International Journal of Research in Electrical and Electronic Engineering
http://www.wrpjournals.com/V/IJREEE
Vol. 5, No. 6, pp. 010-012, June 2016

Research Article

Critical Load Factor for Different Piezoresistive Cantilever Geometries

[1,*]Ankit Sagar, [2]Chetan Kamble and [3]Panse, M.S.

[1]M.Tech electronics, VJTI, Matunga
[2]P.hd. scholar, VJTI, Matunga
[3]Professor & Dean Faculty, VJTI, Matunga

Received Article 24th May 2016; Published Article 30th June 2016

Cantilever are gaining wide spread popularity as actuators and sensors. Cantilevers are fixed at one end and free at other end. Thus a weight added to the free end causes the cantilever beam to bend. Buckling is considered as a mathematical instability. It can cause sideways failure. In this paper various cantilever geometries are studied and their critical load factor for a fixed weight is calculated. It also shows the effect of modifying the geometry on critical load factor.

Key words: Cantilever Beam, MEMS, Piezoresitive Readout, Linear Buckling.

INTRODUCTION

Micro Electro Mechanical systems (MEMS) have received immense interest as sensors and actuators. MEMS device are being used to detect gases, temperature, pressure and many other physical parameters. But the sensitivity of cantilever beam is not as high as other sensors and actuators. Hence it is necessary to improve and optimize the cantilever's geometry to improve its sensitivity [Chetan Kamble et al., 2016]. A number of cantilever geometries have been studied. However modifying the geometry of a cantilever beam can change its load bearing capacities. Buckling is a mathematical instability which leads to instability. It is sudden sideways failure of a structure which is under high stress. COMSOL multiphysics was used to simulate various geometries and find out the critical load factor (https://en.wikipedia.org/wiki/Buckling.).

Cantilever geometries

Cantilever geometries which had been developed were subjected to a constant load of 5 nano kilograms [Ankit Sagar et al., 2016]. One side of the cantilever was kept fixed and other side was free to move. Very fine meshing was done. Critical load factor was calculated by using linear buckling model. The Cantilever geometries are shown in figure 1 to figure 5. And the results are shown in figure 6 to figure 10.

RESULTS AND CONCLUSION

The critical load factor of cantilever geometries is given in table 1. For the same amount of load, hammerhead cantilever is the strongest geometry among all.

***Corresponding author: Ankit Sagar,**
M.Tech electronics, VJTI, Matunga.

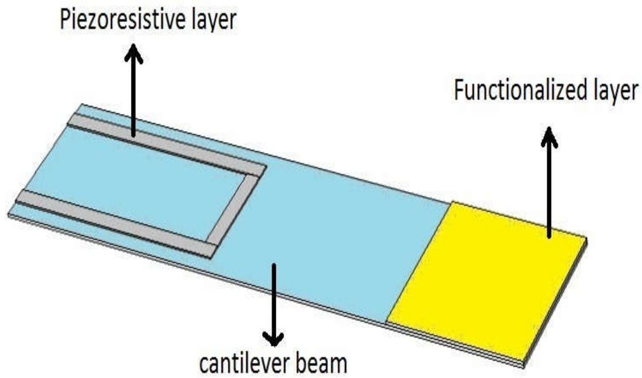

Fig. 1. Rectangular cantilever beam

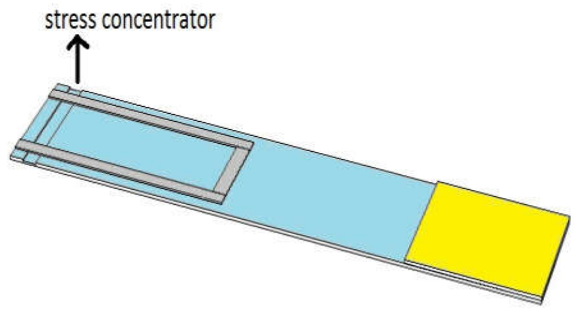

Fig. 2. Rectangular cantilever beam with stress concentrator

Hammerhead cantilever with slot is the weakest geometry among the above geometries. However all the cantilevers are capable of withstanding loads well above the intended $5*10^{-9}$ Kilogram.

Table 1. Critical load factor of cantilever geometries

Cantilever Geometry	Critical load factor
Basic cantilever	33525
Cantilever with stress concentrators	32647
Slot cantilever	29469
Hammerhead cantilever	33532
Hammerhead cantilever with slot	9315.4

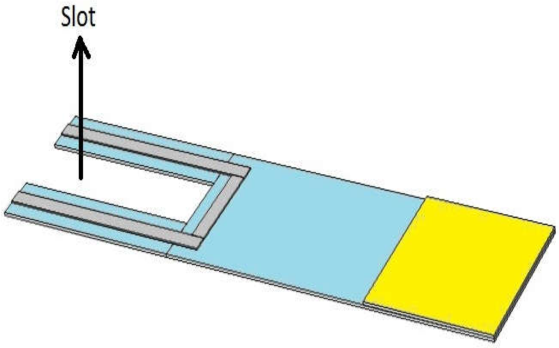

Fig. 3. Rectangular cantilever beam with slot

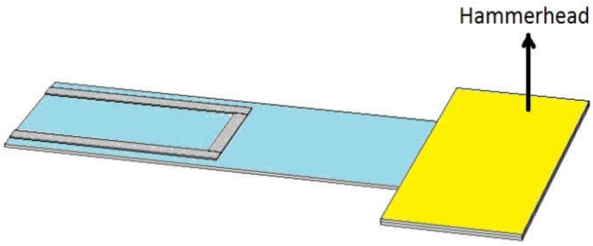

Fig. 4. Rectangular cantilever beam with hammerhead

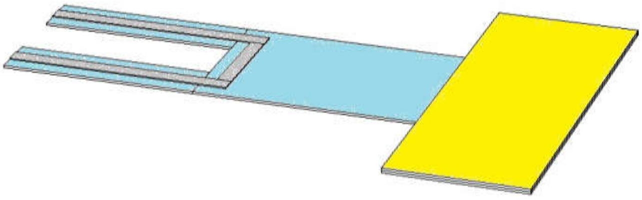

Fig. 5. Rectangular cantilever beam with hammerhead and slot

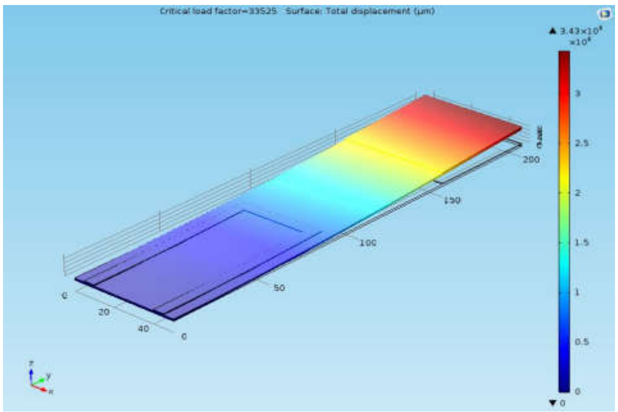

Fig. 6. Rectangular cantilever beam under load

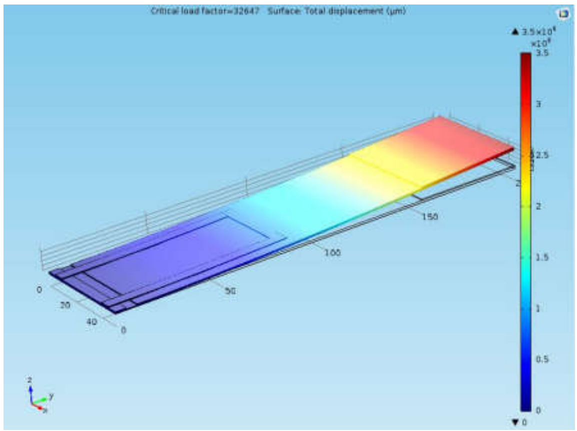

Fig. 7. Rectangular cantilever beam with stress concentrator under load

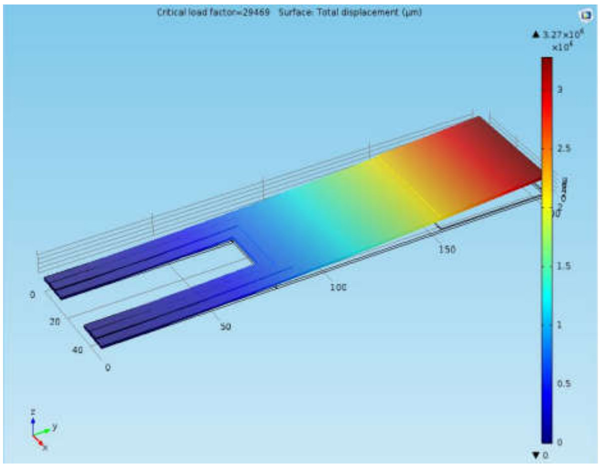

Fig. 8. Rectangular cantilever beam with slot under load

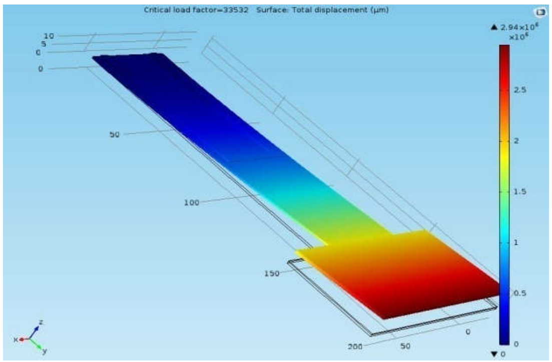

Fig. 9. Rectangular cantilever beam with hammerhead under load

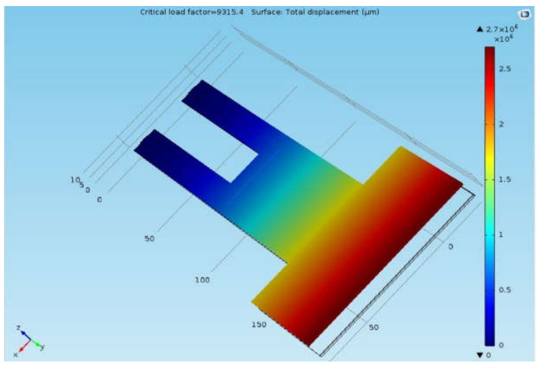

Fig. 10. Rectangular cantilever beam with hammerhead and slot under load

REFERENCES

Ankit Sagar, Chetan Kamble, M.S. Panse, 2016. “Comparision of cantilver shapes for maximizing sensitivity”, *International Journal of Computer and electronics research* (IJCER), FEB 2016, Volume 5. issue No. 1 Pages 5-8.

Ankit Sagar, Chetan Kamble, M.S. Panse, 2016. “Resistance change for different piezoresistive cantilever geometries”, *International Journal of Engineering Research and General Science*, Volume 4, Issue 3, May - June, 2016, pages 495-500.

Bharat Bhushan “Springer Handbook of Nanotechnology”, 3rd edition, pages: 436-438.

Chetan Kamble, Dr.MS Panse, 2016. Design of Acetone Vapour Sensor using Microcantilever‖ Sixth International Congress on Computational Mechanics and Simulation (ICCMS), IITB Mumbai, 27 june - 1 july.

https://en.wikipedia.org/wiki/Buckling.

John P. Uyemura, 2010. “Introduction to VLSI Circuits and Systems”, First edition, 2012 reprint, pages 78-81.

Marc J. Madou, 2002. ”Fundamentals of Microfabrication: The Science of Miniaturization”, second edition, pages 311-313.

Sandeep kumar Vashisth, 2007. “A review of microcantilever for sensing applications”, *Journal of nanotechnology*, Vol.3, Pages 1-18, June.

****