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3D CAD Model of Multifunctional Seat Used in Military Vehicle

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Abstract: ***The primary postural strain experienced by the human body on extended off-road journeys is caused by the vibrations transmitted to the undercarriage and vehicle structure through the seat, as well as by the seating posture impacting the spine. The absorption of shocks and vibrations that happen during travel, linked to changes in speed and manoeuvres like braking, is crucial to minimizing vibrations. The effectiveness of vibration reduction relies heavily on the overall suspension system of the vehicle, particularly the design of the seats.***
Keywords: Comfort, vibration, and body pressure are important factors to consider when evaluating the quality of a product or experience.

I. INTRODUCTION

In recent times, the importance of seating systems in military vehicles cannot be emphasized enough. However, the existing designs often fail to meet the complex requirements and challenges faced by military personnel during missions. Conventional seats may lack adequate support for prolonged operations, fail to mitigate the effects of high-energy incidents or vibrations, or lack the necessary flexibility to adapt to various mission scenarios and user preferences.

The primary objective of this study is to evaluate and analyse multifunctional seats specifically tailored for military vehicle usage. It aims to explore the current landscape of military vehicle seating systems, identify key limitations, and highlight opportunities for improvement. The research will focus on developing innovative design concepts for multifunctional seats that offer both structural durability and adaptability to diverse operational needs. Advanced analysis techniques, such as finite element analysis (FEA), will be utilized to evaluate the performance and safety of the proposed seat designs under different loading conditions. By accomplishing these goals, this research seeks to enhance the design and analysis of military vehicle seats, ultimately improving the capabilities and well-being of military personnel in the field.

II. LITERATURE REVIEW

The highest level of safety on the road depends on the interaction between humans, vehicles, and the road system. It is essential for each of these components to function properly in order to ensure road safety. When it comes to special vehicles, crew protection should be given top priority during operational tasks.[1] When operating a military vehicle in rugged terrain, the driver is subjected to whole-body vibrations that can result in muscle fatigue, especially in the shoulder area responsible for steering.[2] The main data obtained from ISO 2631 is calculated using the power spectral densities of tri-axial acceleration readings collected at the interface of the seat cushion. These densities break down vibration signals into different frequency components. ISO 2631 assigns weights to these frequency components according to human sensitivities that have been empirically determined. The frequency range of 4-6 Hz is identified as the most critical for vertical human movements.[3] Professional drivers frequently dedicate over eight hours each day, all week long, operating a vehicle.[4] In order to tackle this problem, the Suffield Research Centre of Defence Research and Development Canada carried out thorough research to analyze this difference and implement essential modifications to the testing procedure to reduce variability.[5] The findings indicate a significant enhancement in the blast-resistant capacity of the cutting-edge sandwich armor design by incorporating the isolating layer.[6] Protection measures have evolved from solely focusing on blast mine protection to now encompassing defense against both blasts and projectiles. While the fundamentals of blast mine protection still play a crucial role, a more comprehensive approach is now being adopted.[7] The hook spring, a rigid spring, offers stability to the seat and passenger under regular circumstances. If there is a sudden impact, the seat and passenger disconnect from the hook spring and are subsequently upheld by the cushion spring, a more flexible spring.[8] Furthermore, the setup consists of two vertical rails attached to the plate, enabling a chair to move back and forth on the rails.

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A low-capacity component, like a pneumatic spring or shock absorber, links the plate and seat, whereas a high-capacity shock absorber, designed to react only to strong impacts, is linked to the plate.[9] Blast mitigation continues to be a significant field of research concerning military vehicles. The main obstacle lies in effectively dealing with the consequences of the vehicle's global motion following an explosion.[10].

III.3D CAD MODEL GENERATION

CAD is a combination of hardware and software used by design experts to create and specify physical objects. AutoCAD and Micro-Station are currently the leading general-purpose CAD platforms, serving a wide range of applications. Various organizations in engineering, architecture, surveying, and construction sectors rely on these systems to provide a variety of services. The 3D CAD Model of the Multifunctional Seat, based on Catia, is meticulously designed with precise dimensions. This seat incorporates 10 springs, along with bolts of the same size and grade (ISO: 4014 Bolt M20*80 Steel Grade a Hexagon Head). The seat's height measures 940mm, width is R25/25mm, and the horizontal seating area has a breadth of 546mm, while the vertical seating area measures 682mm. The figure below illustrates the detailed dimensions of the multifunctional seat.

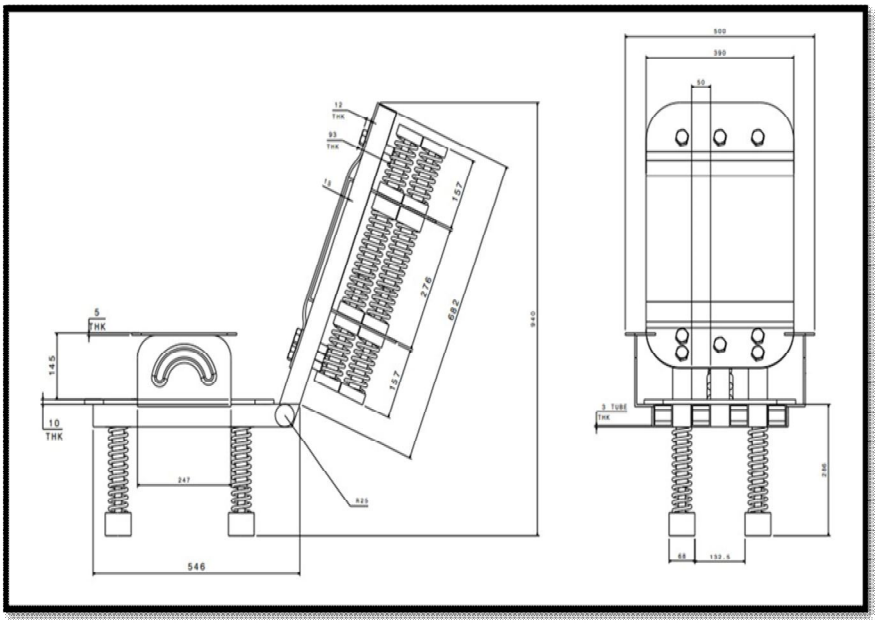
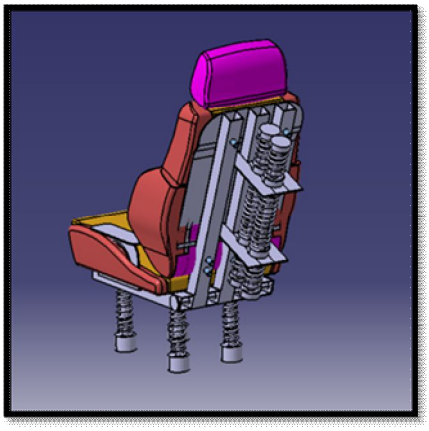


Figure 01: Dimensional Diagram of Multifunctional Seat

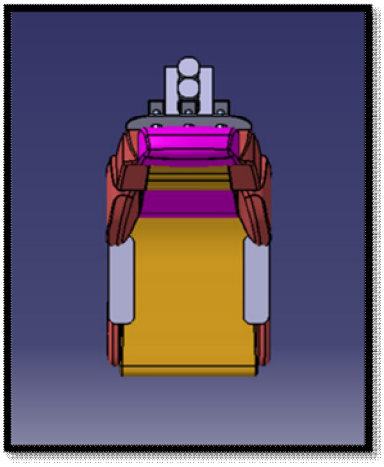
The 3D CAD Model of Multifunctional Seat utilized in Military Vehicle is depicted in the figures (a), (b), (c), and (d) below.



(a)



(b)



(c)



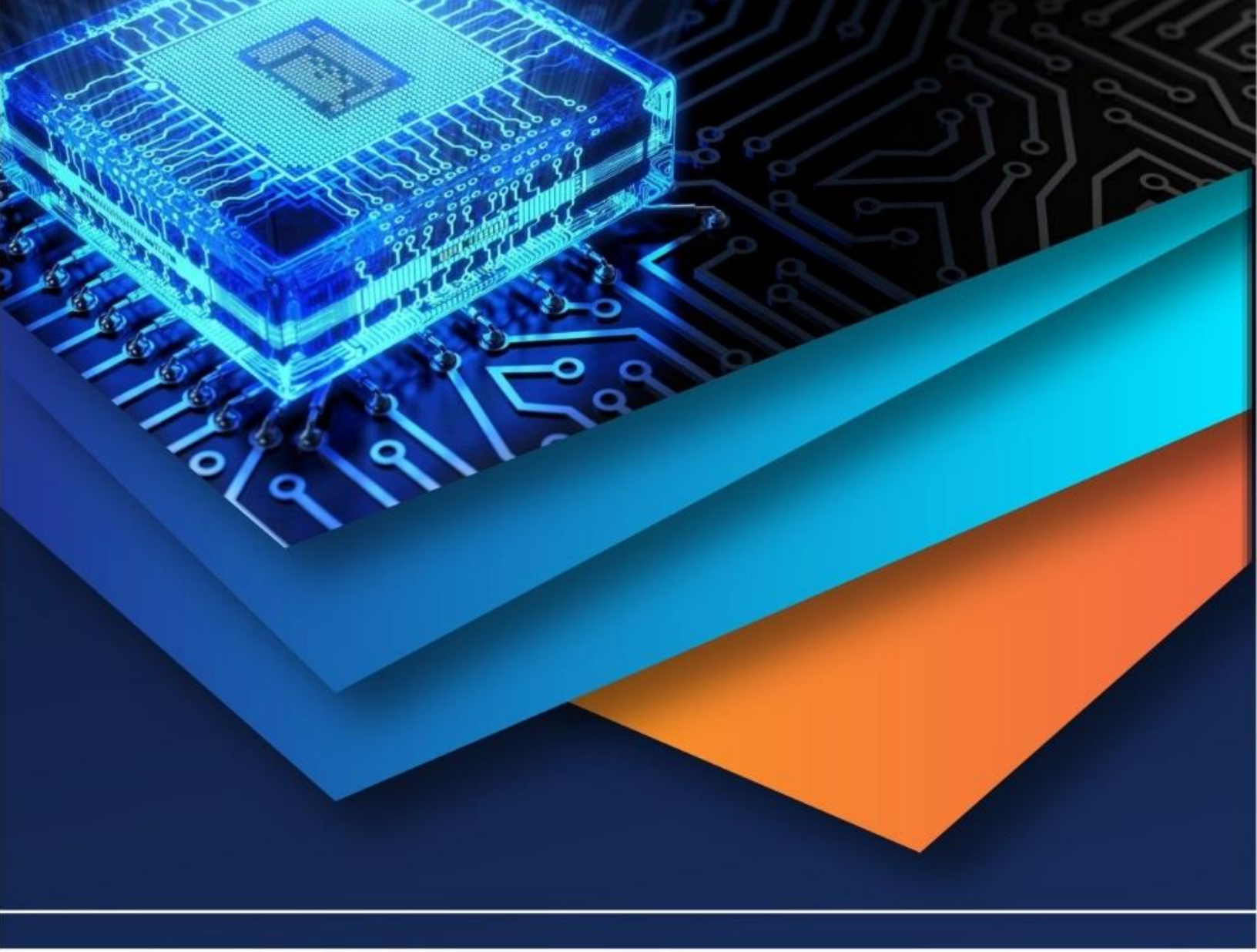
(d)

IV. CONCLUSION

Through the utilization of 3D CAD modelling, designers successfully created a virtual representation of the seat, enabling a comprehensive analysis and visualization of its various components. This enabled them to make informed design decisions and ensure that the seat met all the required criteria. The military seat plays a crucial role in meeting the distinct demands and difficulties encountered by military members, effectively addressing their individual needs and hurdles. By employing 3D CAD modelling, designers could thoroughly examine and visualize the seat's parts, allowing them to make well-informed design choices and guarantee that the seat adhered to the necessary specifications.

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