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"Comparative structural Analysis of Acme and Square Thread Screw jack''

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Abstract: ***A screw jack is a device used to lift the vehicle above the ground level in order to ease repairs. A power screw is designed to translate radial motion to linear motion. Many users are familiar with manually operated car jack which still included as standard equipment in cars. A car jack is an important device in vehicle to change flat tire in our journey. Every year near about 160 injuries are associated with car jacks. The correct use of jacks can prevent the accidents and injuries. Improvement in Design of car jack is really important to make the tool more efficient and user friendly with high safety features. The objectives of this project work is to critically analyze and compare between ACME and SQUARE threads from stress and strain perspective in order to improve the performance from safety and durability point of view for developments in the field of thread design. In this project selection of two different types of screw threads namely Square and Acme threads are considered. The square threads are named after their square geometry. They are the most efficient power screw, but also the most difficult to machine as compared to Acme and Buttress thread, thus most expensive. The Acme threads are machining with multipoint cutting tool on thread milling machine, it is an economical operation. Acme threads have more thickness at core diameter than of Square threads therefore a screw with Acme threads is stronger than equivalent screw with Square threads. Assumptions made in designing a Power screw are the total load is distributed among the threads i.e. of car jack of capacity 1.5 to 3 tones threads are in direct shear, various stresses in screw like tensile or compressive in the body of the screw due to an axial load. Thus, the different type of screw threads is designed as per the dimensions, experimental calculations and analyzed using Abaqus FEA software. Model developed is validated using experimental and analysis calculation.***

I. INTRODUCTION

A. Screw Jack

A screw jack is a mechanical utility consisting of a screw mechanism used to lift or lower down the load. The principle upon this jack works is alike as of an inclined plane. Basically there are two main types of jacks-hydraulic & mechanical. A hydraulic jack deals with cylinder and piston mechanism. To raise or lower the load the movement of piston is responsible. Mechanical jacks are either hand operated or driven by power. Jacks are used normally in lifting cars so that a tire can be changed. A screw jack is mostly used in cars but also used in many other ways, including industrial machinery & even airplanes. They may be short, may be tall, fat, or thin depending on the amount of pressure they will be under and the area or the space which they need to fit into. The jack is manufactured by various types of metal, screw jacks are designed purposely for lifting or lowering loads, they are not designed or ideal for side loads, though few can withstand side loads it's all depend upon the diameter and size of the lifting screw. The Shock loads must also be minimized. Few screw jacks are built or designed with anti-backlash. The anti-backlash mechanism moderates axial backlash in the lifting Nut and Screw assembly to a regulated minimum. To have the good efficiency of the screw jack, it should be used in ambient temperatures, or else lubricants must be applied at required place. Oil lubricants purpose is to enhance the capability of equipment's. To optimize the usefulness of screw jack it is advised to employ it according to the designers or manufactures instruction

Power screw is an essential component of screw jack. It is a tool to lift and lower the load of materials / goods. There is a lot of research and developments has been done related to the improvement of the design of Power Screws as well as different types of thread analysis of screw jack. To enhance the performance of the power screw, it is required to modify screw jack design and make it to reduce the effort requirement to operate screw jack equipment. Objective of design the Power screws is to minimize the amount of effort needed by the user for lifting and lowering mechanism.

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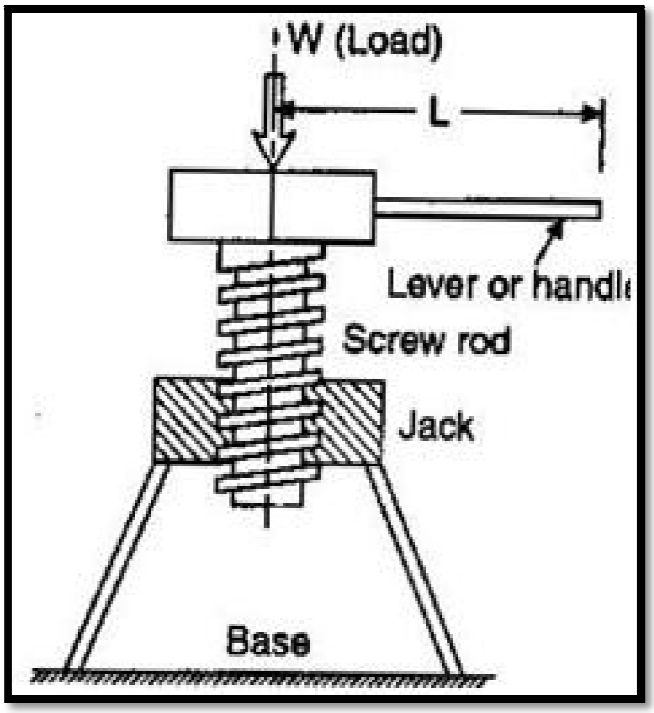


Figure 1.1: Simple Screw Jack [12]

An advantage of screw jack over some other types of jack is that they are self-locking in nature that means when the rotational force removed, it will remain motionless where it was left and its motion will not rotate backwards, irrespective of how much weight it is going to support.

B. Car Jack

A car jack is mechanical utility used for raising or lowering heavy loads. Jacks make use of a screw thread or hydraulic cylinder for applying very high forces. The Car jacks mostly do use of mechanical advantage to ease the work of human being to lift any medium segment vehicle by human effort alone. More powerful jacks make use of hydraulic power energy for providing more lift for greater distance. By making use of the Mechanical Advantage a mechanism multiplies the force or torque applied to it. Many people are in familiar with basic auto jack which still consider as standard equipment in many vehicle. People who are required to rotate the tires of their vehicle themselves or the people who required to install snow tires before the winter and remove them in the spring need to use a jack to perform the job.

C. Related Work

1) *Thrugnanam, Amit Kumar &Lenin Rakesh (2014)* [1]*:* -This paper studies design and analysis of screw jack using Pro-E and ANSYS under torque and compressive force as loads, in this analysis determines shear stress induced at the cross section square thread under bearing pressure. Objective of this paper is to study shear stress state of power screw have been considered following design values, Pitch = 6, *Dc* = minor diameter = 30 mm, *Do* = major diameter = *dc* + pitch = 30 + 6 = 36 mm, with the help of this The power screw is designed according to the design process and analyzed using ANSYS software. Model developed is to be validated using theoretical calculations.
2) *Patil Manoj,Nilesh & Udgirkar Gaurav (2014)* [2]*:*-This paper deals changing tire effort requirements and that comfort of women in the automobile 4 wheeler vehicles. Women requires more effort in the changing tires by using existing manual screw jack. This project concluded that less effort is applied with motor attachment In the modified design, the power screw is rotated through its gear power transmission using electrical power flows through it. Scope of this project is Performance enhancement need to be developed
3) *Egwero Oghenekome,Oladimeji Tolulolope (2014)* [3]**:-** This paper involve designing system and also building a unit which could be used to raise up, any car as controlled by receiver and transmitter. Microcontroller control the receiver circuit. It also consists of designing of an infra-red transmitter circuit which can transmit coded frequency. Scope of this project is to develop the controller to operate screw jack & enhance performance and at the same time minimize the cost of screw jack system development.

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4) *Gaurav Shashikant Udgirkar (2014)* [4]*:* -Described in their paper, emergency like tire puncher, is a problem mainly we see in cars. Traditional car jacks use mechanical advantage to allow a man to raise up vehicle by manual effort. In this work they used electrically operated Toggle jack using power of car battery. Lifting power increased by the gear ratio. Significance and purpose of this work is modifying existing car jack so that operation can be easier, safe & reliable so that it can save individual's energy & minimize health risks and problems associated with doing work in a bent or squatting position for long time of period. Car jack developed using software CATIA &is being analyzed by making use of FEA for checking safety factor & force acting.
5) *Sonu Yadav (2014)* [5]*:* -As per this research paper, discussed solar power operated screw jack and cost incurred, operating, making cost is high They used external battery power operating on solar energy, The solar driven automated toggle screw jack is put under various force analysis so that its performance criterion will not fail in operation. Conclusion are determined through the appropriate calculations and practical demonstrations: A mathematical model was framed to estimate the power requirement at various loading conditions. The model worked effectively in wide range of loading condition.

II. RESEARCH AND METHODOLOGY

The performance of power screw investigation to carry out simulation technic and validated by manual calculations

A. Simulation technique

Finite element analysis method is less expensive, quick and flexible than experimental methods hence it is to be carried out to predict the deformation and exact areas of deformation before laboratory testing. FEA is to be done in 3 major steps with the help of their respective software's they are:

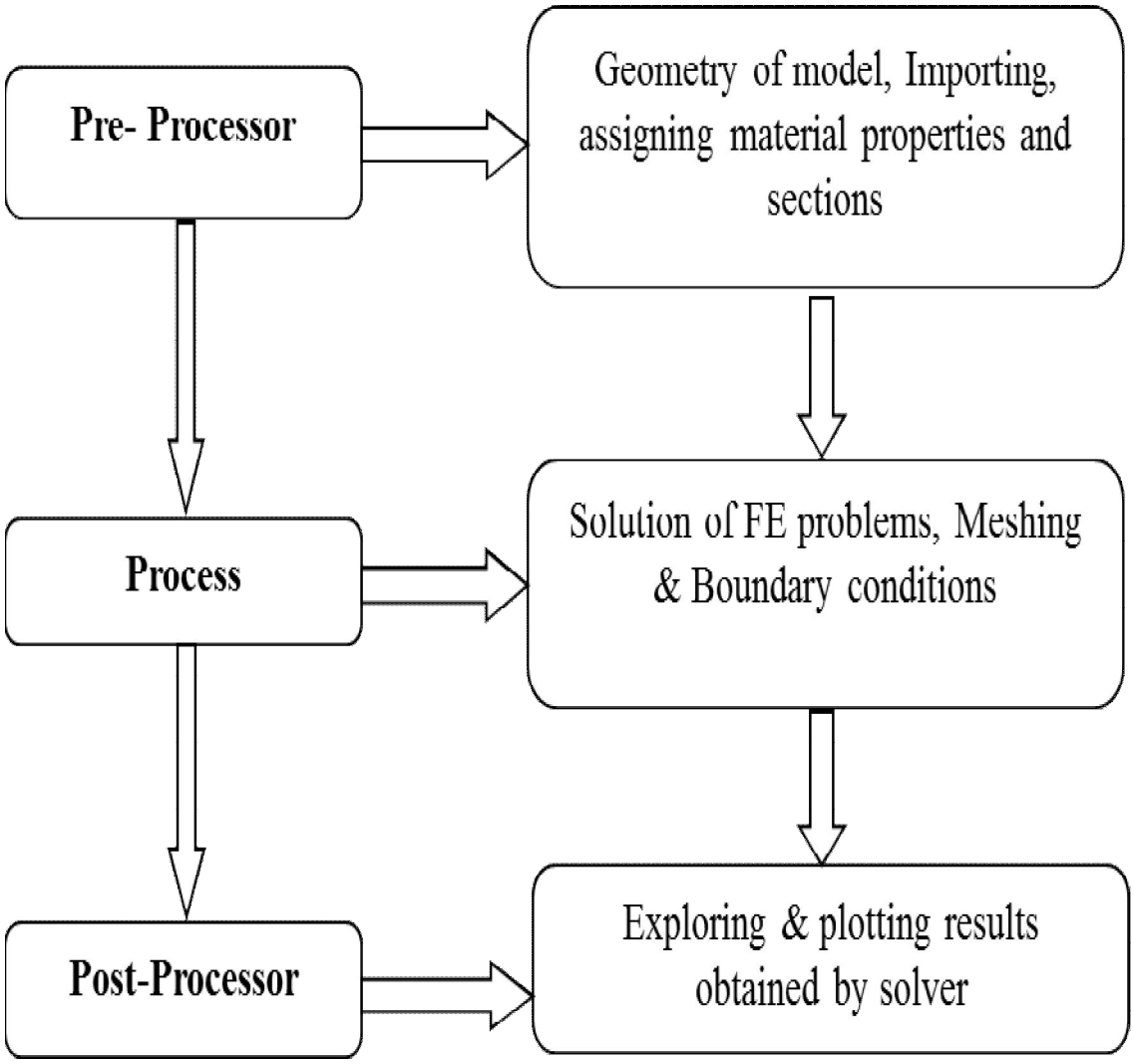


Figure: Typical Finite element analysis procedure

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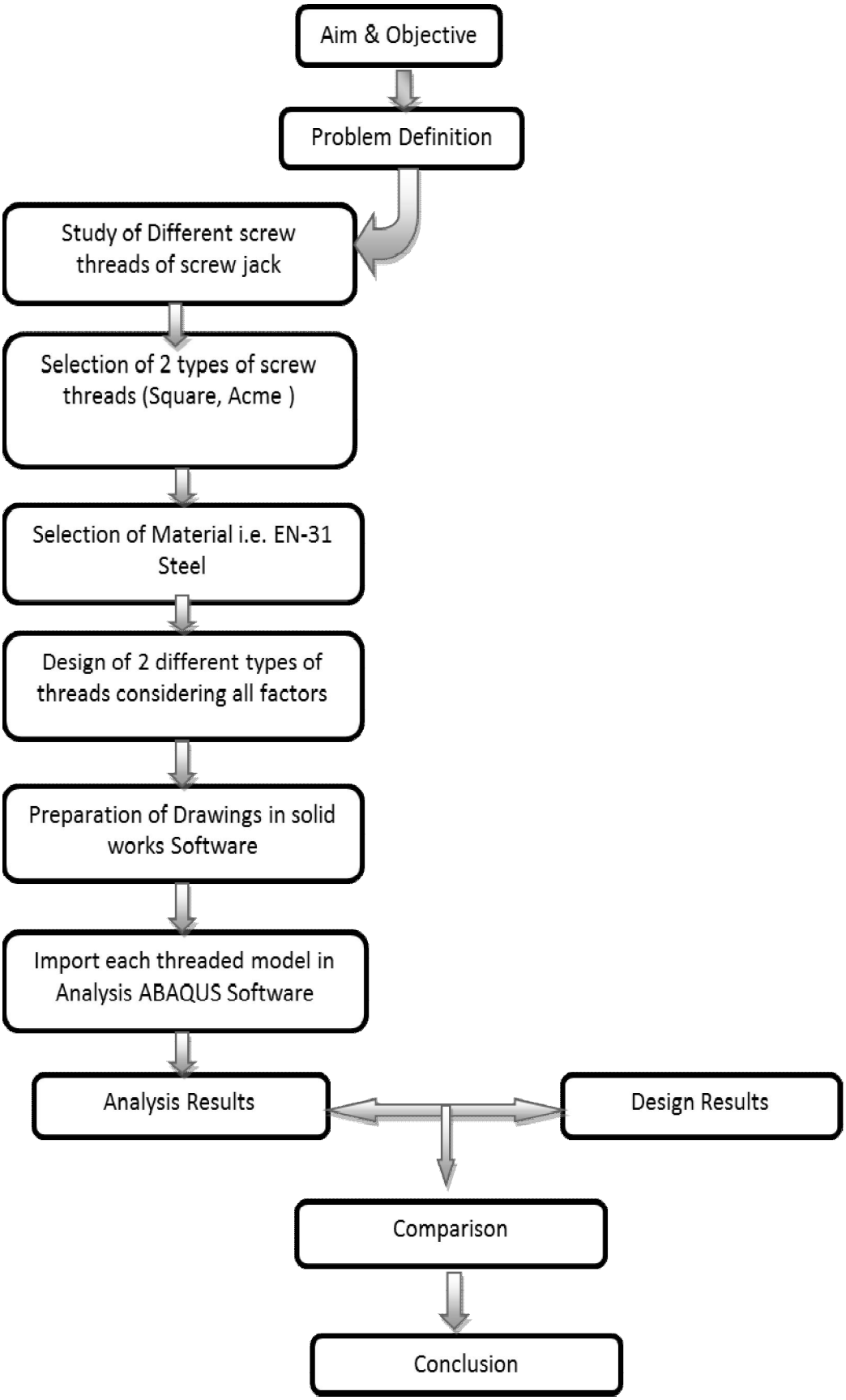


Fig: block diagram of research methodology and flow of work

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III. CONCLUSION

Comparison of square and acme thread by different stress & strain parameters

Table-7.1 Comparison of square and acme thread

Parameter	Square	Acme
Von misses stress	124Mpa	180Mpa
Max.displacement	$8.30*10^{-2}$ m	$8.02*10^{-2}$ m
Max, Principal stress	274Mpa	264Mpa
Min Principal stress	127Mpa	187Mpa

A. From this comparison we can deduce following Conclusion

1) If cycle of operation is more for screw jack then Acme thread is to be used though Max. von misses stress more for acme thread, for analysis is to be safe. For fatigue point of view Acme threads are preferred

2) if fatigue is not a problem then square threads are recommended

3) on an average max displacement for square thread is always more than Acme thread for same load

4) If tolerance is not an issue and length is of no concern square thread should be recommended

5) Average minimum Principal stress for square thread is always less than that of Acme thread so stress fluctuation and positioning fluctuation are always more for square thread

6) If we need same stress level square thread will be least weight as compared to acme thread hence design will be conservative of square thread which will be comfortable to ladies

7) Sudden failures chances of square thread are higher so in risky or corrosive environment square thread should not be recommended & design modification required in future

IV. FUTURE SCOPE

The screw jack can be studied for desired fatigue analysis; Use of composite material for screw jack and see the effects. FEMFAT analysis of screw jack will be targeted in future. Manufacturing of the screw jack with ACME threads is on the cards now. Plan is to use Optistruct for more detailed analysis of screw jack. Real time dynamic testing is also on the cards.

REFERENCES

[1] Thirugnanam et.al.(2014) "Analysis of Power Screw Using 'Ansys' Middle-East Journal of Scientific Research 20 (7), ISSN 1990-9233, IDOSI Publications, (2014), 868-870.

[2] Manoj R Patil and S D Kachave (2015) "Design and analysis of scissor jack "International Journal of Mechanical Engineering and Robotics Research India. ISSN 2278 – 0149 Vol. 4, No.1, January 2015 © 2015 IJMERR.

[3] Egwero Oghenekome,Oladimeji Tolulolope(2014) "Design and implementation of remote controlled car jack ''Science Q journal'' vol-1, Issue 1.

[4] Gaurav Shashikant Udgirkar et.al. (2014) "Design, Development and analysis of electrically operated toggle jack using power of car battery" ISSN (e): 2250 – 3005 || Vol, 04 || Issue, 7 || July – 2014 || International Journal of Computational Engineering Research (IJCER)

[5] Sonu Yadav (2014) IJSRD – "Effect of Lifting Load on Solar Powered Screw Jack Design In Automotive Vehicles" International Journal for Scientific Research & Development| Vol. 2, Issue 10, 2014 | ISSN (online): 2321-0613

[6] Prashant Kumar Srivastav, et al (2014), —" Analysis of Highly efficient motorized screw jack‖'', —International Journal of Computational Engineering Research| Vol,03, Issue 5, pp 35-41 | ISSN (online): 2451-0820

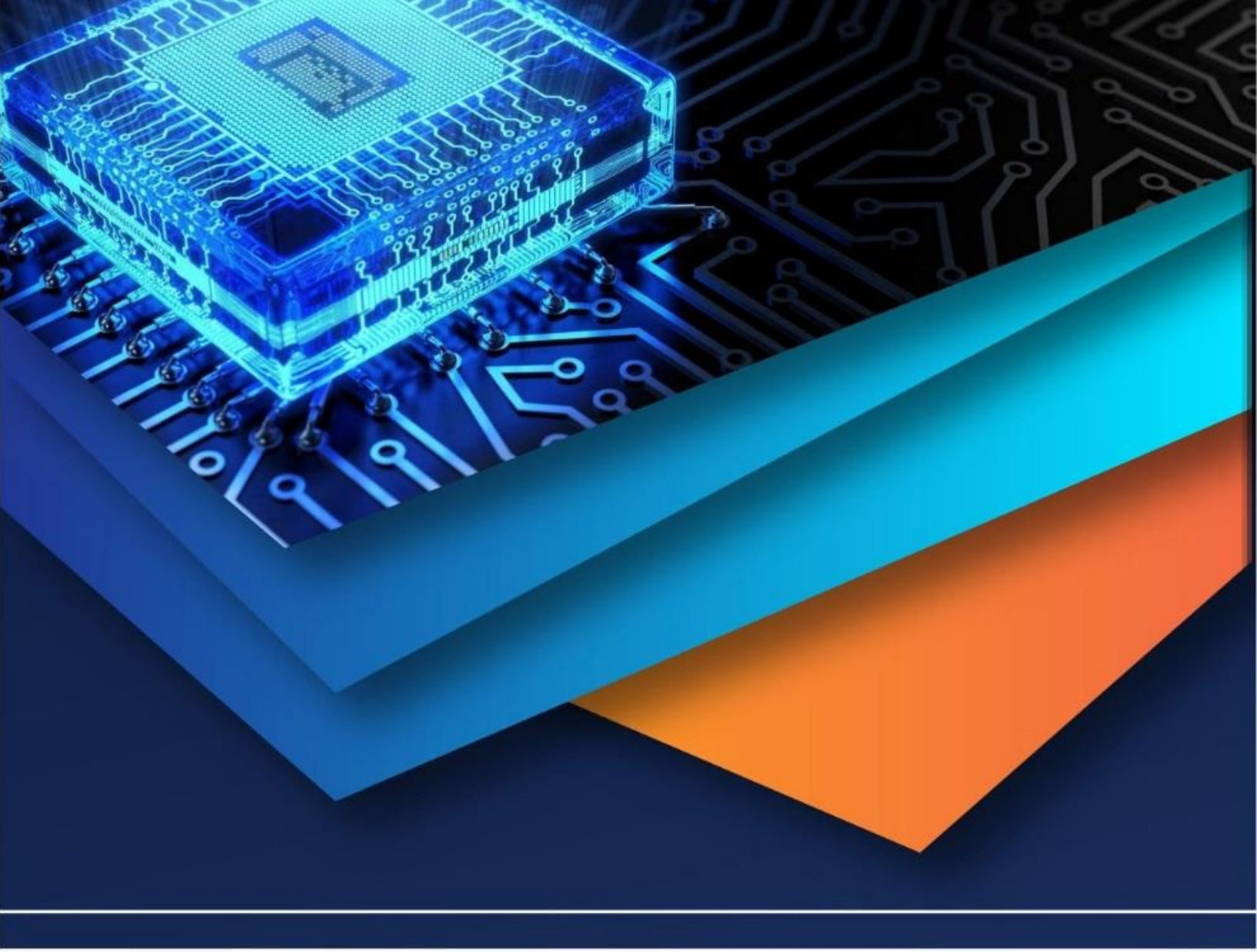
[7] Nitinchandra R. Patel et.al. (2013), "Design of Toggle Jack Considering Material Selection Of Scerw - Nutcombination" International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 5, (2013).

[8] Tarachand G. Lokhande et.al. (2012) "Optimizing Efficiency of Square Threaded Mechanical Screw Jack by Varying Helix Angle" International Journal of Modern Engineering Research (IJMER) Vol.2, Issue.1, Jan-Feb 2012 pp-504-508 ISSN: 2249-6645

[9] Pandya J Milan ,Bhatt jaydeep(2005) :-"Design and Analysis of an Arial scissor lift" journal of information, knowledge and research in mechanical engineering issn 0975 – 668x| nov 12 to oct 13 | volume – 02, issue - 02

[10] M.M. Noor et.al (2010) "Analysis Of Auto Car Jack", National Conference in Mechanical Engineering Research and Postgraduate Students 26-27 may 2010, FKM Conference Hall, UMP, Kuantan, Pahang, Malaysia, (2010) , 198-203.

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