

**FINITE ELEMENT ANALYSIS OF REINFORCED CONCRETE SLAB WITH AND WITHOUT OPENING****Dr. Mohammad Zuhair<sup>1</sup>, Nilesh P Bhopale<sup>2</sup> and Dr. Sachin S Saraf<sup>3</sup>**<sup>1</sup> Department of Civil Engineering, P.R.Pote Patil Wel Trust's Group of Edu Instt. College of Engineering & Management, Amravati, Maharashtra, India<sup>2,3</sup> Department. of Civil Engineering, P.R.Pote Patil Wel Trust's Group of Edu Instt. College of Engineering & Management, Amravati, Maharashtra, India**ABSTRACT**

*In this paper the reinforced concrete one way slab is analyzed using finite element analysis ansys 19. The strength in various aspects such as bending, shear plays critical role during life span of structure. After construction any changes due to the service requirements alter the structural parameters of these members. Openings in reinforced concrete slabs are essential for stairs, elevators or any other services such as air heating, wiring, conditioning ducts. The presence of the opening in reinforced concrete slabs could result in clear reduction in the slab strength and rigidity. These needs to be properly analyzed to avoid the failures. The reinforced concrete slab with and without opening is modelled and analyzed in ansys 19 workbench for normal stress, shear stress and deflection. It was found the values of normal stress, shear stress, deflection and principal stress are increasing in the case of slab opening. It was concluded that the any alteration to the structural members result in strength reduction.*

*Keywords: RC slab , opening ,ansys, stresses*

**INTRODUCTION**

The various reinforced concrete roofing systems are available as per the requirement which includes economy, aesthetics and other parameters. It includes reinforced concrete one way; beam supported two way and flat slabs. Apart from all the relevant considerations of importance structural stability plays a crucial role in the structural design of these elements. One of the conventional roofing adopted systems is the inclusion of beams between columns to support the slab which provides the required structural stability.

Openings in reinforced concrete slabs are essential for stairs, elevators or any other services such as air heating, wiring, conditioning ducts. The presence of the opening in reinforced concrete slabs could result in clear reduction in the slab strength and rigidity [1]. The finite element method is a numerical technique of solving differential equations describing a physical phenomenon. It is a convenient way to find displacements and stresses of structures at definite physical coordinates called nodes. The structure to be analyzed is discretized into finite elements connected to each other at their nodes [2]. With the introduction of advanced computers, Finite Element Analysis became a popular tool to analyze and design complicated structures. The finite element analysis software ANSYS was employed to model the two-way reinforced concrete slab in order to determine the failure pattern and load displacement behavior when subjected to different boundary conditions and loading [3]. ANSYS software allows specifying parameters such as geometry parameters, material properties and boundary conditions.

**METHODOLOGY**

A reinforced concrete (RC) slab of dimension 4m x 4.5m with thickness of 150 mm is modelled in ansys 19 workbench. The reinforcement bar of 10 mm diameter with 150 mm spacing is modelled with fixed support condition. The force of 200 kN is applied to check the behaviour of RC slab in terms of normal stress, shear stress and deflection. The first case considered is the RC slab without opening and in the second case a opening of 150 mm is made in the negative moment region of the RC slab. These models were analyzed in ansys 19 workbench. The material properties are described in the analysis part.

RESULTS

The following results were obtained for the RC slab cases discussed above and found as under.

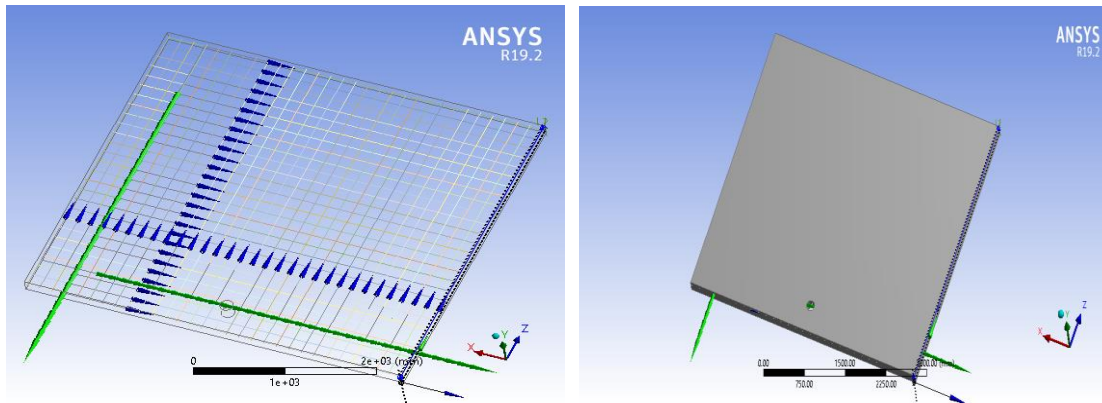


Figure 1-Geometry of RC slab with opening

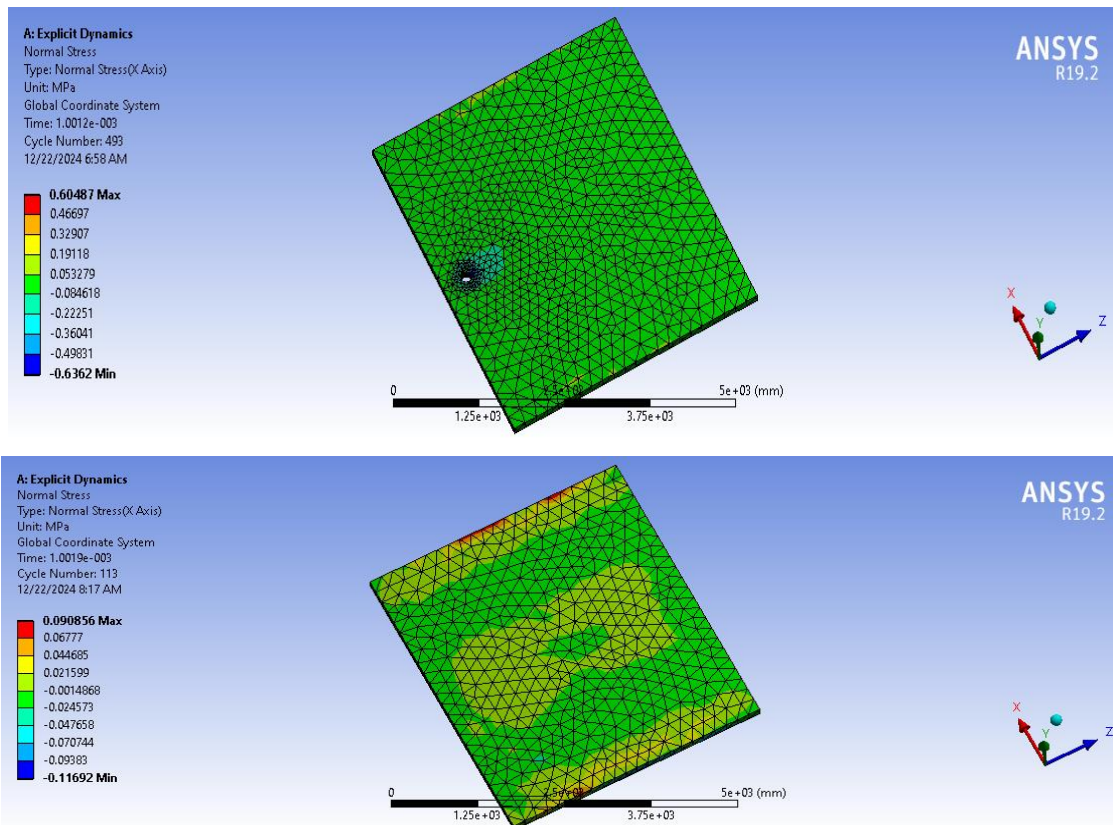


Figure 2- Normal stress in RC slab

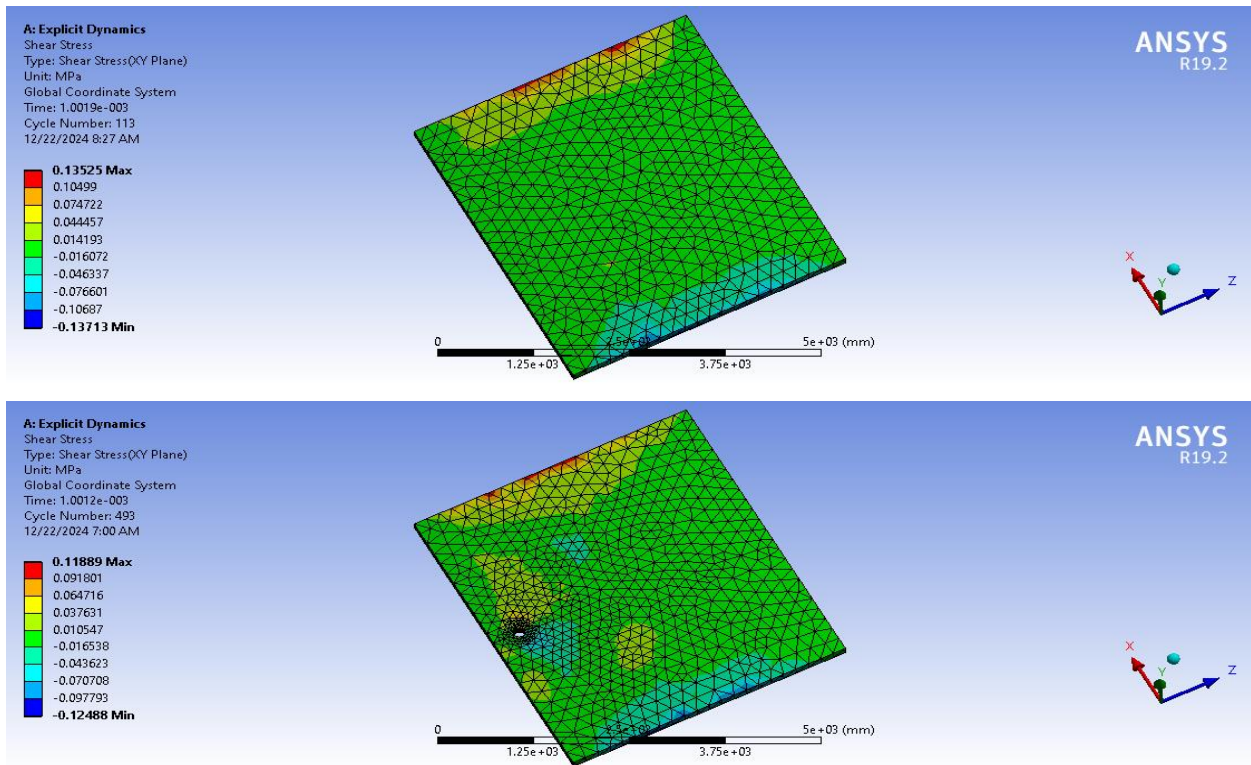


Figure 3- Shear stress in RC slab

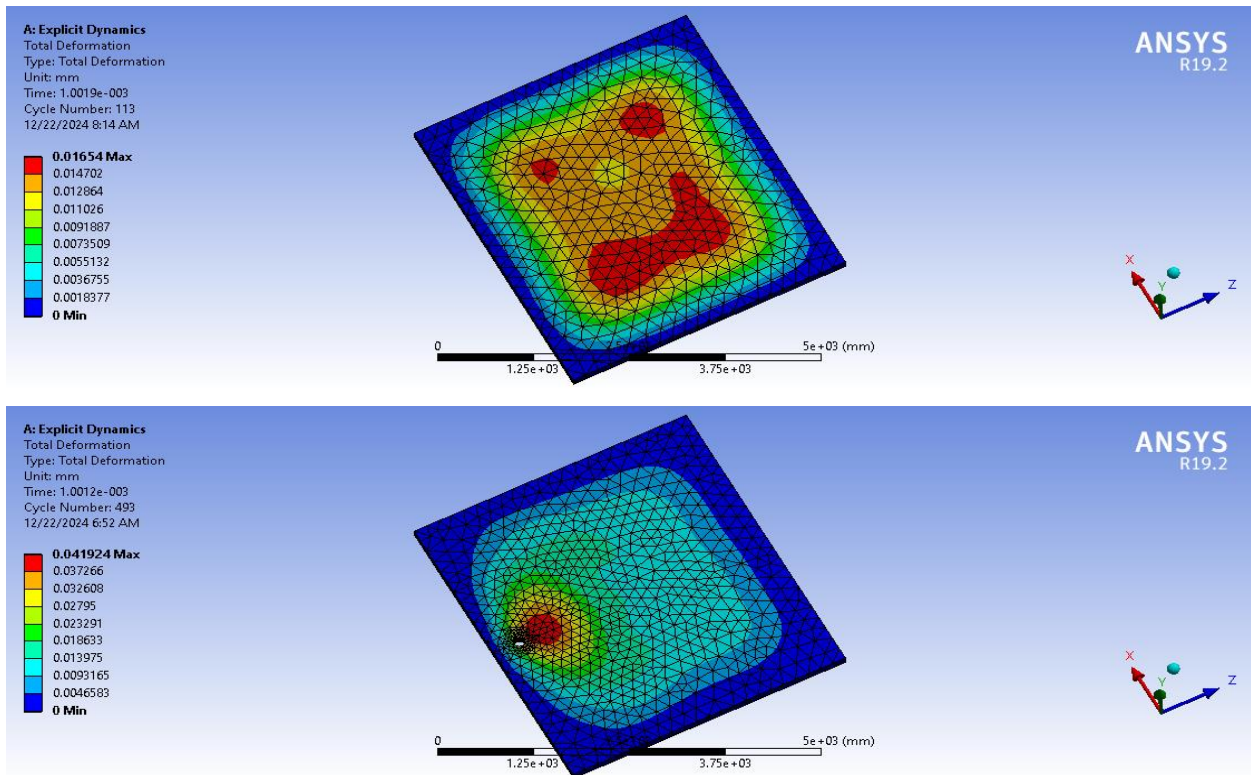


Figure 4- Total Deformation in RC slab

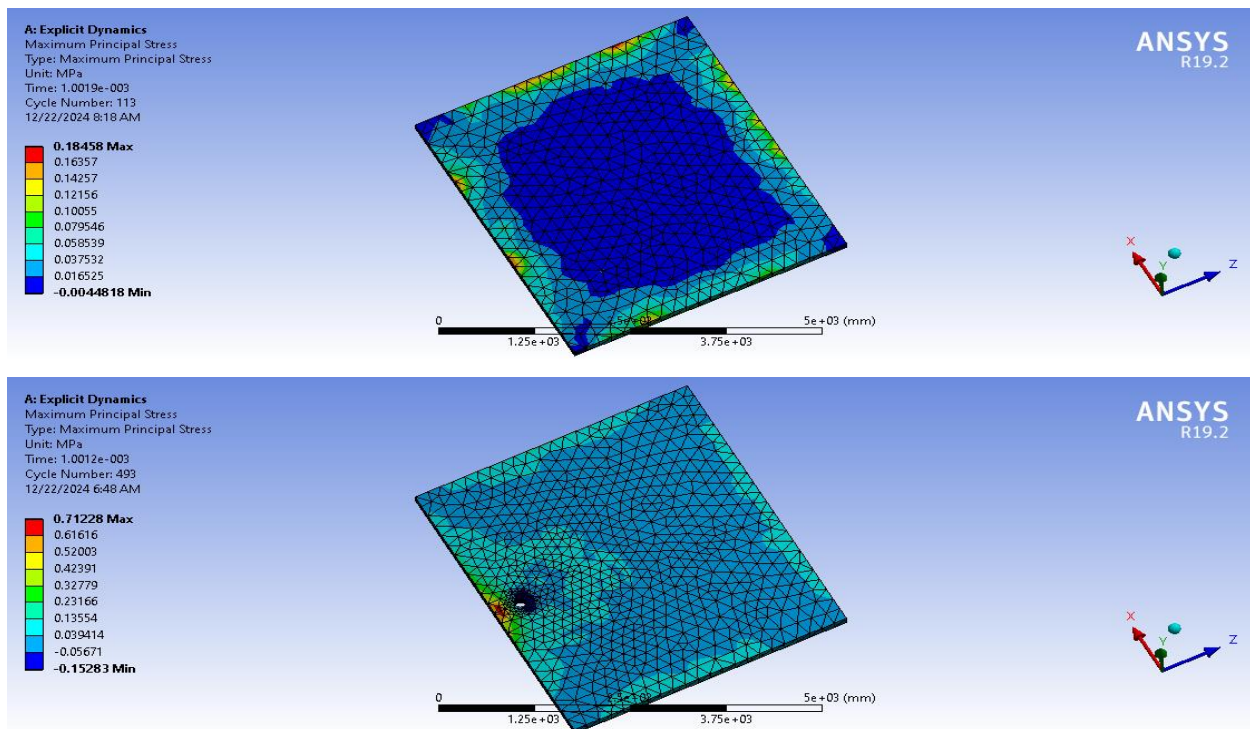


Figure 5- Maximum principal stress in RC slab

## CONCLUSIONS

The analysis of RC slabs using ansys revealed the following results

- The normal stress for the slab without opening near the support is found to be 0.024Mpa and for the slab with opening is 0.36 Mpa. The increase in the stress shows the reduction in the slab strength due to opening and carefully to be addressed.
- The shear stress for the slab without opening near the support is found to be 0.016 Mpa and for the slab with opening is 0.043 Mpa. The increase in the shear stress shows the reduction in the slab strength due to opening.
- The total deformation for the slab without opening near the support is found to be 0.0073 mm and for the slab with opening is 0.041 mm. the deflection is increased in the case of opening.
- The maximum principal stress is found to be increase in in case of slab with opening.

## REFERENCES

1. Wissam D. Salman, Ahmed Abdullah Mansor , Mohammed Mahmood (2018) Behavior Of Reinforced Concrete One-Way Slabs Strengthened By Cfrp Sheets In Flexural Zone ,International Journal of Civil Engineering and Technology (IJCIET) ,Volume 9, Issue 10, pp. 1872–1881, Article ID: IJCIET\_09\_10\_186
2. Shivakumar V Poojar, T. Geetha Kumari,(2015), Non Linear Finite Element Analysis of SFRSCC and SFRNCC One Way Simply Supported Slabs In Flexure using ANSYS, International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 04
3. A. Gherbi, L. Dahmani, A. Boudjemia (2018) , Study on Two Way Reinforced Concrete Slab Using ANSYS with Different Boundary Conditions and Loading ,World Academy of Science, Engineering and Technology International Journal of Civil and Environmental Engineering Vol:12, No:12

*International Journal of Applied Engineering & Technology*

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4. Ali M. Al-hafiz, Salam S. Chiad, Mohannad S. Farhan ,(2013), Flexural Strength of Reinforced Concrete One-Way Opened Slabs with and without Strengthening , Australian Journal of Basic and Applied Sciences, 7(6): 642-651, 2013
5. Waleed Khalid Hadi , Majid Muttashar, Effects of Opening on Load Carrying Capacity of Reinforced Concrete Slabs: Analytical Study (ICSET 2020), 3rd International Conference on Sustainable Engineering Techniques IOP Conf. Series: Materials Science and Engineering 881 (2020) 012043 IOP Publishing doi:10.1088/1757-899X/881/1/012043
6. Dina Hassan, Ata El-kareim Shoeib, Magdy M.Genidy & Sherif F.M. Abd Elnaby , The Effect of Introducing Openings of Different Shapes on the Behavior of Two Way Solid Loaded Slabs ,(2017),ICASGE'17.
7. Sunil kumar M. S. , B. S. Suresh Chandra ,(2014) , Experimental Study on Self Compacting RC Slab With and With Out Opening , International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 8.
8. Taehun Ha, Myung-Ho Lee, Jonghwan Park and Dae-Jin Kim ,(2015), Effects of openings on the punching shear strength of RC flat-plate slabs without shear reinforcement , Struct. Design Tall Spec. Build.; 24:895–911