NATIONAL INSTITUTE OF TECHNOLOGY AGARTALA

TOPPIC – DESIGN AND STATIC ANALYSYS OF WEIGHT LIFTING ROBOTICS ARM

PROJECT REPORT

Minor project-2

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ACKNOWLEDGEMENT

THE SUCCESS AND FINAL OUTCOME OF THIS PROJECT REQUIRED A LOT OF GUIDANCE AND ASSISTANCE FROM MANY PEOPLE AND I AM EXTREMELY PRIVILEDGE TO HAVE GOT THIS ALL ALONG COMPLETION OF MY PROJECT . ALL THAT I HAVE DONE IS ONLY DUE TO SUCH SUPERVISION AND ASSISTANCE AND I WOULD NOT FORGET TO THANK THEM.

I WOULD LIKE TO EXPRESS MY SPECIAL THANKS OF GRATITUDE TO OUR RESPECTED

HONOURABLE

TEACHER DR. SUBRATA KUMAR GHOSH

WHO GIVE ME SUCH A GOLDEN CHANCE TO DO A WONDERFULL PROJECT OF ON THE

TOPPIC

__DESIGN AND STATIC ANALYSYS OF WEIGHT LIFTING ROBOTICS ARM__

BY THIS PROJECT I CAME TO KNOW ABOUT SO MANY NEW THINGS.
I AM THANKFUL TO MY PARENTS TO GAVE ME A MORAL SUPPORT AND GUIDED ME TO COMPLETE THIS PROJECT ON TIME.

1. Introduction

A robot is a type of automated machine that can execute specific tasks with little or no human intervention and with speed and precision. Means an automatically guided machine which is able to do tasks on its own called as robot. The first digitally operated and programmable robot was invented by **George Devol** in 1954.

As technology progresses In 2005, 90 percent of all robots could be found assembling cars in automotive factories. These robots consist mainly of mechanical arms tasked with welding or screwing on certain parts of a car.

As we all know in today fast moving life Automation is necessary for safety, quality and productivity.

2.Law of Robotics

There are three basic type of law which was given by scientist was …

1. A robot may not injure a human being , or, through inaction, allow a human being to come to harm.

2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

3.Characteristics of Robots

- Robots consist of some sort of **mechanical construction.** The mechanical aspect of a robot helps it complete tasks in the environment for which it's designed. For example, the Mars 2020 Rover's wheels are individually motorized and made of titanium tubing that help it firmly grip the harsh terrain of the red planet.
- Robots need **electrical components** that control and power the machinery. Essentially, an electric current — a battery, for example — is needed to power a large majority of robots.
- Robots contain at least some level of **computer programming.** Without a set of code telling it what to do, a robot would just be another piece of simple machinery. Inserting a program into a robot gives it the ability to know when and how to carry out a task.

4. Modeling of Robot

The whole design of the robotic arm has been generated by with the help of SOLIDWORKS software. The whole design contains different portions like as base, body, upper arm and fore arm. To deliver proportional motion among these portions' servo motor is used. **Servo motors are equipped for producing an enough torque to move an item rapidly from rest position**. Each portion of the design has dissimilar dimensions. There are three dissimilar stages to regulate robotic arm such as awareness, observation and enactment. Sensors deliver the data about the situation of its linkages and its end effector to the robotic arm, formerly this information is prepared to the control unit and figure the reasonable sign to the motor which moves precisely. The large number of robots we use are mainly controlled by electric motors.

5. Design Methodology

- Create a 2D Sketch Design
- 3D MODELING Using SolidWorks
- Finite Element Analysis Using SolidWorks

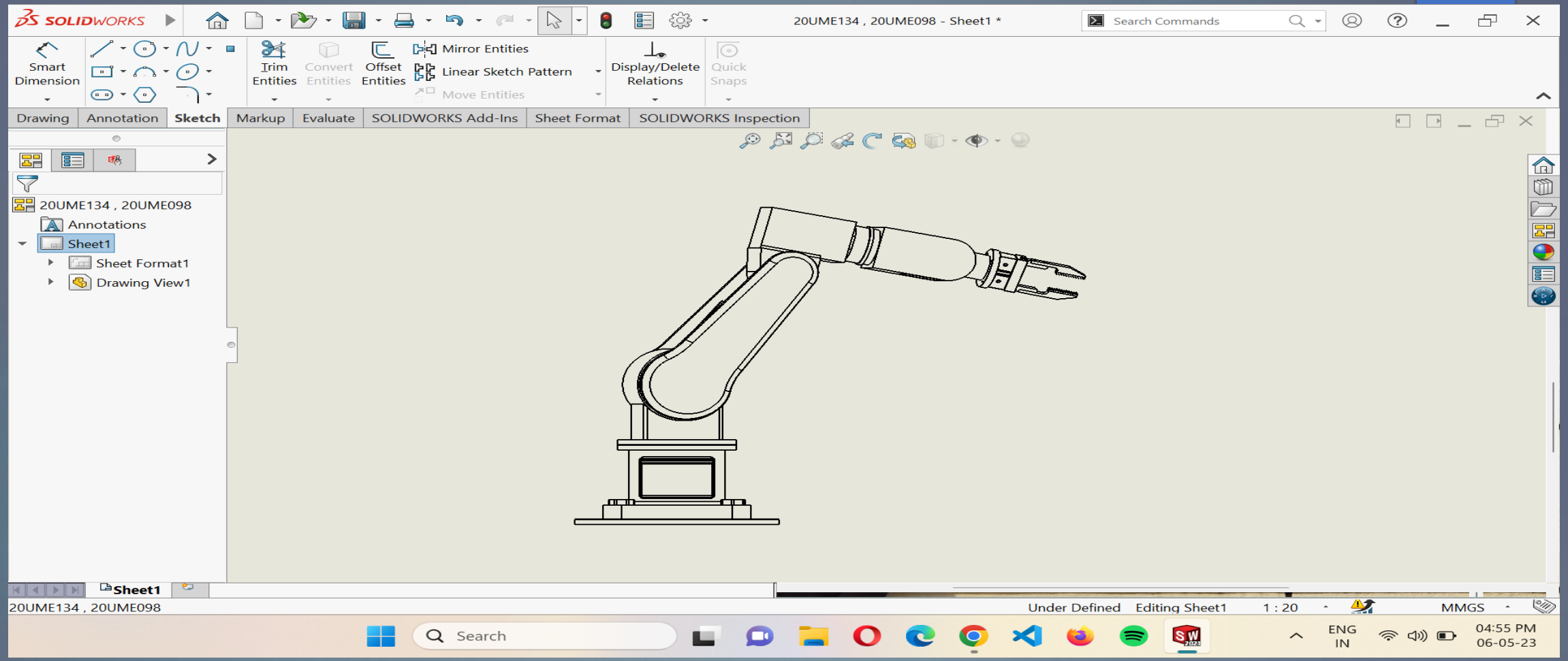


Fig. 2-D Design of Robotic Arm

6. Main Components of a Robot

- **Control System:** the CPU that directs a robot's task at high level.
- **Sensors:** a component that provides electrical signals to allow a robot to interact with the world.
- **Actuators:** the motor parts that are responsible for a robot's movement.
- **Power Supply:** the battery that supplies power to a robot.
- **End Effectors:** the exterior features of a robot that allow it to complete a task.

7. Specifications of Robotics Arm

Table 1. Specification of Model

Specification	Value
Degree of Freedom	5
Total Horizontal Reach	111.5 cm
Total Vertical Reach	157.1 cm
Drives	5 servo motors
Structure	a) All the axes are Self-governing b) concurrently we can control all the axes
Material	Aluminum Density- 2.7g/cm3 Poisson's Ratio- 0.334

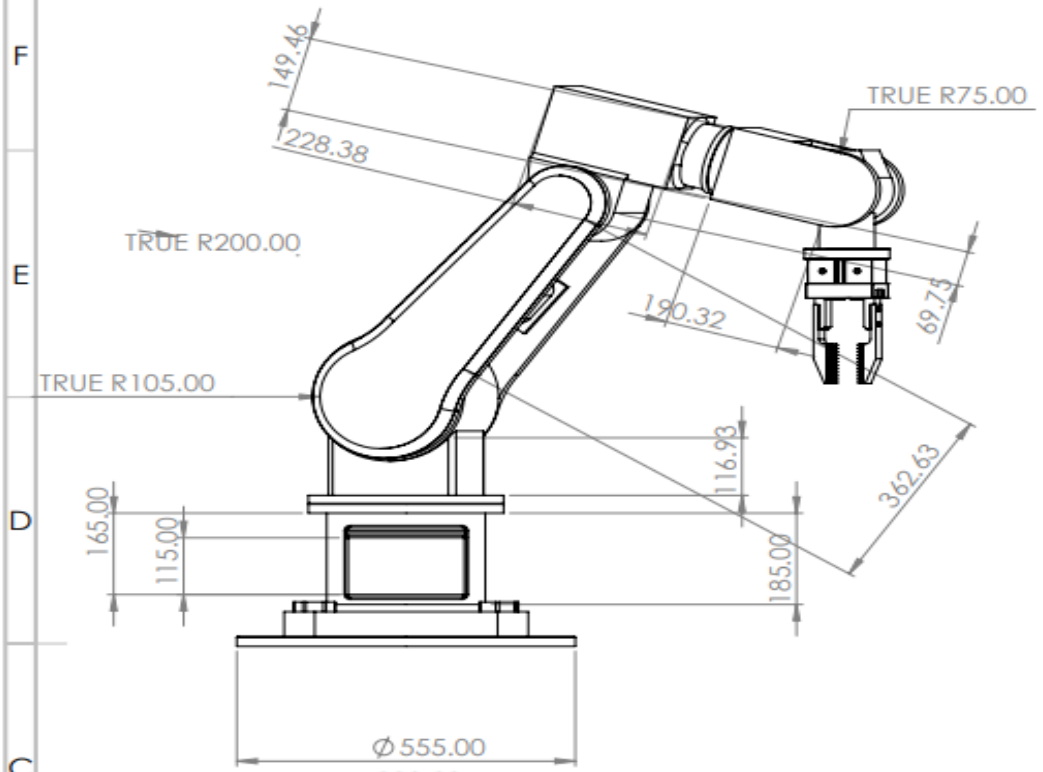
8. Model Analysis

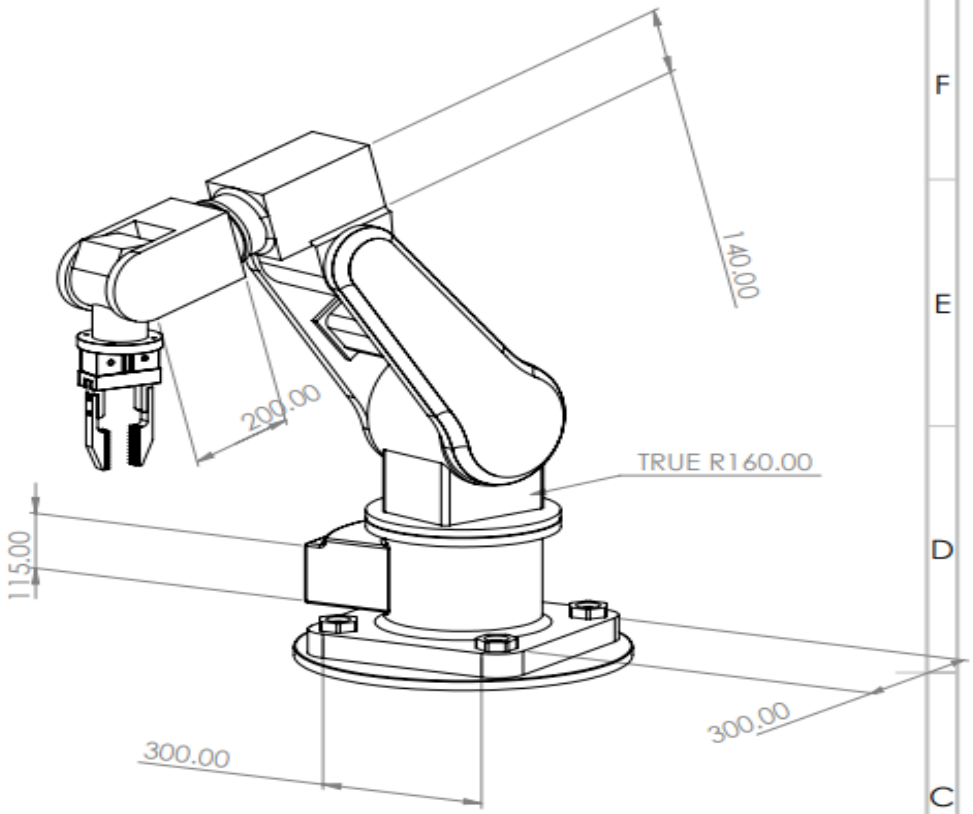
A. Modelling of Robotic Arm in SolidWorks

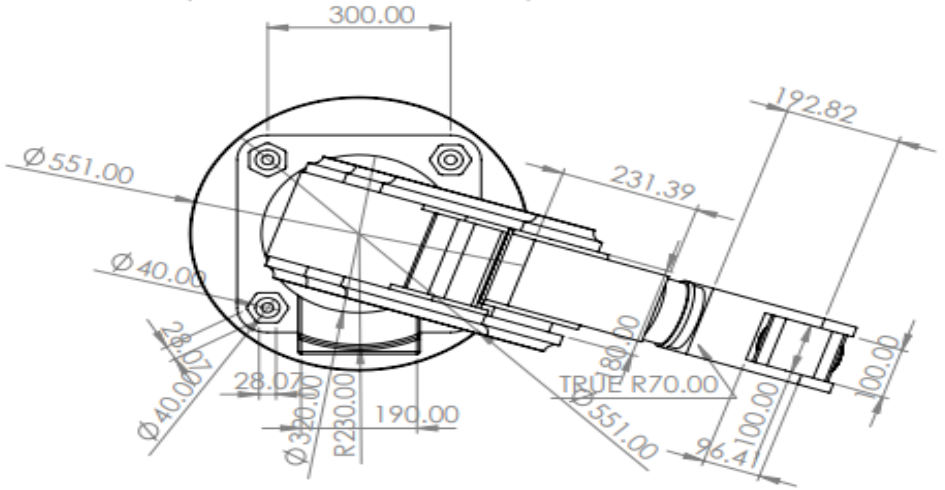
The complete design of the model is built by the software SolidWorks. Initially, the design of each section of the robotic arm is built and after that, each part is assembled to develop the final design of the model . after that the final design of the model goes for analysis of stress , force and deflection . As the design of the model is of five -degree freedom assembly and it must be stationary with the surface, when in workable condition, the lower part of the design must be act as stationary restraint.

B. Finite Element Stress Analysis by SolidWorks

The stress analysis is executed to trial the complete design to resist particular weight situations. In finite element analysis, the design of the model is analyzed to conclude so that it can resist the different weight situations considered earlier in the actual design robotic arm or not. For doing the finite element analysis, the lower part of the structure must be fixed. For doing the calculation mesh dimension is considered as 0.05 mm and dissimilar mass are forced to the nozzle end. For this design, aluminum is picked as a standard material because of its low cost and more reliability.







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SOLIDWORKS

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Assembly | Layout | Sketch | Markup | Evaluate | SOLIDWORKS Add-Ins | Simulation | MBD | SOLIDWORKS Inspection

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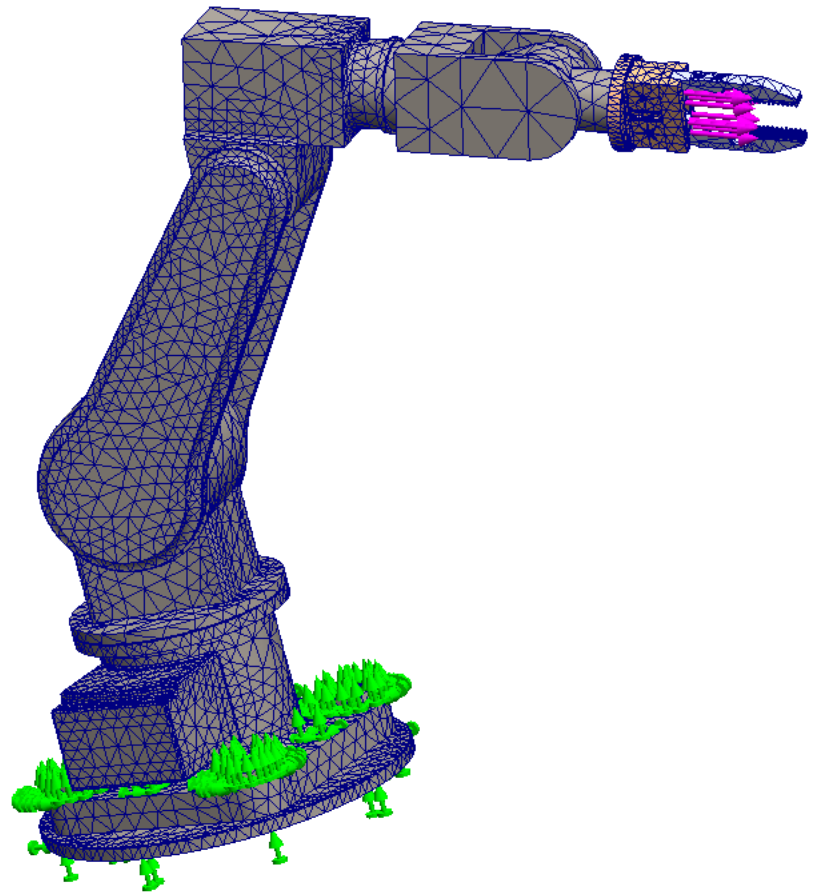
Study name: Static 3(-Default-)
Plot type: Mesh Quality1



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Model | 3D Views | Motion Study 1 | Static 1 | Static 2 | Static 3

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Assembly | Layout | Sketch | Markup | Evaluate | SOLIDWORKS Add-Ins | Simulation | MBD | SOLIDWORKS Inspection

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History

Static 3 (-Default-)

Parts

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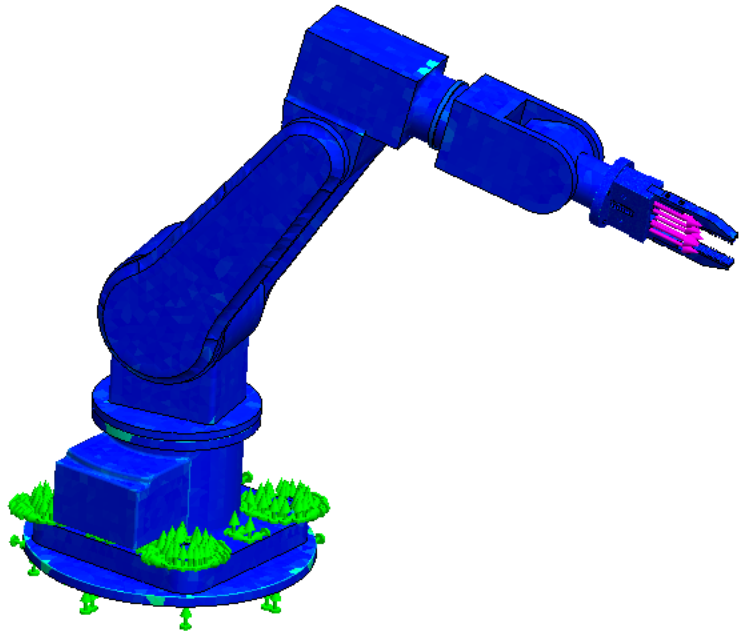
Result Options

Model name: 20UME134 , 20UME098
Study name: Static 3(-Default-)
Plot type: Aspect ratio Quality3



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6.248e+00
3.630e+00
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Model | 3D Views | Motion Study 1 | Static 1 | Static 2 | Static 3

SOLIDWORKS Premium 2021 SP0.0

Under Defined | Editing Assembly | MMGS

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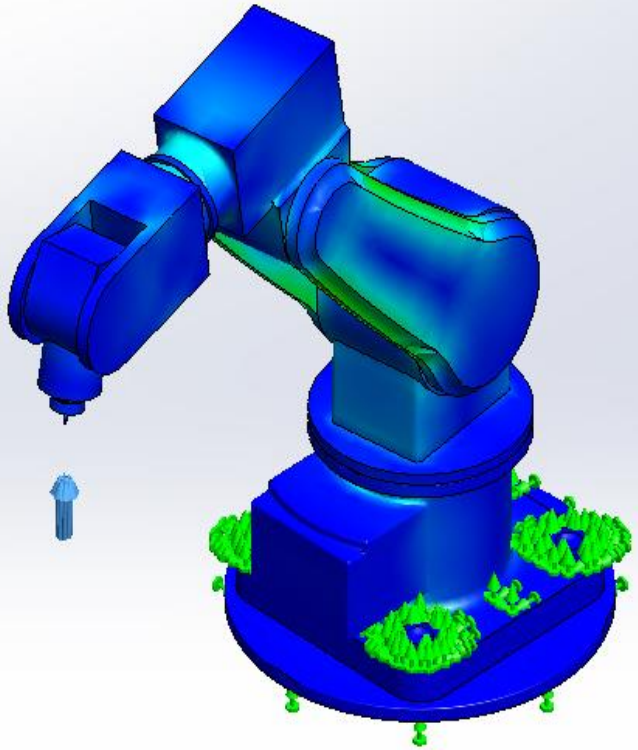
Plot type: Static nodal stress Stress1
Deformation scale: 18,197.3



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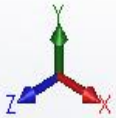
Yield strength: 2.827e+08



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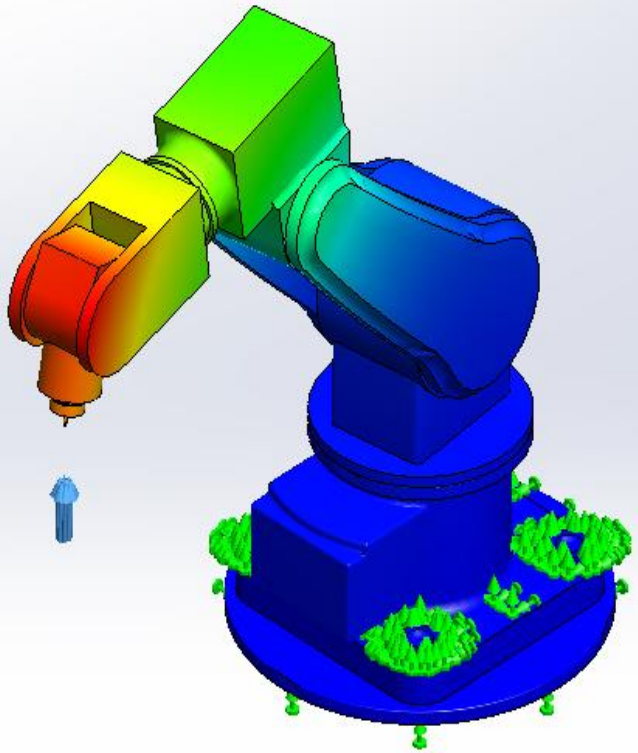

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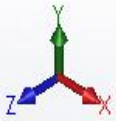

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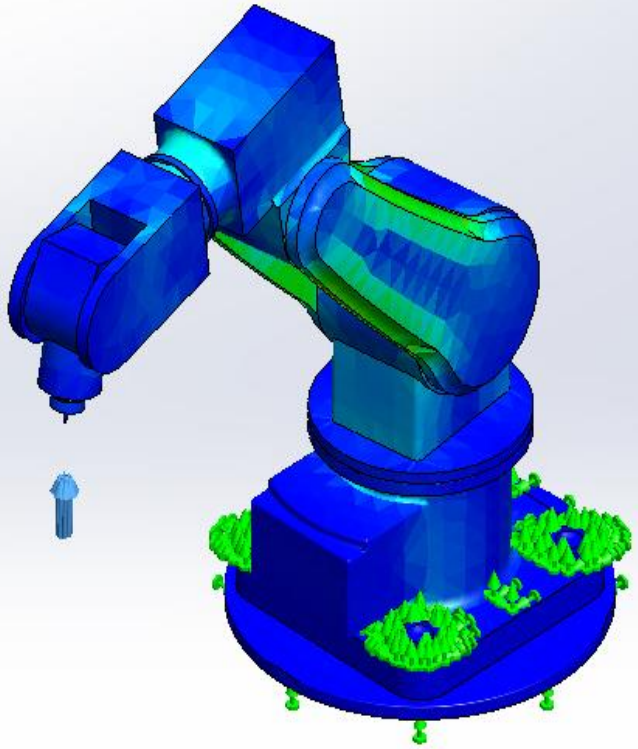

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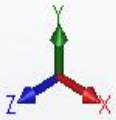


9. Results and Discussion

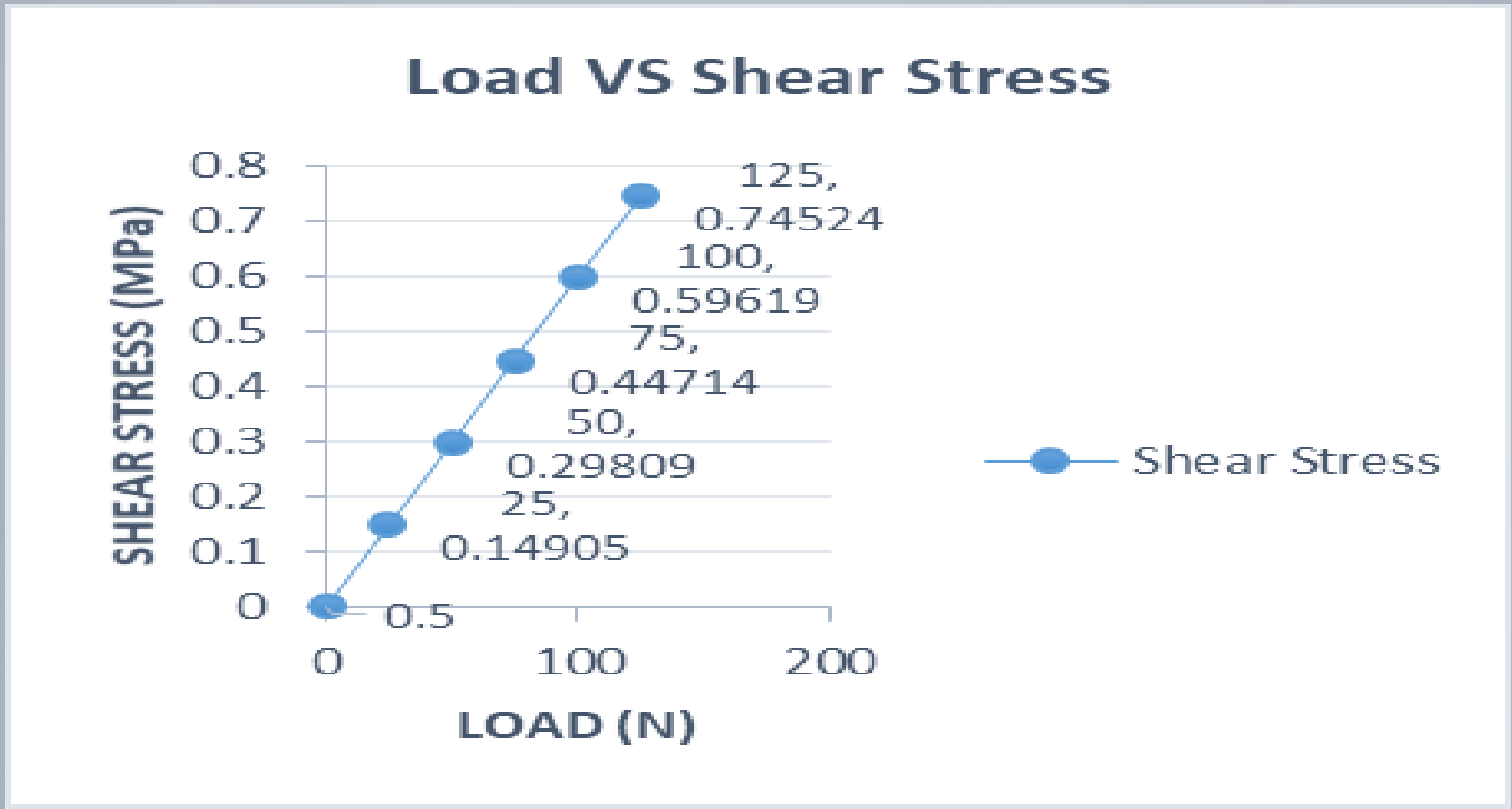
For an improved model of the robotic arm design, every characteristic of industrial instruments where the different shapes can incorporate is examined. For the different load acted on the robotic arm to get the value of shear stress (**SS**) and total deformation are mentioned in Table 2.

Table 2. Data of total deformation and maximum SS on six dissimilar weight conditions

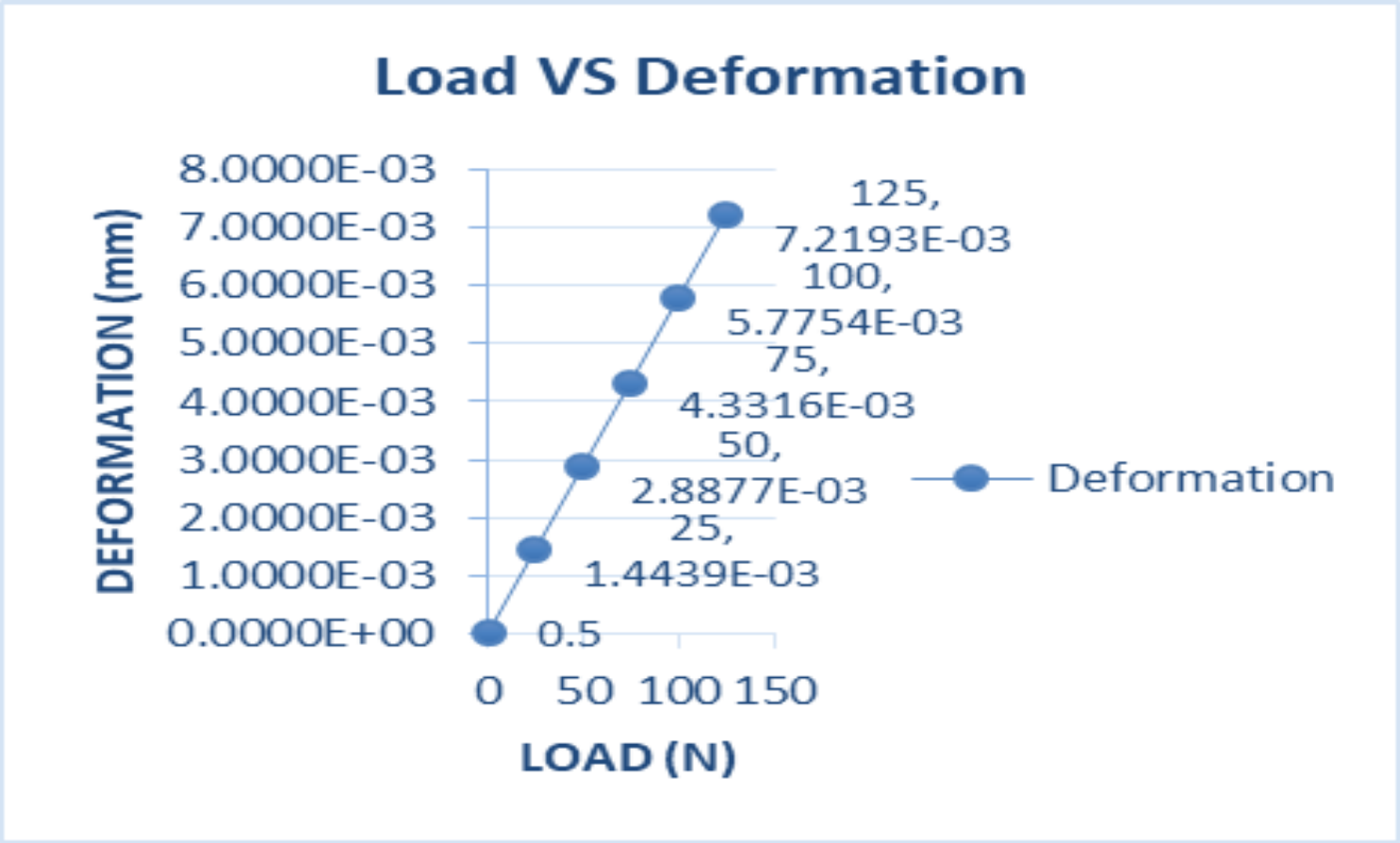
S. No.	Nozzle loads (N)	Total Deformation (mm)	Maximum Shear Stress (Mpa)
1.	0.5	2.8877e-5	0.002981
2.	25	1.4439e-3	0.14905
3.	50	2.8877e-3	0.29809
4.	75	4.3316e-3	0.44714
5.	100	5.7754e-3	0.59619
6.	125	7.2193e-3	0.74524

The analysis of total **deformation** and **stress** of the model provides the basic information regarding life span, destruction and screw-up of the design

10. Graphical Representation Between Load and Stress



11. Graphical Representation Between Load and Deformation



12. Types of Robots

1) Pre-Programmed Robots
2) Humanoid Robots
3) Autonomous Robots
4) Teleoperated Robots
5) Augmenting Robots
6) Software Robotics also called bots

13. Advantages of Robot

1) Lower Cost
2) Increased Productivity
3) Energy Efficient
4) Save Space
5) Faster Operating Speeds
6) Heavy lifting for long durations of time

14.Disadvantages of Robot

1) Potential Job Losses
2) Initial Investment Costs
3) Hiring Skilled Staff
4) Expensive Maintenance
5) Availability of Space

15. Uses and Application of Robots

Robots have a wide variety of use cases that make them the ideal technology for the future. Soon, we will see robots almost everywhere. We'll see them in hospitals, hotels and even on roads.

1) **Robotics in Manufacturing**

The manufacturing industry is probably the oldest and most well-known user of robots. These robots and co-bots (bots that work alongside humans) work to efficiently test and assemble products, like cars and industrial equipment.

2) **Logistics Robots**

logistics companies employ robots in warehouses, and even on the road, to help maximize time efficiency.

3) **Robots for Home**

Robots can be seen all over our homes, helping with chores, reminding us of our schedules and even entertaining our kids.

4) **Travel Robots**

Is there anything more science fiction-like than autonomous vehicles? These self-driving cars are no longer just imagination. Companies like Tesla, Ford, and BMW are all working on the next wave of travel that will let us sit back, relax and enjoy the ride.

5) **Healthcare Robotics**

Examples of robots at work in healthcare are Toyota's healthcare assistants, which help people regain the ability to walk, and TUG.

16.Conclusion

Today we find most robots working for people in industries, factories, warehouses, and laboratories. Robots are useful in many ways. For instance, it boosts economy because businesses need to be efficient to keep up with the industry competition. Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans can, e.g. robot can built, assemble a car. Yet robots cannot perform every job; today robots roles include assisting research and industry. Finally, as the technology improves, there will be new ways to use robots which will bring new hopes and new potentials.

Reference

www.google.co.in
www.wikipedia.org

Thank You...