



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 8, August 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Effect of Lateral Loading on Multi-storied Building with Diaphragm Discontinuity

Vishal Kale ¹, Vishwajeet Kadlag ²

P.G. Student, Department of Civil Engineering, Dr. D Y Patil School of Engineering and Technology, Charholi (BK), Pune, Maharashtra, India¹

Associate Professor & PG Coordinator, Department of Civil Engineering, Dr. D Y Patil School of Engineering and Technology, Charholi (BK), Pune, Maharashtra, India²

ABSTRACT: Diaphragms play a vital role in the structural response to seismic forces by distributing lateral loads across the building. However, diaphragm discontinuity, characterized by interruptions or irregularities in diaphragm connectivity, can significantly impact the building's overall seismic performance. The proposed study aims to investigate the effect of lateral loading on multi-storied buildings with diaphragm discontinuity. This study seeks to comprehensively study the behaviour of multi-storied buildings with diaphragm discontinuity under lateral loading, focusing on parameters such as base shear, story, storey drifts, and story displacements. The research will utilize analytical modelling of G+10 Building with various Percentages of Diaphragm Discontinues using ETABS, incorporating the lateral loading provisions of relevant codes and standards.

KEYWORDS: Diaphragm Discontinuity, Irregularities, Seismic Analysis, Response Spectrum.

I. INTRODUCTION

Today, many buildings have irregular designs in both plan and elevation. The amount of land that can be used for construction is limited today due to the rapid growth of urbanization and the development of modern cities, and the high cost of land makes it necessary to build tall structures to accommodate amenities like parking, a clubhouse, etc., which results in irregularities in the structure. Buildings with unequal stiffness and mass distribution, as well as many other structures today, are more likely to sustain extremely severe earthquake damage. Such structures experience torsional movement. An ideal multi-story structure would have symmetrical distributions of mass and stiffness in plan at each level and a consistent distribution along the height of the building in order to resist lateral stresses brought on by earthquakes. Such a structure would only move laterally and is known as a balanced torsional structure. However, due to limitations like functional needs and architectural specifications, it is highly challenging to establish such a state.

Diaphragm irregularity: Diaphragm irregularities occur when the diaphragm, which serves as the horizontal load-carrying system, has openings, discontinuities, or variations in stiffness.

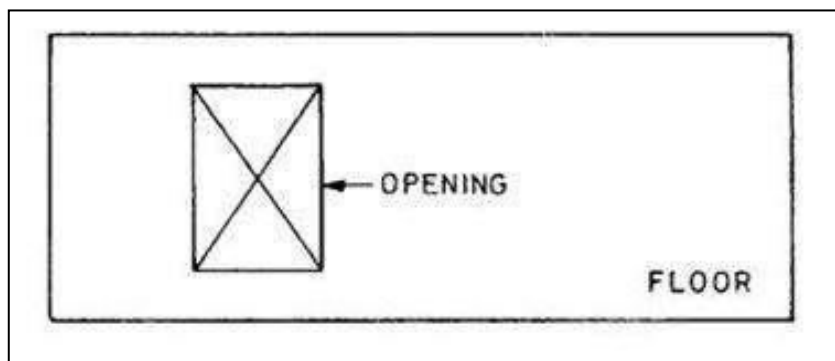


Figure 1.1. Diaphragm Discontinuity

II. OBJECTIVE OF THIS STUDY.

- a. To analyze the behavior of a G+10 storied building with and without diaphragm discontinuity under lateral loading.
- b. To make a RC Frame structural model with different percentage of diaphragm discontinuities i.e. 25 % and 50% using Etabs.
- c. To investigate into the variation in base shear, story shear, storey drifts, and story displacements under earthquake and Wind loads.
- d. To develop suggestions for selecting diaphragm discontinuity in accordance with the results of the study

III. RELATED WORK

[1]“Effect of Diaphragm Openings in Multi- storeyed RC framed buildings using Pushover analysis” P.P. Vinod Kumar, Dr. V.D. Gundakalle. This study uses ETABS-2013 in a modest attempt to portray the behaviour of multiple-story buildings with diaphragm openings during non-linear static (pushover) analysis. For seismic metrics such maximum dead load, base shear, maximum storey drifts, modal time period, and pushover outcomes, multiple models with different percentages of diaphragm openings were examined and compared in order to achieve these objectives. This research is being done to assess any issues with how buildings would behave structurally during earthquakes this study might be helpful in understanding the structures non-linear response. The building will undergo linear static, linear dynamic, and non-linear static analyses as part of the aforementioned seismic analysis.

[2] “Analysis of Buildings with Varying Percentages of Diaphragm” Arya V Manmathan, Aiswarya S. In this work, buildings with variously shaped columns have apertures in the slabs at various positions, including the core, the corners, and the periphery. Investigated were the impacts of the size of the openings in the slabs. Using the ETABS software's Response Spectrum analysis, multistory typical buildings' seismic performance is assessed.

[3] 'Effect of Diaphragm Discontinuity of the Building' Rajesh Kadiyala and Tejaswi Kota. The computer programme SAP2000 (V14) is used to simulate conventional G+5 reinforced concrete (RC) structures with and without diaphragm discontinuity. These structures were eventually altered to become irregular in both plane and elevation. Responses parameters such as stiffness, story displacement, drift, and forces are computed for two building layouts and compared. Although there is no discernible difference across historical periods, it has been shown that irregular structures have a bigger contribution of Responses quantities from higher modes. An analysis of story drift and displacement entities provides insight into the assault on earthquake-prone structure.

IV. METHODOLOGY

Following methodology was applied for this study.

1. Literature Review.
2. Building Selection and modelling.
3. Load Application.
4. Analysis and Results.
5. Data Analysis and interpretation.
6. Conclusion and Discussion.

For this current study following model are considered and modeled in ETABS 21.

Model A1 - G+10 RCC Frame with Regular Structural Configuration

Model A2 - G+10 RCC Frame with 25% Diaphragm Discontinuity

Model A3 - G+10 RCC Frame with 50% Diaphragm Discontinuity

Sr. no	Parameter	Description
1	Plan Area	Approx. 195 Sqm.
2	Number of Storey	G+10
3	Total Height of Structure	35m
4	Height of each storey	3m
5	Column Size	400mm x 400mm
6	Building Type	Public Building
7	Beam size	230mm x 450mm
8	Slab Thickness	150 mm
9	Grade of Concrete	M30
10	Grade of Steel	Fe500
11	Seismic Zone	Zone III
12	Importance Factor	1.2
13	Response Reduction factor	5
14	Wall Load on beam	7.65 Kn/m
15	Live Load	4 Kn/m ² .
16	Floor Finish	1.5 Kn/m ² .

Table 4.1: Specification used in Models

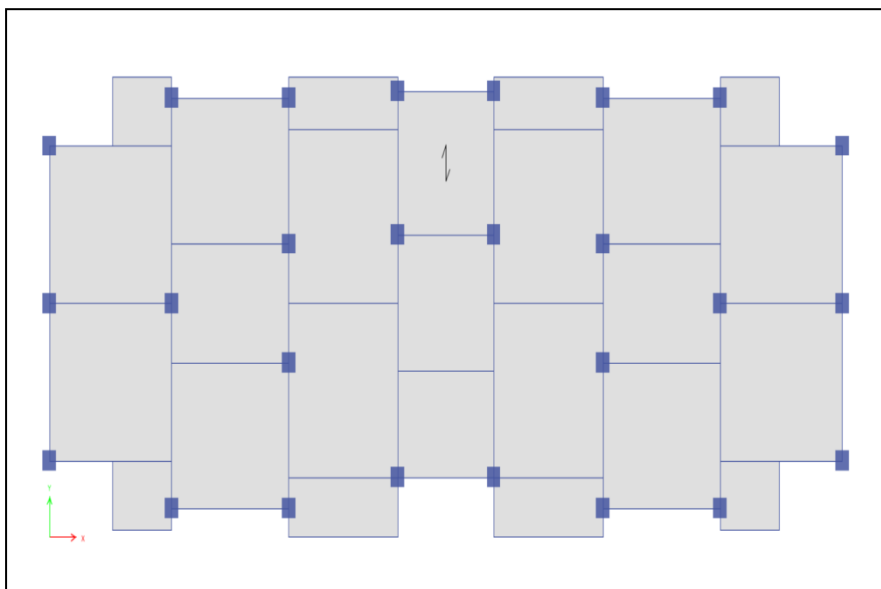


Figure 4.1: Plan for G+10 storied building without diaphragm discontinuity (Model A1)

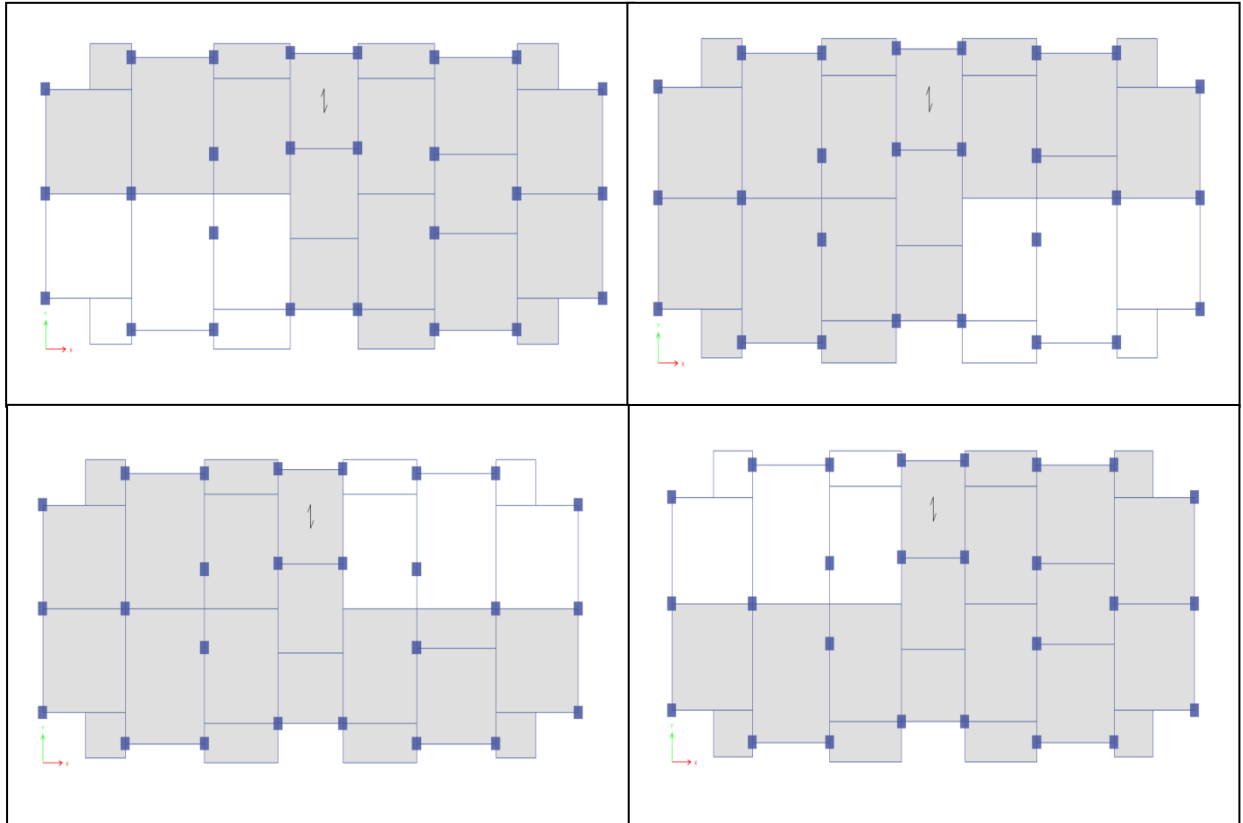


Figure 4.2: Plans for G+10 storied building with 25% diaphragm discontinuity
At each alternate floor (Model A2)

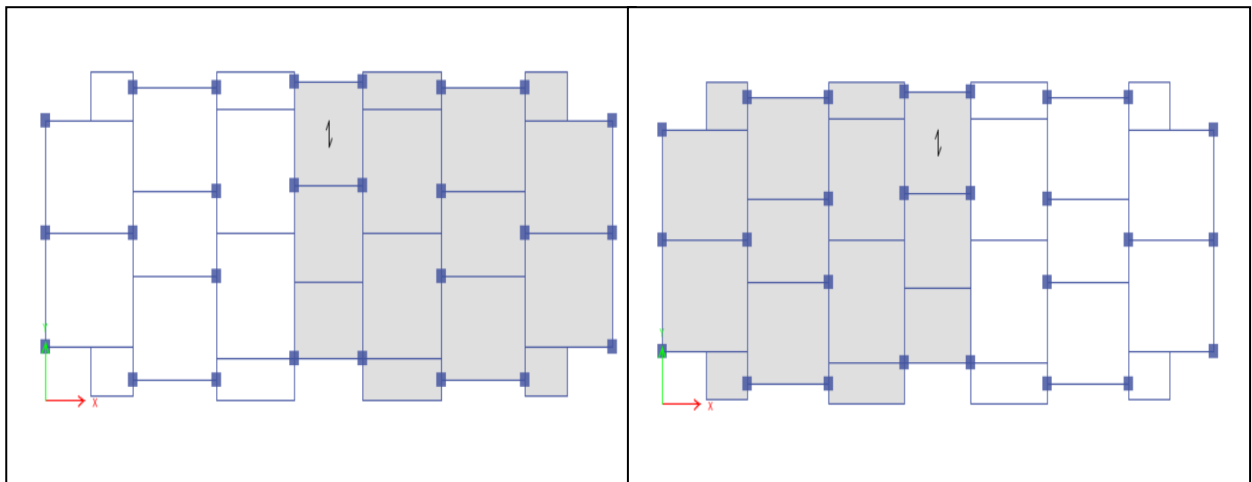


Figure 4.3: Plans for G+10 storied building with 50% diaphragm discontinuity
At each alternate floor (Model A3)

V. EXPERIMENTAL RESULTS

5.1 Maximum Storey Displacement

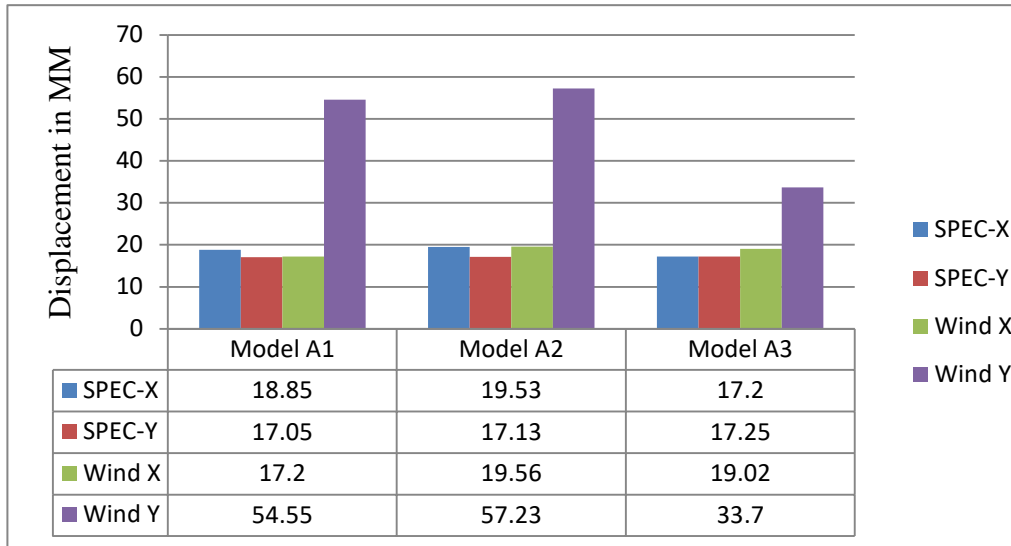


Figure 5.1: Comparison of storey displacement.

It can be observed that the maximum storey displacement can be seen in Model A2 as compared to other models under both wind as well as seismic loading condition. The displacement is increased by 3-5% for response spectrum results and about 12% for wind loading.

5.2 Maximum Base Shear.

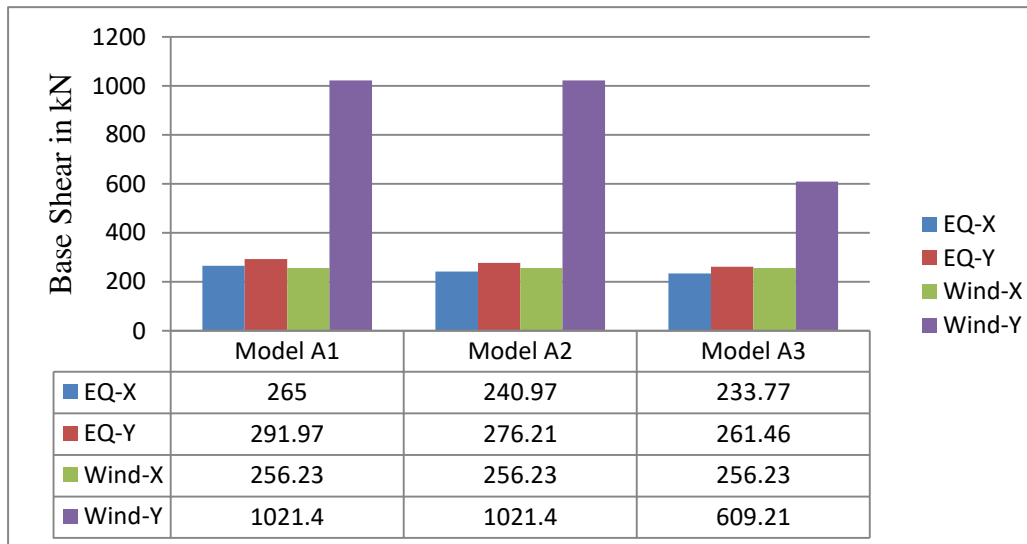


Figure 5.2: Comparison of base shear

The above graph shows the base shear of all different models, the maximum base shear is found in Y direction due to wind loading. With increase in percentage of opening in the diaphragm the base shear decrease.

5.3 Maximum Storey Drift

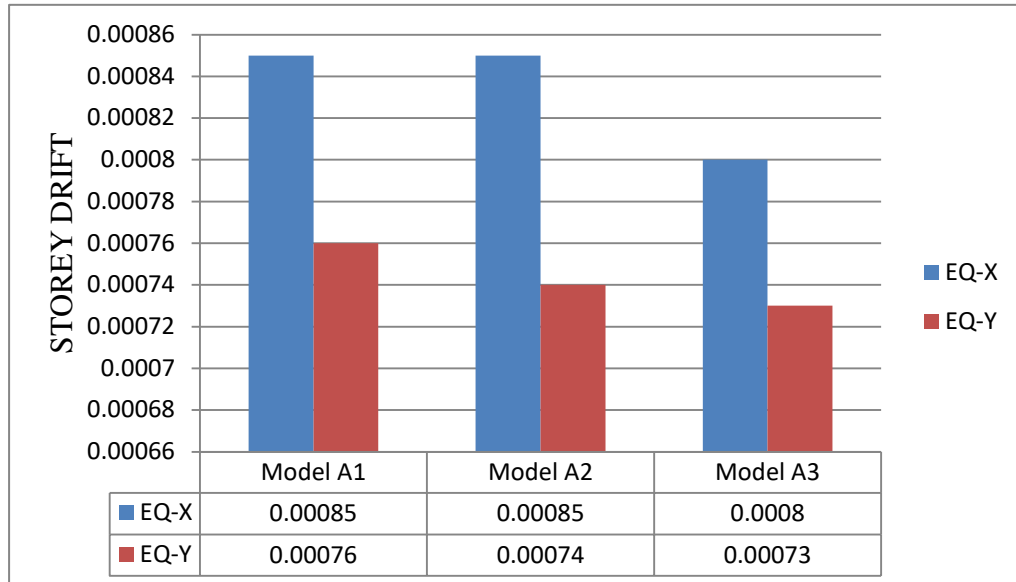


Figure 5.3: Comparison of maximum storey drift

The above graphs show the maximum storey drifts for different models. It can be seen that there is not much change in the drift results between model A1 and A2 for both load cases EQ-X and EQ-Y but the drift result decreases by 2-5% in model A3 for both load case

5.4 Time Period

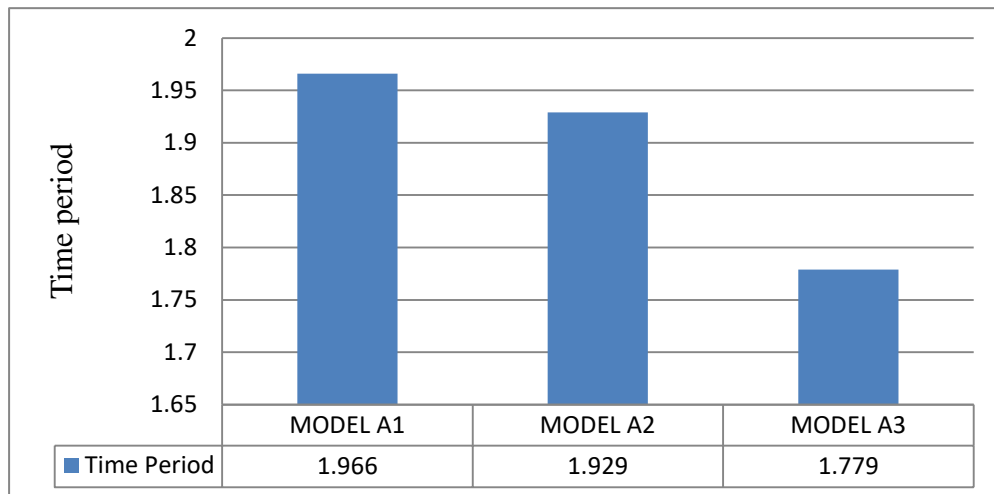


Figure 5.4: Comparison of Time period

It has been found that approx 10% decrease in time period with increase in percentage of diaphragm opening.

VI. CONCLUSION

- From the graphical representation of storey displacement for different models, the maximum displacement is seen in model A2.
- It is observed that with increase in percentages of opening the base shear decreases.
- It is seen that there is not much change in the base shear due to wind X of all the model but the base shear drop by 40% in model A3 in Wind Y load case.
- Diaphragm discontinuity does not affect the storey drift result in G+ 10 storied structures.
- Time period for the 1 mode in decreases by approximately 10% in model A3, which means Model A3 is less stiff as compared with other models.
- From the above observations we can say that among both the models with diaphragm discontinuity, Model A2 i.e Model with 25% discontinuity perform well as compared with model A3 i.e model with 50% discontinuity.

REFERENCES

- [1] "Effect of Diaphragm Openings in Multi- storeyed RC framed buildings using Pushover analysis" P.P. Vinod Kumar, Dr. V.D. Gundakalle. A. Volume 02, Oct 2015.
- [2] "Analysis of Buildings with Varying Percentages of Diaphragm" Arya V Manmathan, Aiswarya S. Vol.6 Issue 06, June -2017.
- [3] 'Effect of Diaphragm Discontinuity of the Building' Rajesh Kadiyala and Tejaswi Kota. , Volume 06 Issue 09, September 2016.
- [4] Shahbaz Khan, Dr. V. G. Sayagavi, N. G. Gore, 'Seismic Analysis Of Multi-Storey Building Of Different Shapes Having Diaphragm Discontinuity', March 2019, Volume 6.
- [5] Nemali Deepika, K.Sai Santosh, 'Effect of Diaphragm Discontinuity in the Seismic Response of Multi-Storeyed Building', Volume-III, OCTOBER-2016
- [6] Babita Elizabeth Baby, Sreeja S (2015) Volume-2 on Analysis of Buildings with Slab Discontinuity'.
- [7] Shahbaz Khan, Dr. V. G. Sayagavi, N. G. Gore, 'Seismic Analysis Of Multi-Storey Building Of Different Shapes Having Diaphragm Discontinuity', March 2019, Volume 6.
- [8] Momen M. M. Ahmed, Shehata E. Abdel Raheem, Mohamed M. Ahmed and Aly G. A. Abdel-Shafy (2016) submitted a paper on 'Irregularity effects on the seismic performance of L-shaped multi-story buildings'.
- [9] "Influence of Discontinuous Diaphragm Characteristics on The Seismic Behaviour of Irregular RC Structure using ETABS" Phadatare Pushpa P., Kadlag Vishwajeet., Volume 10 Issue V May 2022



SJIF Scientific Journal Impact Factor

Impact Factor: 8.423



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details