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CAD Modelling and Analysis of Round Ring Cloth Peg Assembly Machine

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Abstract: Cloth pegs are used for holding clothes especially when kept for drying. There are different types of cloth pegs available in the market, made from different materials like plastic, metal or wood. The two pieces of the cloth peg are held together either by a metal ring, U-pin, or spring. The plastic parts and the metal ring are manufactured separately and then assembled together. Assembly of the plastic parts and the ring is done manually. This is a very tedious and troublesome process. So, the researcher has designed a machine to reduce the human efforts and time.

Keywords: Cloth peg, Clothes, Plastic parts, Metal ring, Assembly machine

I. INTRODUCTION

A cloth peg is a fastener used to hang up clothes for drying, usually on a clothes line. They are made from plastic, metal or wood. A ring, spring or U-pin is inserted between the two parts of the cloth peg. The assembly of the cloth peg (two plastic pieces and ring) can be done manually by workers, or by semiautomatic or fully automatic machines.



Fig.1 Cloth peg assembly

II. NEED OF THE PROJECT

Inserting the ring in the two parts is very tedious and troublesome job for the workers. So, by developing the machine for the same will reduce the manual efforts of the workers which will ultimately benefit the company.



Fig.2 Cloth peg assembly parts

III. MACHINE DESCRIPTION

The major component of the machine is a grooved lever with a knob, mounted on a round up table. The round up table is mounted on a stand. The stand is made by welding two cross MS plates with a central rod. The dimensions of the plates are 250×45×10mm. Bolted holes of diameter 16mm are provided on the two cross plates for foundation and mounting of the whole setup on to a platform. The diameter of the central rod is 24mm. The round up table exactly fits in the central rod. The dimensions of the round up table are 350×50mm. At the two ends of the table two sockets having the shape of the cloth peg are made. The fulcrum of the lever is at the center of the round up table. The diameter of the fulcrum pin is 5mm. The dimensions of the cross-section of the lever are 13.4×6.7mm. A groove of 1mm thickness is made on one side of the lever to hold the ring. A knob is provided on the other side of the lever. The knob restricts the horizontal and vertical motion of the ring. A plier is used for stretching the ring for inserting it into the rectangular and circular grooves of the cloth peg.

IV. DESIGN CALCULATIONS

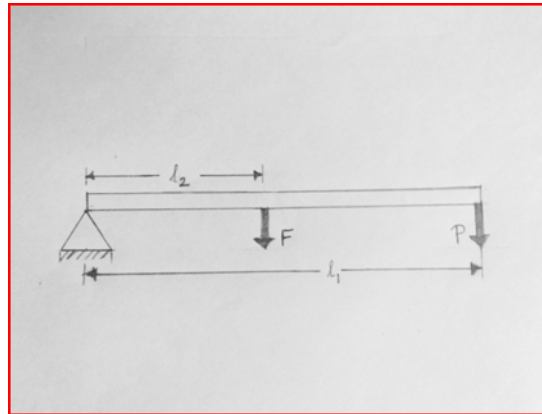


Fig.3 Lever

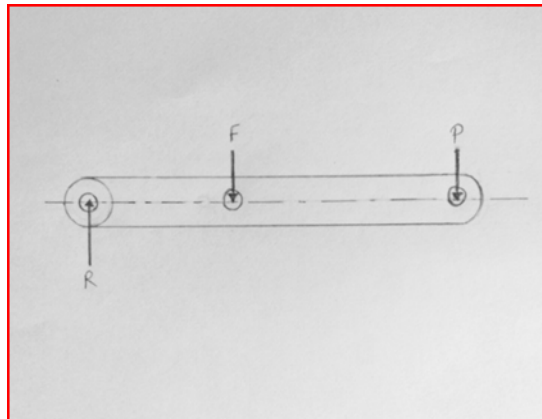


Fig.4 Free body Diagram of Forces acting on Lever

Where, F- Force to be applied on the knob to hold the ring in the groove

P- Effort required to produce that force

R- Reaction at the fulcrum pin

l_1 - Effort arm

l_2 - Load arm

1) Step I: Force Analysis

Taking moments about the fulcrum, we get,

$$F \times l_2 + P \times l_1 = 0$$

$$P \times l_1 = -F \times l_2$$

$$P = -F \times (l_2 / l_1)$$

$$= -0.5 \times 9.81 \times (0.138 / 0.353)$$

$$P = -1.917 \text{ N}$$

$$= (0.5 \times 9.81) + (-1.917)$$

$$\underline{R = 2.988 \text{ N}}$$

$$R = F + P$$

2) *Step 2: Design Of Lever Arm*

Bending moment, $M_b = P \times (l_1 - d_1)$

Where, d_1 - Diameter of pin

We have $d_1 = 0.5 \text{ cm} = 0.005 \text{ m}$

$$M_b = -1.917 \times (0.353 - 0.005)$$

$$\underline{M_b = -0.667 \text{ N-m}}$$

$$\text{Bending stress, } \sigma_b = \frac{M_b \times y}{I} \quad \text{————— (1) ———}$$

Where, I - Moment of Inertia

y - Distance from neutral axis to the outer-most fibre.

We have, $I = \frac{bd^3}{12}$ and $y = \frac{d}{2}$

Where, b - Distance parallel to the neutral axis

d - Distance perpendicular to the neutral axis

$$\text{We have, } \sigma_b = \frac{\text{Force}}{\text{Area}} = \frac{F + P}{d \times b} = \frac{2.988}{d \times b} \quad \text{————— (2) ———}$$

Equating equations (1) and (2)

$$\frac{2.988}{d \times b} = \frac{0.667 \times \frac{d}{2}}{\frac{bd^3}{12}}$$

Generally, $d = 2b$

$$\frac{2.988}{2b \times b} = \frac{0.667 \times \frac{2b}{2}}{\frac{b \times (2b)^3}{12}}$$

$$\underline{b = 0.67 \text{ cm}}$$

$$\text{Therefore, } \underline{d = 1.34 \text{ cm}}$$

V. CAD MODEL OF ROUND RING CLOTH PEG ASSEMBLY MACHINE



Fig.5 Round Ring Cloth Peg Assembly Machine

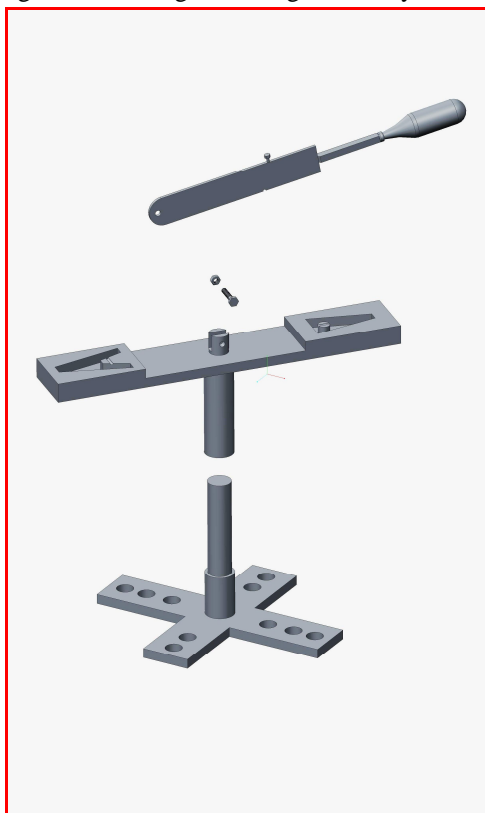


Fig.6 Exploded view of the machine

VI. CAD MODEL OF DIFFERENT PARTS OF THE ASSEMBLY MACHINE

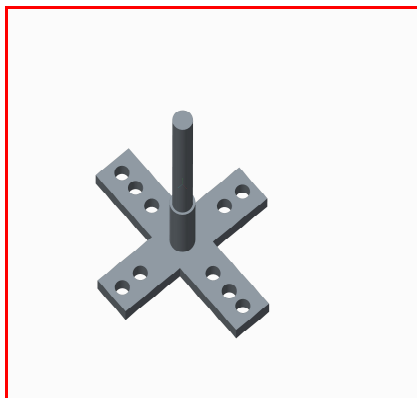


Fig.7 Stand

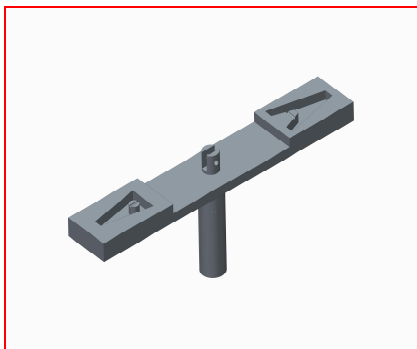


Fig.8 Round Table



Fig.9 Grooved Lever with knob

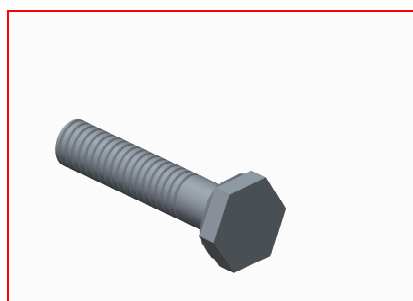


Fig.10 Bolt



Fig.11 Nut

VII. DESIGN ANALYSIS- ANSYS WORKBENCH-16.2

Mild Steel is selected for fabrication of the machine.

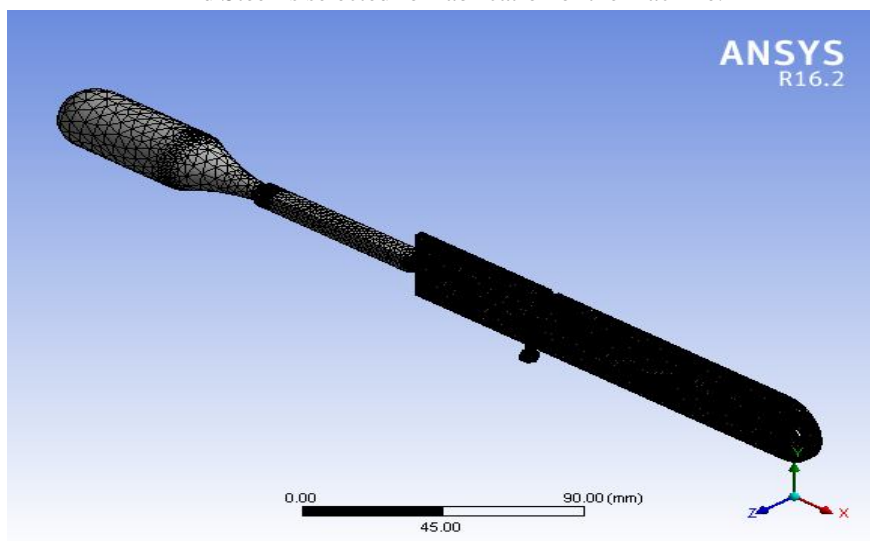


Fig.12 Meshing of lever

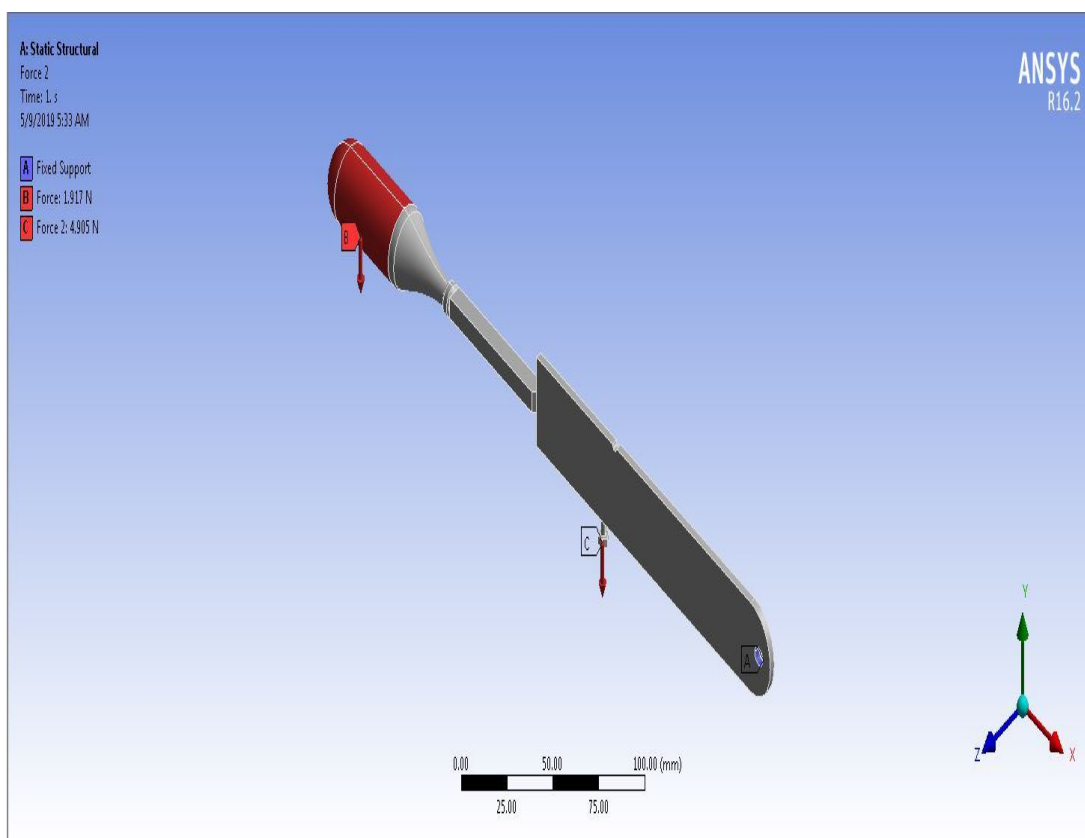


Fig.13 Boundary conditions of forces acting on the lever

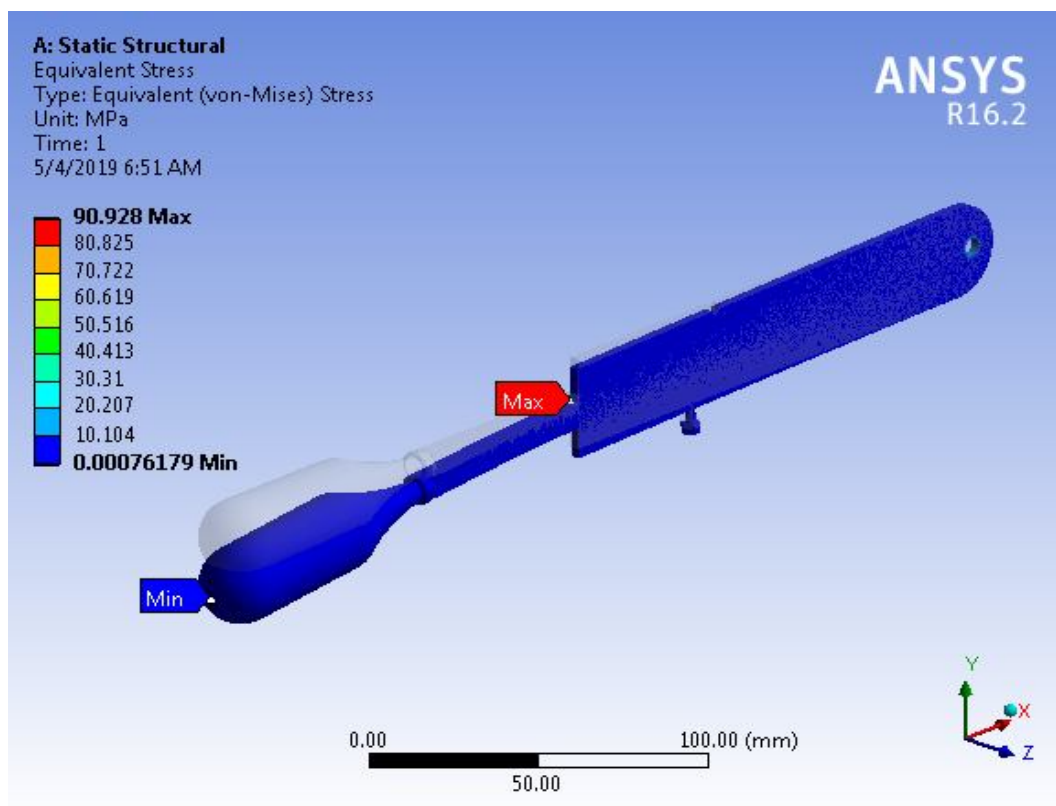


Fig.14 Stress due to the forces acting on lever

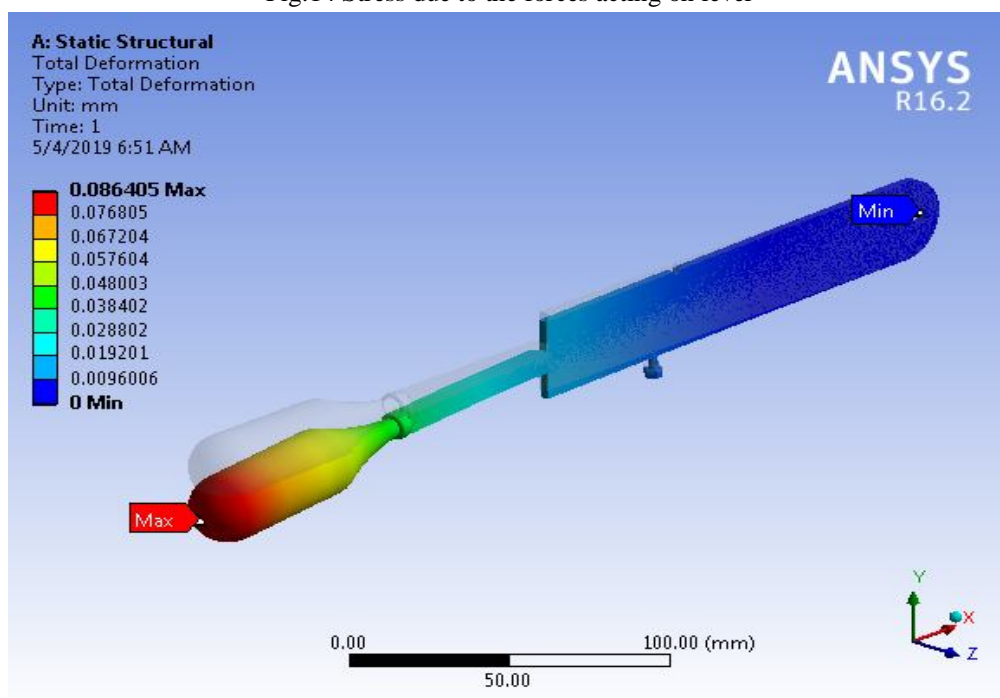


Fig.15 Deformation due to the forces acting on lever

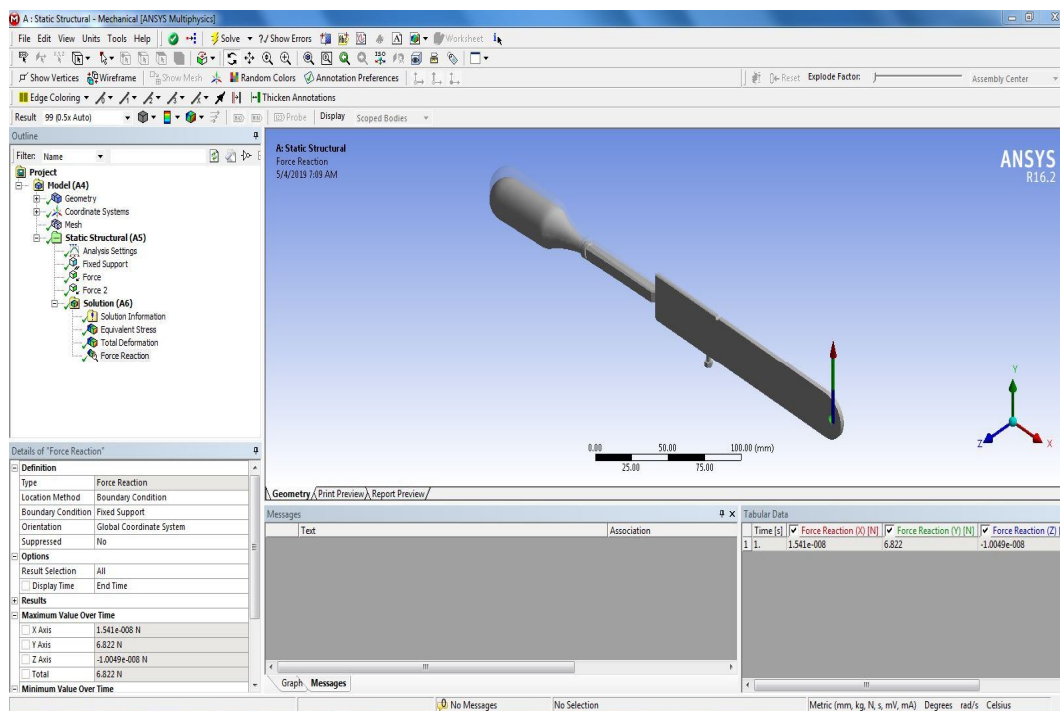


Fig.16 Force reaction

TABLE I: Force Reaction

Time [s]	Force Reaction (X) [N]	Force Reaction (Y) [N]	Force Reaction (Z) [N]	Force Reaction (Total) [N]
1.	1.541e-008	6.822	-1.0049e-008	6.822

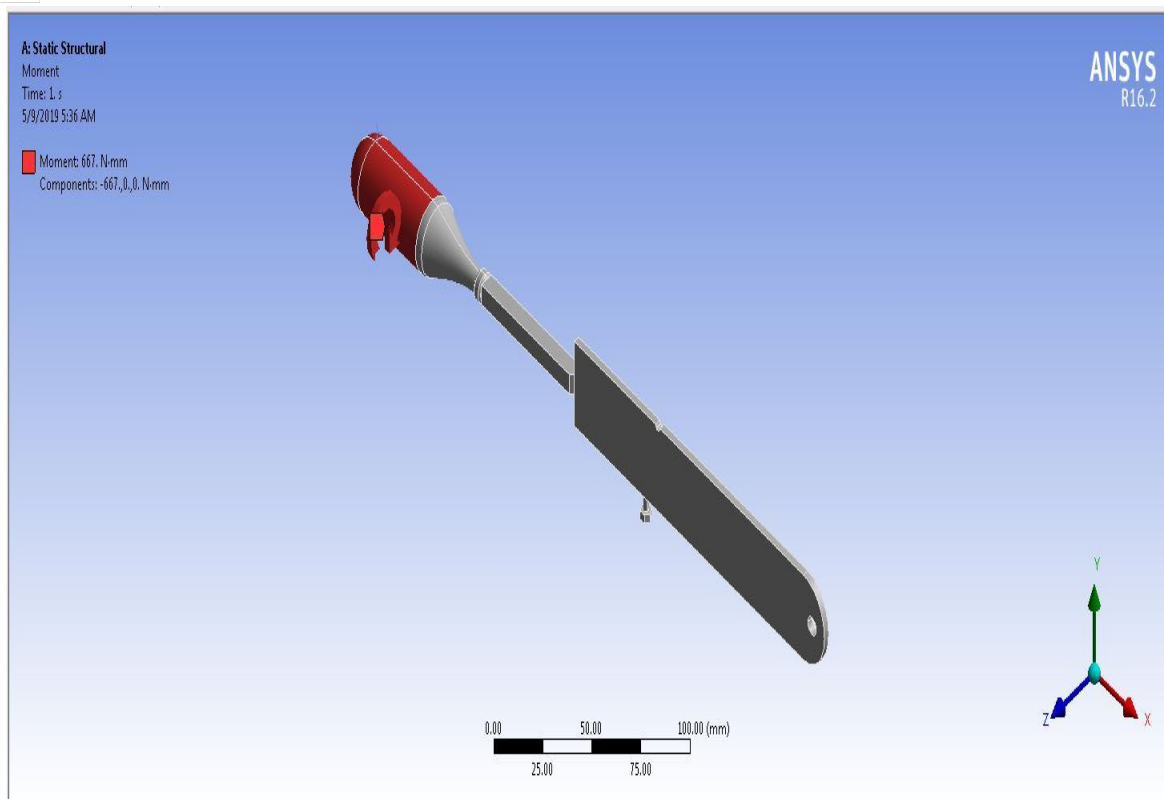


Fig.17 Bending Moment acting on lever

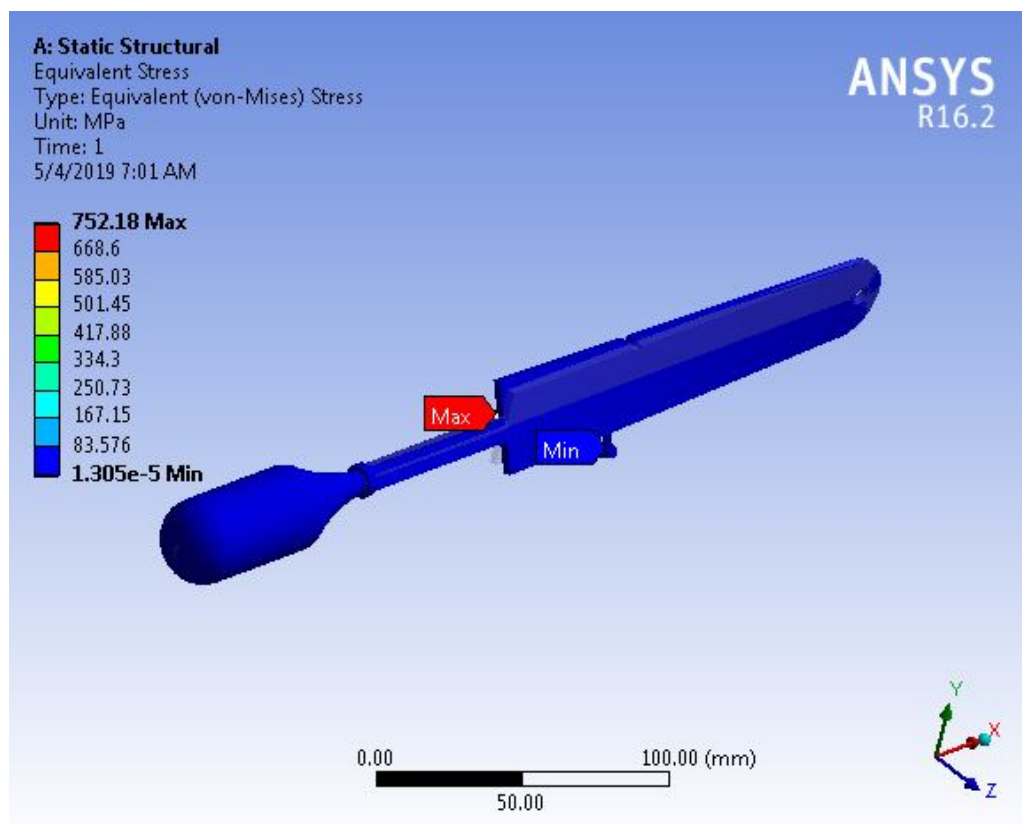


Fig.18 Stress due to the Bending Moment acting on lever

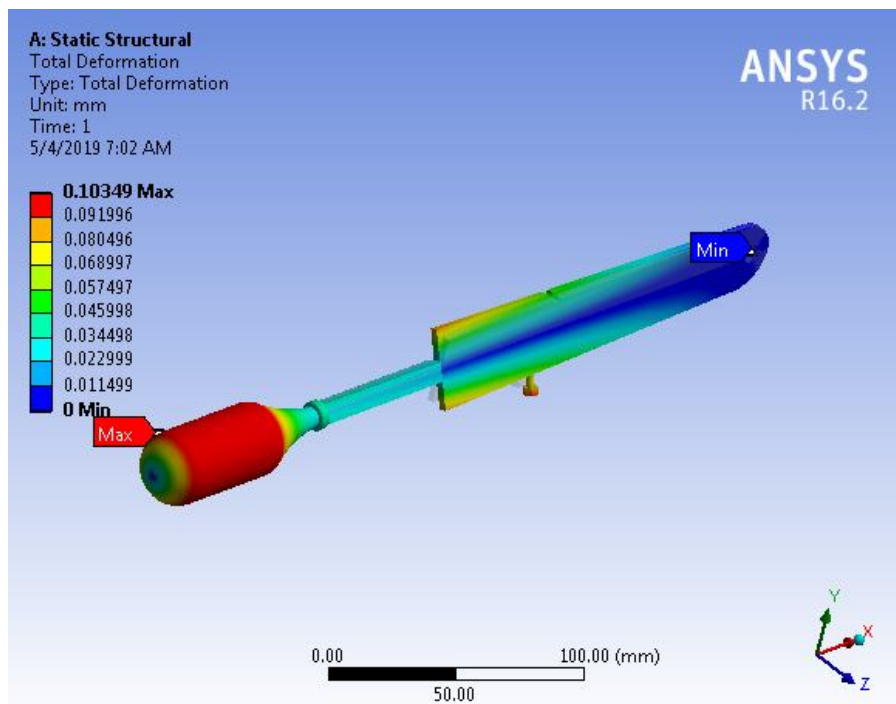


Fig.19 Deformation due to the Bending Moment acting on lever

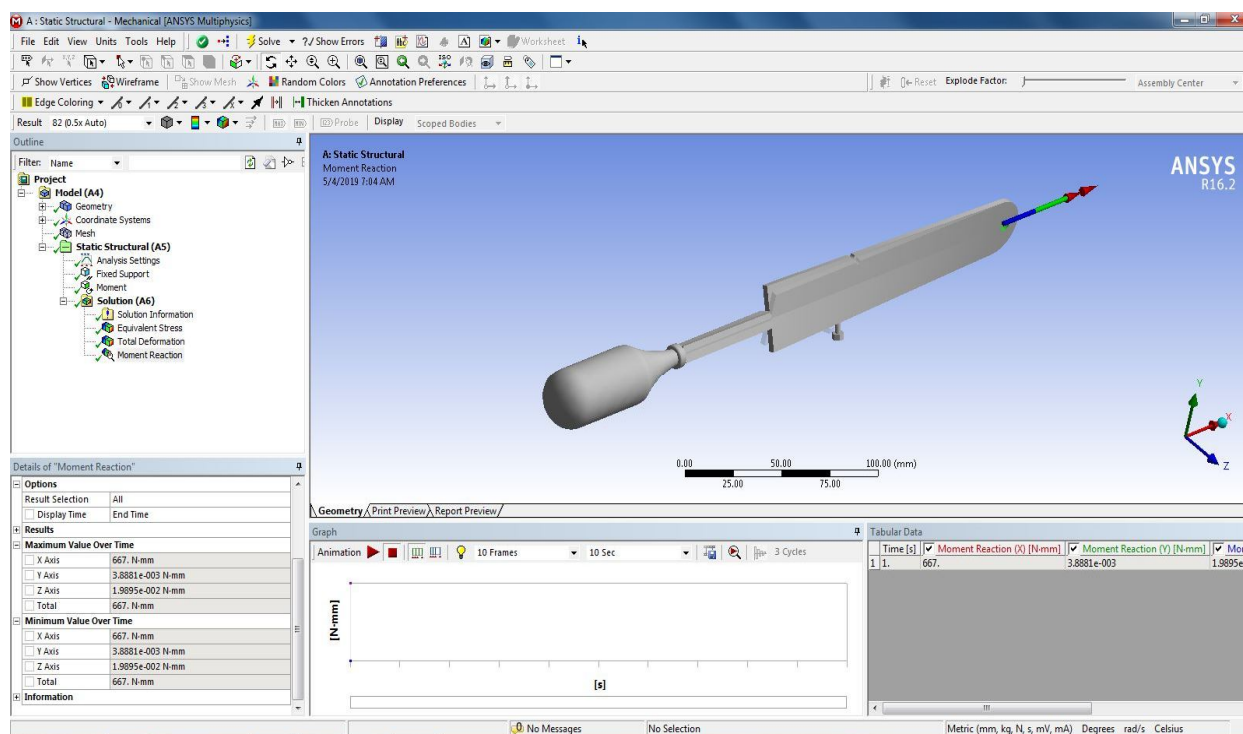


Fig.20 Moment reaction

TABLE III: Moment Reaction

Time [s]	Moment Reaction (X) [N·mm]	Moment Reaction (Y) [N·mm]	Moment Reaction (Z) [N·mm]	Moment Reaction (Total) [N·mm]
1.	667.00	3.8881e-003	1.9895e-002	667.00

VIII. CONCLUSION

As per the machine description and design, the CAD model of the Round Ring Cloth Peg Assembly Machine is prepared and its analysis is done using Ansys Workbench-16.2.

IX. ACKNOWLEDGMENT

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