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Rapid Visual Screening for Seismic Evaluation of an Existing Building

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Abstract: The objective of this study is to assess the seismic vulnerability of R.C.C. and load bearing structure of the Pofali village by R.V.S (Rapid Visual Screening) method for Indian condition. The RVS method is a preliminary survey conducted to check the seismic vulnerability of existing structures in a systematic way. The method consists of the steps as, visual inspection followed by detailed investigation and finding a score which decides the need of detail seismic structural analysis. An attempt has been made to do rapid visual screening of RCC building and Load bearing building which available in Pofali village.
Keywords: Survey, Skill, Rapid visual screening, RVS forms for load bearing and RCC structure

I. INTRODUCTION

The all humans are totally depends on the activity of earth. Some of activity are helpful some of the very danger to human life. For example three season summer, winter and rainy season are essential to human. In other hand volcano, tsunami, cyclone, greenhouse effect and earthquake are such most danger activity on our planet. Whereas the volcano, tsunami, cyclone are predicted before activity, so we can reduce the losses. But earthquake is most complicated and unpredictable activity on the earth.

We know that no any structure in the earth is totally earthquake resistance. But we can minimize the losses for earthquake by taking some precautions. India faces serious earthquake problems by a rapid growth of urban population. Nearly 59% of landmass in India is under moderate to severe earthquake prone area. Bihar Nepal border (M6.4) in 1988, Uttarkashi, Uttaranchal (M6.6) in 1991, Latur, Maharashtra (M6.3) in 1993, Jabalpur, Madhya Pradesh (M6.0) in 1997, Chamoli, Uttaranchal (M6.8) in 1999, Bhuj, Gujarat (Mw7.7) in 2001 and Muzaffarabad, Kashmir (M7.2) in 2005 and Sikkim (M6.8) in 2011. These earthquakes caused around 2 lakh causalities. However, similar high intensity earthquakes in the US, Japan, etc., do not lead to such an enormous loss of lives, as the structures in these countries are earthquake resistant. The recent earthquake is happen in Delhi (M5.5), which cause also sever damages to the structures as well as to human life

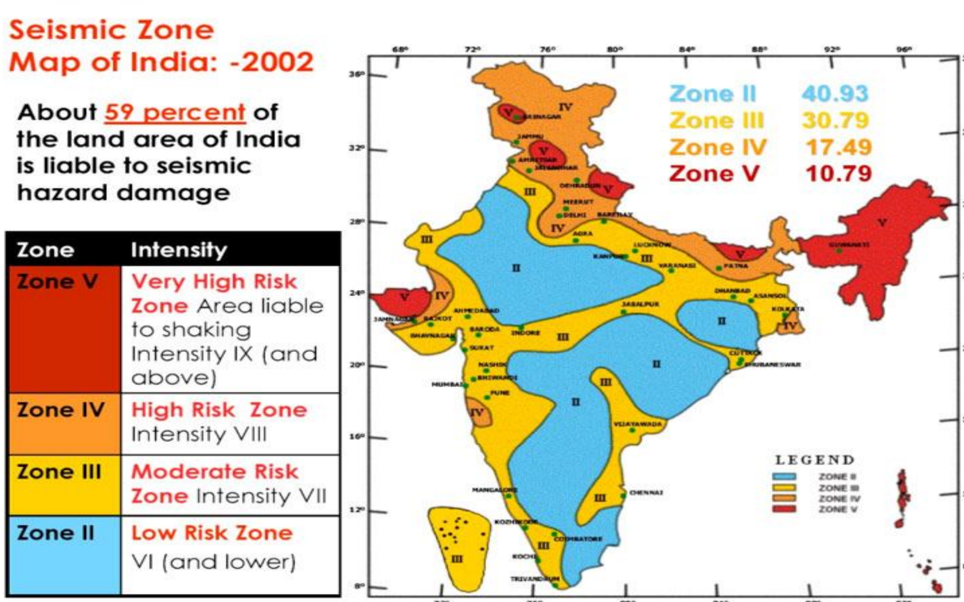

Fig. 1 Seismic zonation and intensity map of India

II. HISTORY OF RVS

In 2011, the Applied Technology Council (ATC), with funding from the Federal Emergency Management Agency (FEMA) under Task Order Contract HSFEHQ-08-D-0726, commenced a series of projects (ATC-71-4, ATC-71-5, and ATC-71-6) to update the FEMA 154 Report, Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook (FEMA, 2002a). The purpose of FEMA 154, which was developed by ATC under contract to FEMA (ATC-21 Project) and published in 1988, was to provide a methodology to evaluate the seismic safety of a large inventory of buildings quickly and inexpensively, with minimum access to the buildings, and determine those buildings that require a more detailed examination

A. *Other RVS Methodologies*

The method suggested by national research council, Canada (NRCC 1993) is based on a seismic priority index which accounts for structural as well as non-structural factors including soil conditions, building occupancy, building importance, falling hazards to life safety, a factor based on occupied density, and the duration of occupancy.

The Japanese procedure (JPDPA 2001) is based on seismic index (Is) for total earthquake resisting capacity of a story which is estimated as the product of a basic seismicindex based on strength and ductility indices, an irregularity index, and a time index.the evaluation is based on very few parameters and lacks clarity regarding ranking ofbuildings based on a scoring system.

In the method proposed by has san and sozen (1997) for RC-frame buildings in turkey, priority for remedial action is expressed in terms of a priority index obtained by adding wall and column indices. wall index is obtained by normalizing the total area of shear walls and in fill walls with the total floor area of the building. similarly, columnindex is obtained by normalizing the total column area with the total floor area. Thus ,the method is primarily based on two parameters, the total wall area and the total column area besides total floor area. also, it has been assumed here that the seismic demand isreasonably uniform as are the quality and type of construction.

The new zeal and code (NZSEE 2006) recommends a two-stage seismic performance evaluation of buildings. the initial evaluation procedure (IEP) involves making an initial assessment of performance of existing buildings against the standard required for a new building, known as percentage new building standard (%NBS; assessed structural performance of the building, taking into consideration all reasonably available information, compared with requirements for a new building expressed as a percentage). A %NBS of 33 or less means that the building is potentially earthquake prone according to the building Act and a more detailed evaluation is required for the same. the processrequires the expertise of earthquake engineers to yield quality results.

A fuzzy logic based RVS procedure was developed in Greece (Demartinos and Dritsos 2006) for the categorization of buildings into five different damage grades in theevent of a future earthquake. the method was developed based on information on 102buildings affected by the Athens earthquake of 1999. the fuzzy logic-based RVS (FLRVSP) proposed a probabilisticreasoning method that treats the structural properties of a building in a holistic way and gives a score that represents possible damage in the event of major earthquakes producing ground accelerations equivalent to the values provided by the relevant codes.

III. STUDY AREA AND METGHODOLOY USED

The aim of present project is to identify the building volnurability against earthquake by using its performance score which is calculated by collecting various data of the structures from the field survey. The factor affecting the performance of score of the buildings are listed below

A. *Study Area*

The Pofali village is situated about 20 km from Koyana dam which is main reason for RIS (reservoir induced seismicity). Already Koyana is in IV zone of seismicity so before earthquake occurs we have to ready for minimize the damages for structure and human life as well as economy also. During the Koyana earthquake (1967), the Pofali village is greatly affected by the earthquake vibration. Serious damages to human life as well as to the structures.

Pofali is very old village so that there having more old structure in which include old wooden structures, steel with wooden structure, load bearing laterite structure and R.C.C. frame structures etc.

Main reason for selecting these area is that the 2nd Asian hydro power electric generation plant is situated in a Pofali. More than 2000 peoples are coming from outside for the jobs and they are leaving in this village, and to ensure there safety this study is prepared.

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B. Methodology

The evaluation is based on a few parameters of buildings. The parameters of the buildings are building height, frame action, pounding effect, structural irregularity, short columns, heavy overhang, soil conditions, falling hazard, apparent building quality, diaphragm action etc. On the basis of above mentioned parameters, performance score of the buildings has been calculated. The data collection form is completed for each building screened through execution of the following steps:

1) Verifying and updating the building identification information.
2) Walking around the building to identify its size and shape, and sketching a plan and elevation view on the data collection form.
3) Determining and documenting occupancy.
4) Determining soil type, if not identified during the preplanning process.
5) Identifying potential non-structural falling hazards, if any, and indicating their existence on the data collection form.
6) Identifying the seismic lateral-load resisting system (entering the building, if possible, to facilitate this process) and circling the related basic structural hazard score on the data collection form.
7) Identifying and circling the appropriate seismic performance attribute score modifiers (e.g., number of stories, design date, and soil type) on the data collection form.
8) Determining the final score, S and deciding if a detailed evaluation is required.
9) Photographing the building and attaching the photo to the form (if an instant camera issued), or indicating a photo reference number on the form.

For present study more than 46 buildings form market area at Chiplun which includes load bearing structure, R.C.C. structure, steel structure and wooden structure are visually observed.

According to the study and preparing the RVS form filled with proper notification. After filling the form calculate the final score. This final score finalized that the building required detailed investigation or not required detailed investigation.

IV. FIELD SURVEY

A. Example 1- MSCB Godown

Fig 4.1 MSCB Godown

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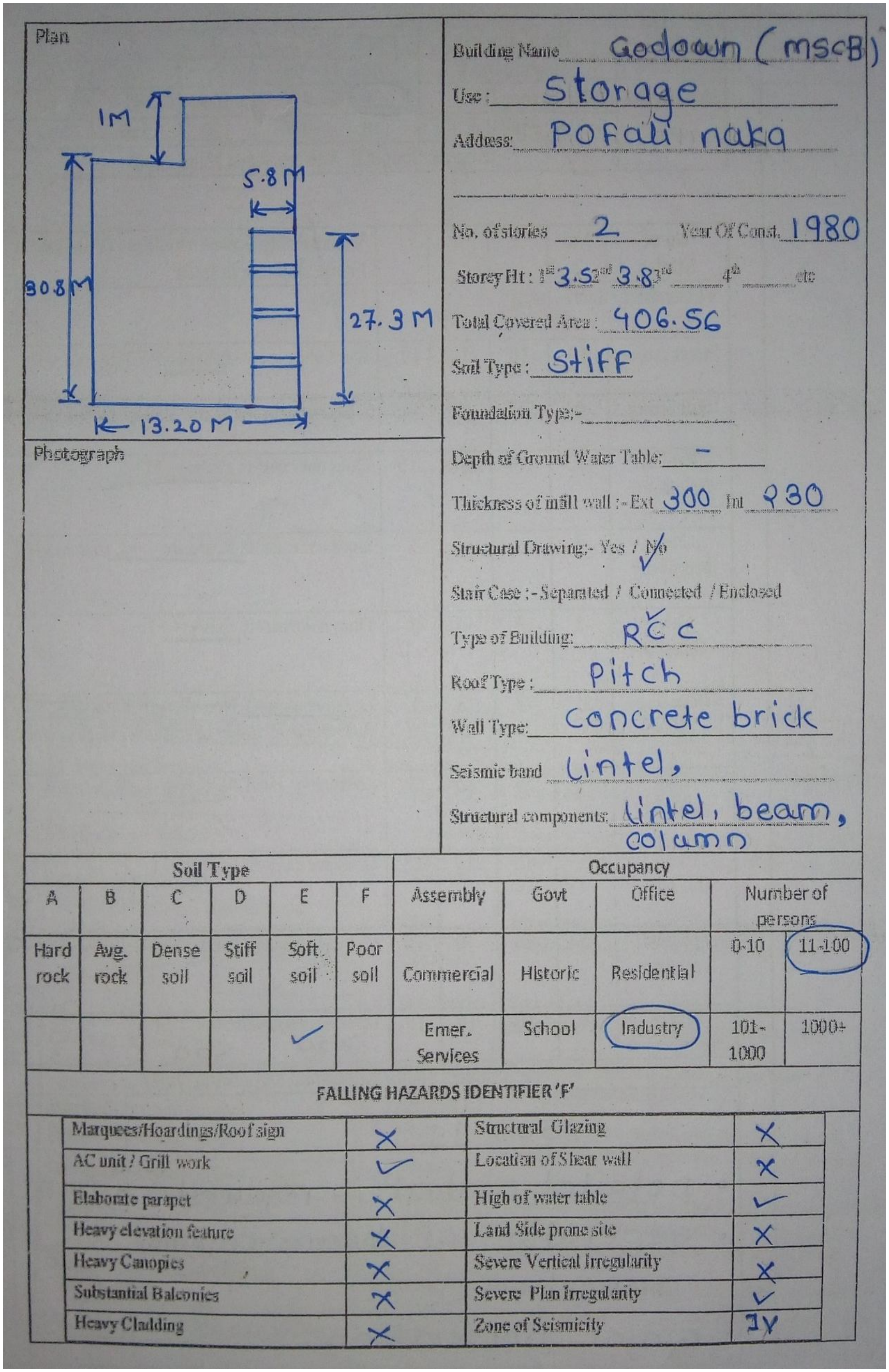
B. Screening Form



Plan

1M | 5.8 M | 30.8 M | 27.3 M | 13.20 M

Photograph

Building Name: Godown (MSCB)

Use: Storage

Address: Pofali naka

No. of stories: 2   Year Of Const. 1980

Storey Ht: 1st 3.5 2nd 3.8 3rd ___ 4th ___ etc

Total Covered Area: 406.56

Soil Type: Stiff

Foundation Type:- ___

Depth of Ground Water Table: -

Thickness of infill wall :- Ext 300 Int 230

Structural Drawing:- Yes / No

Stair Case :- Separated / Connected / Enclosed

Type of Building: RCC

Roof Type: Pitch

Wall Type: concrete brick

Seismic band: Lintel,

Structural components: lintel, beam, column

Soil Type						Occupancy				
A	B	C	D	E	F	Assembly	Govt	Office	Number of persons	
Hard rock	Avg. rock	Dense soil	Stiff soil	Soft soil	Poor soil	Commercial	Historic	Residential	0-10	11-100
				✓		Emer. Services	School	Industry	101-1000	1000+

FALLING HAZARDS IDENTIFIER 'F'

Marquees/Hoardings/Roof sign	X	Structural Glazing	X
AC unit / Grill work	✓	Location of Shear wall	X
Elaborate parapet	X	High of water table	✓
Heavy elevation feature	X	Land Side prone site	X
Heavy Canopies	X	Severe Vertical Irregularity	X
Substantial Balconies	X	Severe Plan Irregularity	✓
Heavy Cladding	X	Zone of Seismicity	IV

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Base Scores (BS) and Vulnerability Scores (VS) for RC Frame Buildings in India

Base Score	No of Stories	1 or 2	3	4	5	>5	130
	Seismic zone V	100	90	75	65	60	
	Seismic zone IV	(130)	120	100	85	80	
	Seismic zone II & III	150	140	120	100	90	
	(Source: Sudhir K. Jain and Keya Mitra 2008)						

No of Stories	1 or 2	3	4	5	Vulnerability Scores Modifiers (VSM) for RC Frame Building in India	(VS) x (VSM)
Vulnerability Scores (VS)					(VSM)	
Frame Action	10	10	10	10	Does not exist = -1; Exists = 1, Not sure = 0	10
Soft Storey	0	-15	-20	-30	Does not exist=0; Exists = +1	0
Vertical Irregularity	-10	-10	-10	-10	Does not exist=0; Exists = +1	-10
Plan irregularity	-5	-5	-5	-5	Does not exist=0; Moderate = +1, Extreme=+2	-5
Short Columns	-5	-5	-5	-5	Does not exist=0; Exists = +1	-5
Pounding Effect	0	-2	-3	-3	Does not exist=0, Non-aligned Floors=+2, Poor apparent quality of adjacent buildings = +2	0
Soil condition	10	10	10	10	Medium=0, Hard =1, Soft = -1	-10
Heavy Overhang	-5	-10	-10	-15	Does not exist=0; Exists = +1	-5
Apparent quality	-5	-10	-10	-15	Good=0, Moderate=+1, Poor=+2	-10
Year of construction	-5	-10	-10	-15	Does not exist=0; Exists = +1 >50 <50	0
(Source: Sudhir K. Jain and Keya Mitra 2008)						
COMMENT 130 > 95 • Detailed evaluatn is required • seperation of beam coloumn connection • major detoriation.					Performance score ∑BS + ∑{(VS) x(VSM)}	95

B. Detailed photographs

C. Comment

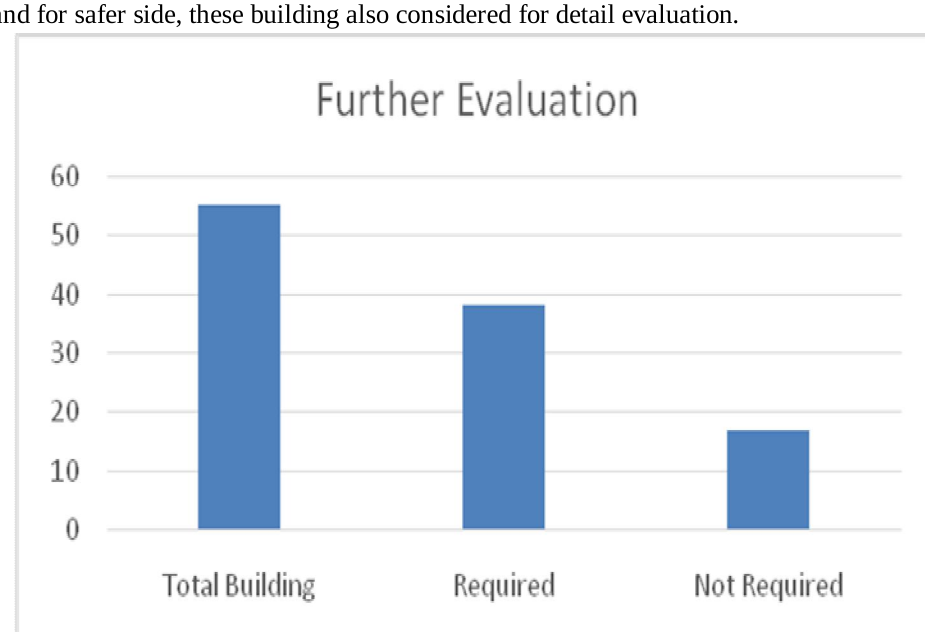
The said structure is RCC structure. There are two buildings attached together one is RCC structure and another is Steel structure which is connected to the each other. The structure is constructed in year 1980. The condition of the structure is very bad in appearance (fig-1). In a building observe plan and vertical irregularities (fig-2) which make structure instable for earthquake. The condition of the roofing is quite bad. Many of the sheets are breaks. In the building observe that dislocking of beams and column (fig-3), crakes in wall as well as in plaster. Condition of Door and window are not good. The bulking of columns is also observed during the survey. The said structure does notseen to be suitable for any use. The performance score is less than basic score, so building required detailed investigations.

V. RESULT AND CONCLUSION.

An attempt has been made to do rapid visual screening of RCC building and Load bearing building which available in Pofali. RVS score has calculated for 60 buildings and plotted normal distribution Graph for each typology of building to understand the distribution of RVS score of buildings in Pofali.

From the study it is concluded that total 31 buildings out of 55 requires detail evaluation for its further use and 24 buildings does not required any detail evaluation at current stage.

Out ofthese 24 buildings, 7 buildings satisfy the performance score equal to the basic score but considering the falling hazards, non-structural deficiency and for safer side, these building also considered for detail evaluation.



V. ACKNOWLEDGEMENT

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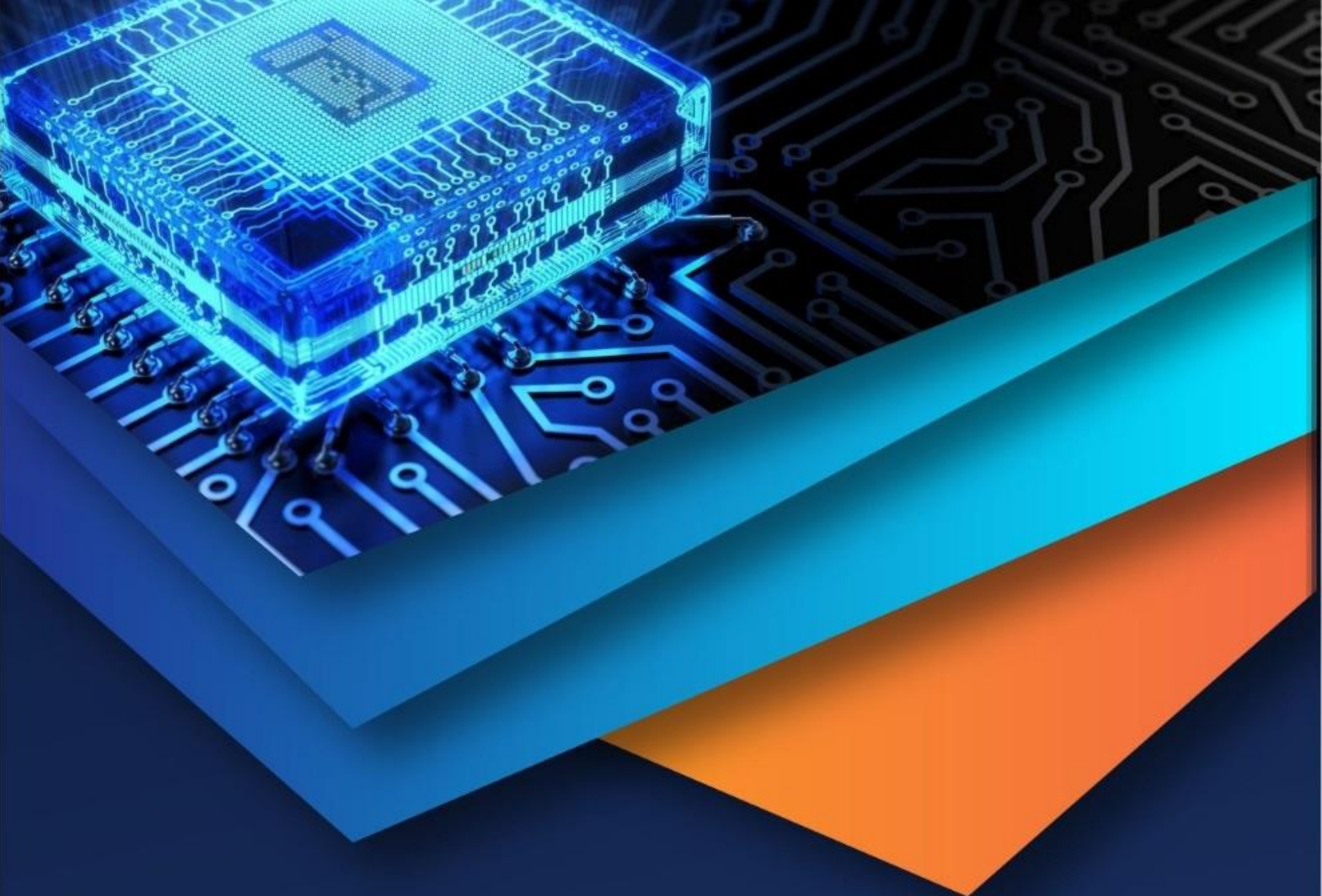

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