

Study and Effectiveness and Reconfiguration of a Jar Tilting Mechanism of an RFC Machine

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Abstract: *Jar Tilting Mechanism profile is designed by using PTC Creo Parametric and Creo Parametric Simulation. Its obligatory to validate that the results obtained from Creo Parametric Simulation with experimental measurements. Jar Mounting is Designed for moments of the jar takes in form of To and Fro motion, the load bearing element is considered as the Pin and mutually different types of Pneumatic Cylinder are also considered in this thesis. The project reports the highlights of the designing procedure of two components used for a measurement of Tilting Frame Mechanism for studying the behaviour of reconfiguration and effectiveness of a jar tilting mechanism. In this project the Tilting Mechanism is part of the RFC Machine which takes moment of action in a span of five Second this is done through by the load bearing element of pin, pneumatic cylinder. The detailed design work of the jar tilting mechanism and about its simulation is highlighted in this thesis report.*

Keywords: *Pneumatic Cylinder, Pin, RFC Machine, Tilting Mechanism.*

1. INTRODUCTION

The Rinsing Filling Capping Machine is the most reliable fully automatic bulk water prewash, rinsing, filling, capping. The features include durable stain less construction with safety first design and programmable logic control. This RFC Machine is a double headed including six stations of Rinsing at capacity of 450JPH. Apart of this machine the preferred section is tilting mechanism, this mechanism plays a role of jar lifting mechanism from one location to another location within in known time of period. The Jars from the customers are carried into the plant inspected rinsed by different stations and filled by using the product water and lastly capped by the capping. All operations are carried out in water surrounded atmosphere, constructed with SS 304 Stainless steel grade materials. The elements inside the machine are made lubricant-free so that oil does not get onto the jars.

For the moments of the tilting jar mechanism the bearings are used, these bearings are made by IGUS Company available at open in the market at reasonable prices. These bearings are made of a polymer avoids lubrication free, maintenance free dry operation, Easy install, lightweight, compensation of misalignment and edge loads etc, the material construction of the RFC Machine is done through welding for the joining to assemble the overall construction of the machine. Here the joining process is done by welding named Gas Metal Arc Welding (GMAW) it's an one type of the joining manufacturing process, this process is an electrical curve that exploits a incessantly nourished solid electrode, defensive gas from an outwardly abounding source and electrical power to dissolve the electrode and deposit this liquefied material in welded joint.

The tilting mechanism moments take To and Fro due to the retracts and protrusion of the pneumatic cylinder. The pneumatic cylinder is a cylindrical metal machine that guides a piston in a straight-line reciprocating movement in a cylinder. The air converts heat energy into mechanical energy through expansion in the engine cylinder, and the gas receives piston compression in the compression cylinder to increase the pressure. The jar mounting which carries out the water jar from one location to another location these water jars capacity is 20 litres accessible for stowing drinking water. These jars are light in mass, leak proof, easy to preserve and crack resistant. The jars are completely made of best grade of plastic which safeguards that the water leftovers fresh and fit smooth drinking after hours of storage.

All the sides of the machine, the tanks, geared motors etc, are fully accessible for easy cleaning and maintenance. All the pipe works is concealed within the framework of the system and streamlined and aesthetically pleasing design ensures pipe safety and reduces overall footprints and all stainless-steel piping in the washer and filler is sanitary.

Salient Features of the Machine

- Fully Automated System
- Safety Features throughout
- Extremely quiet operation
- Aesthetic in looks, compact in size and occupies less floor space
- Concealed pipes reduce damage, increase available floor space and more aesthetically pleasing
- The best in craftsmanship and materials.

2. Material and Methods

It is a material that combines two or more material for better and effective mechanical properties. The best advantage of using composite is that it can meet the newer material with

our definite requirements. It can mold into our desire and defined shape required. The composite used for the required shapes can be cost-effective. By using the composites, the most effective products can be formed. The metal matrix composites are mainly classified into three typed namely particle reinforced metal matrix composites, short fibers metal matrix composites, continuous fiber metal matrix composites. In the material matrix composites, the first one should be metal and the other one is material which can be ceramic or organic compound.

2.1 Properties of SS 304 Based Alloys

Melting point: 1510 °C, 2750 °F

Boiling point: 1400-1450 °C

Density: 7.930 g/cm³

Stainless-Steel grade 304 is the most versatile and the most widely used of all stainless steel. Its chemical composition, mechanical properties, weldability and corrosion/oxidation resistance provide the best all-round performance stainless steel at relatively low cost. It also has excellent low-temperature corrosion in the heat-affected zone may occur, it suggested that CS 304 is used.

Applications:

- Tanks and containers for a large variety of liquids and solids.
- Springs.
- Heat Exchangers.
- Chemical containers, including for transport.
- Architectural panelling, railings, and trim.
- Threaded fasteners.

The best example of the matrix composites are aerospace applications and the product obtain should possess high mechanical properties, chemical properties, physical properties, and electrical properties. Stainless steel density denotes to substance mass per unit volume, it is one of the typical properties of stainless steel, commonly, density of stainless-steel ranges from 7600 kg/m³ to 8000 kg/m³. Stainless steel is a broadly used material comprehending at least 10.5% of chromium, and other elements added to form stainless steel structure, these elements have carbon, Silicon, Manganese, Phosphorus, Sulfur, Nickel, Molybdenum, Titanium, and Copper, it is noted as high strength and exceptional corrosion resistance.

2.2 Creo Software

Creo is a 3D CAD solution that assistances you build improved products faster by hastening product innovation, salvaging the superlative of your strategy and swapping expectations with facts. Go from the earliest phases of product design to a clever associated product with Creo. Add amplified authenticity to everyone to envisage your design. In this shifting world of the industrial IoT.

Almost thirty-five years, Pro Engineer has been the most powerful and popular three-dimensional computer aided design software in the industry. It has the most variety in terms of advancement in product development capabilities that are currently available on the market. The current version of Pro Engineer is simple to use and learn. It is also very affordable, no matter whether you have small or medium size company.

Basically, it has every functional that a small business requires to be successful. There are many client testimonials that provide product feedback. This is identical significant since it is always good to hear it straight from your peers. Many people who represent the small business sector were recently asked about why they used this particular CAD software.

Key Benefits

- Increase production with more competent and lithe 3D detailed design abilities.
- Rapidly and effortlessly create 3D models of any part or assembly.
- Enthusiastic toolset for working with large assemblies.
- Create manufacturing drawings inevitably with complete assurance that they will constantly replicate your current design.
- Improve the designing aesthetics with inclusive surfacing proficiencies.

3. Methodology of the Project

The main intension in this project to analyse the tilting mechanism with the help of pneumatic cylinder at different supports of the tilting frame assembly, this mechanism takes place due to load bearing element and this load bearing is considered as a pin. This pin undergoes to simulation analysis in view of meshing elements stress and strain distribution. The tilting mechanism would decrease the rate of damage due to slippage and phase angle in the RFC Machine, this method is used in a simple mechanical tilting system by using flexible linkages and the load bearing element. This tilting mechanism would increase dramatically the maximum speed in the jar mounting frame assembly due to retracts and protrusion of the double acting pneumatic cylinder.

3.1 Construction of the Tilting Jar Mechanism

Construction of a jar tilting mechanism design is done through the PTC Creo parametric 3.0. Coming to Real-time of construction total jar tilting is made through SS-304. This tilting jar consists of the following parts like Frame assembly, closing plate, Rib, Jar Mounting and Supporting Rib.

Framing Assembly and Closing Plate

The length of the framing assembly consists of another plate called a closing plate. Here the dimension of the frame assembly with be 630*40 cm area designed in 2D sketch mode with an extrude of 5 cm in terms of solid of both sides of the 2D plane by half the depth of the specified value 20 cm at the both ends of the frame assembly the round operation of 5 cm is taken. The length of the closing plate is 40*20 cm area designed in 2D sketch mode with an extrude of 1 cm in terms of solid of both sides of the sketch plane by half the depth of the specified value 1 cm at the equally ends of the closing plate the round operation of 5 cm is taken.

Rib and Supporting Rib

This rib a height of 64 cm and length of 30 cm and different types of irregular shapes the rib is designed in sketch mode and with solid extrude on equally sides of the sketch plane by half the depth specified value 3 cm is extruded. The Supporting rib has a diverse shape with multiple lengths, heights, angles, and cross-sections as similar as rib. This supporting rib will be fixed to jar mounting under its for supporting of the jar loads.

3.2 Pneumatic Cylinder:

Pneumatic cylinder is commonly called an air cylinder are mechanical devices that use the power of compressed gas to produce a force in a reciprocating linear motion. These cylinders are adjustable cushioning at both ends with elastomer pads and wide varieties of mountings.

High-temperature Viton seals 150⁰C maximum. The non-corrosive stainless-steel piston rod and piston rod lock nut SS304.

- Working Pressure: 0.5 – 10 Bar
- Regular temperature 5⁰ – 60⁰C
- High-temperature applications 5⁰ – 150⁰C Max
- Capacity of cylinder 0 – 20 litres
- Low friction

3.3 Tilting Frame Assembly

The tilting frame assembly rest at the home position as shown in the below the figure. This position where the initial velocity will be zero and energy takes place. As observed in the frame assembly it's consists of a lot of assembly parts like washer, pneumatic cylinders, flange, tilting body, bearing, bolts, etc. previously this mounting part is designed a two head with using one pneumatic cylinder where it takes like 5 seconds to reach from home position to tilted position. Due to this, a heavy load occurs on the tilting frame. Day by the day on the continued usage of this machine is gradually increasing and the effectiveness of the frame is gradually decreasing concerning usage of the machine. Reducing the life of the frame is equal to diminishing the life of the pneumatic cylinder.

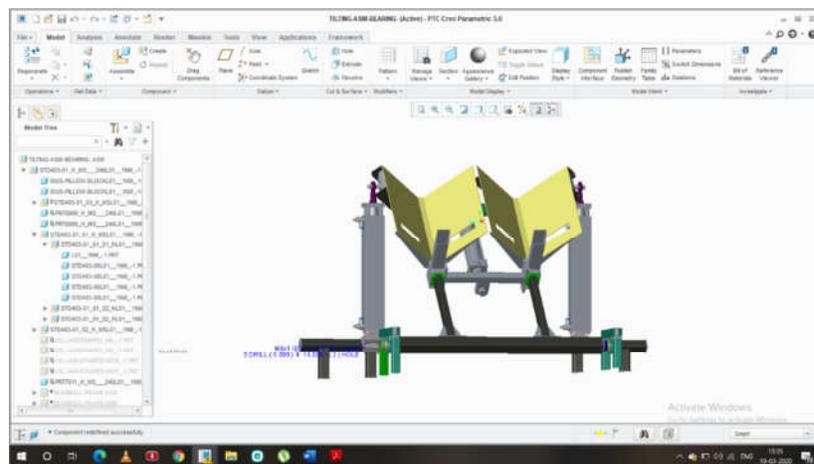


Fig 3.3 Tilting Frame Assembly at home position.

Purchase and installation of the pneumatic cylinder is easy and also these cylinders are accessible in the market at a reasonable price.

3.4 Preceding and Modifications:

Preceding and Modifications of this tilting frame assembly can observe in the below the following figures. At the preceding time of the manufacturer, the total framing and the jar mounting is resisted with a single pneumatic cylinder where this cylinder tends to high amount of the carry load. Due to heavy load carry of the water jar and jar mounting the cylinder of life span is gradually decreased and also the oscillating time of the tilting frame decreases. This tense the output of the machine is decreased and the output of the filling water jar takes a little bit longer. The life of the machine comes to the dead at the earlier stage, the retailer of this machine can't bare the amount of the pneumatic cylinder at every quarterly months of the year.



Fig 3.4(A) Framing of Preceding

Fig 3.4(B) Framing of Earlier

This problem is revealed to the manufacturer company and the company will allocate an operation manager to the vendor to check the machine. While over this operation staff will be changing the pneumatic cylinder with a guarantee at free of cost to the retailer. Here the issue for every quarterly month of year the vendor cannot bear the individual parts of the machine, then the requirement of the machine cannot satisfy the vendor and also the ordering of the product will be diminishing.

Here comes the new idea that the problem with the pneumatic cylinder is resolved by adding the additional pneumatic cylinder at both ends of the tilting frame body. This gives the life span of this machine will be growing and manufacturer cost will be slightly hiked as compared to the preceding action. At both ends of the tilting frame pneumatic cylinder of 037 bar is considered and the midpoint of the frame and a low pressure of 0.3 bar is considered then there will be no change regarding to time delivery of the machine and oscillation time of the tilting mechanism has no change.

Tilting Mechanism

The Tilting mechanism in the RFC Machine plays a crucial role in captivating the role of water jar shifting from one position to another position. the tilting frame is at home position, takes a water jar from the main chain conveyor. It can hold two jars at a time because of the two head selection of the machine. During the home position, the jars are freshly cleaned at the inner part of the body and the outer part of the body. Both the water jars do not contain any types of ingredients and moisture inside of the water jar. At the home position, the water jars do not contain water inside of it because it comes from the cleaning stage.

frame is done by Programmable Logic Controller Interface control panel and man/machine interface tailors' functions as per customer scope.

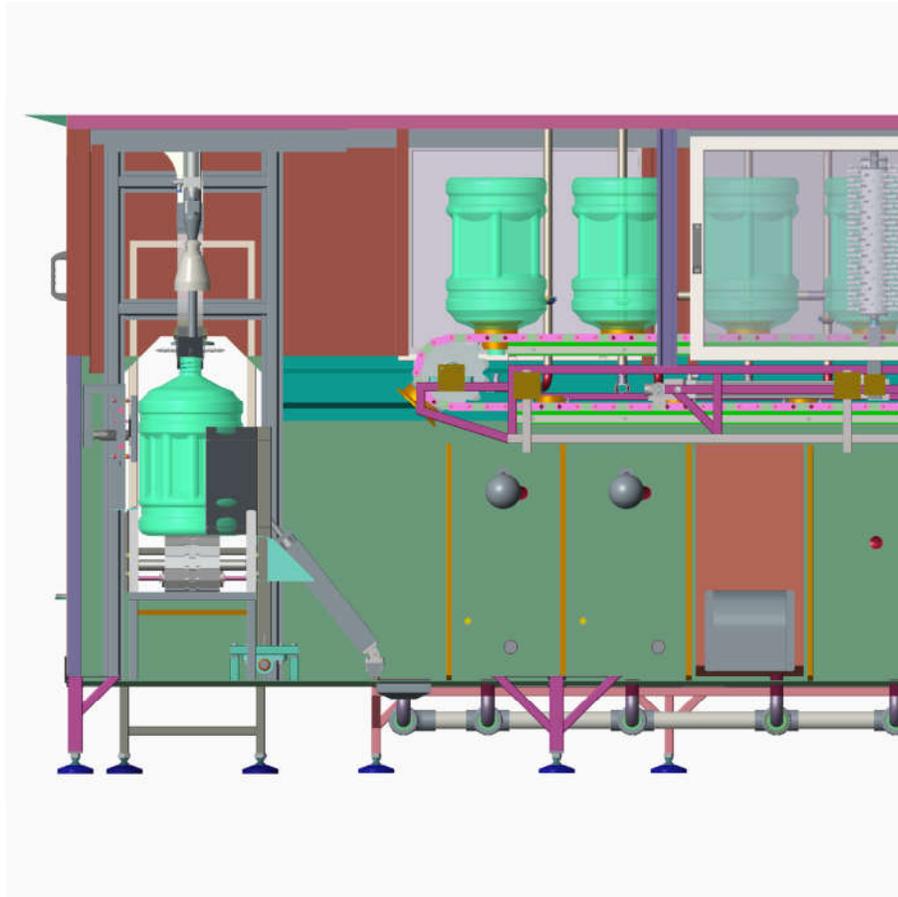


Fig 4.2 Tilted Position of Tilting Frame Assembly

Control panel features have a programmable logic controller that allows your system to be custom programmed to fully automate the plant machine. Motors are endangered with breakers and thermal excesses. For greater safety, a complete emergency disconnects switch isolates everything in the plant machine. Construction also includes indicator status lights for all major functions and a transformed lower voltage control circuit.

4.3 Pin

The load-bearing element of the tilting mechanism is considered as cylinder pin. The content of the pneumatic cylinder and its locking pin are analyzed. The takes the part of the analysis report to the tilting frame assembly. Due to the pin moment, the frame assembly takes an oscillating motion at free without any error during the moment.



Fig 4.3 3D Part Modeling design of Pin

Properties of the Pin

- Material: SS 304
- Density: 7.85×10^{-6} kg /m³
- Poisson's Ratio: 0.29
- Young's Modulus: 193 Gpa
- Tensile Strength at Yield: 215 Mpa
- Ultimate Tensile Strength: 505 Mpa

4.4 Finite Mesh Element of a Pin

Creo Parametric 3D modeling software has been used to prepare a 3D model of a pin. This 3D model is used for analysis to check the sensitivity of the pin. Modeling is started by taking a typical shape of the circle shown in the figure. The standard modeling procedure is used to prepare a 3D model and is shown in the above figure. Creo parametric software has an analysis facility named Creo Parametric Simulation using where the pin sensitivity can be checked. This module is started and step by step procedure as highlighted in the software is followed to carry out the analysis.

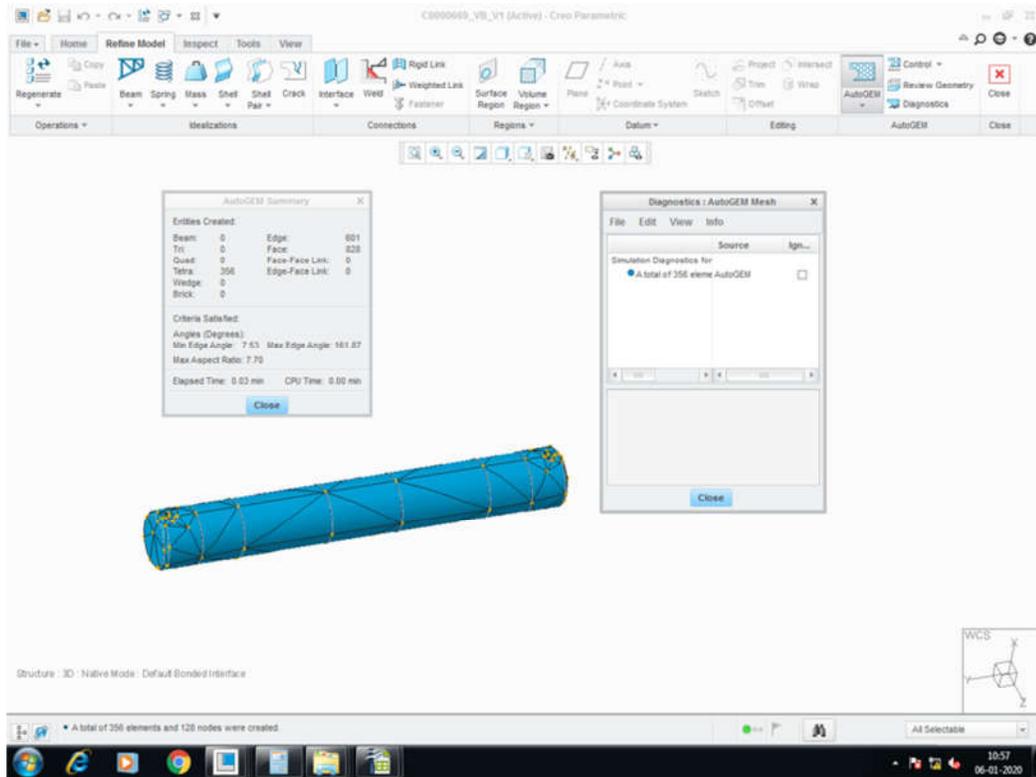


Fig 4.4 Finite Mesh Element of a Pin

Inputs as listed below for analysis

- Material: SS 304
- Fixed Geometry: One End of the pin is fixed
- Load: Force of 672 N
- Meshing: Standard 3D Mesh is generated by meshing command
- Analysis: Run command start analysis for the above conditions and structural analysis is done

4.5 Stress and Strain Distribution

Finite element mesh of pin is shown in the above fig. As seen the model has a solid mesh with a total of 356 elements and 128 nodes are created. The minimum edge angle of 7.53 and maximum edge angle of 161.87 with maximum aspect ratio 7.70. The response from the load sensor, under the load, is studied by carrying out the static analysis. This analysis gives us stress, strain, and deformation at various locations of the sensor. The load sensor is considered fixed and a load of 672 N is functional to the pin.

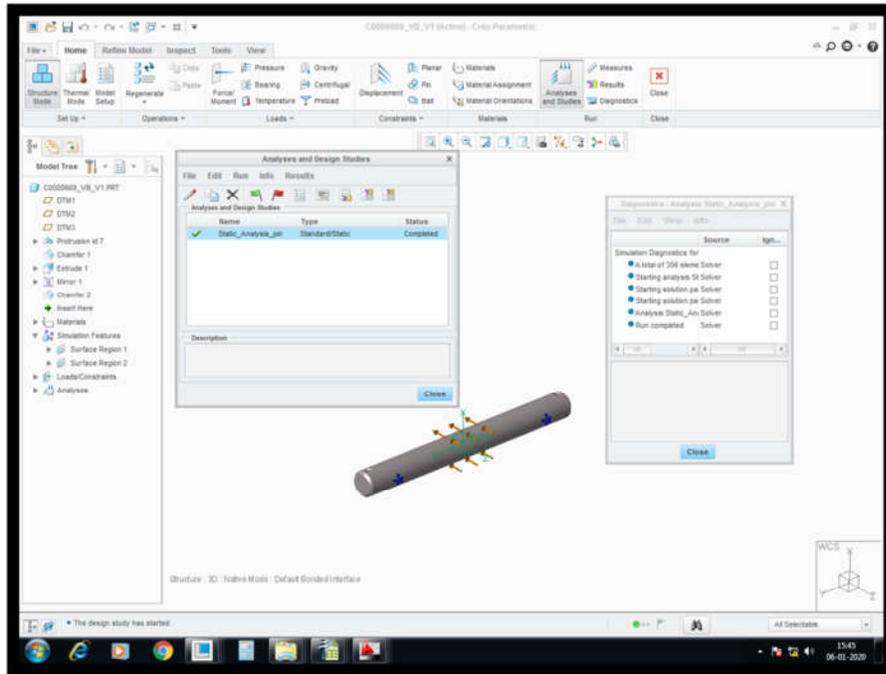


Fig 4.5 Applied Force and Boundary Conditions of the pin

Analysis results highlighting stress and strain distribution is plotted using software structural mode in analysis and design studies tool. The analysis aimed to locate the stress points and negative and positive strains.

Mesh Information Details:

Meshing Type	Solid Mesh
Mesher Used	Standard Mesh
Automatic Transition	Off
Include Mesh Auto Loops	Off
Total Elements	356
Total Nodes Created	128
Maximum Aspect Ratio	7.70
Time to Complete Mesh	0.03 Min

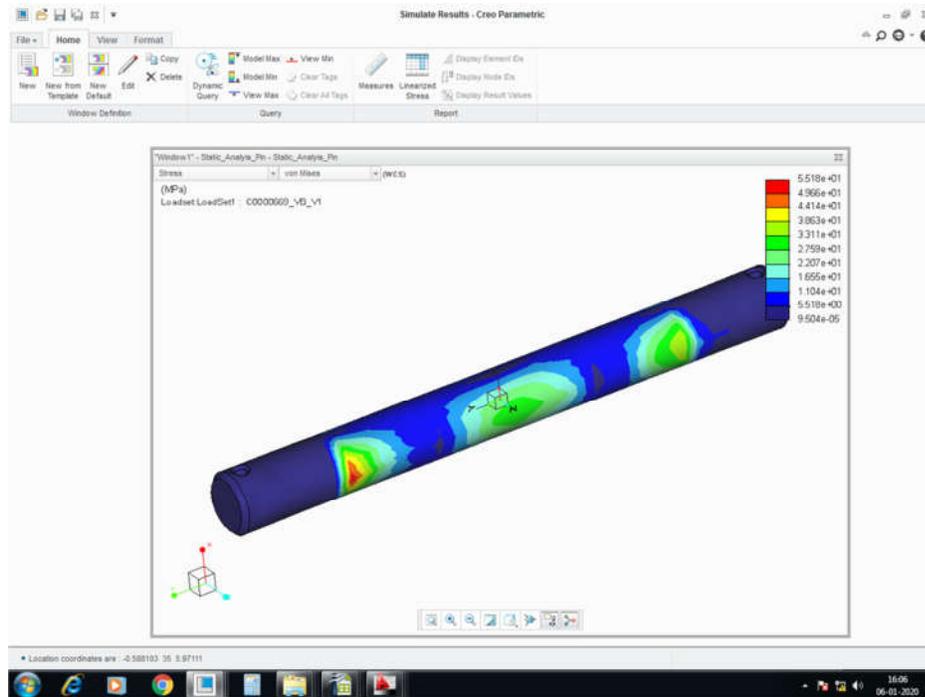


Fig 4.6 Stress Distribution of the Pin

This is seen from these figures and is highlighted by red color (+ Stress) and blue color (- Stress) areas on the sensor body. Corresponding strain values are shown in the figures. It highlights the magnitude of maximum positive strain and also maximum negative strain.

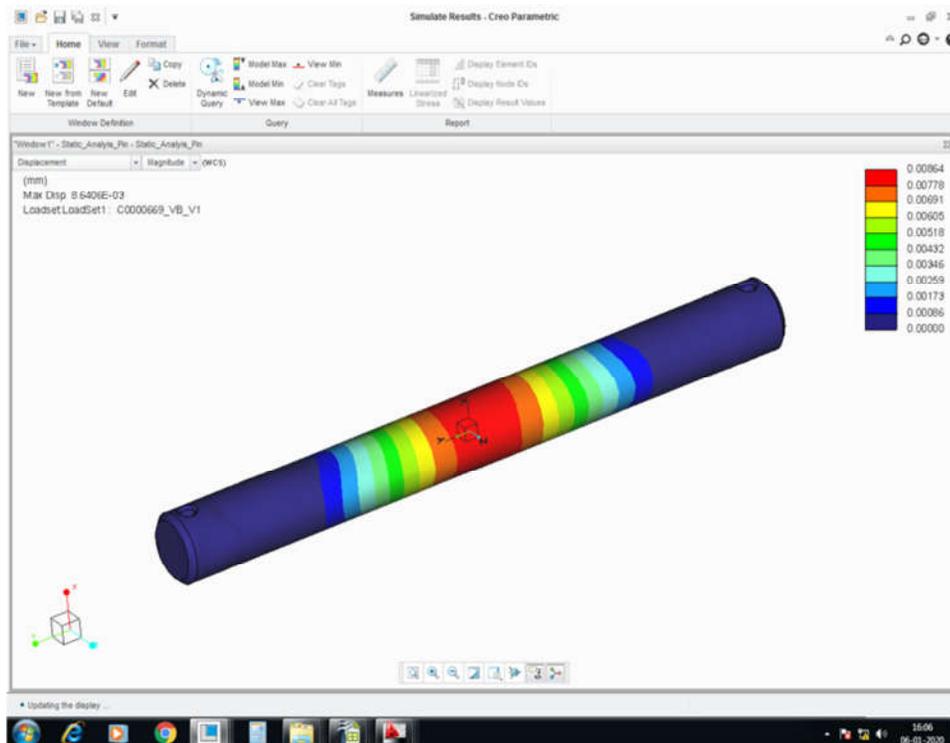


Fig 4.7 Parameters of Strain Analysis of the Pin

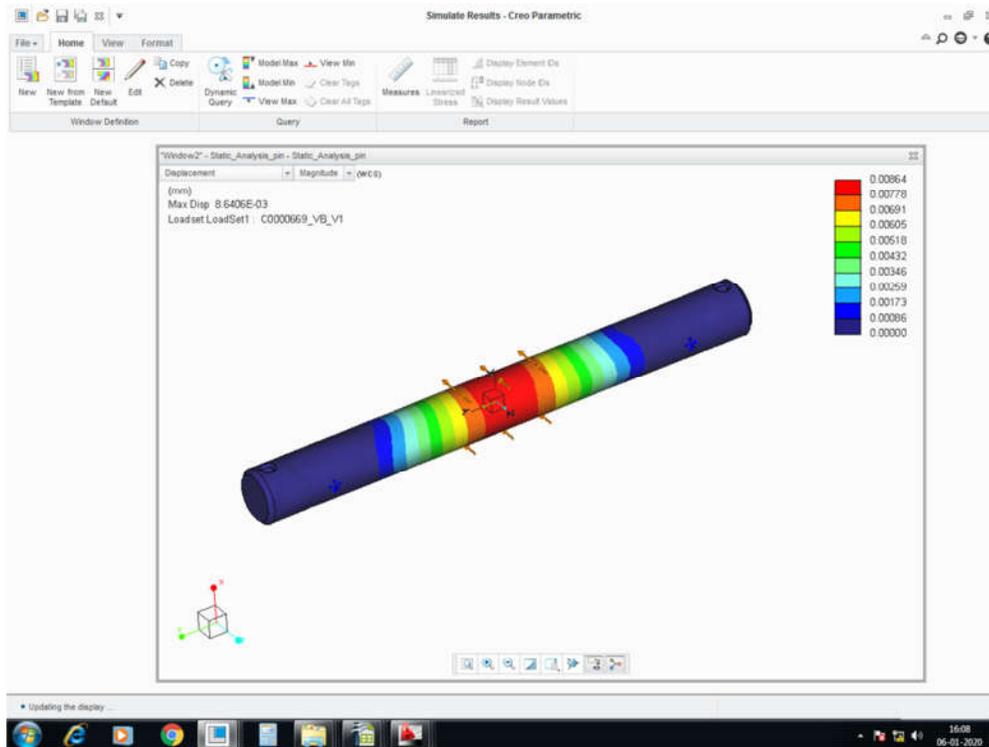


Fig 4.8 Strain Distribution of the pin

4.6 Conclusions

- In tilting mechanism, the load bear element is considered as pin. This pin undergoes stress and strain analysis before the analysis of this pin meshing element process run.
- From the test procedure and typical results can be concluded that the pin designed for the tilting mechanism assembly component of force namely lift drag and turning moment and it can be used for measurement of the tilting mechanism.
- The pin is designed and manufactured according to the analysis of the product. The strains are been noted according to the load application. The strain values have been calculated by the sensitivity of the strain per Newton.
- Here in this project, it can be concluded that the pin designed for moments lift, drag and tiling moment without errors and perfectly subtle.

5. Reference

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