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DESIGN AND DEVELOPMENT OF TWO FINGERS AND FOUR FINGERS GRIPPERS FOR ROBOTIC APPLICATION

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Abstract:
We aim to study the challenges in the design of a two- and four-fingered robot mechanism having the potential to fulfil industrial needs. A four-fingered robot gripper has a high gripper ratio,less deformation, and less stress in holding an object without any varying load parameters. So far, there are so many mechanisms available for robot grippers. The four-finger robot gripper mechanism is a type of mechanism that is used in industrial robots for moving objects and has a higher gripper ratio and less deformation and stress as it holds the object without varying the load parameter. The kinematic system has been designed using a revolute connection joint for one degree of structural motion. In transient analysis, the loads fluctuate with time instance and the results of von-mises stresses and deformation for different reaches of the robotic gripper mechanism.

Keyword: Transient structural, two and four gripper mechanism.

Introduction

Robotic grippers are essential components of robots that enable them to handle objects in various applications. The gripper is a tool designed to grasp and hold objects firmly and then release themwhen required. Applications of end gripper is to perform repetitive work processes which are laboriously tiring but rather important usage of end gripper is to access area which are fragile and can be extremely hazardous. Apart from working hazardous areas there is one more application space research that also demands remotely performing space lab activities instead of cost of astronaut'slabor. Robotic arms fitted with appropriate end-effectors can standby human intrusion in many actions, working independently or being control from less costly earth grounded staff. The load on the gripper assembly mechanism may vary depending on the type of product being handled, and this can lead to deformation or failure of the mechanism.

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Therefore, it is important to analyse the gripper assembly mechanism under varying loads to ensure its proper functioning. In this study, we will focus on the transient analysis of robotic grippers. Transient analysis is critical in optimizing the performance of robotic grippers, ensuring that they can maintain a stable grip under varying conditions.. One important aspect of transient analysis is the selection of the time step. The transient behaviour of grippers and applying appropriate control strategies can help improve their performance.

Statement of the Problem:

Basically, robotic hand grippers face a few issues. The shape of the end effecter is one of the criteria while holding objects, which causes deformation in the object and develops stresses in the gripper assembly. Based on weight of object and shape of the object, shape of gripper and initial conditions of gripper varies. Gripper ratio is one of the main criteria while holding objects and causes slippage of objects in two-finger grippers.

Objectives of the study:

- To minimize stresscaused in object while grasping it.
- To minimize the deformation developed in gripper assembly.
- Analyze the performance of different materials for the gripper fingers and choose the most suitableone.
- Optimize the design of the gripper fingers to ensure they do not slip or damage the object beingheld.
- Increase the lifespan of the mechanism by analyzing stress.

Review of Literature:

Birglen's [1] statistical review of industrial robotic grippers identified key trends and challenges in the field, including the most common types of grippers, the major design parameters, and the performance metrics used to evaluate gripper performance. The study found that mechanical and pneumatic grippers are most common, and gripper design is driven by factors such as the type of object to be gripped and required force and accuracy. Hassana's [2] study focused on modeling and design optimization of a robot gripper mechanism. The research aimed to optimize the design of the gripper mechanism by considering multiple factors such as the gripper's size, weight, and gripping force. The study utilized simulation techniques and optimization algorithms to improve the performance of the robot gripper mechanism. Moghaddam's [3] study focused on the parallelism of pick-and-place operations using multi-gripper robotic arms. The research aimed to optimize the performance of the pick-and-place operations by developing a mathematical model that could predict the efficiency of multi-gripper robotic arms. The study utilized simulation techniques to evaluate the performance of the proposed model and highlighted the potential benefits of using multi-gripper robotic arms in industrial manufacturing processes.

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Research Methodology:

Materials: structural steel, Titanium alloy, Aluminum alloy

Models: In this study we are using two types of grippers, they are

The following fig 1& 2 represents the models of two finger gripper & four finger gripper respectively.

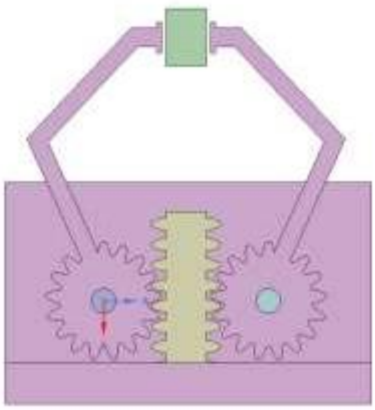


Figure 1: Two finger gripper

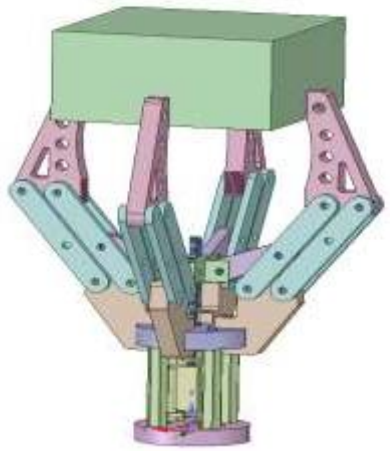


Figure 2: Four finger gripper

Table 1-2 illustrates dimensions of Rack and Pinion of Two-finger gripper assembly.

Dimensions:

Table 1 Two-finger gripper dimensions

	Linear pitch	Rack pitch distance	Pressure angle	Face width	Number of teeth
Dimensions	10mm	13.5mm	15^{O}	20mm	8

Table 2

	Addendum circle	Dedendum circle	Pressure angle	Face width	Number of teeth	circular pitch	Pitch circle
Dimensions	58 mm	44.5mm	15^{O}	20mm	16	8.8mm	51.25mm

Four-finger gripper dimensions are represented in figures 3-5.

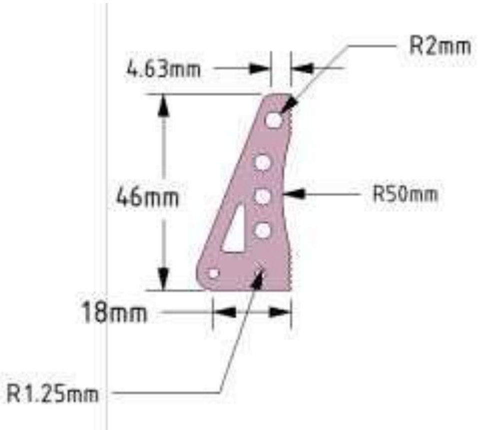


Figure 3: jaw of four finger gripper

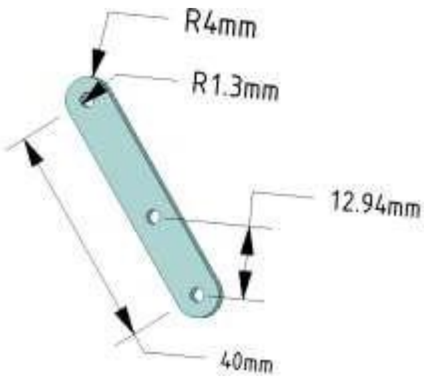


Figure 4: link 1 of four finger gripper

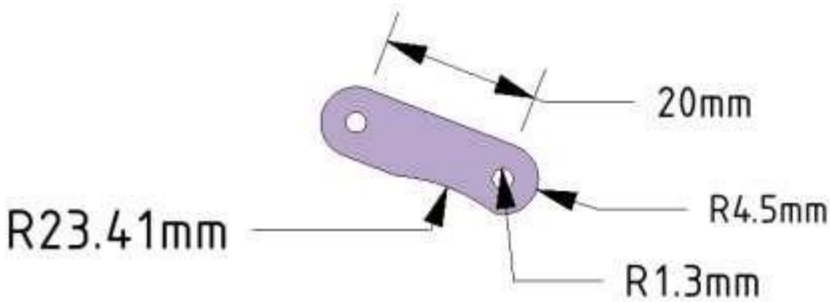


Figure 5: link 2 of four finger gripper

Meshing:

The mesh size are mentioned in the below figures 6 & 7 for both two and four finger grippers

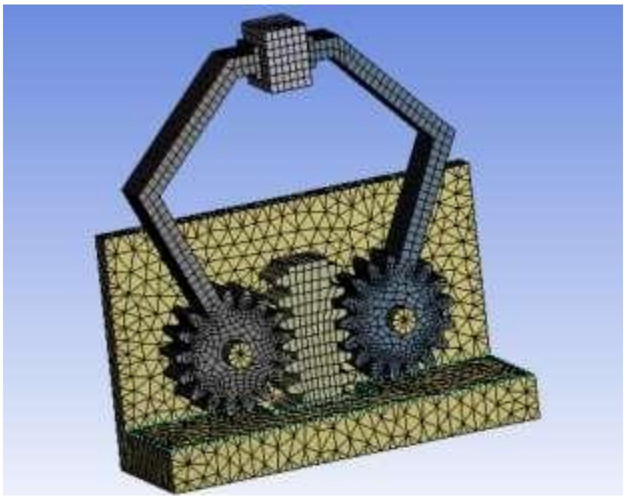


Figure 6: Meshing of Two finger gripper

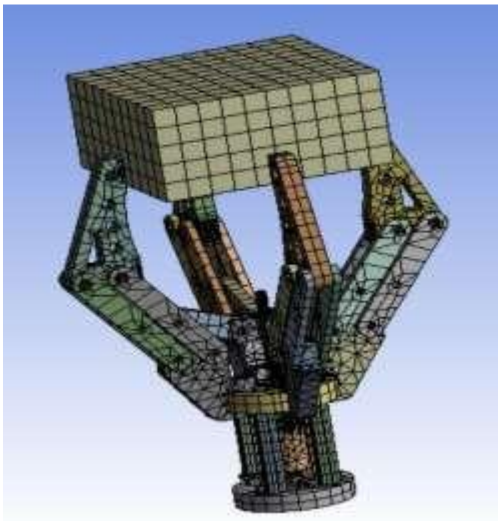


Figure 7: Meshing of Four finger gripper

Boundary Conditions:

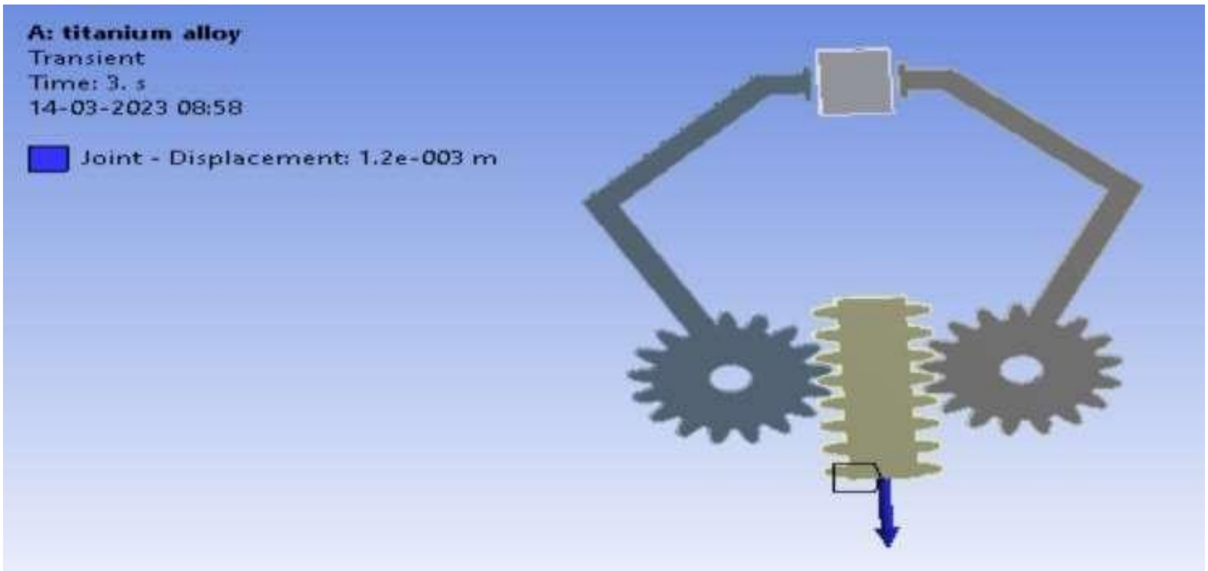


Fig. 8 joint displacement of rack

Figure 8: Illustrates boundary conditions of Two finger gripper as rack displaces downward direction so that pinions with fingers will grasp the object.

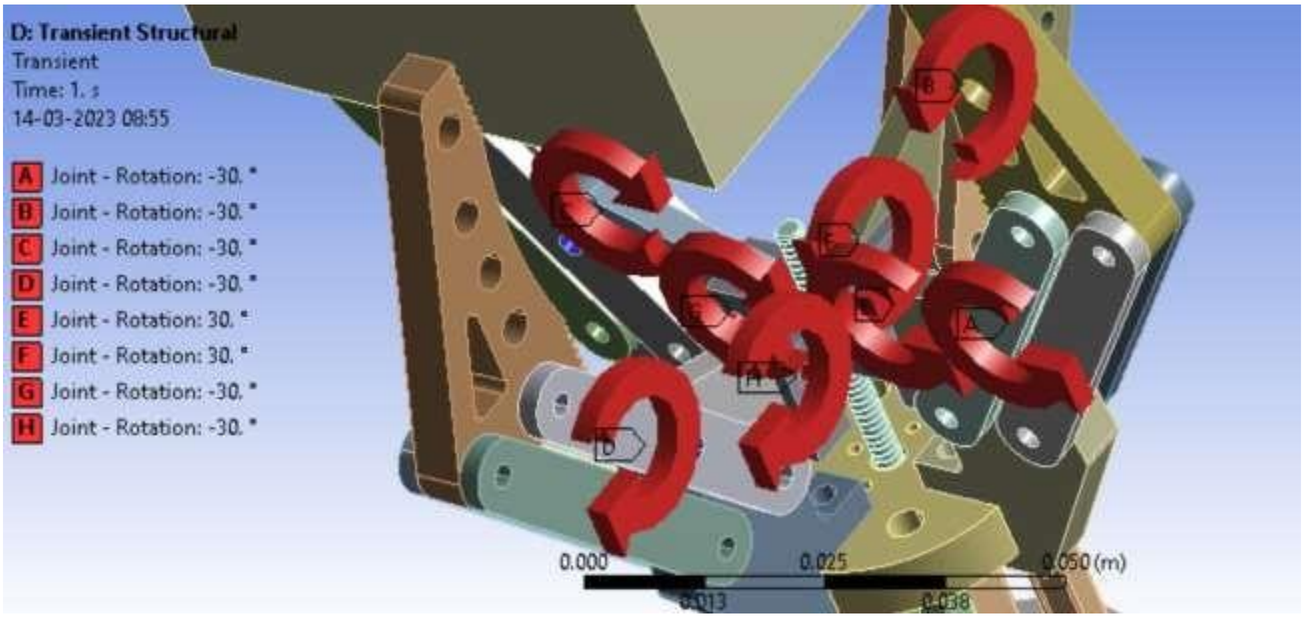
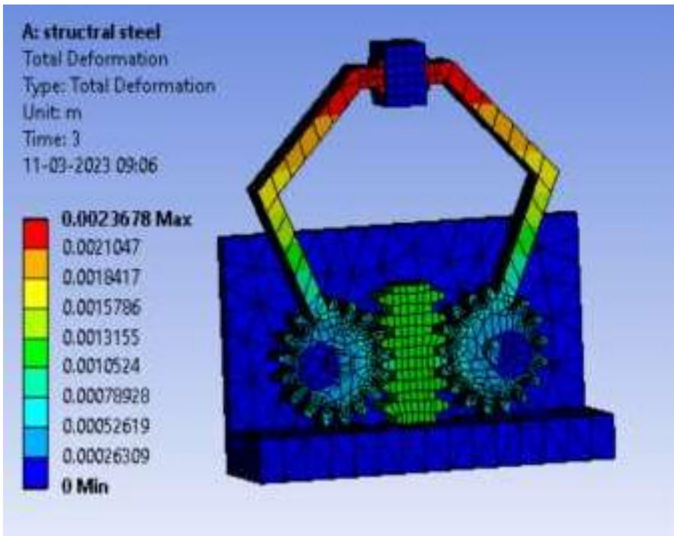


Fig.9 joint rotation for each link in four finger gripper

Figure 9: illustrates the boundary conditions of a four-finger gripper as revolute links with an angle of rotation of 30 degrees.

Results and Discussion:

The following figures (10-21) illustrate the deformation and stresses that occurred in the two- and four-finger gripper assemblies.



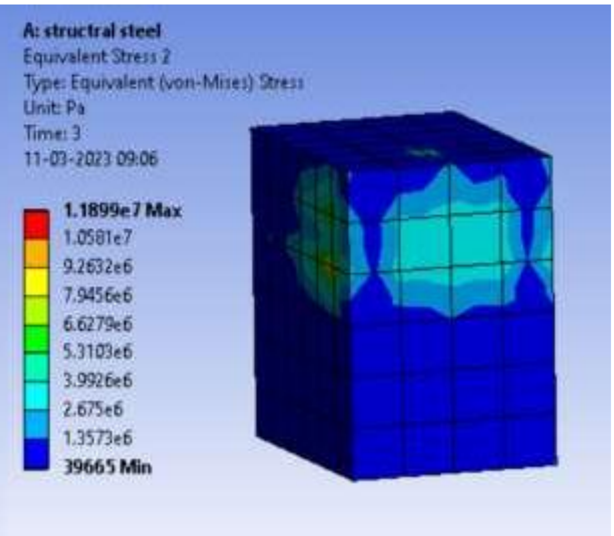
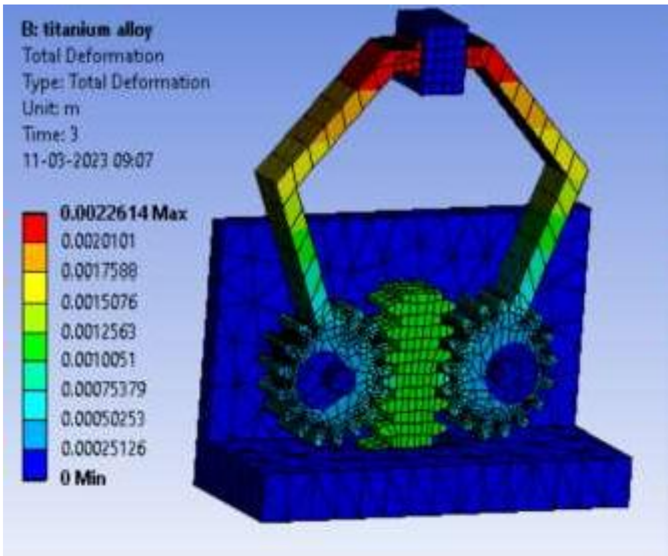


Figure 10: total deformation in two-finger gripper
caused assembly by two finger gripper assembly

Figure 11: equivalent stress in the object of



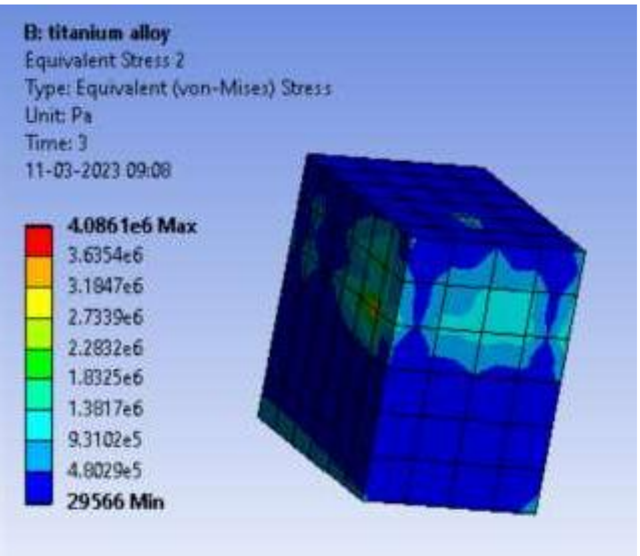
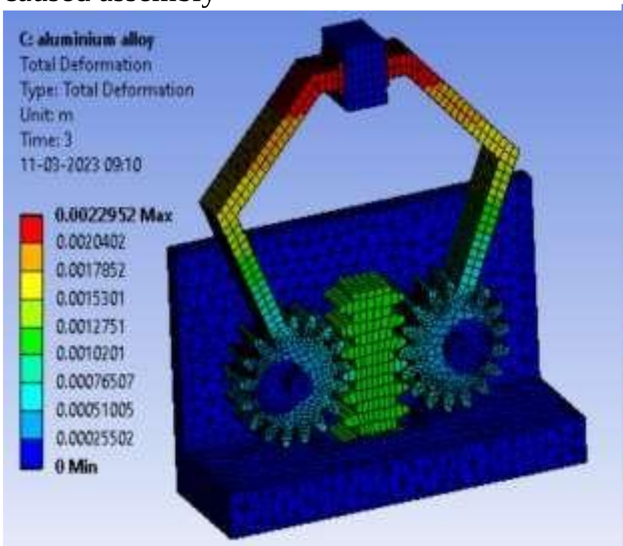


Figure 12: Total deformation in two-finger gripper caused assembly

Figure 13: equivalent stress in the object by two finger gripper assembly



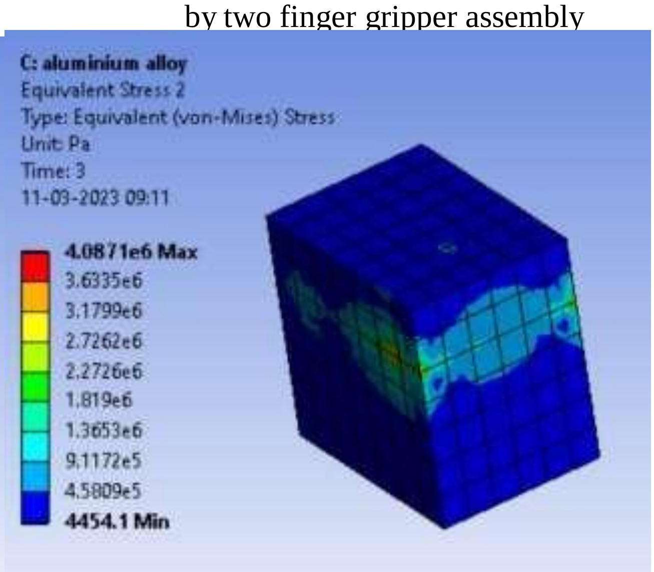


Figure 14: Total deformation in two-finger gripper caused Assembly

Figure 15: equivalent stress in the object by two finger gripper assembly

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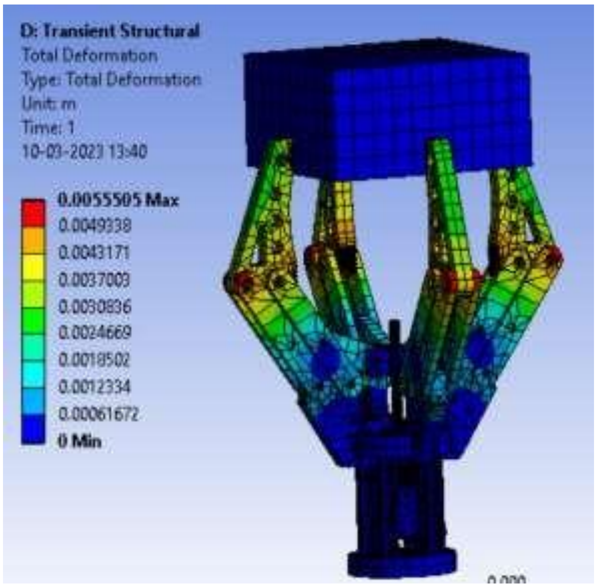


Figure 16: Total deformation in four finger Gripper finger gripper assembly

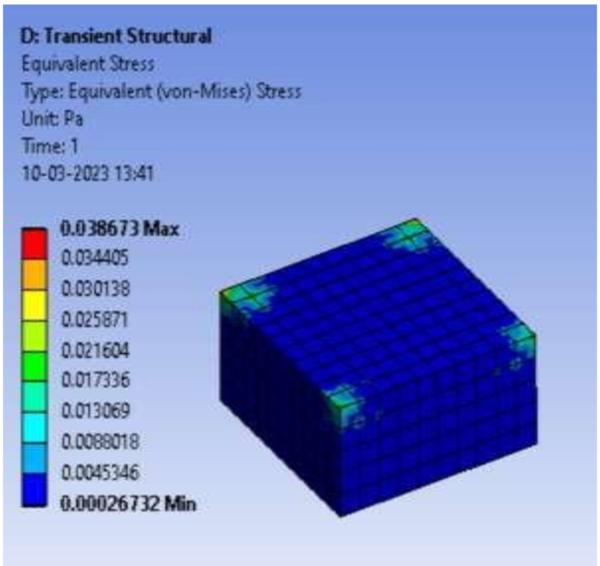
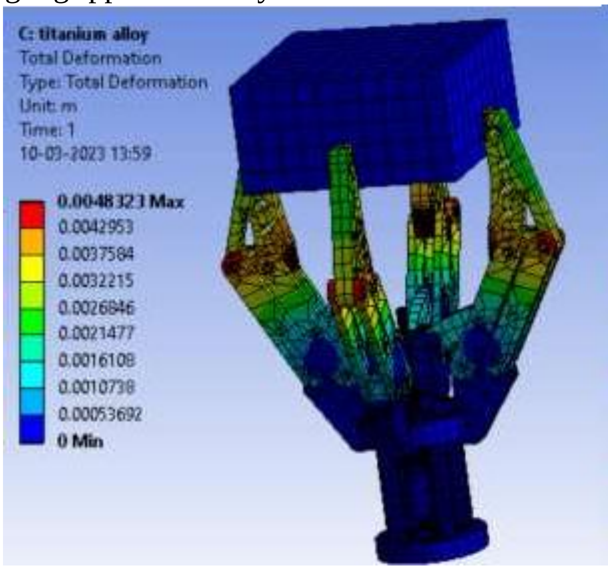


Figure 17: Equivalent stress in the object four



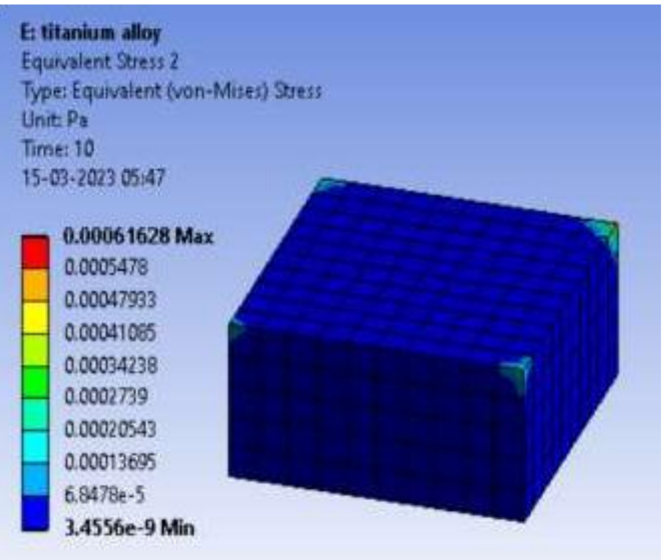
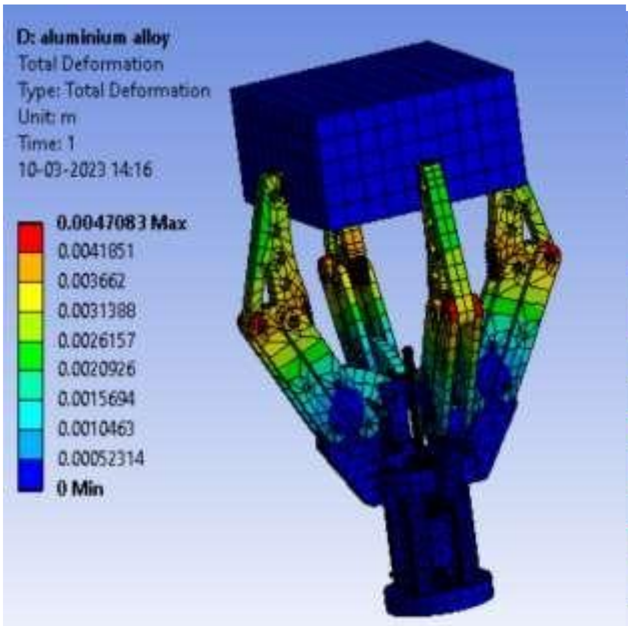


Figure 18: Total deformation in four finger gripper caused byAssembly

Figure 19: Equivalent stress in the object four finger gripper assembly \



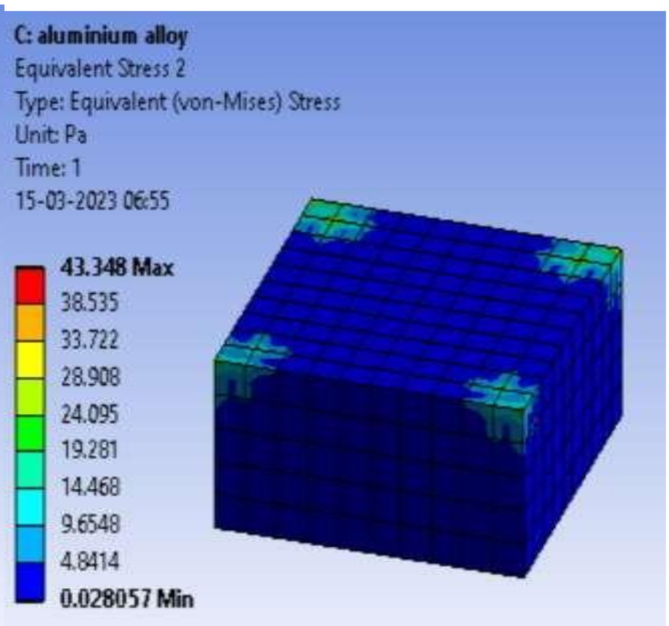


Figure 20: Total deformation in four finger gripper caused by Assembly

Figure 21: Equivalent stress in the object four finger gripper assembly

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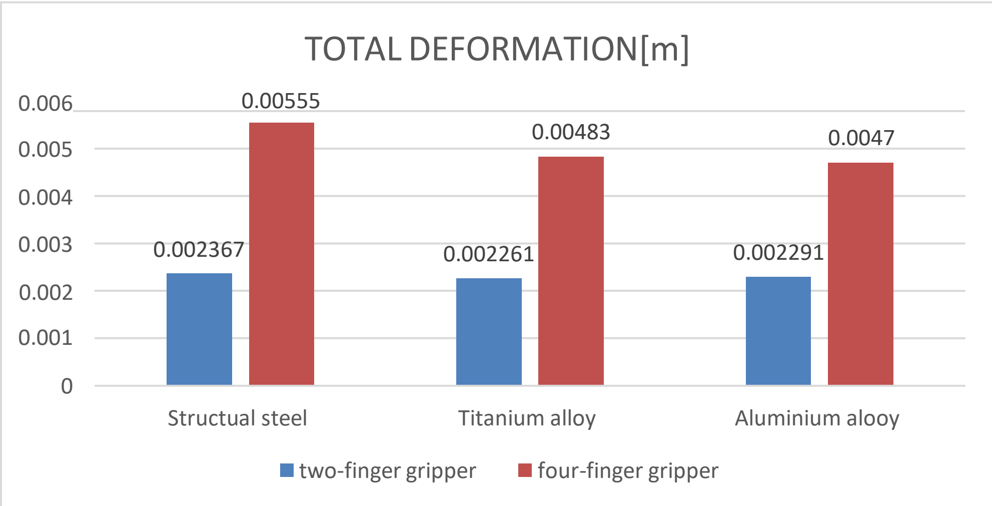
RESULTS:

Table 1: total deformation and equivalent stress of different materials of two finger gripper assembly

Material	**Total deformation**	**Equivalent stress**
Structural steel	0.002367 m	1.1899e7 pa
Titanium alloy	0.002261 m	4.0861e6 pa
Aluminium alloy	0.002291m	4.087e6 pa

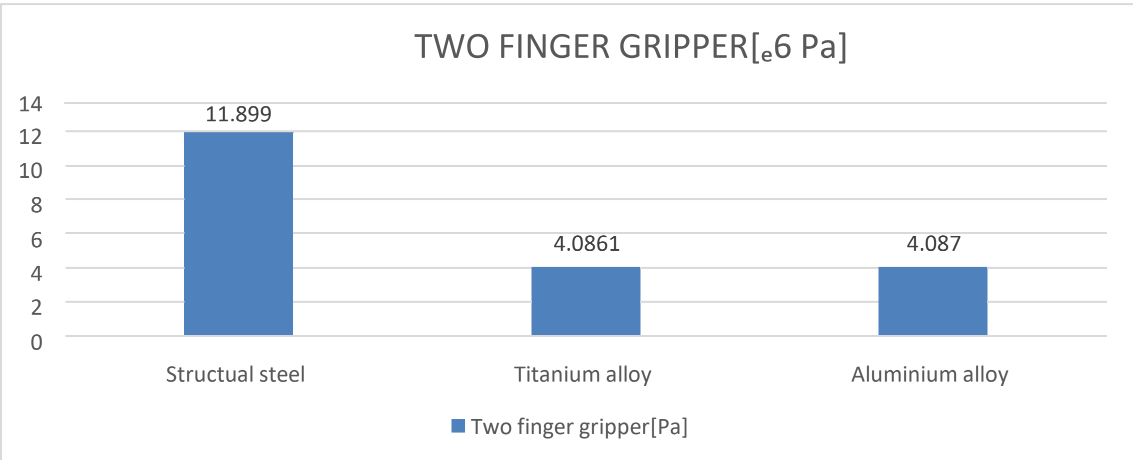
Table 2**:** total deformation and equivalent stress of different materials offour finger gripper assembly

Materials	**Total deformation**	**Equivalent stress in object**
Structural steel	0.00555 m	0.03867 pa
Titanium alloy	0.00483 m	0.000616 pa
Aluminium alloy	0.00470m	43.34 pa



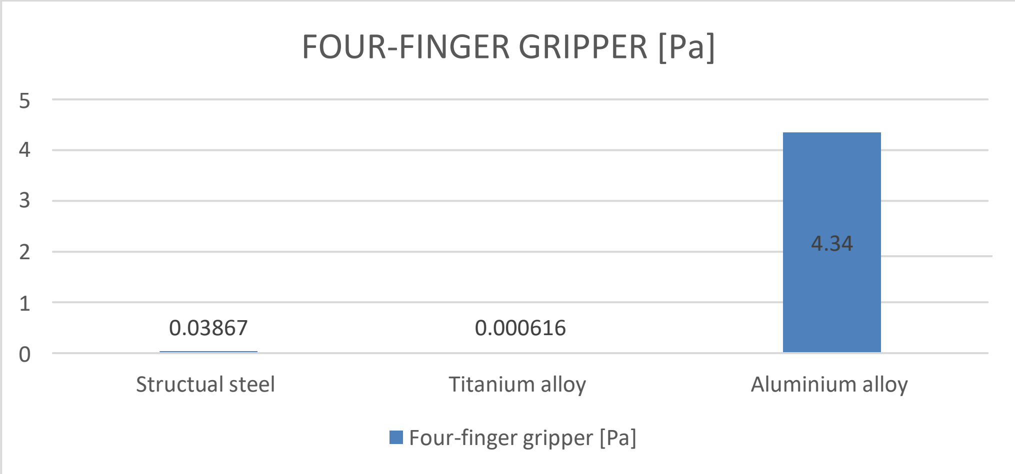
Graph 1. Total deformation

Graph 1: illustrates the comparison of two- and four-finger grippers of total deformation with different materials



Graph 2. Equivalent stresses

Graph 2: illustrates Equivalent stress of a two-finger gripper assembly for different materials



Graph 3. Equivalent stresses

Graph 3: illustrates Equivalent stress of a four-finger gripper assembly for different materials

Conclusion

By analyzing the transients that occur during the gripping process, engineers can optimize the design ofthe gripper and ensure that it can handle objects safely and efficiently. The techniques used in transient analysis include finite element analysis and time domain analysis. From the above tables and graphs, the two-finger gripper assembly. As well as Four Finger titanium alloy, which is the best material for grasping objects with minimum deformation and even though titanium alloy's cost is too high when compared to the other two materials. It is more durable and tough. The grasping ratio is also higher for four-finger gripper assemblies when compared to two-finger gripper assemblies. Four-finger grippers can also hold irregular objects firmly.

References:

1. Birglen, L. (2017). A statistical review of industrial robotic grippers. ELSEVIER Robotics andComputer– Integrated Manufacturing.
2. Hassana, A. (2016). Modeling and design optimization of a robot gripper mechanism. ELSEVIERRobotics and Computer– Integrated Manufacturing (2001)
3. Moghaddam, M. (2016). Parallelism of Pick-and-Place operations by multi-gripper robotic arms.ELSEVIER Robotics and Computer–Integrated Manufacturing