iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6121

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Analysis of Structure with Transfer Slab

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Abstract: ***As the population goes on increasing the land requirement increases with all the facilities surroundings to it and also architectural requirement need the variation in the vertical elements of the structure between the stories of the structure, introduction of transfer floor structure which provides all the facilities in one place, which backing the vertical and lateral load systems and transfers the load system to the below structure. Present study shows that three 12 story model were prepared on E-TABS software with transfer slab respective at 1ST floor, 3RD Floor & 5th floor and the response spectrum analysis is investigated and results were compared to get the conclusion according to the results.***
Keywords: Transfer floor, Seismic load, Lateral & Vertical load, response spectrum analysis.

I. INTRODUCTION

In Developing countries like India, China, Turkey, Qatar, population goes on increasing day by day and the land requirement also increasing with numerous uses and facilities in one place i.e. commercial and residential place, similarly for the inventive architecture designs requirement need the change in position of the vertical elements of the structure between the floors. While the structure with transfer floor can be used for commercial and residential purpose, in commercial it can podium, function hall, shopping mall, parking area etc. below the transfer floor system and above structure can be used for residential as well as office purpose in shorter span area with affordable design. To get such results, design of podium or mall structure to be spacious, the columns are placed in longer span with more spacing while for the upper structure closely spaced column with shorter span. The use of transfer floor has become the familiar solution between different parts of the building. Nowadays many structures with vertical irregularities are constructed it may be columns or shear wall. Transfer floor system is palace between the two different arrangements of column. Transfer girder and the transfer slab are the two different floor system of transfer slab which is use as per the load distribution on the structure.

The figures shows at the first floor level transfer slab is provided and the irregular column arrangement is provided above transfer slab in figure 1.1 and in the figure 1.2 shear wall was used above the transfer slab.



FIGURE 1.1



FIGURE 1.2

II. LITERATURE SURVEY

The external walls found out as the root of shear contraction above transfer floor when they found out that the transfer structure local flexural deformation [1].

By comparing the results of nonlinear, linear time history and response spectrum analysis author concluded that lateral and drift deracination result of response spectrum was more by 20 to 35% than nonlinear time history analysis [2].

It was determined that flexural deformation at the external walls above the transfer floor has the source of shear concentration [3].

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Safety of the structure get affected as there might change in eclipse in room temperature prophecy of design of sections members of structure, during the full process of heating [4].

There were no effect on the response of the building when the transfer slab stiffness was reduced and on the other side building lateral and drift movement got affected by 30% when the horizontal and elements stiffness was reduced [5].

By comparing the results of the model author concluded that shear wall frame model gives the better result of base shear, drift, lateral movement than the moment resisting frame [6].

Column which have the separate foundation having the more lateral stiffness compared to the floating vertical structural members above transfer girder [7].

III. METHODOLOGY & BUILDING DETAILS

This study shows the response spectrum & wind analysis on E-Tabs software for analysis a model selected was prepared on software. Analysis is done with the references of Indian codes IS 1893 & IS 875 (PART3). The floor plan is of 28m X 48m and 12 story model is selected. The model selected having the transfer slab at different levels of building height. To exclude the effect of torsion the biaxial symmetric plan of building was elected. Three different model with floor height 3.5m below & 3.0 m above transfer slab was taken and the model were analysed with 1st, 3rd, 5th floor locations of transfer slab in building.

IV. METHODOLOGY & BUILDING DETAILS

A. Loadings

Live load

Above and at the transfer slab level = 2 kn/m2

Below the transfer slab = 3.5 kn/m2

Dead load

Wall load

Above the transfer slab = (4.14 + 2.07) kn/m2

Below the transfer slab = (3.312 + 1.656) kn/m2

Floor finish

Above and at the transfer slab = 1 kn/m2

Below the transfer slab = 1.5 kn/m2

Response reduction factor = 3

B. Dimensions of the Building

Storey =12 storey

Column dimensions

Above the transfer slab = 0.3 x 0.6 m

Below the transfer slab = 0.5 X 1 m

Slab thickness- Transfer slab = 1m

Above & below transfer slab = 0.15m

V. ANALYSIS

Response spectrum analysis is a linear dynamic statistic. Analytical method that represents the maximum earthquake. Response of elastic structure from natural mode Vibration. Response spectrum analysis provides dynamics Behaviour by spectral acceleration, speed or measurement. Displacement as a function of a given construction period Time history and wetting.

The scale factor is assigned to the response spectrum function According to the [15],

$$S.F = I \times G / R$$

Where, I = Importance factor

R= Response reduction factor

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G=Gravity force

Re-scaling = (I x G / R) x (Static base shear / Response spectrum base shear)

VI. STRUCTURE MODELLING

For the analysis 12 story model was selected with transfer slab in the structure having the column below and above the transfer slab as shown in the figures 6.1 & figure 6.2. Model was investigated on E-tabs software to check the transfer slab vertical position. Following three models with transfer slab provided at 1st floor, 3rd floor, and 5th floor and the analysis was done using E-tabs.

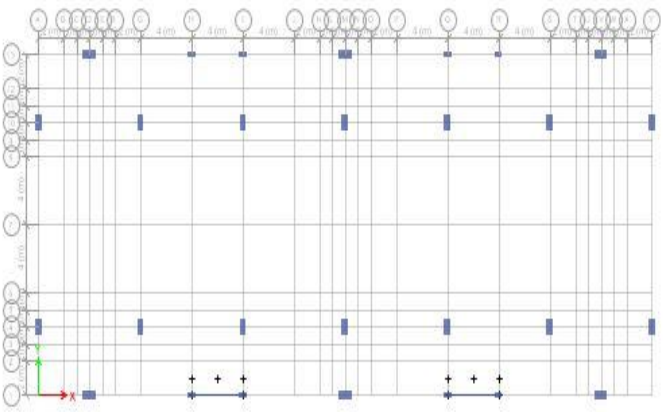


Figure 6.1

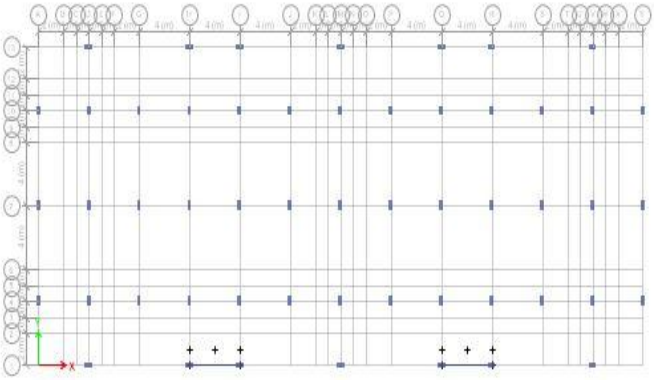


Figure 6.2

Figure 6.3, 6.4 & 6.5 shows the position of the transfer slab in the building,

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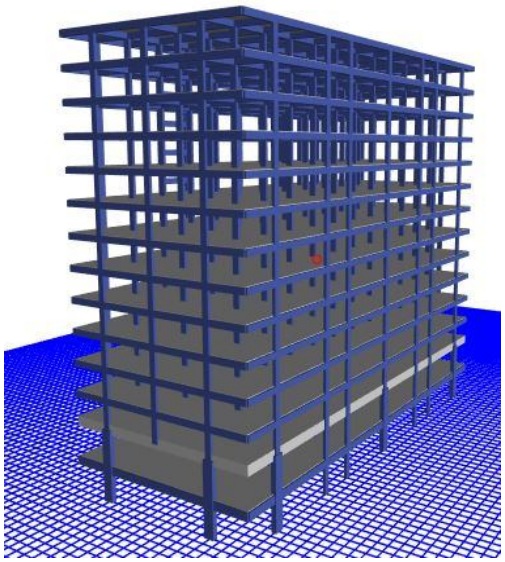


Figure 6.3

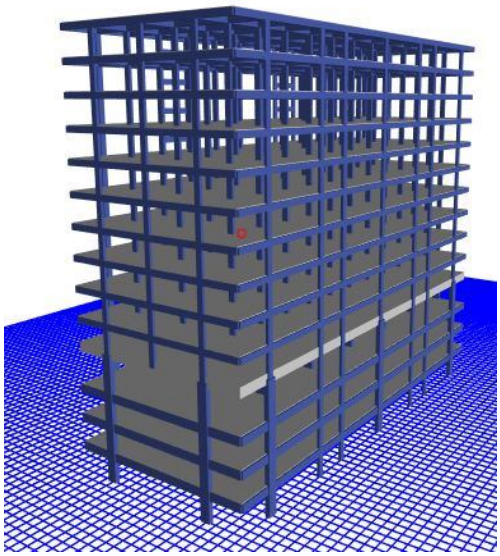


Figure 6.4

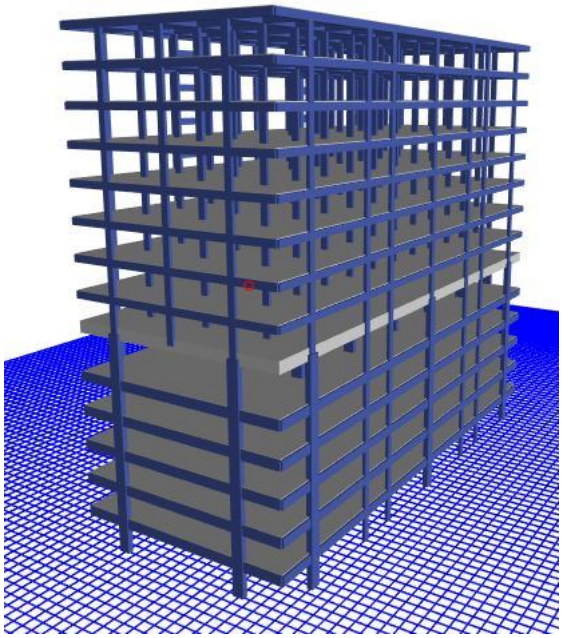


Figure 6.5

VII. RESULTS AND SHORT DISCUSSION

For the behavior of structure with transfer slab was analyzed in the E-tabs structural software, three different 12 storey models were investigated the transfer slab vertical position in the structure and the analysis was done .12 storey model with transfer slab at 1st floor , 3rd floor & 5th floor were analyzed. From the analysis displacement, storey shear and drift results expressed in the form of graphs.

The portion presents the all models with respect the position of the transfer slab results in the following manner.

A. Storey shear
B. Lateral displacement
C. Storey drift

1) Model 1: (Transfer slab at 1st floor level)

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a) *Storey Shear:* Maximum storey shear for each storey is shown in the following graph fig. 7.1 for 1st model with transfer slab at 1st floor level. Storey shear in X-direction linearly goes on decreasing at the top floor level the maximum storey shear obtained at the ground level is 1398.507 KN decreased up to 241.97at the floor level. Fig. 7.2 show the storey shear in Y-direction the maximum and minimum value are at bottom and top storey of the model respectively.



Figure 7.1 Maximum storey shear in direction of X



Figure 7.2 Maximum storey shear in direction of Y

b) *Displacement:* The joint displacement in X-directions & Y-direction shown in Fig 7.3 & 7.4.The maximum displacement in 1st model with transfer slab at 1st floor level is observed at top storey with the value of 24.374mm & 21.906mm respectively.

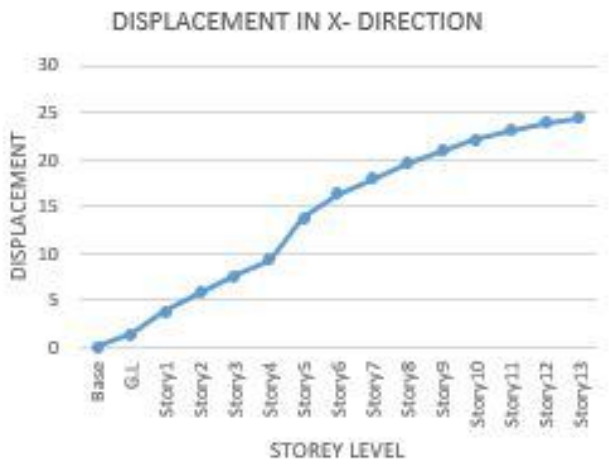


Figure 7.3 Joint displacement in direction of X

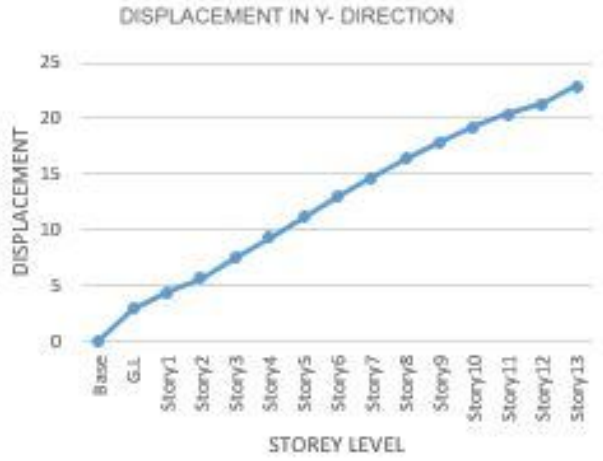


Figure 7.4 Joint displacement in direction of Y

c) *Storey Drift:* The maximum value of storey drift is located at first and storey and gradually decreasing after the 1st floor level to top level show in Fig 7.5.



Figure 7.5 Joint Drift

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2) Model 2: (Transfer slab at 3rd floor level)

a) Storey Shear: In this model Transfer slab is present at the 3rd floor level, Fig.7.6 & 7.7 shows the graph of storey shear values at each floor level which show the 1447.224 & 1963.261 KN are the highest value of storey shear which is at the bottom level of the structure.



Figure 7.6 Maximum storey shear in direction of X



Figure 7.7 Maximum storey shear in direction of Y

b) Displacement: In this model transfer slab is present at the 3rd floor level. Due to change in position of the transfer slab this model gives the maximum lateral displacement in X-direction & Y-direction respectively are 26.281 mm & 32.413 mm respectively shown as follows in Fig 7.8 & 7.9.

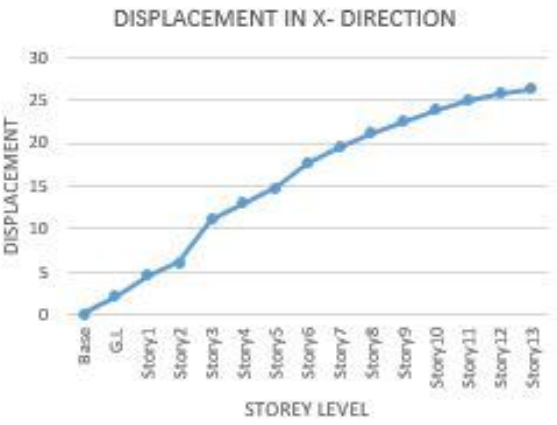


Figure 7.8 Joint displacement in direction of X

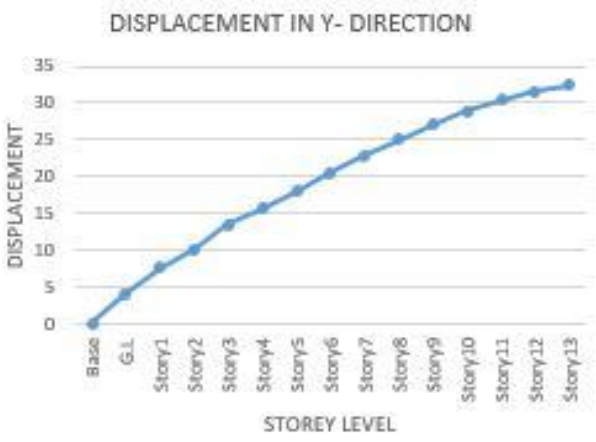


Figure 7.9 Joint displacement in direction of Y

c) Storey Drift: The following graph Fig 7.10 shows the storey drift of model-2 where the transfer slab is present at the 3rd floor level. Graph shows drift value goes on increasing upto the transfer slab level that is upto 3rd floor level after that values goes on decreasing.



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Figure 7.10 Storey Drift

3) Model 3: (Transfer slab at 5th floor level)

a) Storey Shear: This model shows the transfer slab at the 5th floor level. The values of storey shear are shown in Fig 7.11 & Fig. 7.12 The maximum value of storey shear values observe are 1610.67 KN & 1983.24 KN in X & Y-direction respectively.



Figure 7.11 Maximum storey shear in direction of X



Figure 7.12 Maximum storey shear in direction of Y

b) Displacement: The displacement graphs Fig 7.13 & Fig.7.14 highlights the displacement in lateral X & Y-directions graph presents the maximum values of displacement from ground floor to top floor. The maximum values of joint displacement are noticed at top storey of the structure with the values of 29.932 mm & 33.413mm.

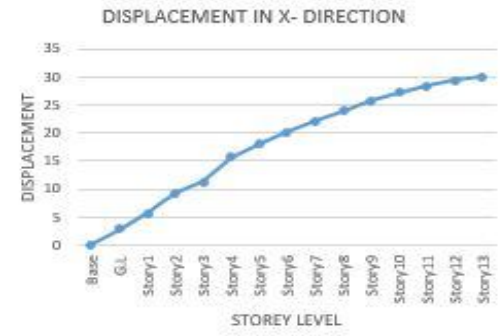


Figure 7.13 Joint displacement in direction of X



Figure 7.14 Joint displacement in direction of Y

c) Storey Drift: The following graph Fig 7.15 shows the storey drift of model-2 where the transfer slab is present at the 3rd floor level. Graph shows drift value goes on increasing upto the transfer slab level that is upto 3rd floor level after that values goes on decreasing.



Figure 7.15 Storey Drift

VIII. COMPARISON RESULT

The comparison of all models is done with respect to the position of the transfer slab, to know the behaviour of all the structures. In this chapter comparison of the results storey shear, joint displacement, and maximum storey drift presented.

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A. Storey Shear

Below figure 8.1 & 8.2 shows the Storey shear in Both X & Y direction for the 12 storey model with transfer slab at different locations in the building getting the result from the response spectrum analysis. By observing the figures it show that there is linearly decrease in storey shear in x & in y direction there is gradual fall in shear as the transfer slab location is in the lowest position in the building respect to the total height of building. Storey shear value is more when the position of the transfer slab is upper level and less when it is at lower level.

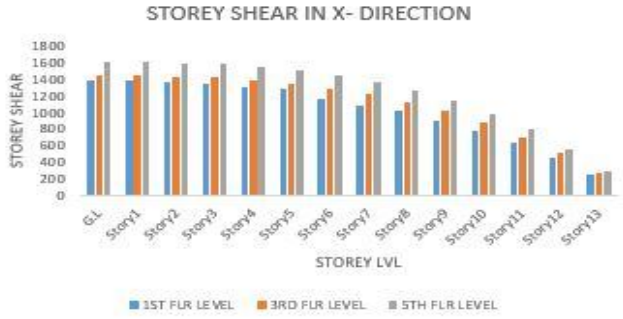


Figure 8.1 Maximum storey shear in direction of X



Figure 8.2 Maximum storey shear in direction of Y

B. Displacement

Below figures 8.3 & 8.4 shows result occur from the analysis for the 12 storey model with transfer slab at different location in the building from which storey joint displacements in X & Y directions observation was investigated. By observing the figure it shows that there is more displacement where the location of the transfer slab is the high level & displacement goes on increasing as the height of structure goes on increasing i.e. there is increase in the displacement above transfer floor and is decrease in the displacement below transfer floor.

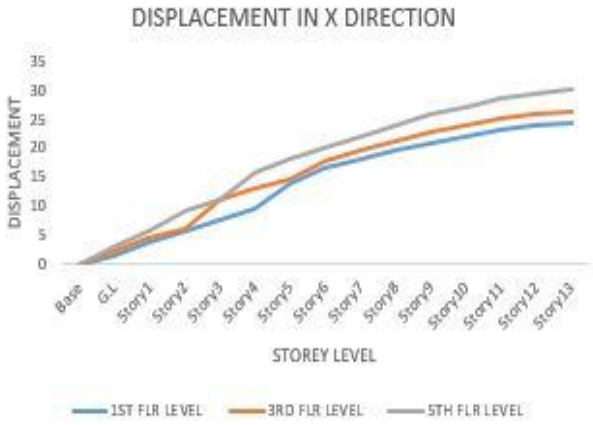


Figure 8.3 Joint displacement in direction of X



Figure 8.4 Joint displacement in direction of Y

C. Storey Drift

Drift of structure with different locations of transfer slab is shown in the below figure 8.5, from figure it is observed that there is decrease in drift above transfer slab & sudden rise at transfer slab level.

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Figure 8.5 Storey Drift

IX. CONCLUSION

To observe the transfer slab vertical position in the structure a study was supervised, with the different locations of the transfer slab in the structure with respective to the height of structure. Following are the some conclusion obtained by study.

A. There is increase in storey shear as the transfer floor system location is in the lowest position in the building as compared to the total height of building.

B. Story shear goes on decreasing above transfer slab position in every case because of unusual mass devaluation.

C. Decrease in the displacement as the location of transfer slab at lowest level and increase when it is at upper level in X & Y directions.

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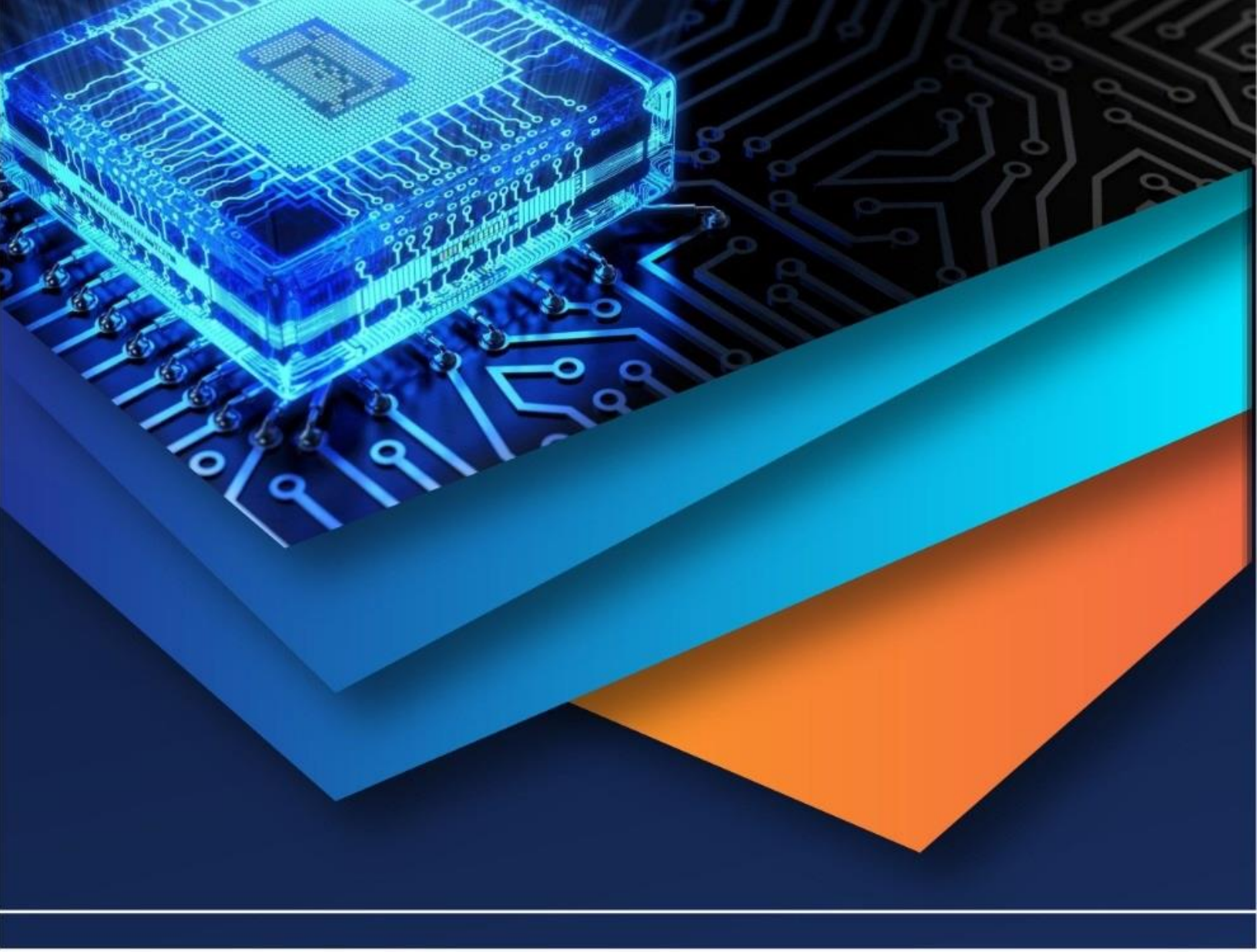
[15] IS 1893-2016 Part1.

[16] IS 875-2015 Part3

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