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Design of Suspension Bridge at Connolly's Plot

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Abstract: ***This project proposes a suspension bridge at Conolly Plot, near Nilambur, the world's oldest teak plantation established in 1846 by H. V. Conolly; the previous bridge was destroyed during the 2019 floods, forcing tribal communities to depend on unsafe makeshift crossings and making daily life difficult. The project aims to improve transportation and connectivity for tribal and local residents while promoting tourism in the forested Nilambur region, with the bridge design focusing on load and deflection analysis, cost estimation, and the use of locally available materials and labor to reduce costs, involve the community, and create lasting social a nd economic benefits.***
Keywords: Suspension Bridge, Connolly's Plot

I. INTRODUCTION

Bridges have always played a crucial role in connecting people, places, and economies by overcoming natural obstacles such as rivers, valleys, and rough terrains. Among the different types of bridges, suspension bridges stand out for their ability to span long distances with elegance, strength, and minimal use of materials. They are widely recognized for their engineering excellence and aesthetic appeal. The Canoly plot in Nilambur, Kerala, is a location of historical and ecological importance, known for its rich biodiversity and scenic beauty. Constructing a suspension bridge at this site is not only a technical challenge but also an opportunity to enhance accessibility while preserving the natural surroundings. This project aims to study and design a suspension bridge that ensures safe pedestrian or light vehicular movement, supports local tourism, and blends harmoniously with the environment.

The report focuses on the fundamental aspects of suspension bridge design, including site analysis, structural components, load considerations, materials used, and construction methodology. It also highlights the relevance of such a project in Nilambur by addressing both engineering requirements and socio-economic benefits. By applying modern engineering principles while respecting the cultural and environmental context of the Canoly plot, this project serves as a practical example of how civil engineering can contribute to sustainable development.

II. DEVELOPMENT OF SUSPENSION BRIDGE

The suspension bridge represents one of the most remarkable achievements in the history of bridge engineering, combining simplicity of concept with efficiency of structural performance. Its development can be traced back to ancient civilizations, where rudimentary forms made of ropes, vines, and wooden planks were used to span rivers and gorges, providing vital connections for communities.

With the advent of iron chains during the 18th century, suspension bridges began to take a more permanent and reliable form, leading to their first large-scale applications in Europe and America. The introduction of steel cables in the 19th century marked a turning point, as it enabled the construction of longer spans, lighter structures, and safer bridges, revolutionizing the possibilities of bridge design.

Over time, suspension bridges have evolved not only in materials but also in their structural analysis, design methods, and construction techniques, making them capable of spanning distances well beyond the capacity of other bridge types. Today, they are widely recognized for their ability to connect vast stretches across rivers, valleys, and urban waterways, serving both functional and aesthetic purposes. The development of suspension bridges has therefore played a crucial role in advancing transportation networks, symbolizing progress in civil engineering while standing as iconic landmarks around the world.

III. SIGNIFICANCE OF SUSPENSION BRIDGE

The Suspension Bridge at Connolly's Plot holds multiple layers of significance—historical, ecological, cultural, and tourism-related. Historically, it represents early engineering efforts undertaken during the British colonial period to support the world's oldest teak plantation, reflecting the foresight of H. V. Connolly in promoting sustainable forestry practices. The bridge itself is an example of simple yet effective suspension bridge design, highlighting how infrastructure was harmonized with natural landscapes without disrupting the river ecosystem.

Ecologically, the bridge contributes to minimal environmental disturbance by allowing pedestrian and light vehicular traffic across the Chaliyar River while preserving the flow and biodiversity of the water body. It also provides a vantage point for observing the rich flora of the teak plantation and surrounding forested areas, promoting environmental awareness among visitors.

Culturally and socially, the bridge has become a local landmark and a symbol of Nilambur's forestry heritage. It draws researchers, students, and tourists, serving as an educational site for understanding historical forestry practices, bridge engineering, and river ecology.

From a tourism perspective, the bridge enhances eco-tourism in the region, offering panoramic views of the river and teak plantations and providing a serene natural experience that blends history with scenic beauty.

Overall, the Suspension Bridge at Connolly's Plot is more than just a crossing point—it is a living testament to Kerala's forestry legacy, early engineering ingenuity, and the harmonious relationship between human activity and nature.

IV. HISTORICAL BACKGROUND

Connolly's Plot, located in Nilambur, Kerala, holds the distinction of being the world's oldest man-made teak plantation. It was established in the 1840s under the guidance of H. V. Connolly, the British District Collector of Malabar, who recognized the economic and ecological value of teak. With the help of forest officer Chathu Menon, vast areas along the banks of the Chaliyar River were systematically planted with teak, creating a landmark project in scientific forestry.

This plantation later became a model for teak cultivation worldwide and remains a living testimony to sustainable forest management practices introduced during the colonial era.

To provide easy access to this unique plantation and to connect different parts of the Nilambur region, a suspension bridge was constructed across the Chaliyar River. The bridge not only served as a functional crossing but also symbolized the fusion of engineering with natural heritage. Built with a simple yet sturdy design, the structure allowed workers, officials, and later visitors to move between the plantation and surrounding areas without disturbing the river ecosystem.

Over the decades, the Suspension Bridge has transformed from a purely utilitarian structure into a cultural and historical landmark. Today, it stands as a reminder of Kerala's forestry legacy, the vision of H. V. Connolly, and the early application of engineering solutions in harmony with nature. Alongside the teak plantation, the bridge continues to draw historians, researchers, and tourists, making it an inseparable part of Nilambur's heritage landscape.

V. SCOPE

1) Tourism Development: The suspension bridge enhances the accessibility of Connolly's Plot, one of the world's oldest teak plantations, making it a major attraction for eco-tourism and heritage tourism. Its presence improves the overall visitor experience by offering safe and scenic access across the Chaliyar River.
2) Accessibility: The bridge provides the only direct pedestrian route to Connolly's Plot. It plays a crucial role in ensuring uninterrupted visitor movement, especially important for promoting local tourism and community development.
3) Structural Safety: Designed as a pedestrian suspension bridge, the structure ensures safe crossing over a wide river span. Its reconstruction or restoration scope includes incorporating flood-resistant features to withstand extreme weather conditions and natural disasters.
4) Sustainability: By reducing reliance on temporary or unsafe crossings such as rafts and boats, the bridge promotes eco-friendly tourism and sustainable infrastructure within a sensitive forest environment.
5) Cultural & Heritage Value: The bridge has become an iconic symbol of Nilambur's heritage. Its preservation and maintenance contribute to protecting the historical significance of Connolly's Plot.
6) Flood Resilience: Since the structure was damaged during the 2018–2019 floods, the scope includes redesigning with stronger materials, higher elevation, and better anchorage to withstand future monsoon floods.
7) Maintenance & Longevity: Regular inspection, cable tensioning, and deck replacement will be part of the scope to ensure durability, safety, and reduced long-term maintenance costs.
8) Community Benefits: The restored bridge supports local livelihoods by boosting tourism-related income, creating job opportunities, and promoting Nilambur tourism.
9) Cost Effectiveness: Compared to constructing alternative large-scale infrastructure, restoring or reconstructing the suspension bridge remains a cost-effective solution while delivering maximum cultural and tourism value.

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VI. OBJECTIVES

1) To design the main components of a suspension bridge such as towers, cables, deck, and anchorage.
2) To understand the structural behavior of suspension bridges under various loading conditions.
3) To simulate and analyze the performance of the designed bridge using STAAD.Pro

VII. CAD DRAWING

Computer-Aided Design (CAD) is a computer-based technology used to create accurate and detailed engineering drawings. It helps engineers design structures with better precision and efficiency. In this project, CAD software was used to draw the suspension bridge structure. The drawing shows the main components of the bridge with proper dimensions, making the design clear and easy to understand.

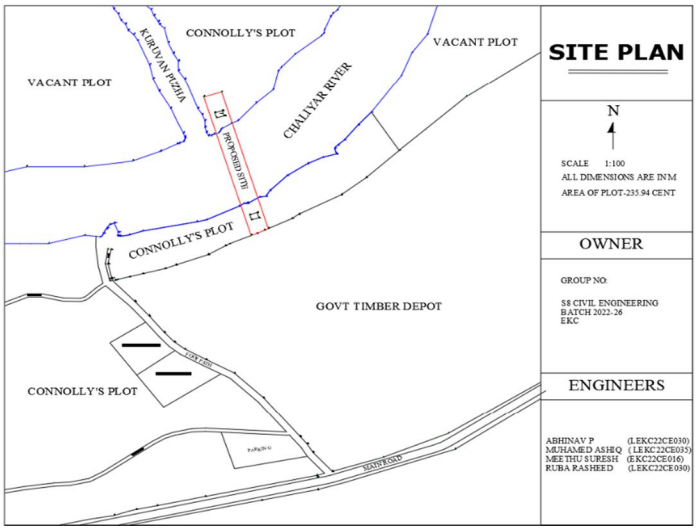
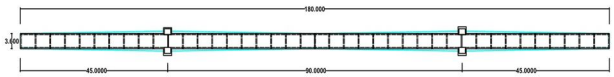
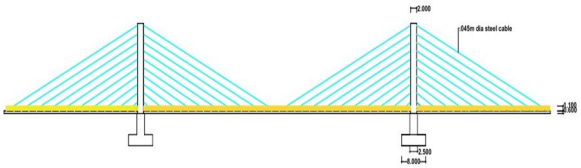


Fig.1.Site plan



TOP VIEW

Fig.2.Top view of suspension bridge



SIDE VIEW

Fig.3.Side view of suspension bridge

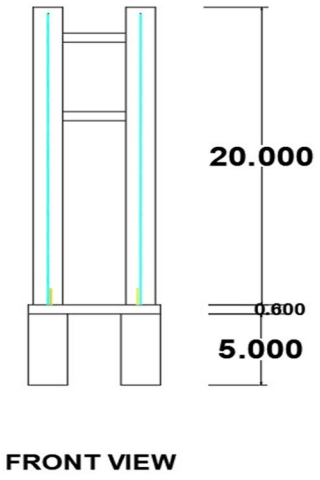


Fig.4.Front view of suspension bridge

VIII. STAAD DRAWING

STAAD.Pro is structural analysis and design software used by civil engineers to analyze structures such as bridges, buildings, and towers. It helps in calculating loads, stresses, and structural stability. In this project, STAAD.Pro was used to analyze the suspension bridge model and ensure that the design is safe and structurally efficient.

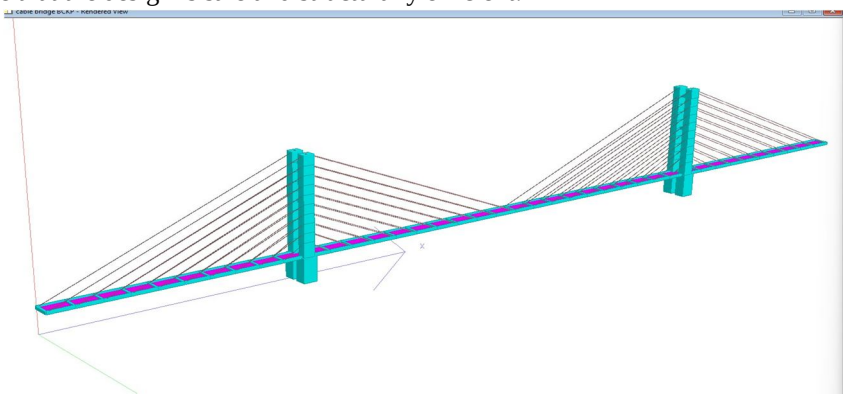


Fig.5.3D view of suspension bridge

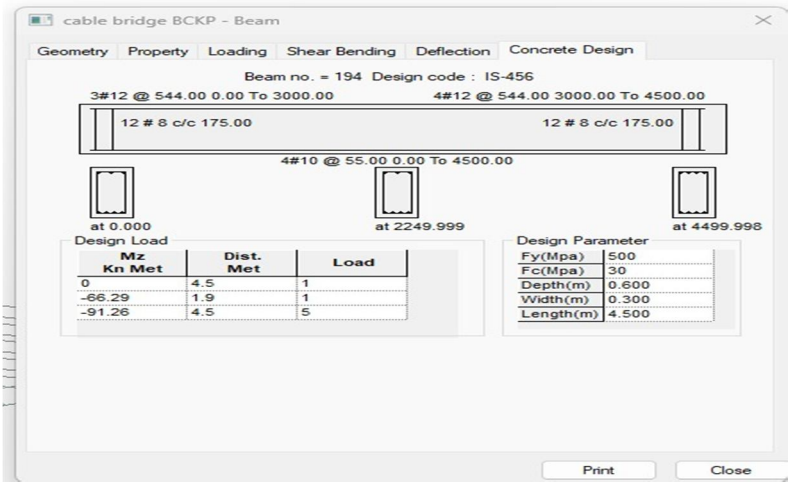


Fig.6.Cross section of beam

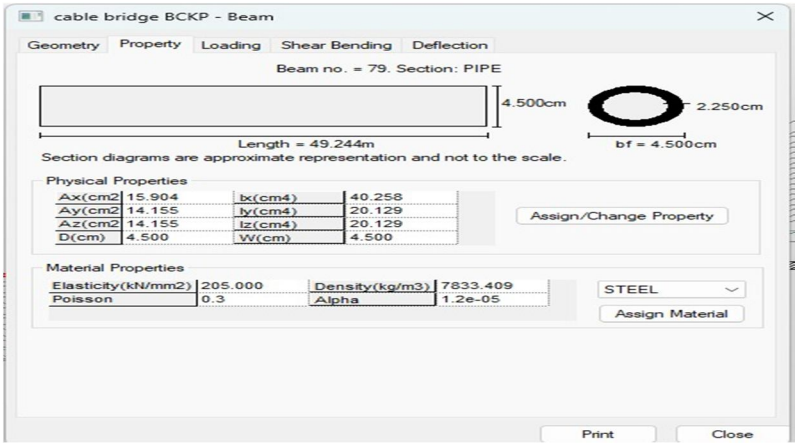


Fig.7.Cross section of cable

Fig.8.Design parameters

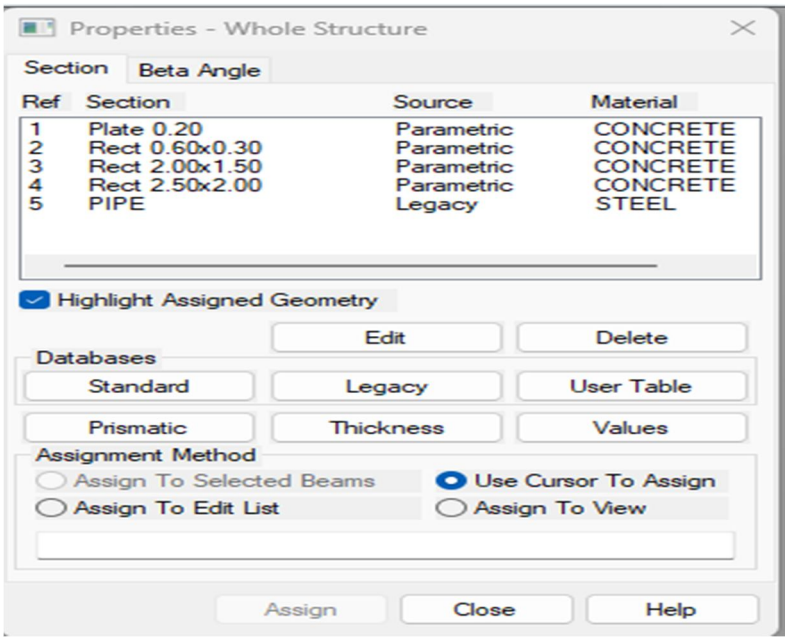


Fig.9.Section properties

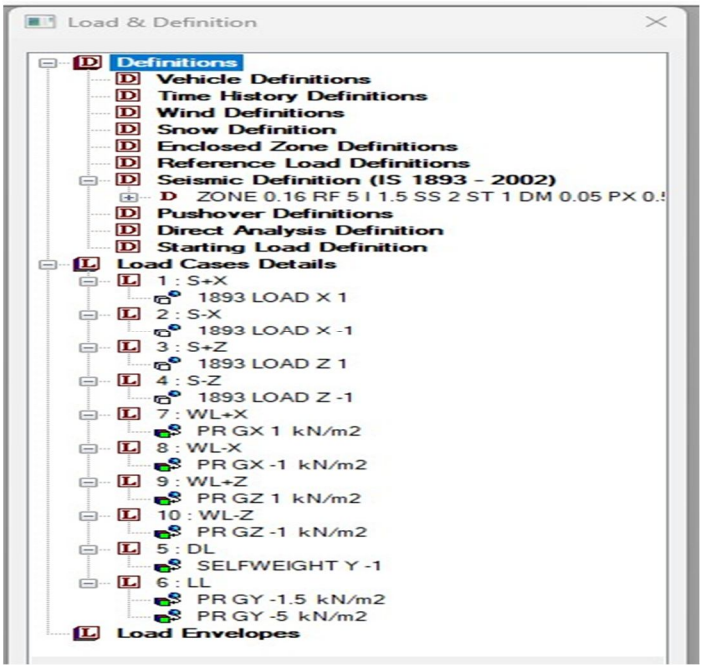


Fig.10.Loads and definitions

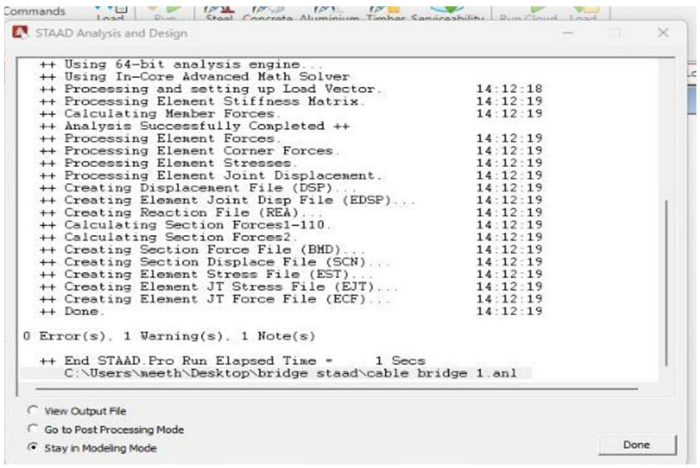


Fig.11.Analysis result

IX. CONCLUSION

The design and analysis of the suspension bridge at Connolly's Plot have been successfully carried out to provide a safe, efficient, and aesthetically pleasing structure suitable for the site conditions. Detailed site surveys and geotechnical investigations confirmed that the location possesses favorable topographical and soil characteristics, making it appropriate for a suspension bridge type. The structural system was selected to efficiently span the required distance while minimizing the impact on the natural landscape and maintaining harmony with the surroundings. Through systematic data collection and careful material selection, the design ensures adequate load-carrying capacity, stability, and durability under various conditions such as wind, seismic forces, temperature variations, and live loads. The use of high-strength cables and durable deck materials enhances the overall safety and longevity of the structure. Proper consideration has also been given to economic feasibility, ease of construction, and long-term maintenance requirements. The suspension bridge at Connolly's Plot not only improves connectivity and accessibility between regions but also contributes to the visual and functional enhancement of the area, reflecting a balance between engineering excellence and environmental sensitivity, and demonstrating a comprehensive approach to modern bridge design that will serve the community safely and effectively for many years to come.

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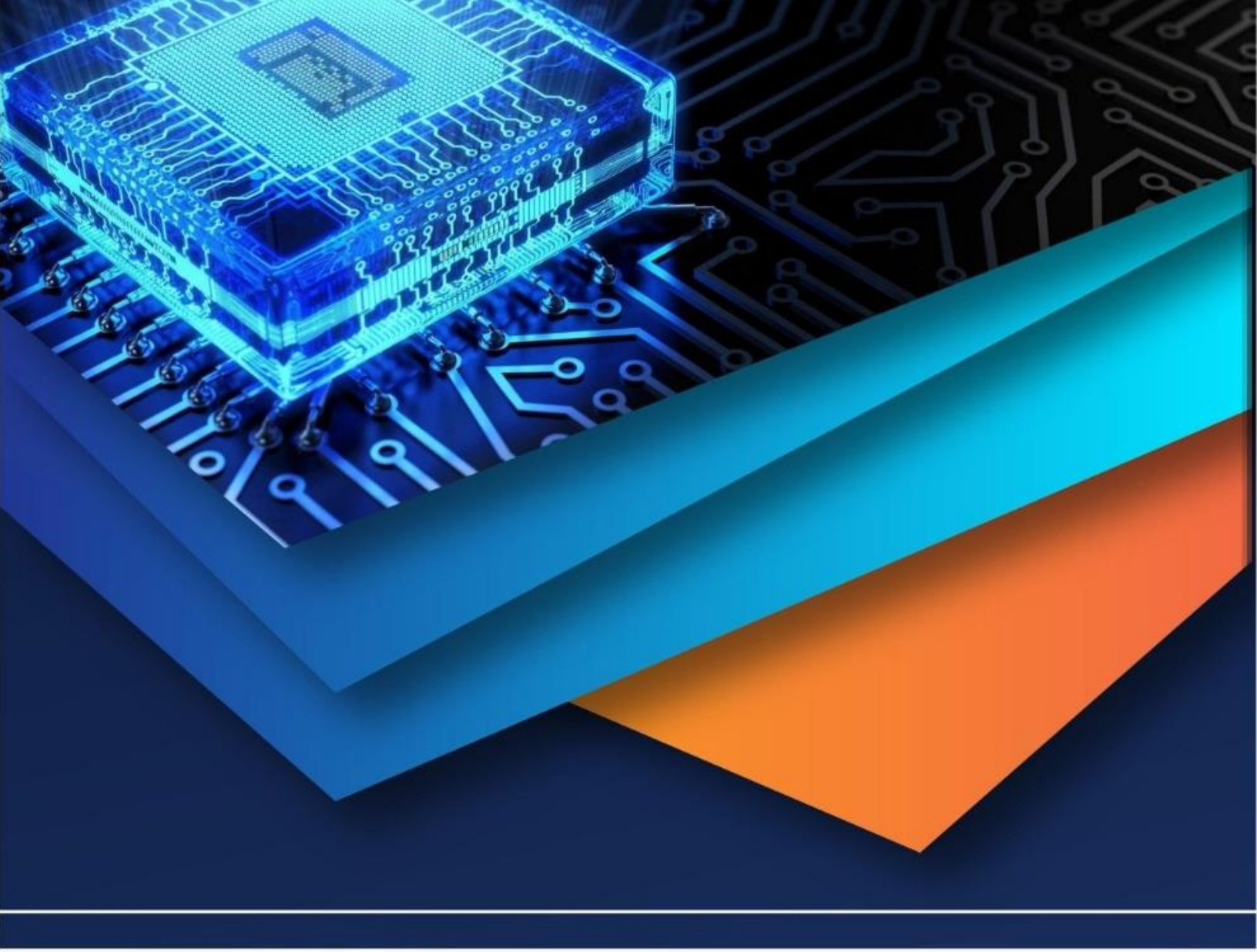

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