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Slab Culvert Design as a Review

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Abstract: ***Culverts are the monolithic structure made to pass across a roadway, railway lines etc. Soil strengthening is most to balance the flood water on both sides. It follows the traffic, water deigning, walking purpose, and any other activity is taken on culverts. The risk follow water level and up word and downward flooding is most important earth to reduce, water level reducing risk for the flooding. The structures to accomplish such water flow and traffic flow without any disturbance flow across the road are called culverts, small and major bridges depending on their span such as major span, lesser span it is totally depend on water flowing discharge. Culverts are commonly used both as cross drains for channel release and to pass water under a road at natural drainage and river crossings. Drains can be of changed forms such as circular arch, span, flat slab etc. Culverts can be built with different substantial material such as masonry, concrete, Bricks, stone or reinforced cement concrete. The structural elements are required to be designed to withstand to safety point and design structure and economical with all criteria are competed such as maximum bending moment and shear force. This research Paper provides full thoughts on the provisions in the Codes, design criteria, considerations and justification of all the above aspects on design. Culverts are required to be provided under earth embankment for crossing of water course like streams, Nallas across the embankment as road embankment cannot be allowed to obstruct the natural water way without any obstruction. The structural design involves consideration of load cases Slab empty, full, surcharge loads and design criteria are covered. And factors like live load, actual width, braking force, dispersal of load through fill, impact factor, co-efficient of earth compression etc. Applicable IRC Codes are compulsory to be mentioned in the examination and design of Slab ducts. The aim of this project is to analyse the Slab Culvert using STAAD PRO software. The structural basics of Slab Culvert are designed to resist maximum bending moment and shear force. The results obtained from STAAD in Research paper are almost similar to manual calculations as per the authors are suggested. The factor consideration cushion Depth, coefficient of earth pressure for lateral pressures on walls, width or angle of dispersion for live loads on Slab without cushion and with cushion for structural deformations are important items. The IS standard requirements in the design manual for roads and bridges (IRC-6-2000, IS 21- 2000) is used in the structural designing of concrete Slab Culverts.***

Keywords: culvert, types of culverts, IRC Condition, Software, Percent reinforcement, Pressure Cases, Side walls, Top slab.

I. INTRODUCTION

A conduit is a construction that permits water to flow under a street, track, trail, or alike obstacle from one side to the other side. Classically entrenched so as to be enclosed by soil, a duct may be made from RCC. Channels are normally used both as cross-drains for channel respite and to permit water below a road at natural drainage and stream crossings. A culvert may be a bridge-like construction calculated to allow vehicle or ordinary traffic to cross over the waterway while allowing adequate passage for the water. Ducts come in many sizes and forms counting round, oval, flat-bottomed, flared, and Slab-like structures. The culvert type and shape assortment is based on a amount of factors which include supplies for hydraulic performance, limitation on upstream water surface elevation and roadway embankment height. The main difference is the span length to demarcate between bridge and culvert. If the span is less than 6.5 m as per the the IRC condition give in the codal provision it is recognised as culvert and if the span is more than the specified length than it is known as bridge. Slab Culvert design is the most important aspect design various calculation are done and its specific provision are accumulated for the design of Slab Culvert .Culverts can be of different shapes such as arch, slab and Slab. These can be built with different substantial such as masonry (brick, stone etc) or steel-clad cement concrete. Since culvert pass through the earthen embankment, these are exposed to same circulation loads as the road carries and therefore, obligatory to be intended for such loads. The size of culvert are mostly base on the design of hydraulic structure mean catchment area of the water and River margined. The pad depends on road profile at the duct site. It is massive construction taking parts are top slab, lowest slab and perpendicular ramparts and wing ramparts. Ducts are provided to allow water to pass through the ridge and follow usual sequence of movement and street passes and culverts are also provided to balance the water level on both sides of embankment throughout floods, such ducts are called as balancers.

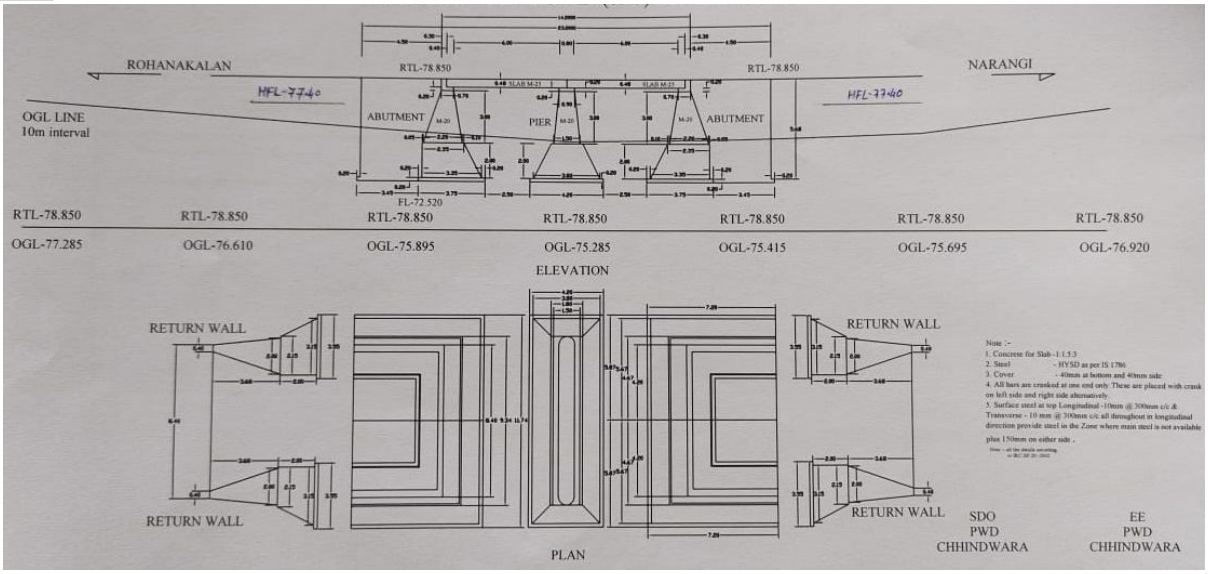

Fig:-1 plan double Slab Culvert

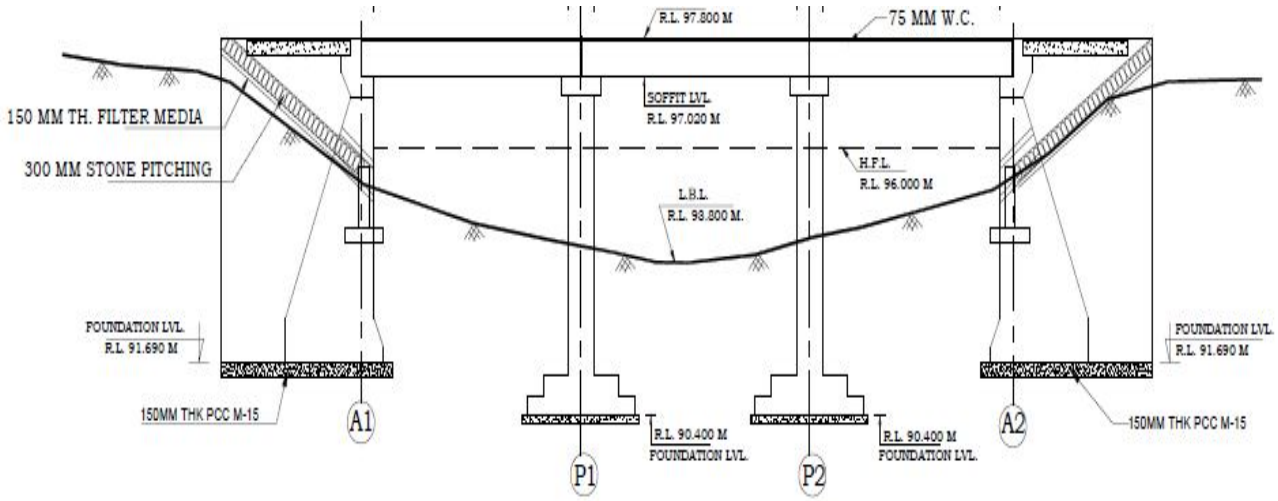

Fig:-2 double Slab Culvert

II. NECESSITY OF WORK

A few things like constant of earth pressure for side pressure on walls, effective width (run of culvert) for live loads and applicability of decelerating force on Slab without cushion (or little cushion) for physical distortion are significant items where essential to be dealt in much part. These touch the project meaningfully then consequently, obligatory to be measured properly for scheming a safe structure. It is customary to consider Slab a rigid frame and unit length of Slab is taken for design by considering the effect of all forces acting on this unit length (generally 1.0 m of Slab), Since very few literature is available for design of Slab Culvert It is necessary to study the design of Slab duct.

III. LITERATURE SURVEY

Ram Gan (2019) has studied that with the occurrence of every major earthquake, there has been in the past, almost a world-wide tendency to increase the capacity demand of the structure to counteract such events. It is only in the last decade that new strategies have been successfully developed to handle this problem economically. The current international practice has shifted towards a performance-based engineering design, wherein the accent is on serviceability and safety under different levels of magnitude of earthquakes. And he concluded that there is scope after both 'passive' control by prescribed detailing procedures as well as 'active' control by specific devices for earthquake-resistant bridges. The judicious use of these ideas can lead to economical and safe bridge structures.

R.maora and S. Patil (2019) have presented a complete study of Slab Culvert by using computational methods such as Grillage analysis and Finite element method. Grillage analysis is versatile in nature and can be applied to verity of bridge decks having both simple and complex configurations with ease and confidence. Grillage analysis has done by most commonly using softwre STAAD Pro. Their main objective was to know the behaviour of Slab Culvert and variation of stresses in terms of Shear force and bending moment values.

A.D PATIL, A. A GALATAGE (2020): had done analysis physically. The design and analysis issues of Slab were done with mitigating and without cushioning. The maximum bending moment in each and every loading were determined. The result is the load combination to be found very critical for all aspect ratio bending moments for different ratio or aspect is varying or constant for with and without cushion.

AJAY R. POLRA, PRO. P. CHANDRESHA, DR. K.B

Had done the analysis and contrast by using design thought in mind of container constant of earth weight, cushion, breadth or angle of dispersal and weight case for project. The consequence is deprived of cushion or through cushion and viewpoint of dispersal is nil there will be maximum live load greater stresses are created without cushion.

Perrin and Jhaveri (2020) carried out a financial examination of culvert life cycles. They renowned that most ducts are not substituted at the end of their lifetime series, slightly spare occurs after failure and is costly. When these culverts fail, they are then replaced at emergency rates. Perrin and Jhaveri also, stated that inspection and maintenance programs will lead to an overall savings when compared to emergency replacements. Perrin and Jhaveri concluded that it is important to consider whether a pipe with longer life is more cost effective simply based on the likelihood that the pipe may not be replaced at the end of its design life.

Y. Vinod Kumar, Dr. Chava Srinivas (2015) It shows the study of design of Slab Culvert and determines the stresses such as shear force and bending moment of the structure under railway loading conditions and these stresses have been determined by computational methods as well as conventional methods and compares the results. All the design parameters have been determined as per Indian railway standards.

Zaman Abbas Kazmi, Ashhad Imam, Vikas Srivastava (2017) This paper deals with the comparison of results between the manual approach and the computational approach (staad pro). In this study, it was also observed that manual calculation are very tedious and complex so it is better to solve it by computational method.

Mahesh D. Kakade Rajkuwar A. Dubal (2017) This paper deals with the soil interaction of Slab Culvert structure with Slab full and Slab empty conditions using the finite element analysis tool ANSYS. It also consider the design parameters such as effect of earth pressures and depth of cushion varies on the top slab of the culvert. It also compares the various cases of Slab Culvert with or without cushion.

Prema S Bangari, Guruprasad T N, Dr T V Mallesh, S R Ramesh (2019) In this study it is concerned with the analysis of Slab Culvert structure manually and with software. It also considers the effect of various types of loading conditions. In last, compares the results of moments and shear force with staad pro and manual approach647.

Sinha et. al. (2009) (Rcc Slab Culvert - methodology and Designs including computer method) Journal of the Indian Roads Congress, October-December 2009, Ducts are required to be given under earth dike to intersection of water course like streams, Nallas over the dike as street bank can't be permitted to block the normal conduit. The ducts are likewise required to adjust the surge water on the two sides of earth dike to lessen surge level on one side of street accordingly diminishing the water head thus decreasing the surge hazard.

Lande Abhijeet, International Journal of Advanced Technology in Engineering and Science, Volume No.02, Issue No. 06, June 2014, The courses are required to adjust the surge water on the two sides of earth bank to lessen surge level on one side of street in this way diminishing the water head therefore decreasing the surge danger. Courses can be of various shapes, for example, curve, section and Slab. These can be built with block, stone or strengthened bond concrete. Since duct goes through the earthen bank, these are exposed to same activity stacks as the street conveys and accordingly, required to be intended for such loads. The extent of this has been additionally limited to the basic plan of Slab.

Yerpude G and Eunterb (2019) In this paper we also study about design of Slab culvert and comparative study of reinforcement details. Vent size of the culvert is fixed based on flood discharge from upstream side. Clear dimensions of the Slab culvert is3mX3m. Thickness of slab is 400mm.Grade of concrete is M30, grade of steel is Fe415 and angle of repose is 30.

Pandit M and limaye H (2020) classified loads subjected to Slab culvert to dead load and live load. Dead load comprising of self-weight of top and bottom slab of the culvert and two side walls of the structure which is calculated based on clear dimensions of the culvert and thickness of the culvert. Super imposed dead load depends on the typed of the constructed road above the culvert and is calculated from standards and specifications code of practice.

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IV. MATERIALS AND METHODS

Study Area We conducted culvert surveys in the lower Shavers Fork and the Dry Fork watersheds of the upper Narangi Village(MP) (Fig. 3). Reduced Level (RL) is plotted against Reduced Level (RL) with 10 m interval chain ages to find river bed area and velocity of the river.

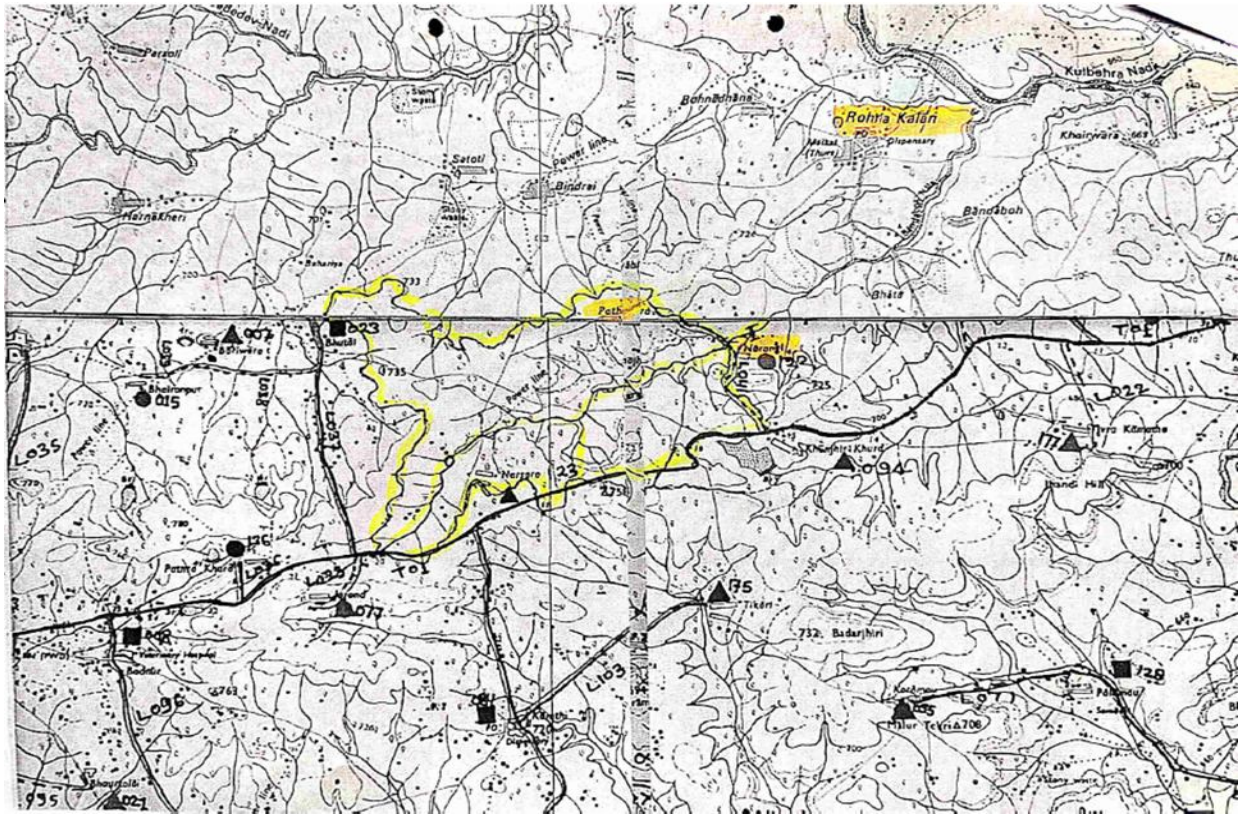

Fig:-3 Top sheet no. 55J/16 & 55K/13

In the Fig 3 topographic map is drawn which is a two dimensional representation of a three dimensional land surface to find the catchment area of the proposed site. This topo sheet is measured/scaled 1:50000 or 2 cm = 1 km.

Steps involving Calculation of Bridge load and water calculation.
Step I: Hydraulic design is calculated for slab culvert to check the discharge capacity of water.
Step II. Soil Investigation: Soil investigation is to be perform to check the ground strata.
Step III. Load capacity for abutment, pier and slab need to be calculated.
Step IV Analysis and plan by STAAD star.
Step V Analysis strategy received for RCC Slab is MDM (Moment Distribution Method).
Step VI Designing Slab Bridge considering LSM.

V. CONCLUSION OF REVIEW

The literature appraisal has optional that use of a finite element modelling of the culvert construction.
Thus it has remained obvious to use STAAD. Pro aimed at the Finite Element Modelling.
By the assistance of this software instruction of culvert has been done.
STAAD. Pro also helps in Finite Element Modelling in view of different types of forces can apply to get the actual results.
Research paper Results obtained from analysis of Slab Culvert in STAAD Pro are almost same as results obtained from manual analysis.
Some research paper showing the 3D modelling of Slab Culvert with beam element in STAAD Pro proves a good option for analysis.
In case of Retaining wall construction For Without cushion case, braking force causes considerable moments. Hence it is very necessary to consider braking force separately in the analysis

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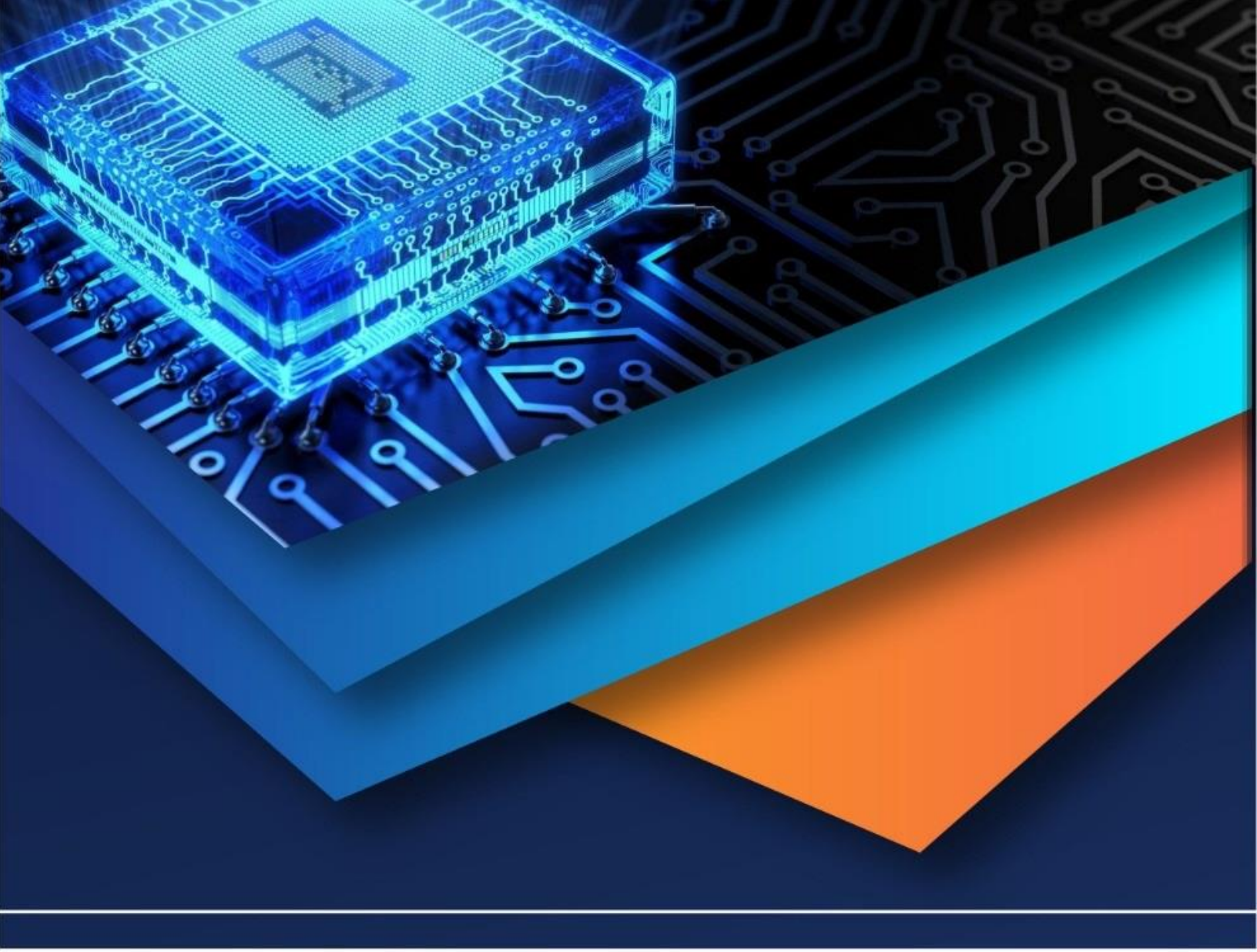

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