

# A Study of Geometrical Shape of Central Plate in Electrostatic actuation

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**Abstract:** This study is performed to know which central plate geometry is best suited for electrostatically actuated switch. The simulation is carried out in CAD software COMSOL Multiphysics, where user is free to model the geometry without depth knowledge about geometrical dependency of electrostatic. The study of the centrally suspended geometrical models such as circle, square and rectangle suspended by two short anchors is done. It is found that rectangular central plate suspended plate shows good deflection compared to other three geometries with constant voltage between for all three geometries.

**Keywords:** Electrostatic actuation, Anchors, central plate, COMSOL

## 1. Introduction

This study is performed to check which of the geometry is best suited for electrostatically actuated switch. To perform this study it is necessary to keep the actuation voltage and area of the geometry same. Firstly area of circle is calculated by using formula  $\pi r^2$  with 'r' radius of circle as  $25\mu\text{m}$ , the area calculated is  $1.96495408\text{e-}9\text{ m}^2$ . Keeping this area as a constant the geometrical area of plate such as square and rectangle is calculated by using the formula Area of circle = area of square = area of rectangle ( $\pi r^2 = a^2 = lb$ ). Where 'a' is length of the side of square, 'l' and 'b' are the length of the sides of the rectangle.

## 2. Modeling in COMSOL

The basic idea behind using short anchors is to deflect the central plate prominently rather than anchors. If in case long anchors were used, the deflection of anchors would have become more prominent. Firstly circular plate of radius having area  $1.96495408\text{e-}9\text{ m}^2$  is considered in modeling the geometry as shown in Figure 1. Then a square plate having area  $1.96495408\text{e-}9\text{ m}^2$  is considered in modeling the geometry. The square plate is suspended by two short anchors as shown in Figure 2. Finally Rectangular plate of area  $1.96495408\text{e-}9\text{ m}^2$  is considered in modeling the geometry. The rectangular plate is suspended by two short anchors as shown in Figure 3.

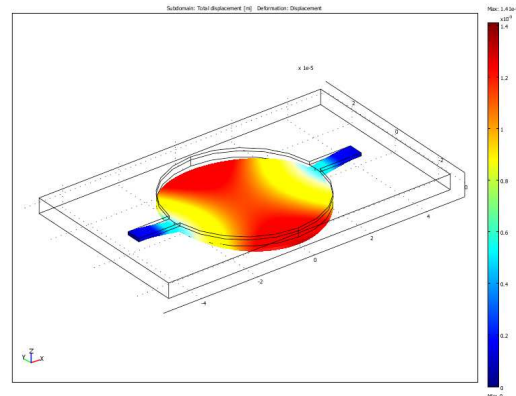


Figure 1. Centrally suspended circular plate

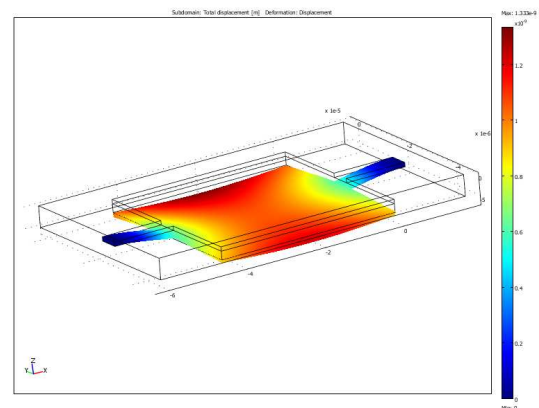


Figure 2. Centrally suspended Square plate

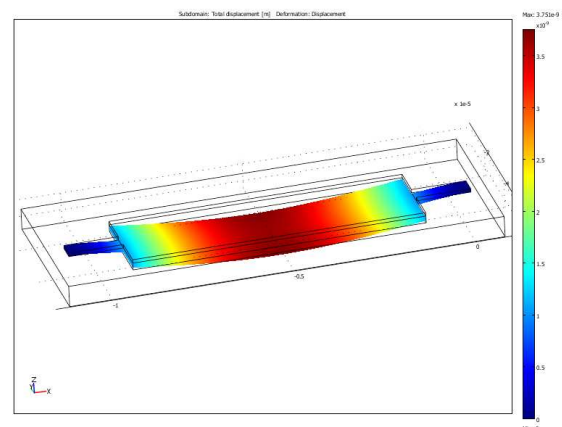


Figure 3. Centrally suspended Rectangular plate

### 3. Result

**Table 1** Deflection observed in COMSOL due to applied voltage.

| Geometrical shape | Deflection |
|-------------------|------------|
| Square            | 1.333nm    |
| Circle            | 1.41nm     |
| Rectangle         | 3.75nm     |

The result shows that the deflection for centrally actuated rectangular plate shows good deflection

### 5. Conclusion

Comparing all the geometrical shapes of the central plate rectangular suspended plate shows good deflection for electrostatic actuation compared to other shapes, Hence rectangle is best suited geometry for switches.

### 6. Futurework

It is required to develop mathematical and logical explanations to the derived result. The result is required to be supported by fabricating the above modeled switches.

Acknowledgement

### References

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