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International Journal For Research in
Applied Science and Engineering Technology

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FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

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Study of Various Strains Calculated on a Crane Hook using FEA and Mathematical Data Analysis

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Abstract: On applying a certain load on an object it is a physical phenomenon that the object get deformed. The variation of deformation however may differ due to various influencing factors like- Quantity of load, Geometry of object, time of application of load, etc. A numerical study of various strains and strain related effects has been carried out on a Crane Hook design for further modification in the design of Crane Hook.
*Keywords: Crane Hook, Strain, Strain Intensity, Strain Energy, Equivalent Total Strain, ANSYS R19.0.*

I. INTRODUCTION

Crane Hook is a load carrying element that follows various stresses and strains with some amount of deformation and distortion. To study the most affected part while loading that comes into huge deformation a test has been carried out. The various strains and deformations are meant to find out the major affected portion.

II. GEOMETRY AND LOADING

Here "A" is the fixed support and "B" is the part which comes into contact for loading. The force has been applied in Z-direction as similar to practical situation.

Static Structure   Meshed Structure
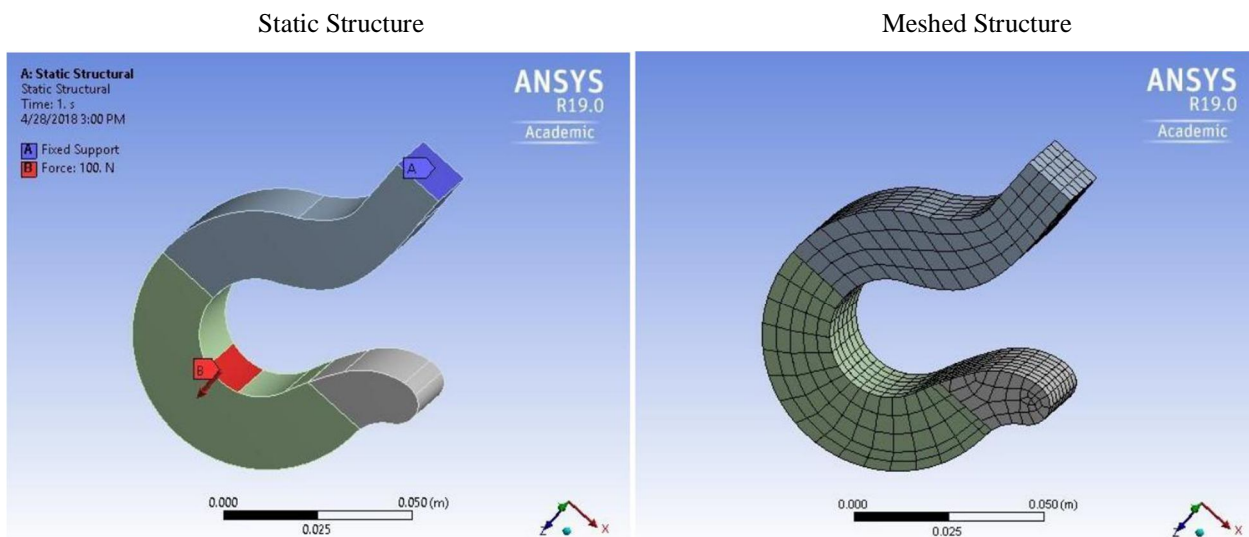
Further analysis has been done by creating a meshed system which allows us to brought the accurate conclusions.

A. Strain Analysis

Strain is a mode of calculation of deformation which shows the displacement between two points in the element with reference to a given length.

An isotropic material that falls under Hooke's Law produces Normal Strain while in a Shear Strain is an isochoric plane deformation with a combination of line elements relatively to a given reference that stays fixed during the deformation.
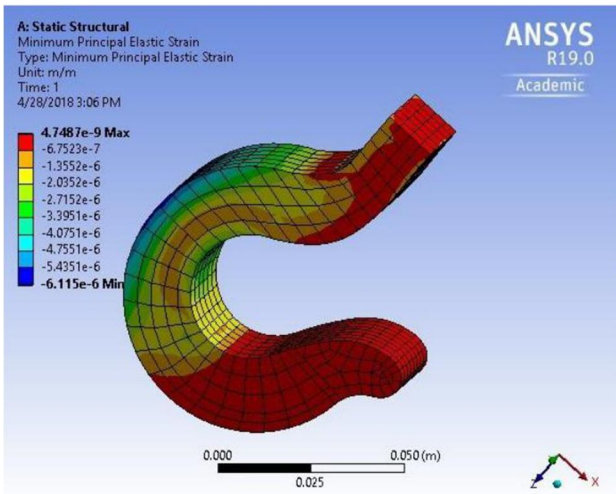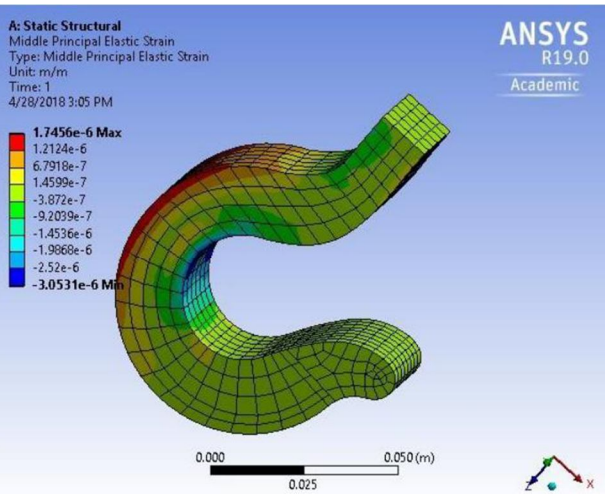
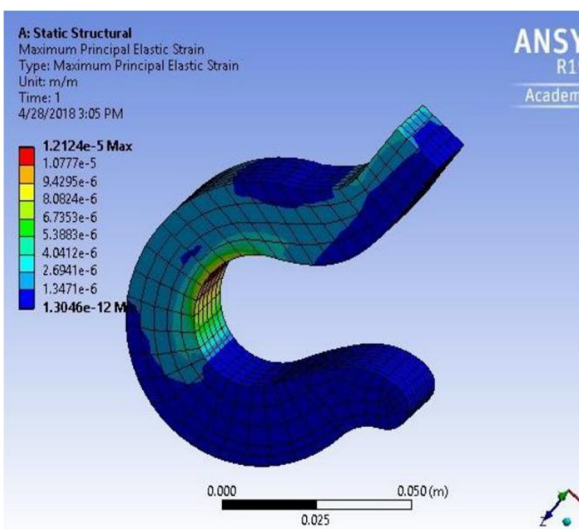Normal Elastic Strain
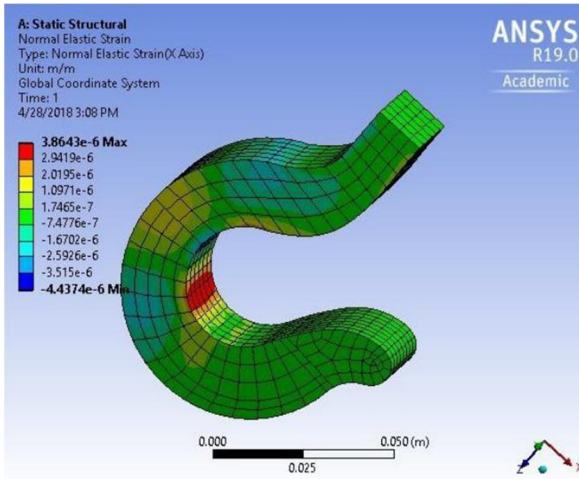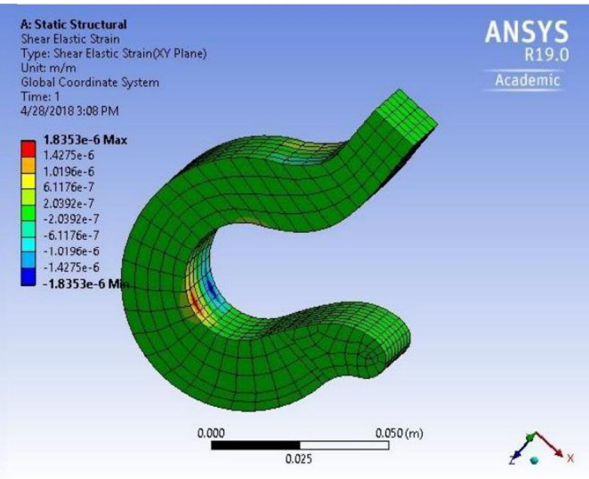
Shear Elastic Strain

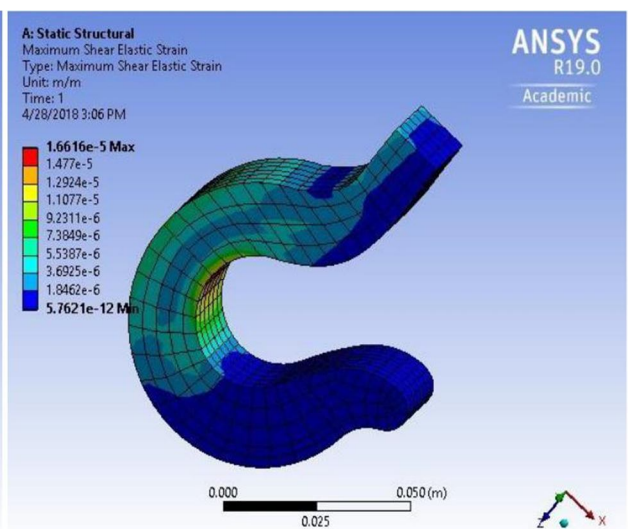Minimum Principal Elastic Strain

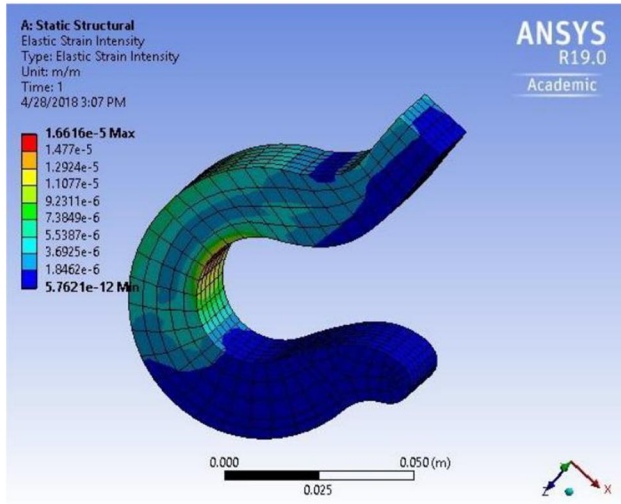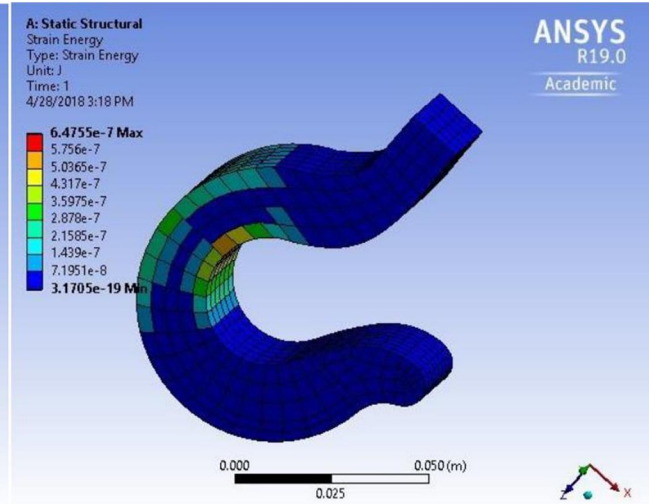Middle Principal Elastic Strain

Maximum Principal Elastic Strain
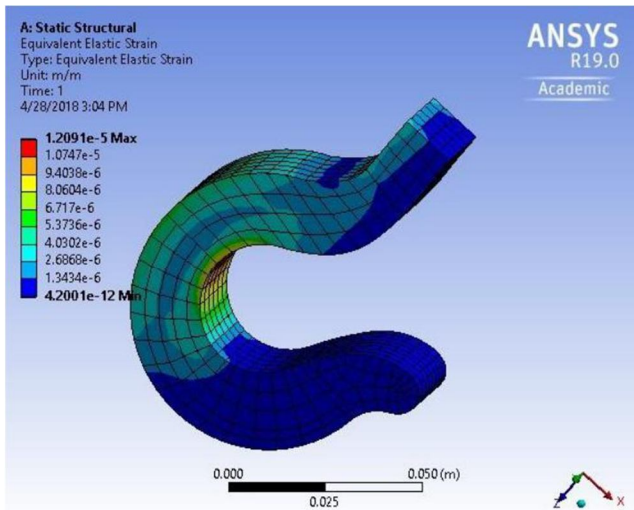
Maximum Shear Elastic Strain
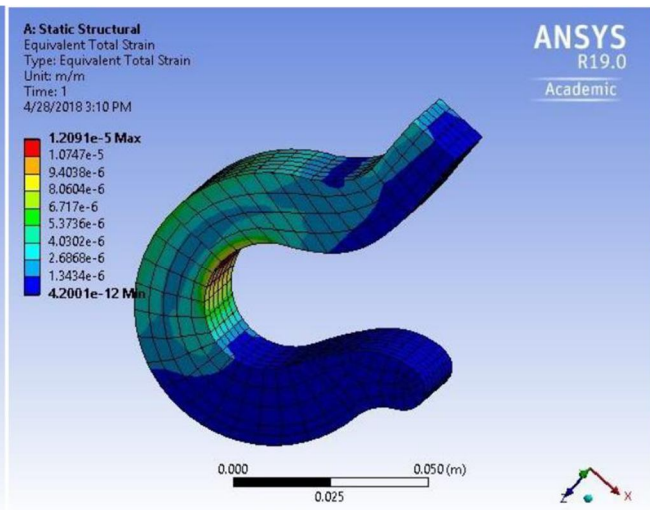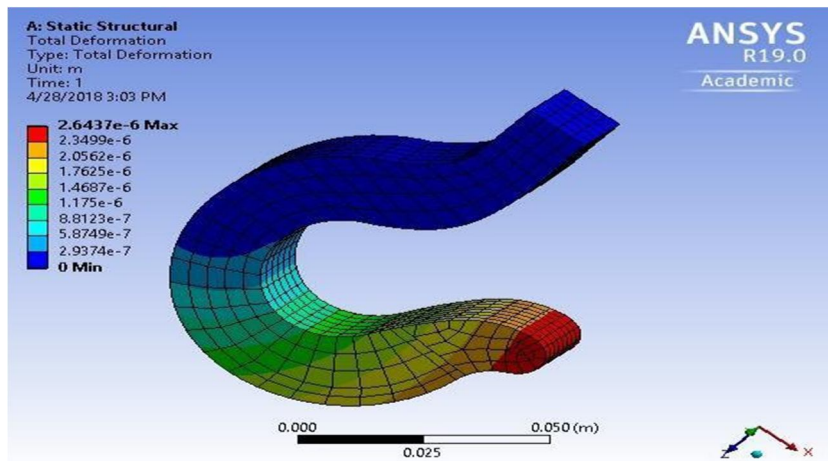
Elastic Strain Intensity

Strain Energy

Equivalent Elastic Strain

Equivalent Total Strain

Total Deformation

113

III. RESULTS & CONCLUSIONS
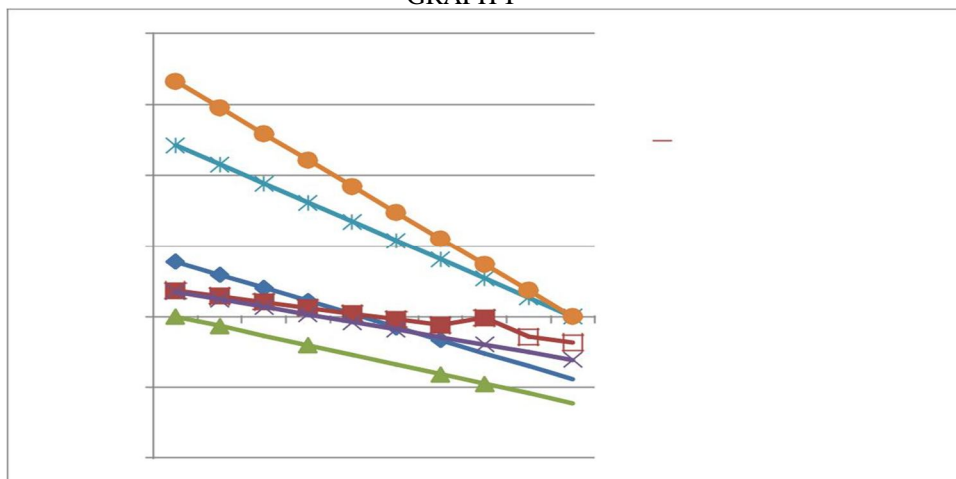
TABLE-1

S.NO.	NORMAL ELASTIC STRAIN	SHEAR ELASTIC STRAIN	MINIMUM PRINCIPAL ELASTIC STRAIN	MIDDLE PRINCIPAL ELASTIC STRAIN	MAXIMUM PRINCIPAL ELASTIC STRAIN	MAXIMUM SHEAR ELASTIC STRAIN
1.	3.8643e-6	1.8353e-6	4.7487e-9	1.7456e-6	1.2124e-5	1.6616e-5
2.	2.9419e-6	1.4275e-6	-6.7523e-7	1.2124e-6	1.0777e-5	1.477e-5
3.	2.0195e-6	1.0196e-6	-1.3552e-6	6.7918e-7	9.4295e-6	1.2924e-5
4.	1.0971e-6	6.117e-7	-2.0352e-6	1.4599e-7	8.0824e-6	1.1077e-5
5.	1.7465e-7	2.0392e-7	-2.7152e-6	-3.872e-7	6.7353e-6	9.2311e-6
6.	-7.477e-7	-2.0392e-7	-3.3951e-6	-9.2039e-7	5.3883e-6	7.3849e-6
7.	-1.6702e-6	-6.1176e-7	-4.0751e-6	-1.4536e-6	4.0412e-6	5.5387e-6
8.	-2.5926e-6	-1.016e-7	-4.7551e-6	-1.9868e-6	2.6941e-6	3.6925e-6
9.	-3.515e-6	-1.4275e-6	-5.4351e-6	-2.52e-6	1.3471e-6	1.8462e-6
10.	-4.4374e-6	-1.8353e-6	-6.115e-6	-3.0531e-6	1.3046e-12	5.7621e-12

A graphical representation of the comparative data of strains has been shown below:

2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
-5.00E-06
-1.00E-05

GRAPH-I

- ◆ NORMAL ELASTIC STRAIN
- ■ SHEAR ELASTIC STRAIN
- ▲ MINIMUM PRINCIPAL ELASTIC STRAIN
- ✕ MIDDLE PRINCIPAL ELASTIC STRAIN
- ✱ MAXIMUM PRINCIPAL ELASTIC STRAIN
- ● MAXIMUM SHEAR ELASTIC STRAIN

IV. CALCULATIONS

A. Elastic Strain Intensity
MAXIMUM VALUE= 1.6616e-5
MINIMUM VALUE= 5.7621e-12

B. Strain Energy
MAXIMUM VALUE=6.4755e-7
MINIMUM VALUE=3.1705e-19

C. Equivalent Elastic Strain
MAXIMUM VALUE= 1.2091e-5
MINIMUM VALUE=4.2001e-12

D. Equivalent Total Strain
MAXIMUM VALUE=1.2091e-5
MINIMUM VALUE=4.2001e-12

E. Total Deformation
MAXIMUM=2.6437e-6
MINIMUM=0

V. ACKNOWLEDGEMENT

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