment force, etc.).

2.1 Torque required –

Suppose 100 kg of weight to be lifted.

- Force required = 100 x 9.81

= 981 N

- Torque required = Force x Radius
  = 981 x 40 …… (Consider motor sprocket, OD = 3.14” ≈ 80mm)
  = 39240 Nmm
  = 39.24 Nm
  = **335.89 kg.cm**

2.2 Wheel RPM required –

- Human walking speed = 1420 mm/sec
  = 1420 x 60 mm/min
  = 85200 mm/min
  = 85.2 m/min
  ≈ 83 m/min

- Wheel Perimeter = 250 x π…… (Consider wheel diameter = 2500mm)
  = 785.39mm
  = 0.785m

- Speed of wheel = Human walking speed / Wheel curvature
  =85.2 / 0.785
  = 108.53
  ≈ 109 rpm

2.3 Selection of motor:-

- Torque required = 39.24 Nm
- Speed required = 109 rpm
- Considering FOS = 2
- Initial movement power: P = 2πNT / 60

= 2 x 2π x 109 x 39.24 / 60
= 891.94 watt
≈ **892 watt**

Assuming 75% efficiency of motor
= 892 / 0.75
= 1189.33 watt
≈ **1190 watt**

From manufacturer catalogue nearest motor rating = 1.5 kW
Standard motor in HP = 2HP
Motor RPM = 1440 RPM……. (Standard motor RPM from manufacturer catalogue)

3. Transmission –

Gear ratio = Motor rpm / speed of wheel
= 1440/109 …… (Consider motor rpm = 1440 rpm)
= 13.21
≈ **14:1**

3.1 Speed reduction by speed control unit –

- Motor RPM = 1440
- Required RPM = 109
- Max speed reduction ration of belt drive = 4

Motor speed to be reduced by speed control device = 109 x 4 **= 436 RPM**

3.2 Design of belt drive –

- Motor RPM (N1) = 436
- Wheel RPM (N2) = 109
- Motor pulley dia. (D1) = 40mm

Dia. of pulley (D2): N1/N2 = D2/D1

D2 = 436/109 x 4

D2 = 160mm

3.3 Design of belt–

- Material used for belt = Oak tanned/ mineral tanned leather
- Working stress of belt = 2MPA
- Material used for pulley = casting(CI) ……..(High damping quality)
- Service condition / factor = 1.2

3.3.1 Length of belt–

= 2 x C.D. + πR1 + πR2 + (R1-R2)2/2 x C.D

R1= 80mm

R2= 20mm

C.D = 80+20+20 = 120mm

=2 x 120 x π x 80 x π x 20 x (80-20)2 /120

= 584.

≈ **585mm**

3.3.2 Thickness of belt–

Till 1000 mm width of belt 2.6 mm preferred

So **Thickness of belt is 2.6 mm**

3.3.3 Width of the belt–

Wrap angle/ Angle of contact (driver) =

= 180 -2 sin-1(D1-D2/2 x 2 C)

=180 -2 sin-1(160-140/2 x 120)

=120°

3.4 Design Power (Pd)–

Pd = P x Fa x Fd

Fa = Load correction Factor = 1…… (Fa =1 for normal load)

Fd = Arc of contact factor = 1.3…… (Fd=1.33 for θ = 120°)

P = 1.5 KW

Pd = 1 x 1.33 x 1.5

= 1.995

≈ **2 KW**

3.4.1 Rated power (Pr)–

= 0.0147 x v / 5.08

V = π x D1 x N1 / 60
= π x 40 x 436 / 60
= 913.15 mm/s
≈ **0.92 m/s**

Pr = 0.0147 x v / 5.08
= 0.0147 x 913.15 / 5.08
= 2. 65 watt / ply

- Considering slip factor for flat belt = 30%
- No of plies of belt = 4
- Width of belt = Pd / (Pr x No of plies)
- = 2000 / (2.65 x 4 x 1.3)
- = 145.13
- Nearest belt width from manufacturer catalogue= 152mm

Width of the belt = 152mm

4. Design of axles (shaft) –

4.1 Weight of the pulley–

- Material used for the pulley: - steel
- Density of the material :- 8000 kg/m^3
- Outer dia. of the pulley = 160mm
- Inner dia. of the pulley = 40mm
- Thickness of the pulley = 152 + 8 = 160 mm …….(4 mm per side of the belt length given)

Volume of the pulley = π / 4 x (0.162-0.042) x 0.160
= 2 x 6 x 10 -5

Weight of the pulley = Density x volume
= 8000 x 2 x 6 x 10 ^-5
= 24.12
≈ **25KN**

Material used for the axles = steel
So considering the maximum principal stress theory
Axle is subjected to both torque and bending moment

4.2 Length of axle–

Length of the axle = width of the frame + thickness of the wheel + 20 (Gap between wheel and the frame 10mm both sides)

Length of the axle = 600 + 100+ 200
= 720 mm

4.3 Diameter of shaft–

- Shaft material = 45C8 steel
- Shear strength of steel = 360 MPA
- Ultimate tensile strength = 480MPA
- Factor of safety = 3

Considering maximum principle stress theory as material is ductile

Support should be equally distributed from center

4.4 Shear force diagram–

= ∑ all forces should be zero

WA + WB = 540 + 25+ 540

WA + WB = 1105KN

=∑ MA = 0

= 540 x 180 + 25 x 360 + 540 x 540 - WB

WA = 552.5 KN
WB = 552.5KN

Take sign convention for S. F. Diagram downward -ve & upward +ve

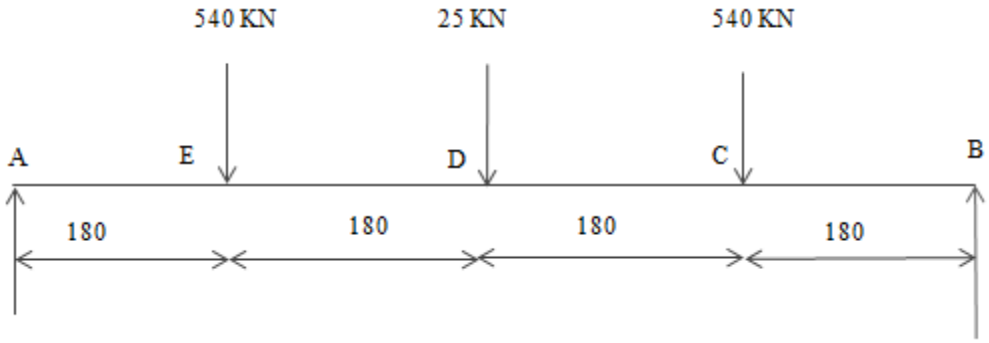
S. F. At wheel B = - 552.5KN
S. F. at bearing C = -552 + 40 = -12.5KN

S. F. At Pulley D = -12.5 +25 = 12.5 KN
S. F. at bearing E = 12.5 + 540 = 552.5 KN
S. F. At wheel A = 552.5KN

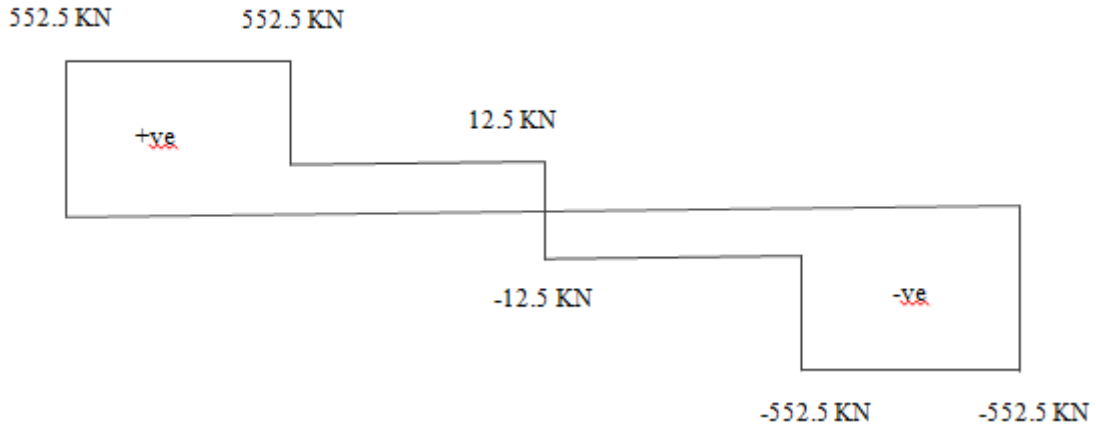
Maximum Bending moment:-
∑MB = 0

Sign convention for hogging –ve & sagging +ve
Mc = 552.5 **x** 0.18 = 99.45 KN.m
MD = 552.5 x 0.36 -540 x 0.18 = 101.7 KN.m
ME = 552.5 x 0.54 -540.36 – 25 x 0.18 = 99.45 KN.m
MA = 552.5 x 0.72 – 540.0 x 0.18 - -25 x 0.36 – 540 x 0.54 = 0

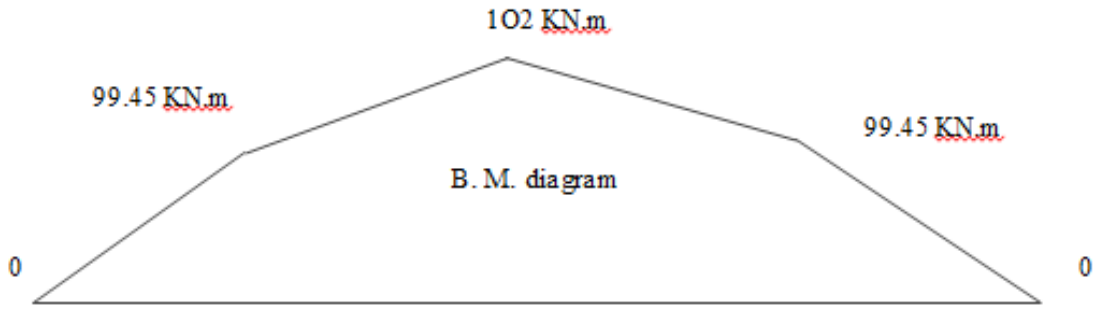
Maximum bending moment occurs at point D = 101.7KN.M
=101.7 x 10^3 KN.MM
≈ **102** x **10^3 kN.mm**



Shear force diagram–



Bending Moment diagram–



4.5 Torque transmitted by the pulley–
Coefficient of friction (μ):- 0.3

Angle of wrap/ belting angle (Ø) = 180 + 2 sin-1(D1-D2 / 2 x 2 C)
=180 + 2 sin-1(160-40/(2 x 120))
=240°
= **1.33 π rad**

P = (T1-T2) x V

V = π x D1 x N1 / 60
= π x 160 x 109 / 60
= 913.15 RPM

P = 1500 KW

T1 - T2 = 1.65……..equation **1**

Belt tension ratio:-
Coefficient of friction (μ) :- 0.3

$T1 /T2 = e^{\mu \times \emptyset}$

From equation 1

$T1 = (T1-1.65) \times e^{(\mu \times \emptyset)}$
$= (T1-1.65) \times e^{(0.3 \times 1.33 \times \pi)}$

T1 =3.5 T1 – 5.77
T1 = 2.31 KN
T2 = 0.67KN

Torque transmitted by pulley = Tension x radius of pulley

= 2.31 x 160
= 369.69 kN.mm
≈ **370 kN.mm**

Considering maximum shear stress theory

Te $= \sqrt{T^2 + M^2}$

$= \sqrt{(370^2 + (102x10^3)^2}$

Te $= 102 \times 10^3$ KN.mm

Te $= \frac{\pi}{16} \times \tau \times d^3 \times FOS$

$d^3 = \frac{102 \times 10^3 \times 16}{\pi \times 120 \times 3}$

d = 16.29mm

d ≈ 20mm……(1)

Considering maximum principle stress theory

Equitant bending moment

Me $= \frac{1}{2} \times (M + \sqrt{M^2 + T^2}$

Me $= \frac{1}{2} \times (102 \times 10^3 + \sqrt{(102x10^3)^2 + 370^2}$

Me =102 x 10^3 KN.mm

Me $= \frac{\pi}{32} \times \sigma \times d3 \times FOS$

Take FOS = 4 ……As road condition and jerky moment as well as eccentric loading

$d^3 = \frac{102^2 \times 10^3 \times 32}{\pi \times 4 \times 120}$

d = 20.53mm

d ≈ 25 mm……(2)

From (1) & (2) diameter or axle = 25 mm

5. Design key–

- Material of the key =hardened steel 55MN68
- Shear strength = 126 MPA
- Crushing strength= 210 MPA
- Factor of safety = 3

5.1 Length of the key = 1.25 x d
= 1.25 x 25
=31.25mm
≈ **35mm**

5.2 Width of the key–

$$W = \frac{2 \times \pi \times d^2}{16 \times l}$$

$$W = \frac{2 \times \pi \times 25^2}{16 \times 31.25}$$

= 7.85 mm
≈ **10 mm**

5.3 Width of the key–

- Material of the key =hardened steel
- Shear strength = 126 MPA
- Crushing strength= 210 MPA
- Factor of safety = 3

Consider the crushing failure of the key

$$T = \frac{\pi \times \tau \times d^2}{4 \times l \times \sigma cr}$$

$$T = \frac{\pi \times 42 \times 25^2}{4 \times 31.25 \times 70}$$

T = 9.42 mm
T ≈ 10 mm

Size of the key = 10 x 10 x 35

6. Selection of bearing–

- Radial force acting on the bearing (Fr) = 540 KN
- Diameter of shaft on bearing mounted = 25 mm
- Type of the bearing used = Ball bearing…… (Medium load & small shaft diameter)
- Revolution of bearing = 109 RPM
- Axial load on bearing (Fa) = 0……. Load is pure radial

6.1 Equivalent dynamic load of the bearing (P):-

As load is pure dynamic load, **P = 540 KN**

6.2 L10 in million revolution

Expected life of bearing = 10000 hr……..assume

L10H ⟶ L10 ……(Million revolution)

Total time (in min) = L10H x 60 min

Total revolution = LH x 60 x N

Life in million revolution = $\frac{\text{LH x 60 x N}}{10^6}$ million revolution

$= \frac{10000\text{x 60 x 109}}{10^6}$

= 65.4 million revolution

6.3 Dynamic load capacity(C) = P x (L10)1/3……ball bearing

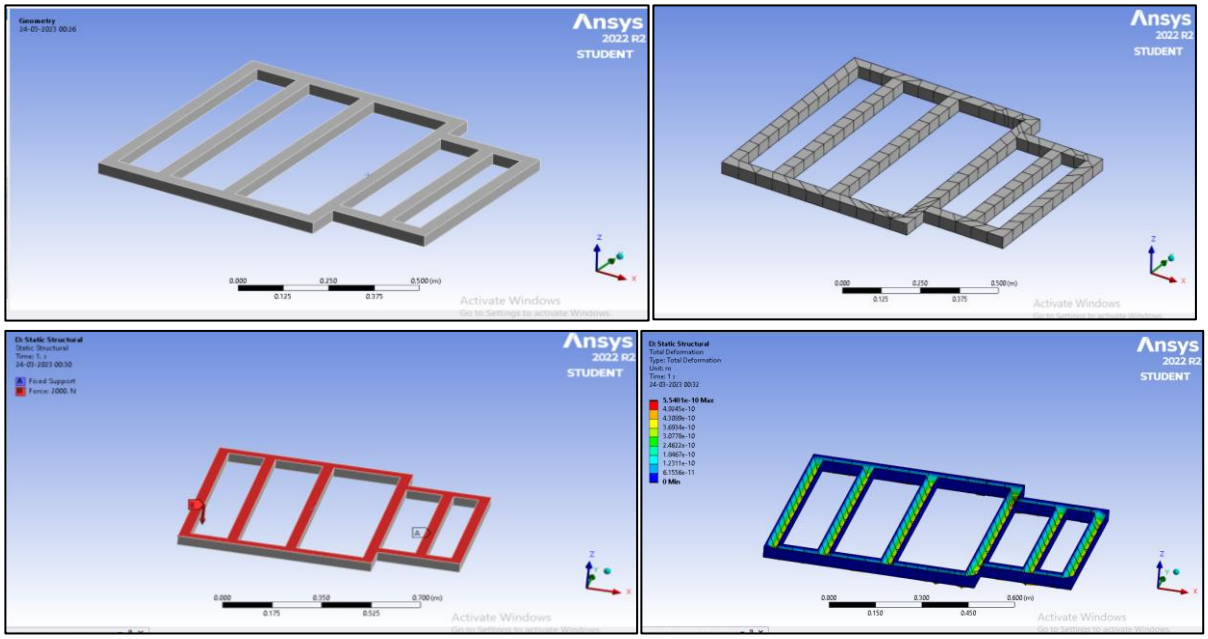
= 540 x (65.4)1/3

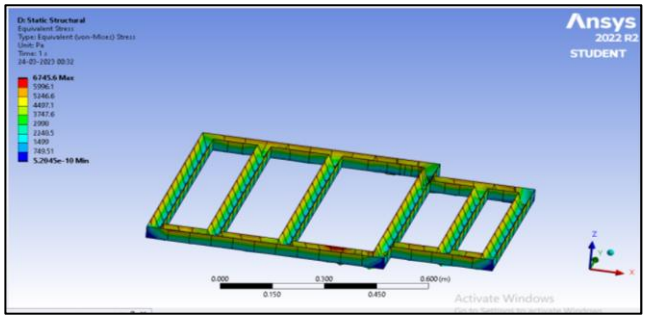
= **2172.582 KN**

(From the manufacturer catalogue for the dia. 25mm & 2172.582 KN Baring no 22228)

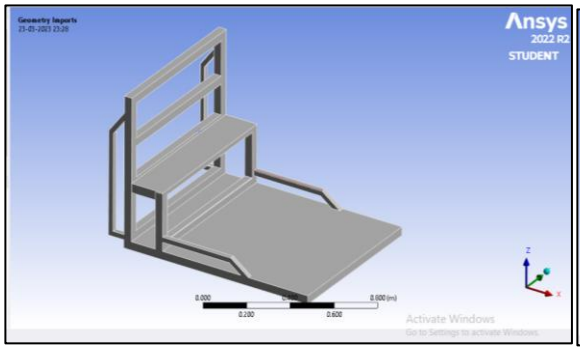
IX. ANALYSIS OF COMPONENTS BY ANSYS-R2 SOFTWARE:

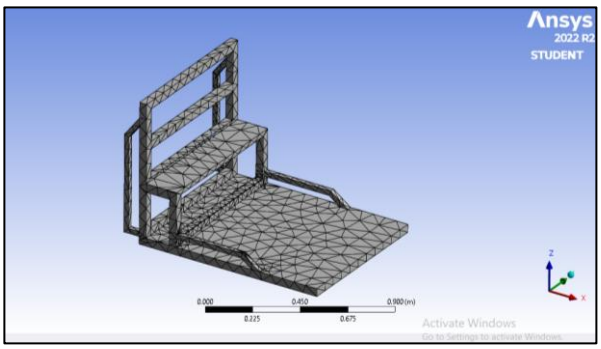
Analysis of chassis–

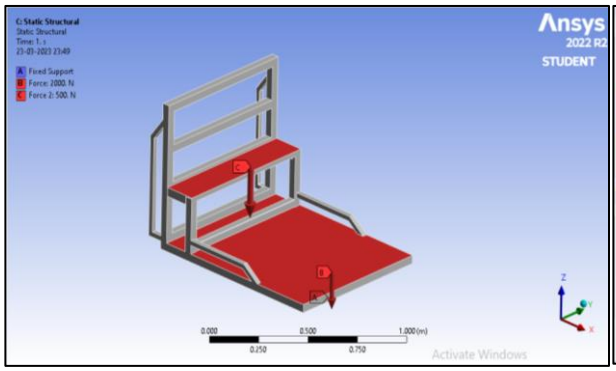


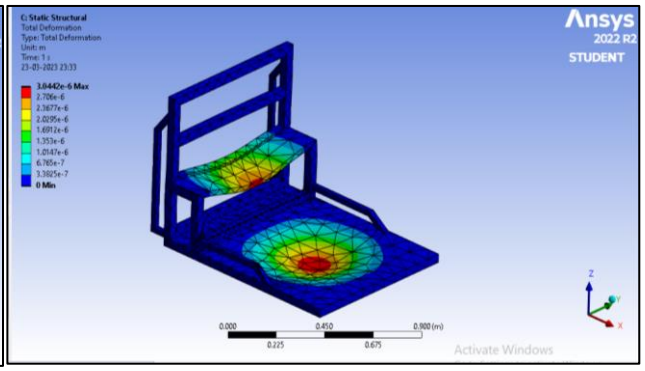


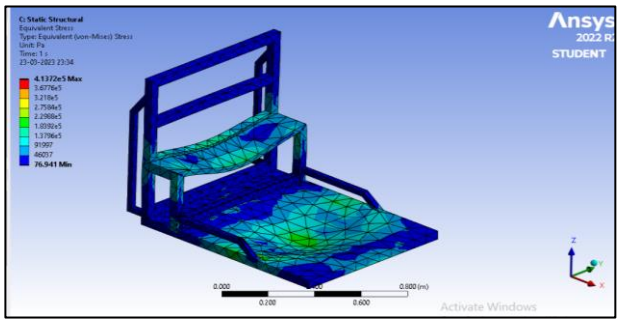
Analysis of Base frame–











X. ADVANTAGES

1. Load carrier is a new creation to assist the workers with working easily with no issue and no risk of any kind of damage and medical problems.
2. It could be utilized at places like construction sites, industries, ports, etc. or we can say where there is need to lift and convey weighty burdens by hands or on shoulders and head. This is an ergonomically designed carrier to improve the working condition of labours and reduce the risk of injuries to head, shoulders, hands, waist, etc.
3. The main objective is to provide the workers with the facility to carry the loads in three simple ways which are over the head, at the back and push or pull activity.
4. These new load carriers are designed so that they are light in weight, simple to utilize and work effectively with practically no strain to the muscles and the body parts

XI. DISADVANTAGES

1. This machine is not suitable for rough roads
2. Need to more space to store
3. Battery cost is high
4. Not to be used as a personal at home

XII. LITERATURE SURVEY

Design and Fabrication of Rocker Bogie Mechanism Geosurvey Rover, B.Babu, N.Dhayanidhi, S.Dhamotharan [1] - The Project work "Rocker Bogie system Geosurvey Meanderer" manages the significant part of working on the wanderer from its past plans. The Geosurvey meanderer needs to work on unpleasant and brutal conditions for which it was planned yet a few variables limit its functional capacities, so the focal point of our examination is to beaten limitations or to decrease it to inside a satisfactory reach for its smooth presentation.

Prospects for Development of Load – Carrying Elements of Freight Car Bogie, O.V. Makhnenko, G.Yu. Saprykina, I.V. Mirzov and A.D. Pustovoj [2] - As of late mishaps connected with break of cast load-conveying components of three-piece intruders of cargo vehicles have become more continuous in the rail lines of Ukraine and Russia. The work proves the judiciousness of advancement and utilization of all-welded load-conveying components of cargo vehicle bogie (FCB), working on their functional dependability. Welded designs of FCBs are generally applied in West Europe. Endeavors to foster designs of all-welded components of FCBs indispensable with cast structures are made in Ukraine and Russia. In any case, none of the created welded structures is right now applied at customary freight transportation, due to non-ideal plan of bogie welded components as far as guaranteeing the necessary weariness obstruction edge.

Design of all-Terrain Vehicle using Rocker Bogie Mechanism, M. Vigneshwaran, R. Siddhartha, G. Vijay and S. Pravin Kumar [3] - The requirement for creating a very stable suspension system that can function on various terrains while maintaining full wheel contact with the ground to create a system that can navigate terrains where the left and right rockers must each climb a different obstacle separately. To maintain an angle of tilt more than 50 degrees without falling over. For conducting scientific examination of goals that

are separated by many meters to tens of kilometers, rocker bogie are crucial.

Study of Failure Pattern on Load Bearing Wall, Anurag Wahane, Vinay Kumar Sahu, Ritik kumar Sahu, Hemendra kumar Sahu [4] - The study of load-bearing wall structure models is the topic of the work. This masonry load-bearing wall may collapse due to instability if it is subjected to vertical concentric and eccentric loading. In this study, the failure patterns of masonry load-bearing walls of various sizes were examined using compressive strength tests and shaking table tests. The outcome demonstrates that the bearing wall cannot support enormous loads, however increasing thickness may result in reduced structural damage.

Risk Evaluation of Bogie System Based on Extension Theory and Entropy Weight Method, Yanping Du, Yuan Zhang, Xiaogang Zhao, and Xiaohui Wang [5] - The essential component of railroad vehicles is a bogie system. Bogies continue to have difficulties in rigorous practical examination. In practice, part-specific experiments are currently used excessively. Based on inspection data and expert evaluation, a risk evaluation index system for a bogie system has been constructed in the current study. The danger status of a bogie system has then been assessed utilizing an extension theory and an entropy weight approach while taking into account quantitative and qualitative features. Finally, four distinct samples' bogie systems have been evaluated using the approach. Results indicate that this method can precisely determine a bogie system's risk state.

Bogie Steering System Improving Alignment of the Urban Railway Vehicle in Track, Michał Podalski, Maciej Slabuszewski [6] - Low-radius curves, which provide significant challenges for contemporary rail vehicles, are a common feature of urban rail systems. To address such issue, numerous technologies have been created over time. One category of these is bogie steering systems, which are in charge of improving the alignment of cars in a curve, improving ride comfort, and minimizing wear on the wheels and rails. The goal of these systems is to reduce the angle of attack by correcting the relative settlement of bogies and car bodies during curve negotiations. This paper describes one of those systems in terms of design, operation, and verification. Results from some simulations and experiments are given and analyzed.

XIII. FUTURE SCOPE

1. Expanded functional proficiency through standardization of operations.
2. Decrease in occurrence of mistakes in work.
3. Uncovering of loopholes in production or processes.
4. Builds efficiency of the staff.
5. Positive effect on the income of an assembling business.

XIV. CONCLUSION

The result of the project was the execution of free directional control using least drive modules which builds the effectiveness.

At the same time, A progression of portability experiments in the farming area, rough roads, inclined, steps and obstacles surfaces concluded that rocker bogie can accomplish some distance navigates on field. This work shows how rocker bogie system works on various surfaces.

XV. REFERENCES

[1] Design and Fabrication of Rocker Bogie Mechanism Geosurvey Rover, B.Babu, N.Dhayanidhi, S.Dhamotharan.

[2] Prospects for Development of Load – Carrying Elements of Freight Car Bogie, O.V. Makhnenko, G.Yu. Saprykina, I.V. Mirzov and A.D. Pustovoj.

[3] Design of all-Terrain Vehicle using Rocker Bogie Mechanism, M. Vigneshwaran, R. Siddhartha, G. Vijay and S. Pravin Kumar.

[4] Study of Failure Pattern on Load Bearing Wall, Anurag Wahane, Vinay Kumar Sahu, Ritik kumar Sahu, Hemendra kumar Sahu.

[5] Risk Evaluation of Bogie System Based on Extension Theory and Entropy Weight Method, Yanping Du, Yuan Zhang, Xiaogang Zhao, and Xiaohui Wang.

[6] Bogie Steering System Improving Alignment of the Urban Railway Vehicle in Track, Michał Podalski, Maciej Slabuszewski.

[7] Fabrication of Rocker Bogie Suspension System, Mohd. Rafeeq Ur Rehman, S. Venu Madhav, P. Aravind, D. Nikhil Reddy, G.S.S. Srinivas.

[8] Design and Fabrication of Rocker Bogie Mechanism using Solar Energy, Rajat Murambikar1, Vinay Omase2, Vivek Nayak3, Karan Patil4, Prof. Yogesh Mahulkar.