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Studies on Structural Analysis of Automotive Door Using Conventional, Present and Proposed Materials

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Abstract: In this work the explicit structural Finite Element Analysis of automotive door of a vehicle is carried out by considering Conventional Galvanized iron material, Present Aluminium material and Proposed PEEK and Carbon 10% with Polypropylene 90% composite. The main objective of the work is to develop a suitable model of car door for TATA Indica V2 car; to conduct a explicit dynamic structural analysis (stress and displacement analysis) of car door by finite element method, to compare the performance of Conventional, Present and Proposed material. The door for TATA Indica V2 vehicle was used to develop the geometric model of the door by SOLID EDGE V.15 modelling software. This 3-D geometric model was imported to ANSYS Workbench 18.0/12.0. The explicit dynamic structural FEA was done after assigning speed and boundary conditions. The equivalent stress and the displacement are noted and investigated to compare with three different beam material such as Stainless steel beam, Stainless steel Bike handle and concrete beam.

***Keywords*; Peek, Carbon reinforced polypropylene composite, Stainless Steel bike handle as (Beam), Concrete beam, Stainless Steel beam.**

I. INTRODUCTION

Automotives play an important role in the transportation of people both individual and in groups, as well as goods. Large-scale manufacture of these automobiles, operation of the transportation (road) network system, and construction of the required infrastructure has dominant impacts on economic growth of the country There exists a substantial need for fabricated materials in this entire sector. Continuous efforts are on developing newer or alternative materials to achieve cost effectiveness, fuel efficiency, reduced emissions, increased safety, and always with a target on future ability to recycle or biodegrade. However, today's rising cost of fuel is a major factor in the move to utilize composites for all transport vehicles, and thereby to achieve a lightweight construction with an ultimate goal of reduction in fuel consumption and emissions. Side impacts are one of the awfully hazardous crashes causing death and injuries annually around the word. Many of these injuries occur when one car runs into the side of another or into a fixed narrow object such as a trees lamp posts, or poles. Over the last few decades, critical steps have been taken that increase vehicle occupant safety for frontal impacts: mandatory driver and front-passenger airbags; improved front and rear crumple zones; improved headrest designs; gas tank redesigns; mandatory seat-belt laws; mandatory under ride beams on commercial trucks, and so on. Unfortunately, they do not provide similar protection for side-impact collisions. A good structure behaviour is necessary to absorb most of the kinetic energy. Automotive vehicle door is a type of door, typically hinged, but sometimes attached by other mechanisms such as tracks, in front of an opening which is used for entering and exiting a vehicle. A vehicle door can be opened to provide access to the opening, or closed to secure it. These doors can be opened manually, or powered electronically. Powered doors are usually found on minivans, high-end cars, or modified cars.

A. Carbon Fiber Reinforced Polypropylene Composite

Addition of reinforcement materials like carbon fibers with an organic compound like maleic anhydride improves the strength of polypropylene. The improvement in mechanical properties of pure polypropylene by introducing small percentages of carbon fibers. Compositions of 2, 4, 6 and 8 percent of carbon fiber and 1 percent of maleic anhydride were added to pure polypropylene. It was observed that increasing the carbon fiber content increased the strength of pure polypropylene. The composite can find its applications in battery housings, automotive parts requiring high impact and bending strength etc.

B. Thermoplastics

Thermoplastics are simplest atomic structure, with artificially free macro molecules. The advantages of using thermoplastic composites include short cycle times, quick installation, recyclability, weldability and elimination of freezer storage. PEEK is a

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colourless organic thermoplastic polymer in the polyaryletherketone (PAEK) family, used in engineering applications. and is characterized by excellent mechanical properties to high temperatures. And it has following Properties like High mechanical force (strength),High working temperature about 260 degree Celsius, High stiff, High creep stability during high temperature operation, Good sliding property, High abrasion resistance and high dimensional strength, conflict hydrolysis

II. METHODOLOGY

Physical Measurement of automotive door

⇩

2D-Modelling of door using solid edge V.15 software

⇩

3D-Modelling of door by solid edge V.15 software

⇩

Import 3D-modelling to ANSYS work bench.18/12

⇩

Apply door and beam materials

⇩

Apply boundary condition (beam as fixed support)

⇩

Various Speed condition applied to door

⇩

Carry the analysis and obtained Von-misses stress and

III. PROPERTIES OF MATERIALS USED

SL NO	DOOR MATERIALS	DENSITY IN Kg/m3	YOUNGS MODULUS IN GPA	POISSONS RATIO
1.	GALVONIZED IRON	1362	6-7	0.3
2.	STAINLESS STEEL	1450	35	0.221
3.	ALUMINIUM ALLOY	1720	4-6	0.33
4.	PEEK	1320	3.6	0.377
5.	CARBON 10% & POLYPROPYLENE 90 % COMPOSITE	1221	84.61	0.385

Table1: Properties of the materials

IV. GEOMETRICAL MODELING OF AUTOMOTIVE CAR DOOR

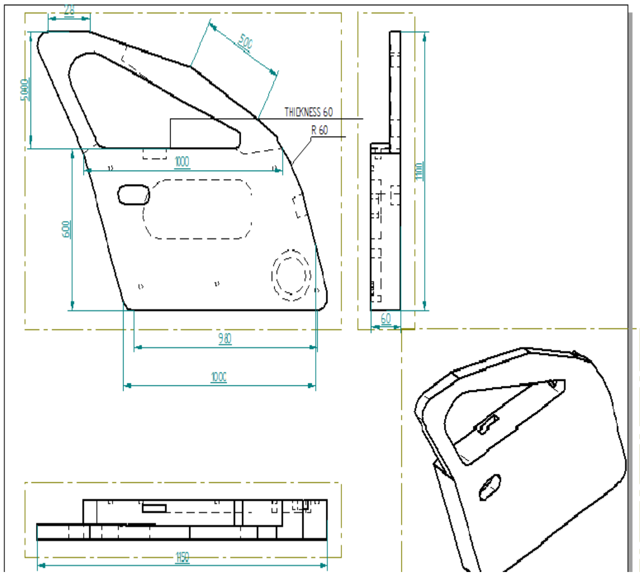

Fig 1: 2-D Diagram of automotive car door

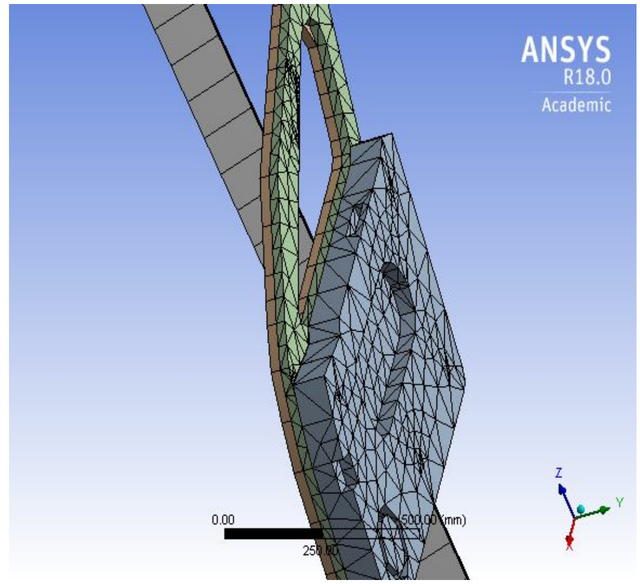

Fig 2: Meshed model

V. DATA INPUT AND ANALYSIS

A. *Analysis of Automotive car door with aluminium alloy door with SS beam*

1) Maximum Von-misses stress and displacement for 30 m/s speed condition:

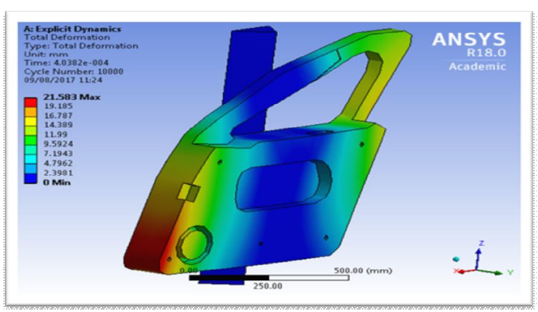

Fig: 3: Total Displacement condition

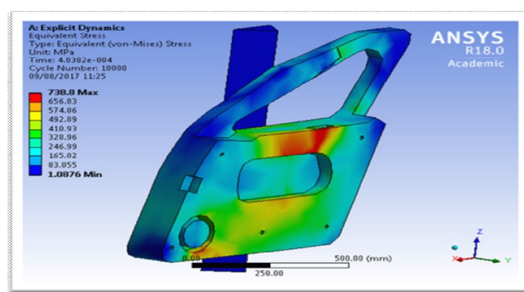

Fig: 4: Von-misses stress

2) Maximum Von-misses stress and displacement for 90 m/s speed condition:

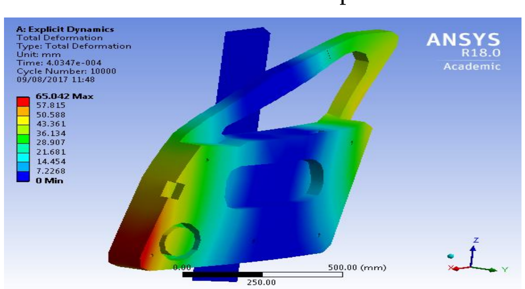

Fig: 5: Total Displacement condition

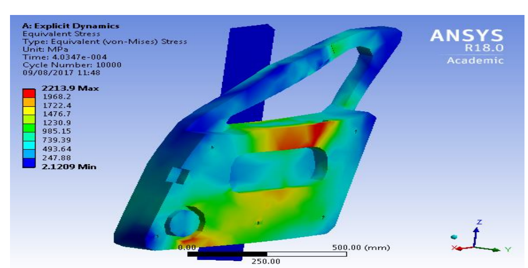

Fig: 6: Von-misses stress

B. *Analysis of Automotive car door with PEEK and SS Beam*

1) Maximum Von-misses stress and displacement for 30 m/s speed condition

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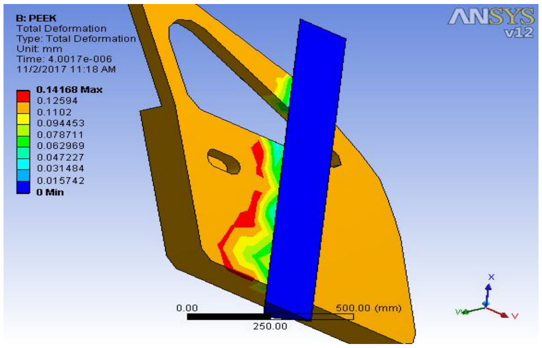

Fig: 7: Total Displacement condition

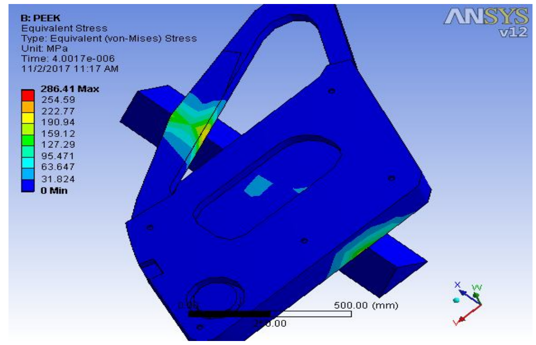

Fig: 8: Von-misses stress

2) Maximum Von-misses stress and displacement for 90 m/s speed condition

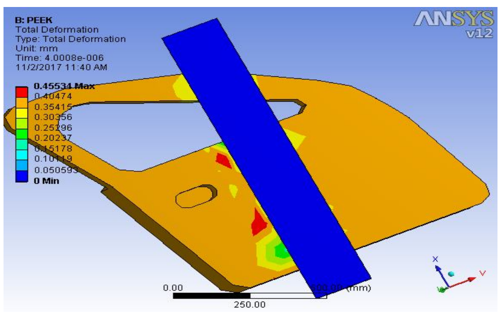

Fig: 9: Total Displacement condition

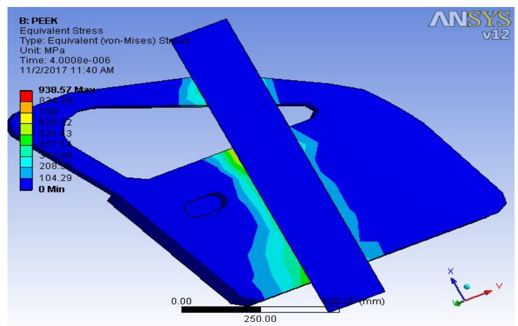

Fig: 10: Von-misses stress

VI. RESULT TABLE

Sl.No	Door Material	Speed Condition	Different beam material used					
			SS Beam		SS Bike Handle		Concrete beam	
			Max stress(Mpa)	TD (mm)	Max stress(Mpa)	TD (mm)	Max stress(Mpa)	TD (mm)
1	G.I	30	2175.7	3.51	2190.3	0.65	1842.6	14.78
		90	6492.1	10.53	6572.1	1.96	5830.5	44.72
2	Al-Alloy	30	738.8	21.58	2220	0.83	167.57	21.26
		90	2214	65.04	6372.6	2.09	422.54	26.56
3	PEEK	30	286.4	0.14	1451	0.03	210.5	0.13
		90	938.57	0.45	1514.4	0.098	534.15	0.4
4	Carbon+ polypropylene	30	1064	0.12	585.02	0.013	773.31	0.12
		90	3108	0.39	2586.1	0.021	1852.5	0.37

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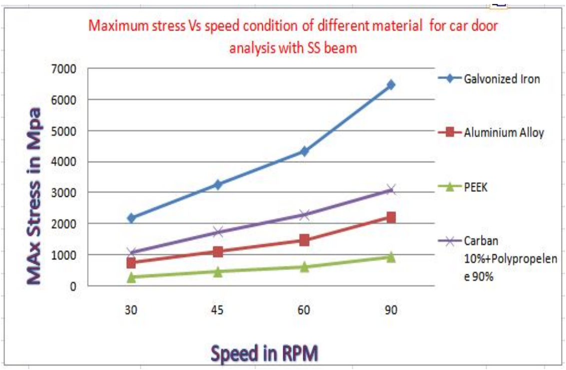
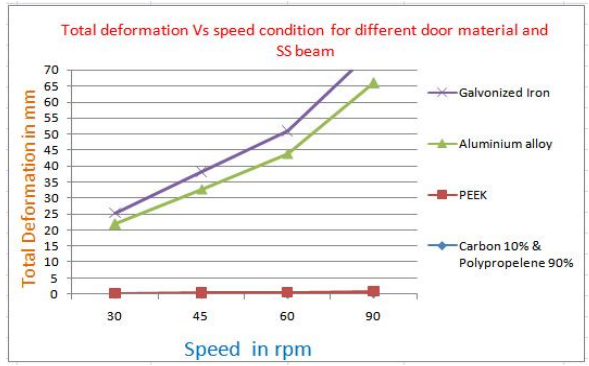
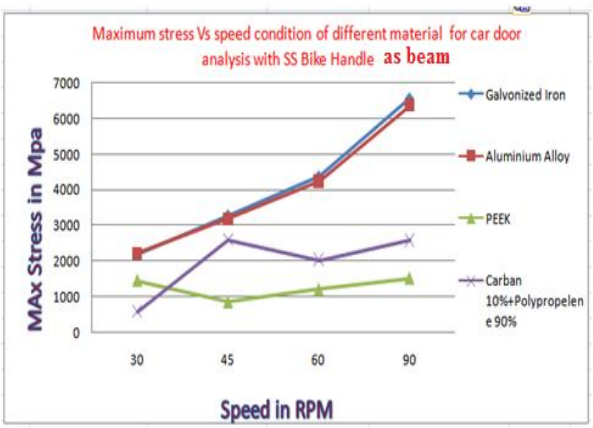
A. Graphical Results



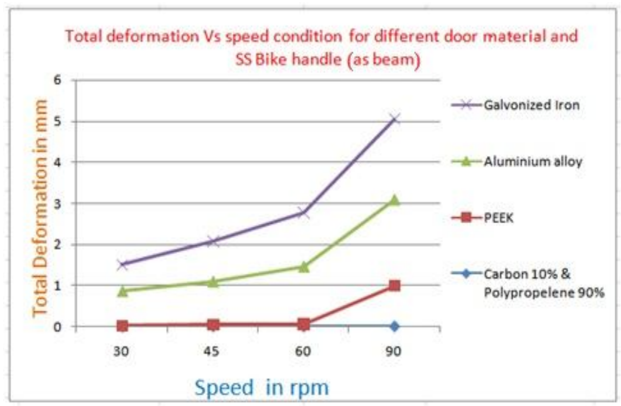
Graph 1. Stress Vs Speed condition for SS beam



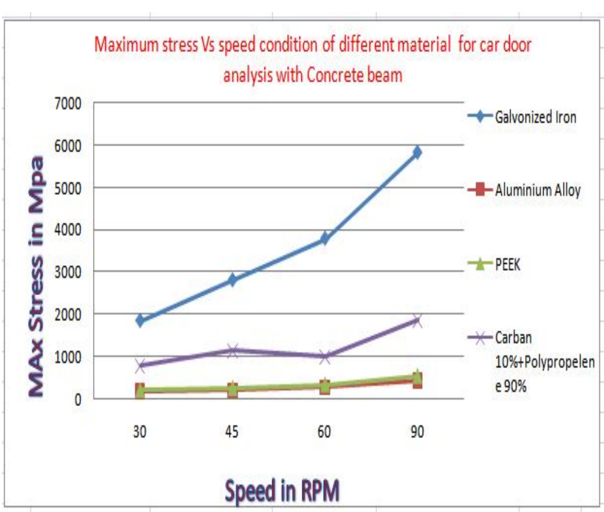
Graph 2. Total deformations Vs Speed condition for SS beam



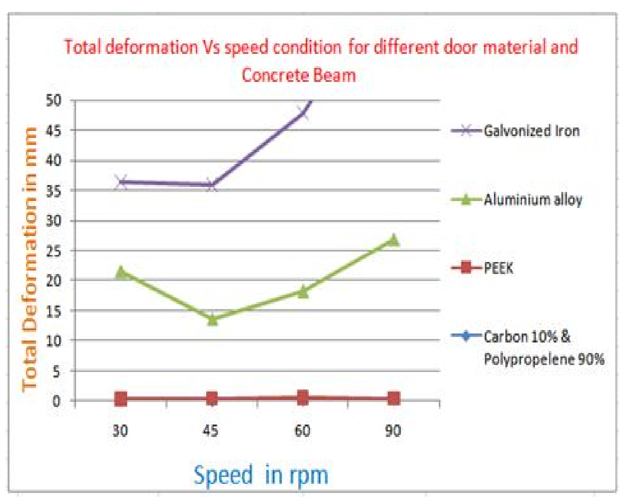
Graph 3. Stress Vs Speed condition for SS Bike handle



Graph 4. Total deformations Vs Speed condition for SS bike handle (as beam)



Graph 3. Stress Vs Speed condition for SS Bike handle



Graph 4. Total deformations Vs Speed condition for SS bike handle (as

VII. CONCLUSION

The present work deals with structural analysis of automotive door for TATA Indica V2 vehicle subjected to explicit dynamic analysis of car door. The analysis shows the stress and Total deformation of car door when subjected to a given speed condition and it also enhances the crashworthiness against different beam materials. Based on the structural analysis of automotive door, we can conclude that our proposed PEEK material provides better stress properties and total deformation properties than compared to Existing materials such as galvanized iron and aluminium alloys which are used for automotive door of vehicles.

REFERENCES

[1] Mr. Sandeep Bundele & Dr. Rupa S. Bindu; "Automotive Door Design and Structural Optimization of Front Door for Commercial Vehicle with ULSAB Concept for Cost and Weight Reduction"; Global Journal of Researches in Engineering (Automotive Engineering); Volume 12 Issue 2 Version 1.0 (2012)

[2] O.M. Terciu, I. Curtu, C. Cerbu; "FEM modeling of an automotive door trim panel made of lignocelluloses composites in order to determine the stresses and displacements in case of a door slam simulation"; The 4th International Conference of Advanced Composite Materials Engineering, COMAT 2012, Brasov, Romania, (2012)

[3] M. Grujicic et.al.; "Multi-Disciplinary Design Optimization of a Composite Car Door for Structural Performance, NVH, Crashworthiness, Durability And Manufacturability"; International Center for Automotive Research, CU-ICAR Department of Mechanical Engineering Clemson University, USA; 2006

[4] Tan Wei, Wang Yan, Li Lingyang, Zhang Yu; "Design of the Vehicle Door Structure Based on Finite Element Method"; The 2nd International Conference on Computer Application and System Modeling; Wuhan, China (2012)

[5] Tawanda Mushiri, and Charles Mbohwa; "Design of a Vehicle Door Structure Based on Finite Element Method"; 6th International Conference on Mechanical, Production & Automobile Engineering (ICMPAE); Cape Town (South Africa); 2014

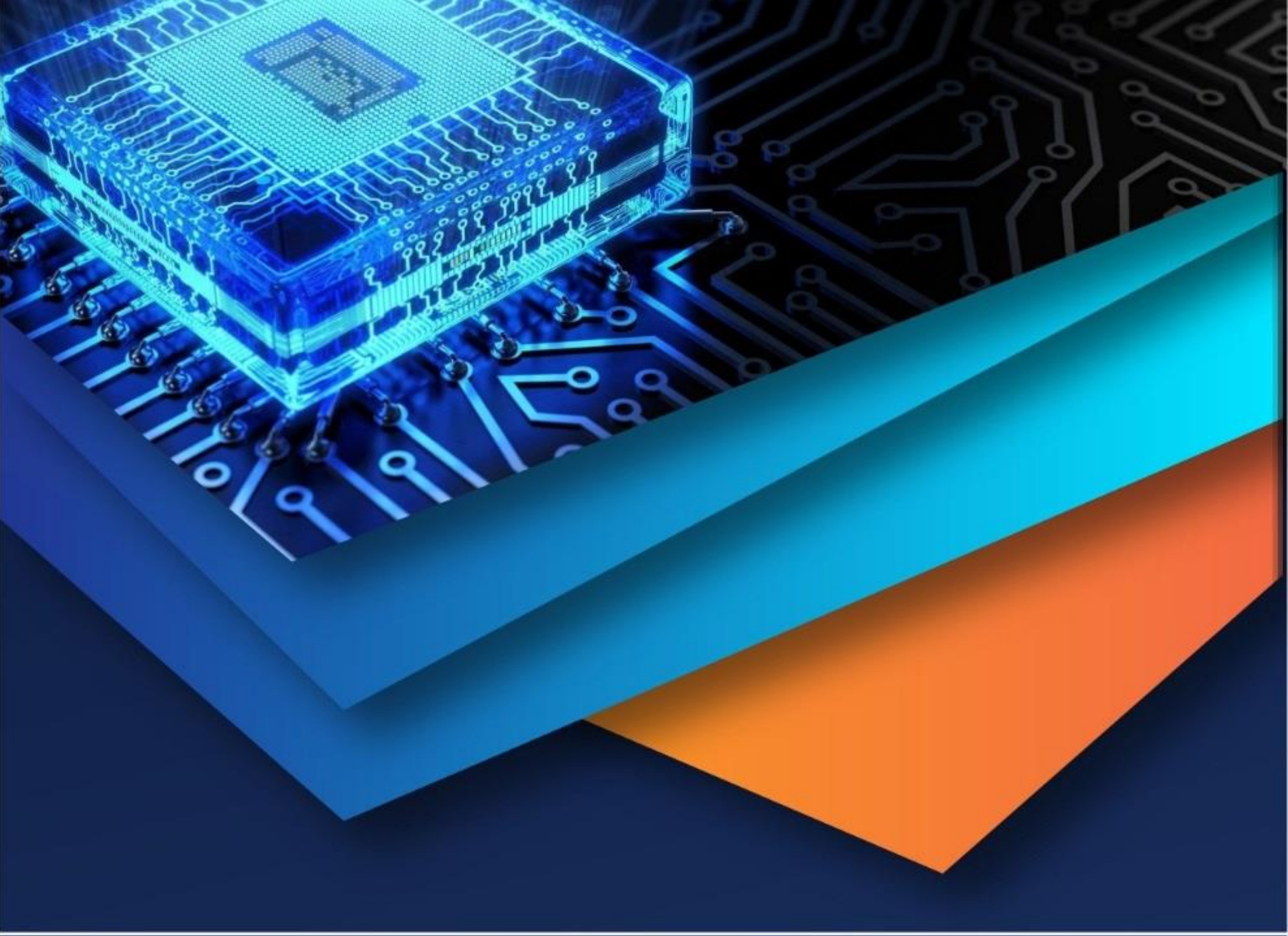
[6] Said Darwish, H. M. A. Hussein and Ahmad Gemeal; "Numerical Study of Automotive Doors" International Journal of Engineering and Technology IJET - IJENS Vol: 12 No: 04

[7] M. Raghuveer, Ganti Satya Prakash; "Design and Impact Analysis of a Car Door"; International Journal of Modern Engineering Research (IJMER); Vol. 4 Iss.9; 2014

[8] Mats Hörnlund and Alexander Papazoglu; "Analysis and Measurements of Vehicle Door Structural Dynamic Response"; Master's Dissertation; Lund University, Sweden; 2005

[9] Enrico Mangino, Joe Carruthers and Giuseppe Pitarresi; "The future use of structural composite materials in the automotive industry"; NewRail, School of Mechanical and Systems Engineering, University of Newcastle upon Tyne, NE1 7RU, UK

[10] Tsuyoshi Watanabe, Satoru Moritomi, Susumu Kanzaki, Polypropylene Compounds for Automotive Applications



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