International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 08 | Aug 2023 www.irjet.net p-ISSN: 2395-0072

Analytical study on behaviour of RCC Solid Wall panel and RCC Central opening Wall panel when subjected to Uniformly distributed loading

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Abstract

This analytical study investigates the behavior of Reinforced Concrete (RCC) solid wall panels and RCC wall panels with central openings under Uniformly distribute loading conditions. The study is done using ETABS software, to simulate the response of these structural elements and analyze their performance in terms of load deflection curve, stress contour.

The central objective revolves around comprehending the dynamic characteristics of both solid and perforated wall panels in the context of Uniformly distributed loading scenarios that emulate real-world seismic occurrences and other dynamic forces. The study further incorporates systematic variations in opening and their impact on the structural response.

Additionally, the study highlights the significance of stress contours in comprehending the behavior of these wall panels under Uniformly distributed loading. Contours provide a visual representation of stress distribution across the panels. Using ETABS software, this study shows the advanced computational tools in predicting and visualizing complex structural responses,

The outcomes of this study hold practical implications for structural engineers and designers, providing the behavior of RCC wall panels under Uniformly distributed loading. Furthermore, the emphasis on stress contours emphasizes their role in interpreting stress distribution, enabling perfect decision-making during the design and assessment phases of structural projects

Keywords: RC Solid wall panel, RC Wall Panel with Central Opening, Ultimate Load, load deflection, Stress Contour, E-tabs

1. INTRODUCTION

In structural engineering, understanding the behavior of reinforced concrete (RCC) wall panels under dynamic loading conditions is of paramount importance to ensure the safety and resilience of built structures. As the modern construction evolves to address very different architectural and functional requirements, the performance of different wall panels configurations becomes a critical focal point. This analytical study begins on a comprehensive investigation into the behavior of two distinct types of RCC wall panels solid panels and panels featuring central opening, under Uniformly distributed loading.

Underpinning this research is the application of advanced computational tools, with a primary emphasis on the utilization of the finite element analysis ETABS software. This tool serves as the means to intricately simulate and analyze the performance of the RCC wall panels. By testing these panels under Uniformly distributed loading, the study aims to unravel essential facets, including deformation characteristics, stress propagation, and response of the structural systems.

In conclusion, this research makes an exact contribution to the existing knowledge in the field, offering practitioners invaluable insights into the dynamic responses of RCC wall panels when subjected to Uniformly distributed loading conditions.

2. OBJECTIVES

- The main objective of this analysis is to compare both RC Solid wall panel and RC Wall panel with Central Opening when load is given axially on the wall panel.
- To compare the two-wall panel performance in terms of load-carrying capacity, displacement and how the stress is distribution.
- Analysis will be performed using finite element software E-tabs.

3. LITERATURE REVIEW

R.K.L. Su, S.M. Wong (2016) conducted an experimental study on three reinforced concrete (RC) wall panel specimens to study the effects of axial load. The walls in the form of a slender vertical cantilever, fabricated with HSC and HLR, were tested. The effects of ALR and confinement on failure, ductility, strength degradation, and axial load capacity were critically examined.

N. Ganesan 1, P.V. Indira (2013) Here wall panels were casted with Ordinary Portland Cement (OPC) and was tested UDL axial load in one-way plane action. This method was proposed to forecast the ultimate load of OPC.

Junfeng Cheng 1, Xiaoyong Luo 1,2 et al (2022) Here the pseudo-static loading has been conducted on the specimens to investigate the axial compression ratio. Analysis was also conducted to know the load deflection behaviour, cracking pattern and stress distribution.

4. FINITE ELEMENT MODELLING

4.1 General

An RC Solid wall panel and RC Wall panel with central Opening is analyzed using E-tabs software and both panels of sizes are 905*100*980mm and central opening of size of one panel is 410*456mm.

4.2 Overview of the Prototype

Here the panels are subjected to Uniformly distributed load of axially loaded and these two panels were evaluated under Uniformly distributed loading. These panels are placed 400mm above the ground level for testing process.

4.3 Model

The wall panel cross section is 905mm width, 100mm thickness, 980mm height. M20 grade of concrete and Fe415 steel is used for all wall panels and 25mm of cover is provided all sides. 10mm diameter of bars were provided to all wall panels, and a spacing of 160mm at shorter direction and 175mm spacing in longer direction.

4.4 Material property

The Young's modulus of concrete defined was 22360.68 N//mm2, Poisson ratio was 0.2. Modulus of elasticity of steel was 200000 N/mm2 & Poisson ratio was 0.3.

4.5 Autocad drawing

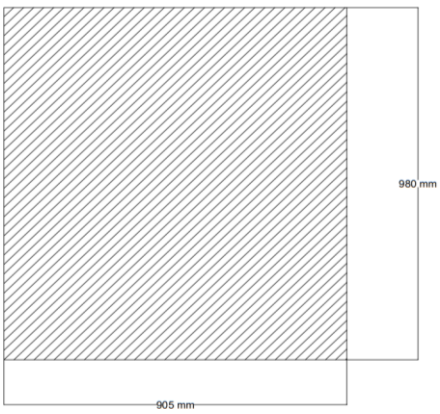

Fig-1: RC Solid wall panel

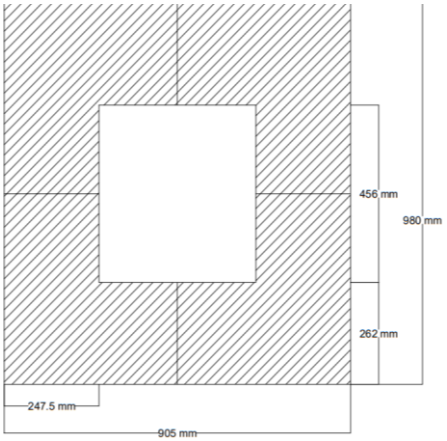

Fig-2: RC Wall panel with Central opening

4.6 Analysis using E-tabs

- Here both RC Wall panels are analyzed in E-tabs software and Uniformly distributed axial loading is applied on the wall panel.
- After analyzing in E-tabs software ultimate loading capacity, load-deflection behaviour, stress contour behaviour is noted.
- This is the elevation view of RC Solid wall panel in which the supports are in simply supported condition

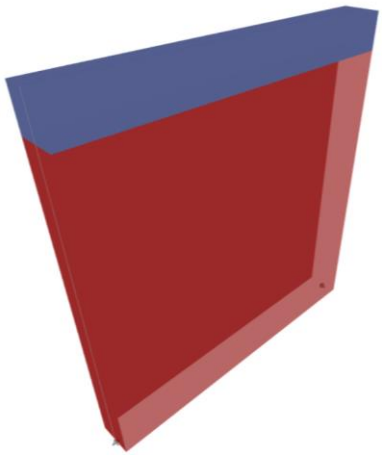

Fig-3: 3d rendered view of RC Solid wall panel

- Here RC Wall panel with Central Opening is also tested and the both wall panels are compared and window opening size is given as 410*456mm

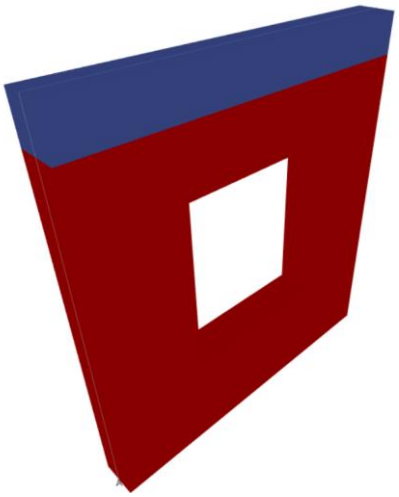

Fig-4: 3d rendered view of RC central opening wall panel

4.7 Loading

- In this experiment uniformly distributed loading is applied axially to the wall panel and load deflection, stress behaviour is studied.
- Loading of 825kN is applied on the RC Solid wall panel.

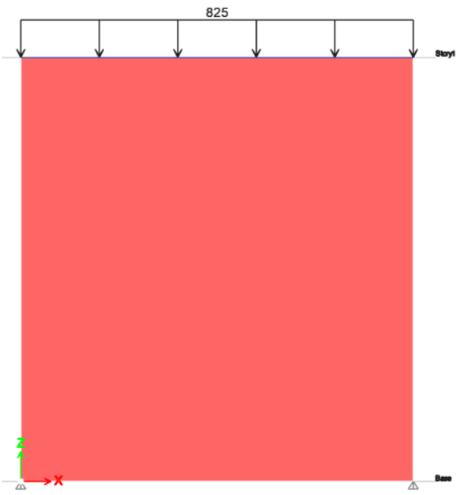

Fig-5: Loading of 825kN

- Loading of 720kN is applied on the RC central opening wall panel

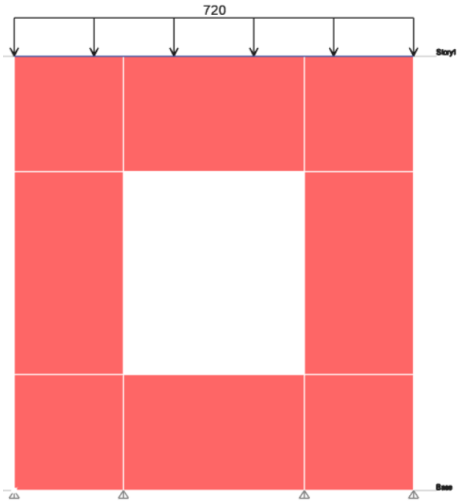

Fig-6: Loading of 720kN

5. RESULTS

- Storey displacement is studied is RC Solid wall panel.
- Maximum of 38mm storey displacement is noted. Starting from 0 it increases gradually to 38mm linearly.
- Storey displacement graph is shown in fig 7.

Fig-7: Maximum storey displacement of RC Solid wall panel

- Storey displacement is studied is RC central opening wall panel.
- Maximum of 100mm storey displacement is noted. Starting from 0 it increases gradually to 100mm linearly.
- Storey displacement graph is shown in fig 8.

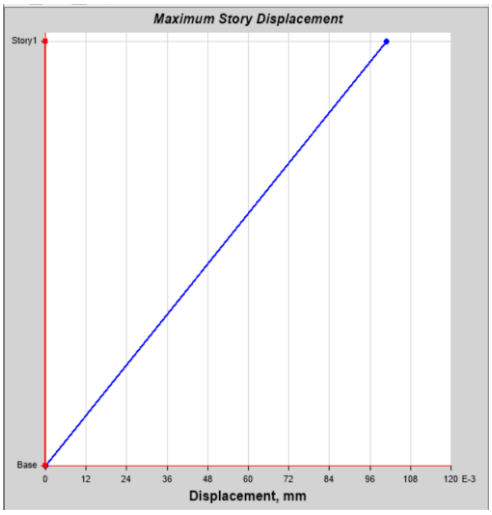

Fig-8: Maximum storey displacement of RC central opening wall panel

- A stress contour is a visual representation in engineering that displays the distribution of stress levels over a surface or within a structure.
- It employs contour color gradients to depict varying stress magnitudes, and each contour line representing a specific stress value.

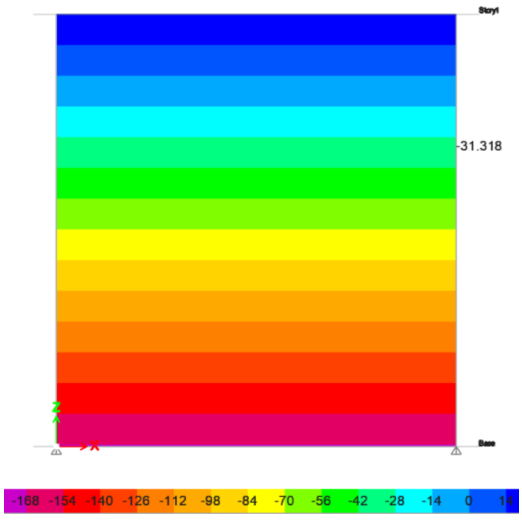

Fig-9: Stress contour for RC Solid wall panel

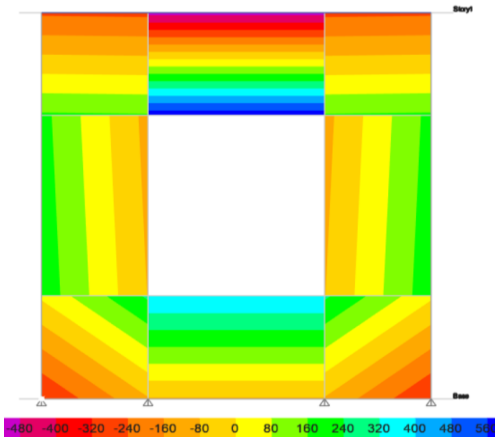

Fig-10: Stress contour for RC central opening wall panel

- Stress contour enables engineers to identify the regions where the stress concentration is more, and critical areas will be highlighted, and we can know how wall panels respond to external loading conditions.

6. CONCLUSION

In conclusion RC Solid wall panel sustains more load when compared to RC central opening wall panel and due to central opening of wall panel diagonal shear failure occurred and in RC Solid wall panel flexural failure was noted. Due to accurate cover spacing the wall panel sustains more load. The interaction between steel and concrete helps the wall panel to sustain more load. Testing these RC Wall panels we will know where the failure is occurred, so that we can give more strength at that failure portion.

7. REFERENCE

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