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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.

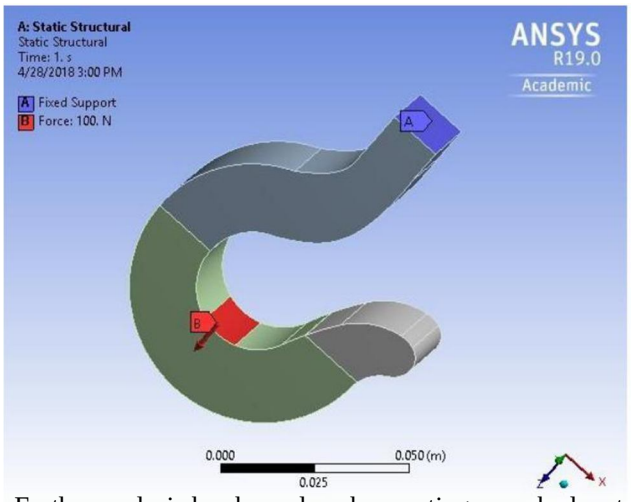
I. INTRODUCTION

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.

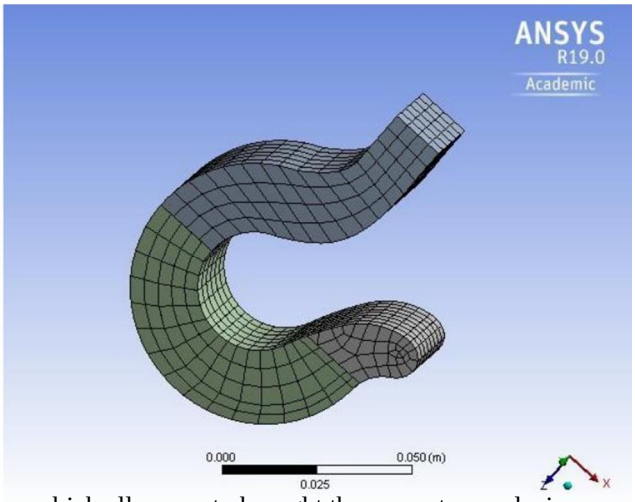
II. GEOMETRY AND LOADING

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



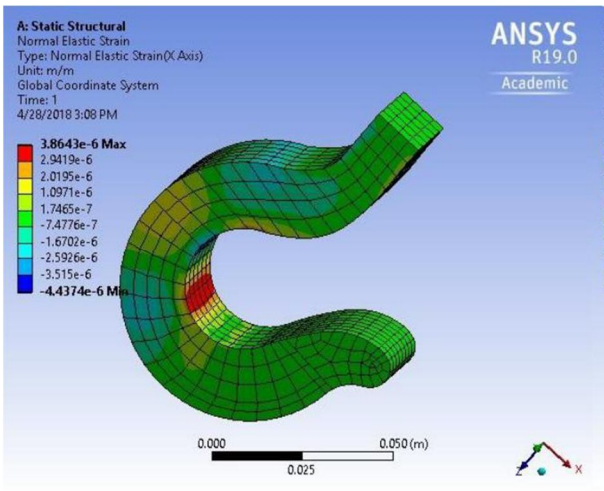
Further analysis has been done by creating a meshed system which allows us to brought the accurate conclusions.

A. Strain Analysis

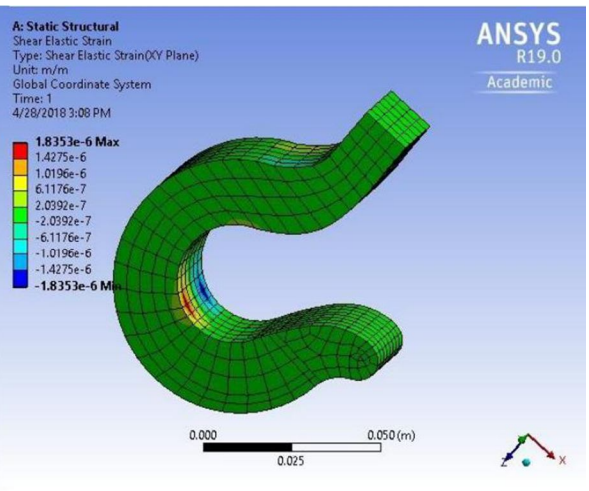
Strain is a mode of calculation of deformation which shows the displacement between two points in the element with reference to a given length.

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.

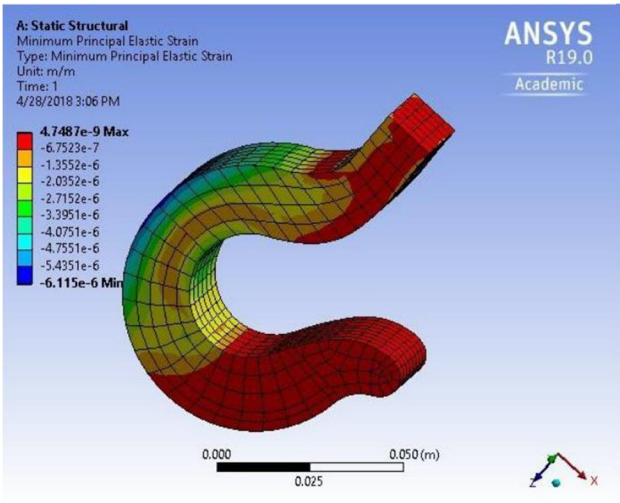
Normal Elastic Strain



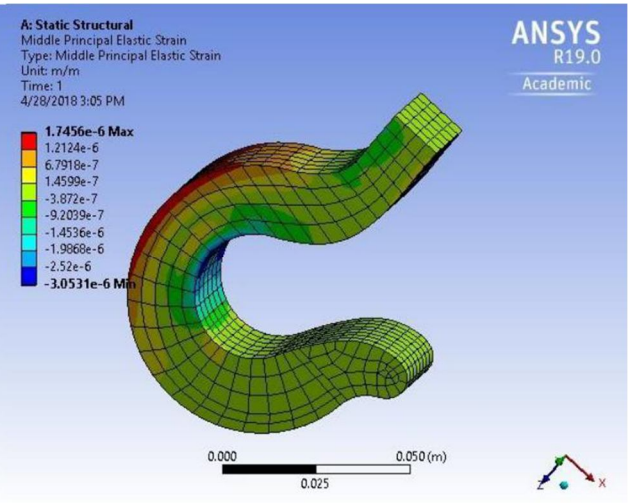
Shear Elastic Strain



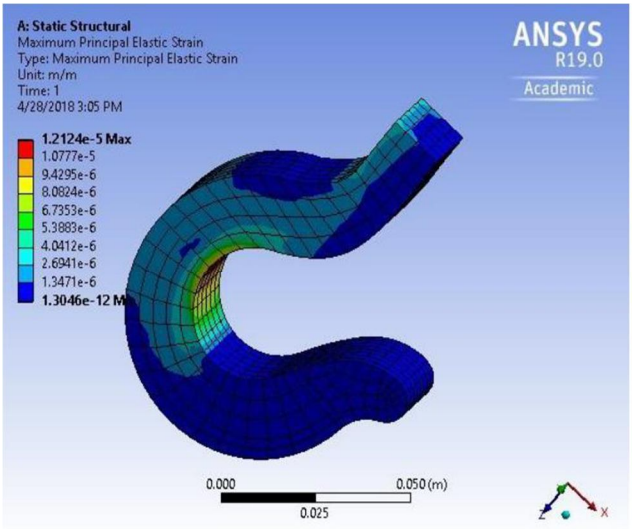
Minimum Principal Elastic Strain



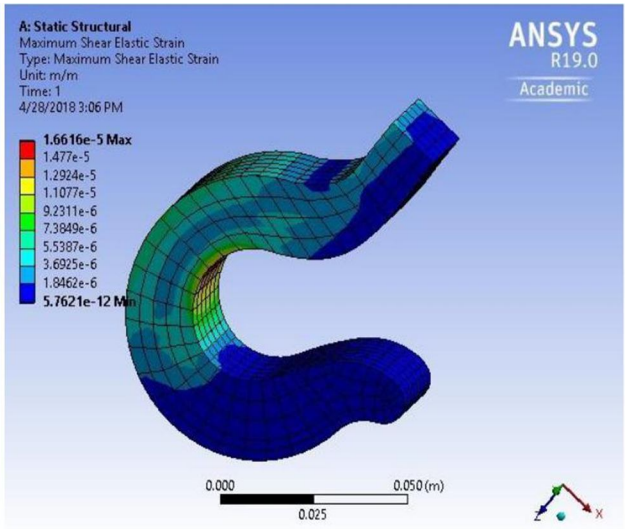
Middle Principal Elastic Strain



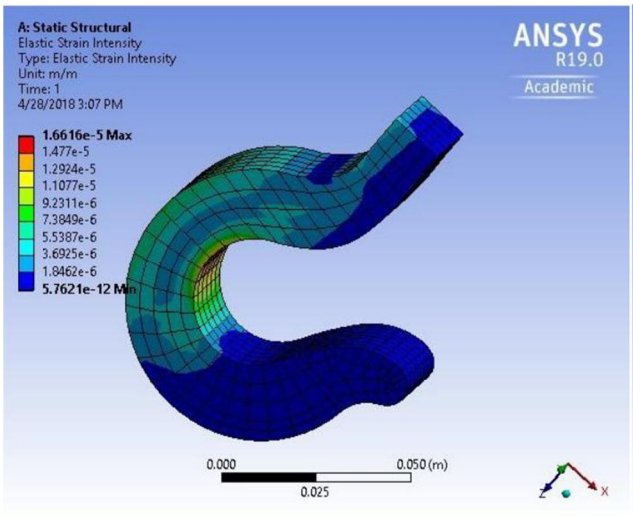
Maximum Principal Elastic Strain



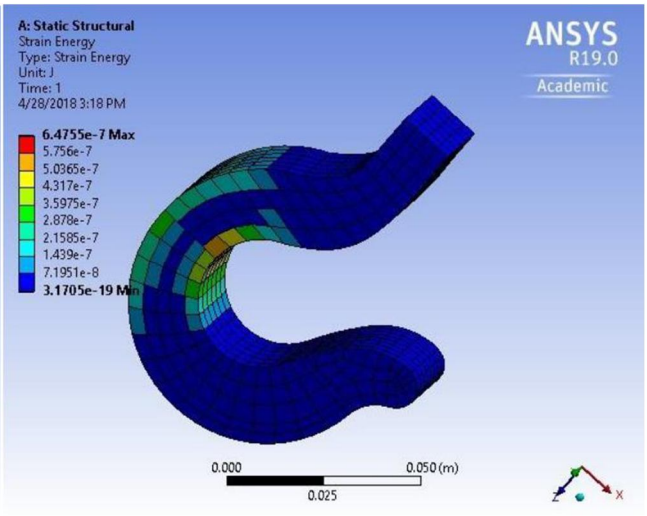
Maximum Shear Elastic Strain



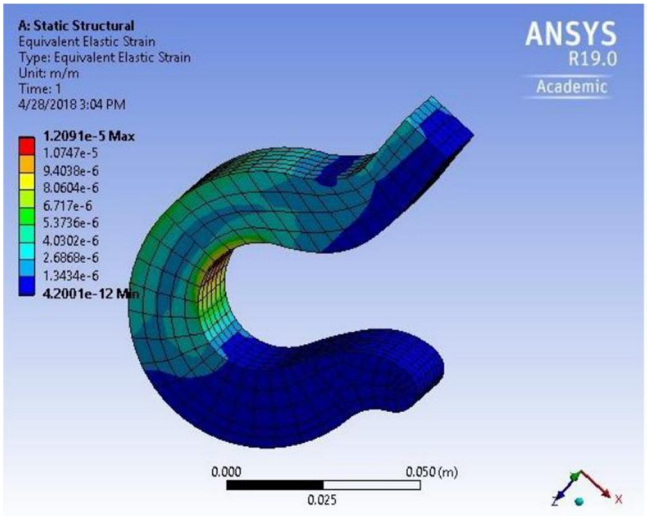
Elastic Strain Intensity



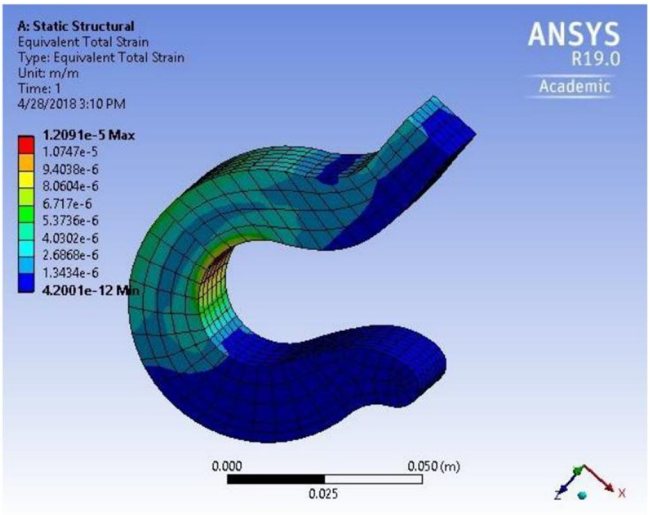
Strain Energy



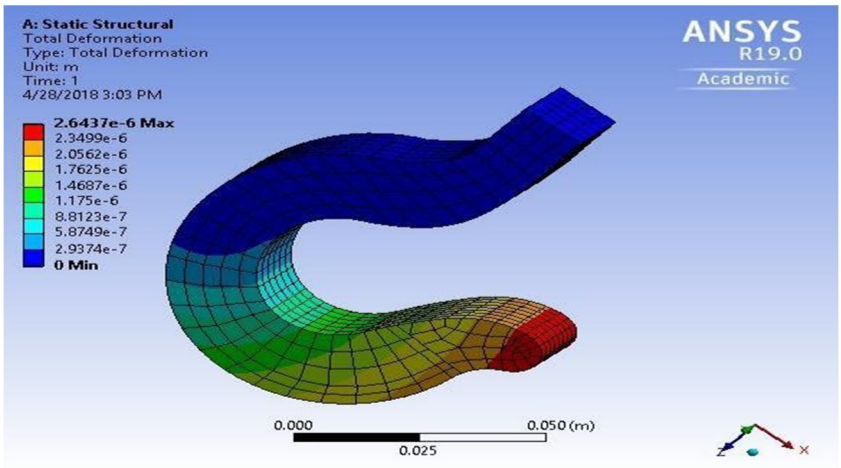
Equivalent Elastic Strain



Equivalent Total Strain



Total Deformation



III. RESULTS & CONCLUSIONS

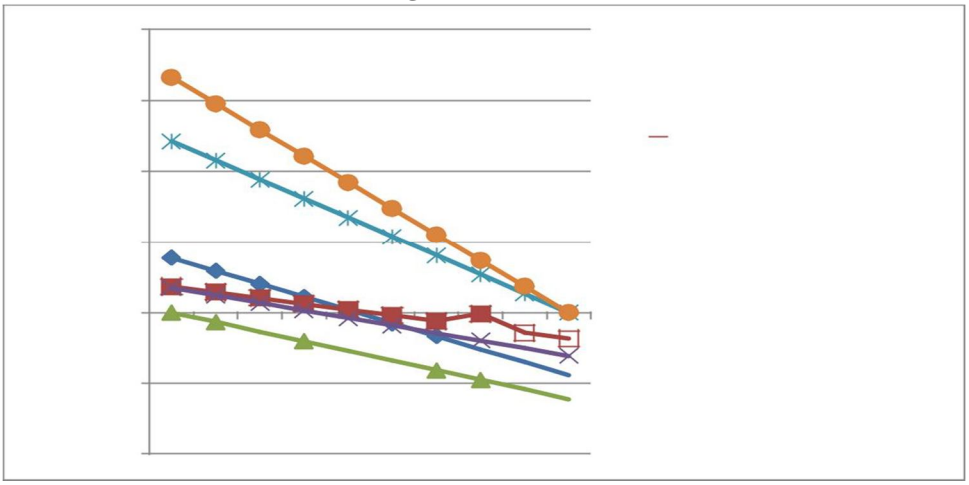
TABLE-1

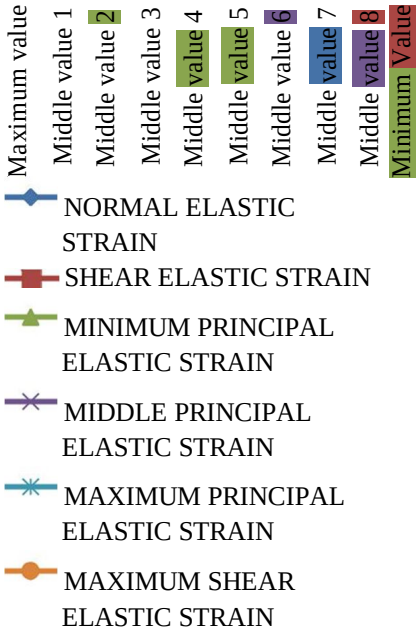
S.NO.	NORMAL ELASTIC STRAIN	SHEAR ELASTIC STRAIN	MINIMUM PRINCIPAL ELASTIC STRAIN	MIDDLE PRINCIPAL ELASTIC STRAIN	MAXIMUM PRINCIPAL ELASTIC STRAIN	MAXIMUM SHEAR ELASTIC STRAIN
1.	3.8643e-6	1.8353e-6	4.7487e-9	1.7456e-6	1.2124e-5	1.6616e-5
2.	2.9419e-6	1.4275e-6	-6.7523e-7	1.2124e-6	1.0777e-5	1.477e-5
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





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

I am thankful to Mr. Sandeep Jain(Guide) and Mr. Ashish Manoria for their support and guidance in completion of this project. I am also thankful to all the authors who worked on Crane Hook System.

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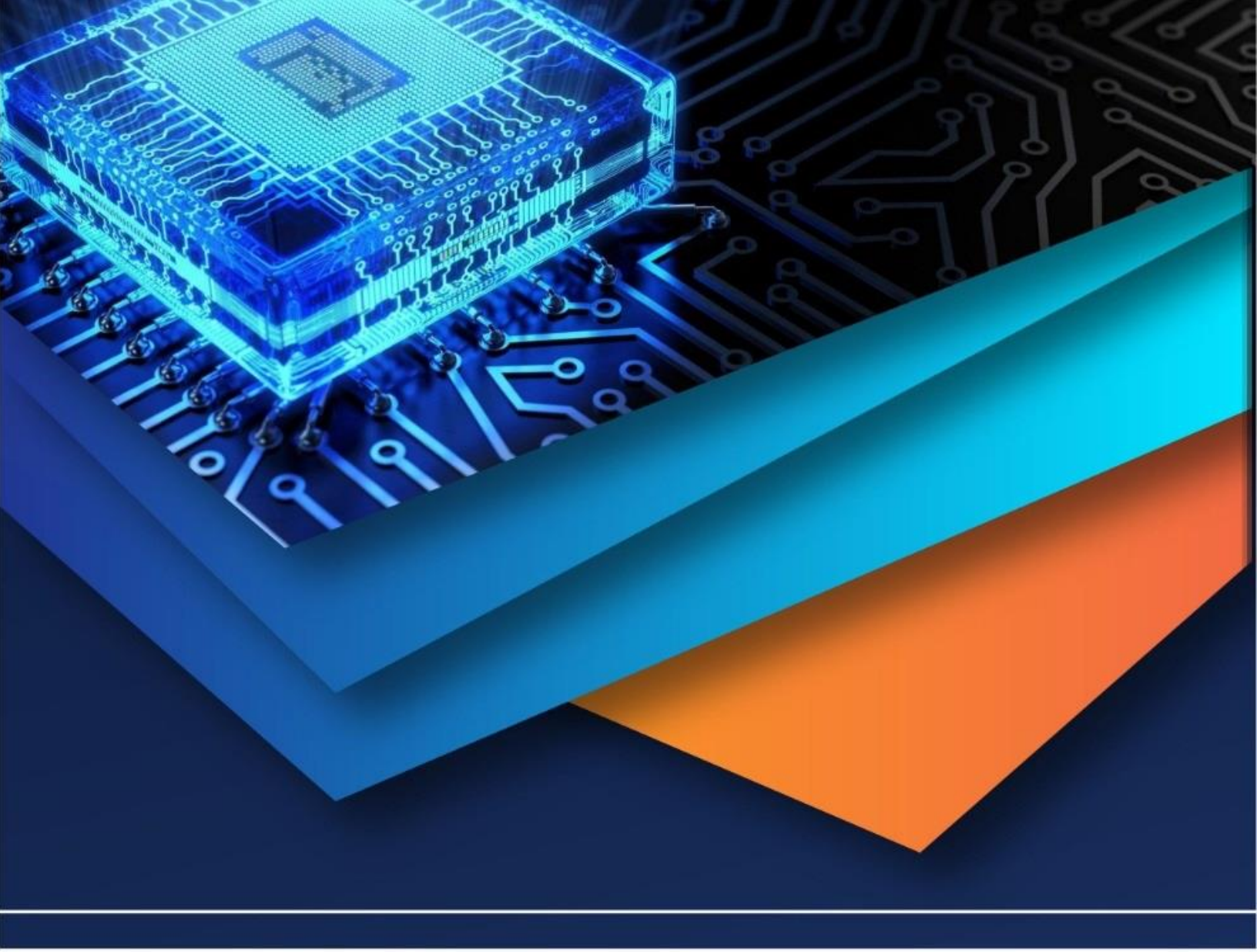

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