Extendable additional steps for busses and trucks

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Abstract - *The Product Design and Development Laboratory is for the students to gain experience in designing and developing a product from feasibility assessment to development. As a part of this laboratory, I have generated ideas and conceptual sketches for these ideas. Using the weighted matrix, I have selected the "Extendable additional steps for busses and trucks". The design for the product is finalized using Pugh matrix and CAD models are created using SolidWorks. This report contains the ideas generated, conceptual design, product design and the CAD model for the finalized idea.*

Key Words: Design, analysis, pneumatic, Steel, busses and trucks

1.INTRODUCTION

Public transportation plays a major role in many people's life. With high steps, bus rides are not smooth for elderly. The low-floor busses are not completely implemented in Tamil Nadu. The low-floor busses are available only on the semi-air conditioned or fully air-conditioned busses such as Volvo and Daimler but the tickets are expensive.

While using high-floor steps in busses, elderly people have the risk of getting knee pain. Also, while using high-floor steps everyone has the chance of getting knee pain by carrying heavy weight. And for children this will be a tough task to do. The ground clearance between the steps and height of all individual steps makes it harder.

For this problem, extendable additional steps can be used to reduce the found clearance. These steps can be extracted and retracted. This additional step can reduce the knee pain as people do not have to strain while landing on the ground and boarding the busses

1.1 Problem definition

With high steps, bus rides are not smooth for elderly. The low-floor busses are not completely implemented in Tamil Nadu. The low-floor busses are available only on the semi-air conditioned or fully air-conditioned busses such as Volvo and Daimler but the tickets are expensive. While using high-floor steps in busses, elderly people have the risk of getting knee pain. Also, while using high-floor steps everyone has the chance of getting knee pain by carrying heavy weight. And for the children this will be a tough task. The ground clearance between the steps and height of all individual steps makes it harder.

1.2 Aim

For this problem, extendable additional steps can be used to reduce the ground clearance. These steps can be extracted and retracted. These additional steps can reduce the knee pain as people do not have to stain while landing on the ground and boarding the busses. These will be retracted so it will not be a disturbance in the side.

2. METHODOLOGY

Methodology is specific procedures followed to identify, select, analyze the process and complete the project. The following methodology is carried for completing the EXTENDABLE ADDITIONAL STEPS FOR BUSSES AND TRUCKS project.

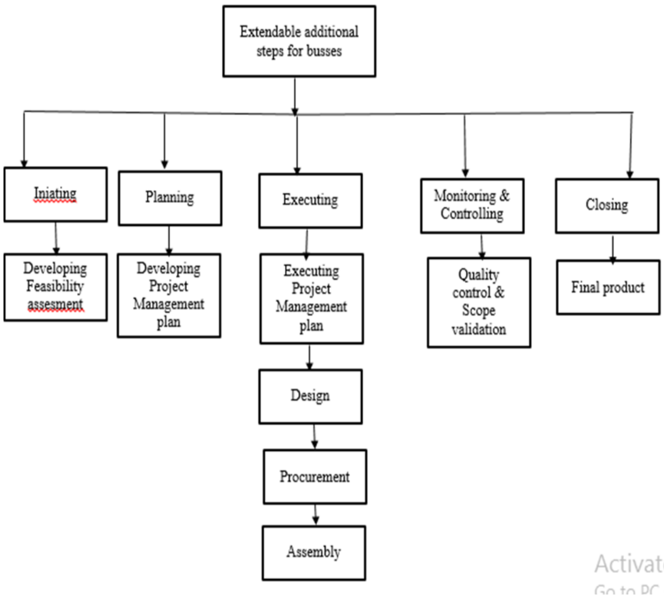


Fig - 1: Flowchart of methodology

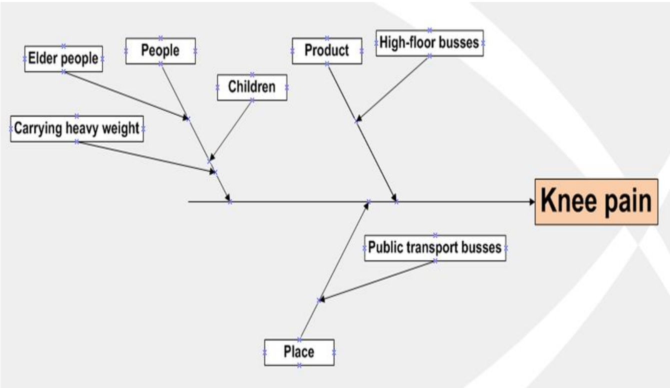


Fig - 2: Cause and effect diagram

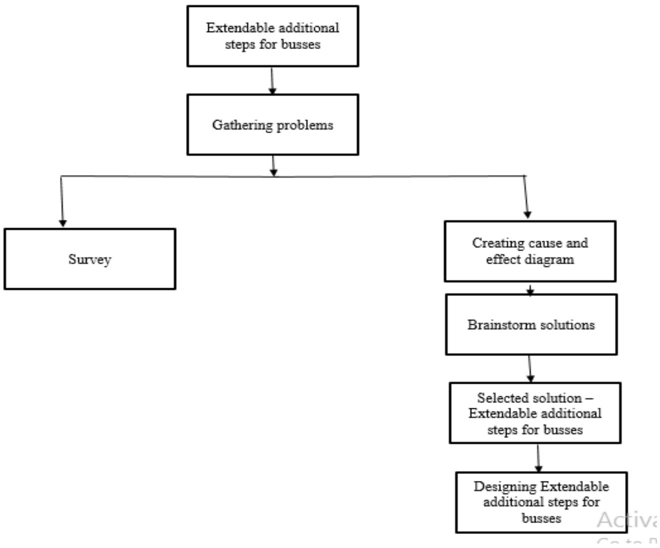


Fig - 3: Hierarchical Task Analysis

3. DESIGN

Based on the requirement and considering various design factor the conceptual sketches were created and finalized one design among the conceptual sketch. The dimensions are adapted based on Indian Anthropometric dimension data. The dimensions such as weight of the person were determined with the help of the anthropometric data. Irjet template sample paragraph, Irjet template sample paragraph .Irjet template sample paragraph. Irjet template sample paragraph.

3.1 Factors considered for Design

3.1.1 Indian Anthropometric Data

Anthropometric data are data of human body size and shape. The core element is weight.

3.1.2 Design Calculation

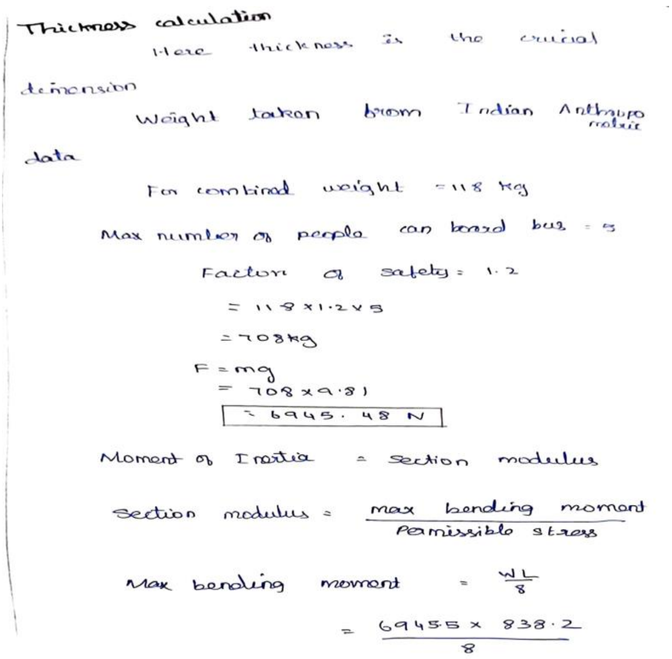


Fig - 4: Design calculation

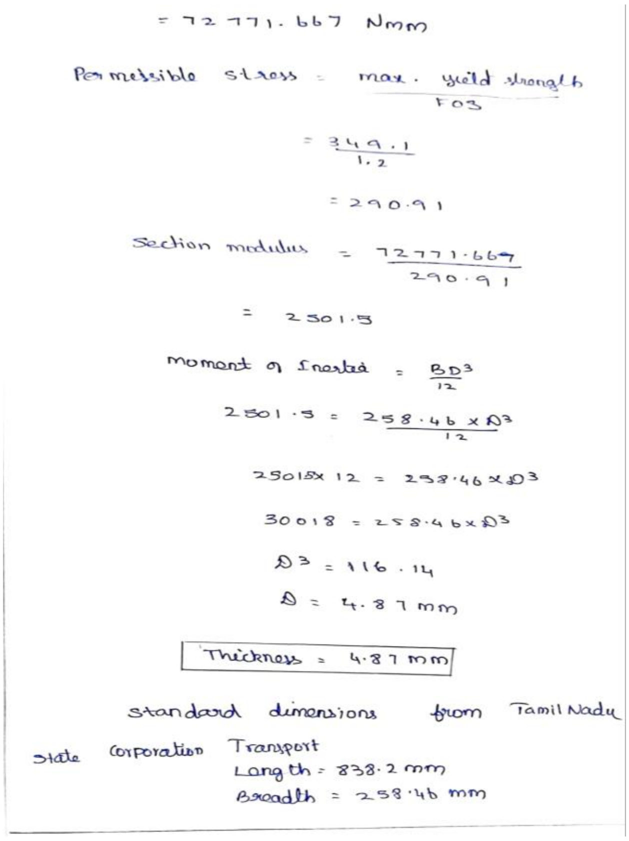


Fig - 5: Design calculation

3.2 CADD Model

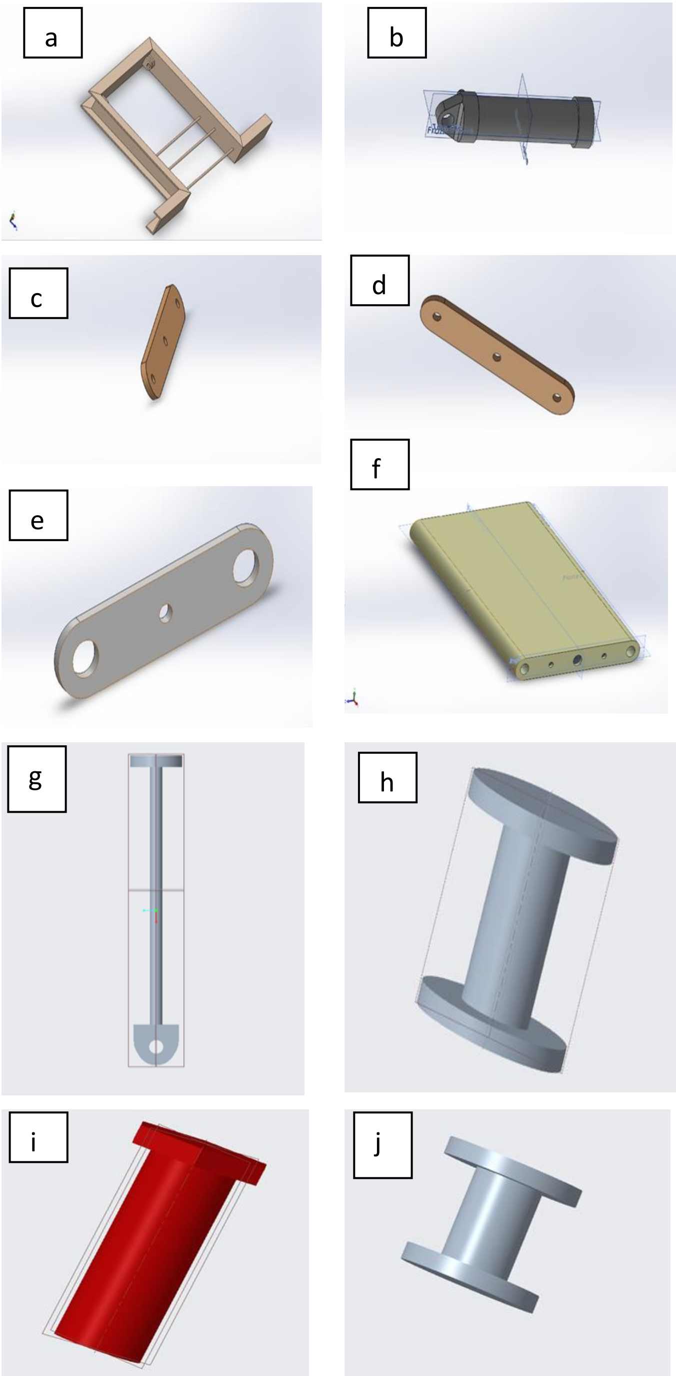


Fig - 6: Components (a-j)

The components of the extendable steps assembly are shown in the above figures from a to j. Listing base frame, cylinder, link 1, link 2, link 3, step, piston, pin 1, pin 2, and pin 3.

3.3 CADD Assembly

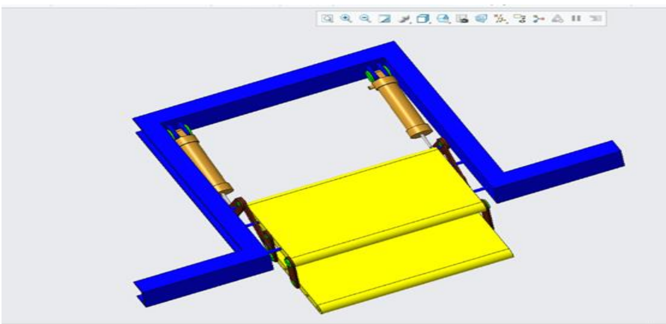


Fig -7: Final assembly 1st view

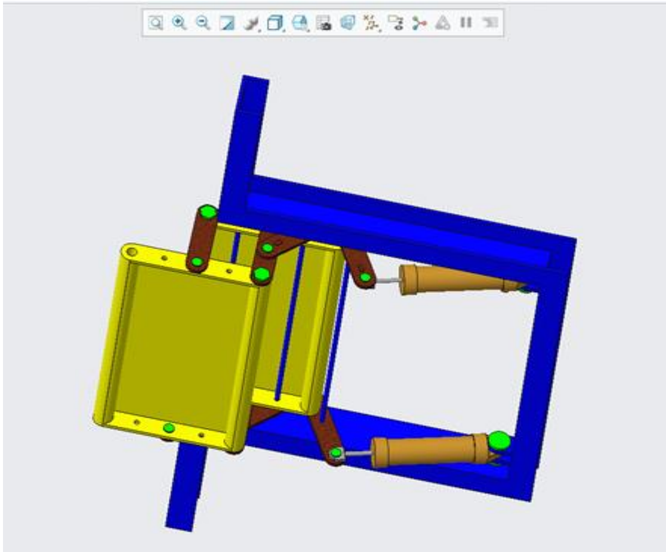


Fig - 8: Final assembly 2nd view

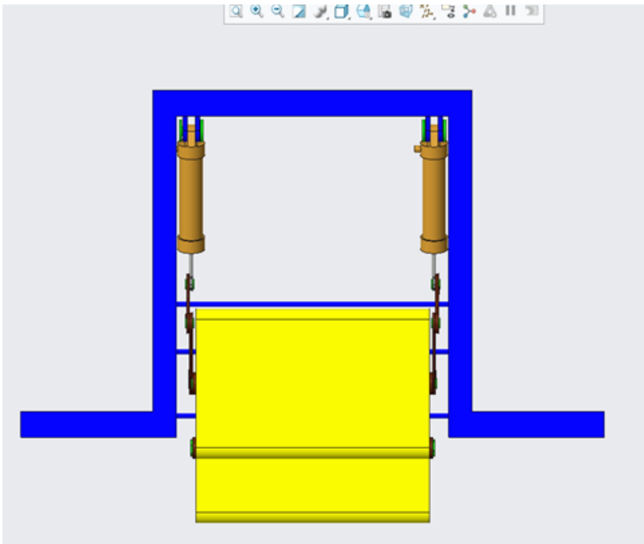


Fig - 9: Final assembly 3rd view

3.4. Bill of Materials

Table -1: Bill of Materials

Item number	Part name	Material	Quantity
1	Link 1	Steel	2
2	Link 2	Steel	2
3	Link 3	Steel	4
4	Step	Mild steel	2
5	Piston	Stainless steel	2
6	Cylinder	Stainless steel	2
7	Base frame	Mild steel	1
8	Pin 1	Steel	2
9	Pin 2	Steel	4

3.5 Parts

The product shown in the assembled model consists of eight major parts: base frame, link, step, piston, and cylinder

Base frame: The base frame supports all other parts and it is connected to the bus.

Link: The link helps in connecting the steps with the frame.

Piston: Piston is the part of double acting cylinder.

Cylinder: The cylinder is the double acting cylinder's body.
Step: The step is a rectangular part and it is the major part of this assembly

4. STATIC STRUCTURAL ANALYSIS

A static structural analysis determines the stresses, strains, displacements, and forces in structures or components or products caused by loads that do not induce significant inertia and damping effects.

The model is imported as iges file into the Ansys software. The above are the boundary conditions applied to the model in Ansys software. Coarse mesh structure type with a size of 5mm is used for generating mesh for the model. The model is solved and the results are obtained.

4.1 Material properties

Table -2: Material properties

Part	Material	Young's Modulus (GPa)	Density (Kg/m^3)
Step	M.S	210	7850
Link	M.S	210	7850
Pins	S. S	210	7850
Base frame	M.S	210	7850
Cylinder	S. S	190	7860
Piston	S. S	190	7860

4.2 Material selection using Ashby chart

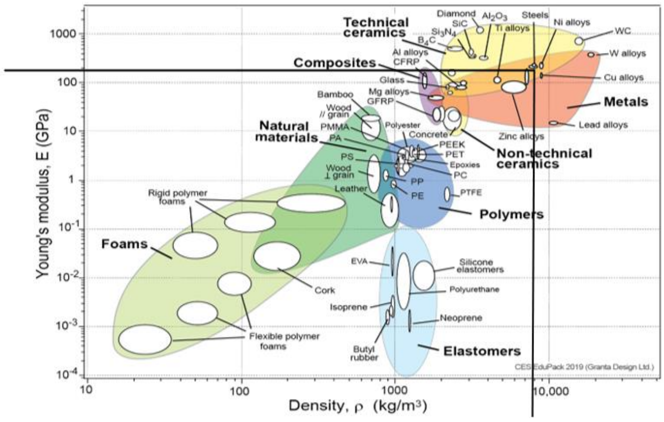


Fig - 10: Material selection using Ashby chart

4.3 Analysis

4.3.2 Analysis of first step

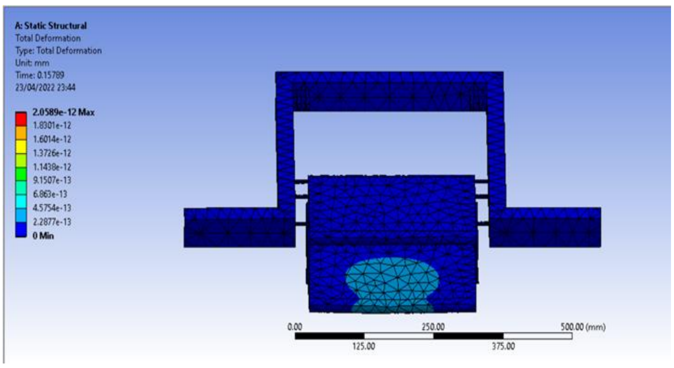


Fig - 11: Total deformation

The maximum total deformation 2.0589e-12 mm and the minimum total deformation was 0 mm.

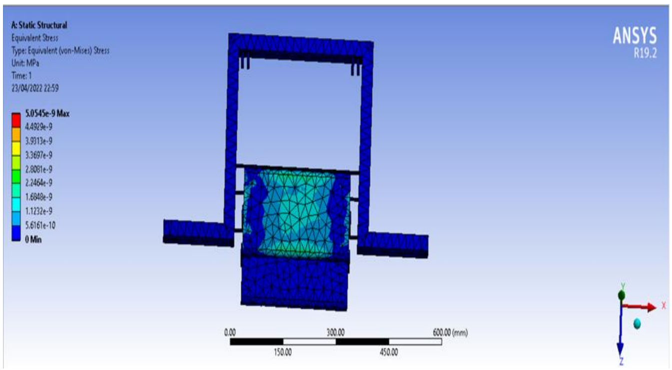


Fig - 12: Equivalent stress

The maximum equivalent stress was 5.0545e-9 MPa and the minimum equivalent stress was 0 MPa.

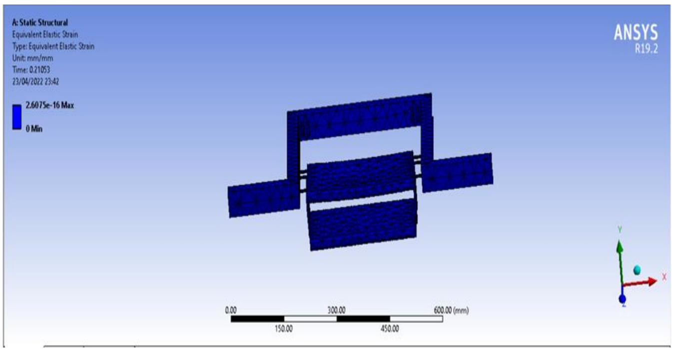


Fig - 13 Equivalent elastic stress

The maximum equivalent elastic stress was 2.6075e-16 mm/mm and the minimum equivalent elastic stress was 0 mm/mm.

4.3.3 Analysis of second step

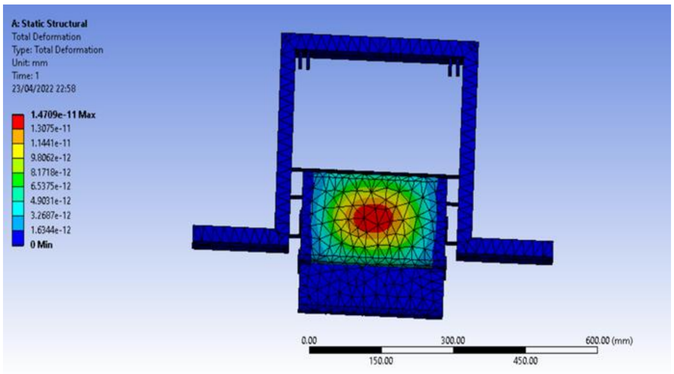


Fig - 14: Total deformation

The maximum total deformation 1.4709e-11 mm and the minimum total deformation was 0

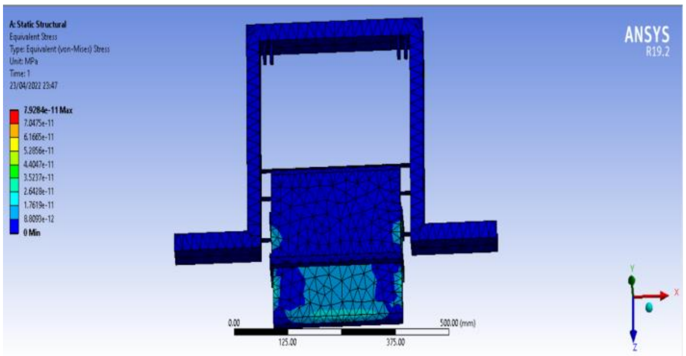


Fig - 15: Equivalent stress

The maximum equivalent stress was 7.9284e-11 MPa and the minimum equivalent stress was 0 MPa.

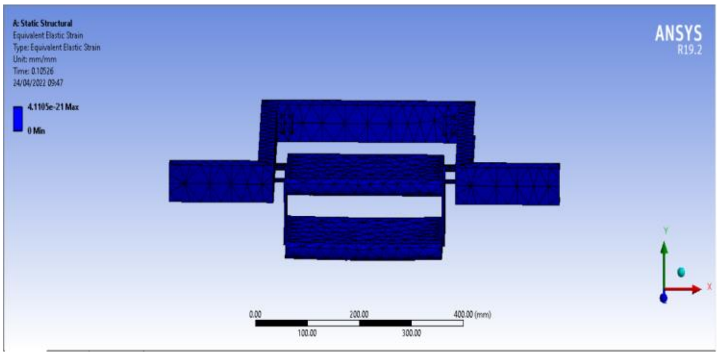
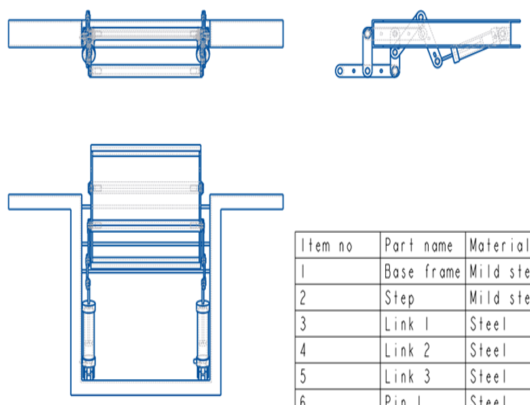


Fig - 16: Equivalent elastic stress

The maximum equivalent elastic stress was 4.1105e-21 mm/mm and the minimum equivalent elastic stress was 0 mm/mm.

5. DRAWING (2D)



Item no	Part name	Material	Quantity
1	Base frame	Mild steel	1
2	Step	Mild steel	2
3	Link 1	Steel	2
4	Link 2	Steel	2
5	Link 3	Steel	4
6	Pin 1	Steel	2
7	Pin 2	Steel	4
8	Pin 3	Steel	10
9	Cylinder	Stainless steel	2
10	Piston	Stainless steel	2

Fig - 17: Assembly

6. CONCLUSIONS

During analysis the project is tested on total deformation, equivalent stress and equivalent elastic stress, modelling and analysis done by using PTC Creo, and Ansys. And the results were within the specification limits defined by automotive standards from Automotive industry standards committee.

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BIOGRAPHY

Motivated project management professional passionate in bringing ideas to life. Proficient in project management, lean methodology, supply chain management and data analytics. Enjoys finding creative solutions in improving productivity.