International Journal of Precious Engineering Research and Applications (IJPERA)
www.ijpera.com ISSN: 2456-2734,
Volume 7, Issue 2 (Jul. – Aug.) 2022), PP 22-30

Analysis of Retrofitted building using ETABS

[1] Albert Thomas,[2] Anagha K M, [3]Jishnu Prakash,[4] Soniya John
[123]Students, Deptof civil engineering of VISAT Engineering college,[4] Asst. Prof of VISAT Engineering College

Abstract
Structural Analysis is a branch which involves in the determination of behavior of structural members in order to predict the responses of different structural components due to effect of loads. Each and every structure will be subjected to either one or the groups of loads, the various kinds of loads normally considered are dead load, live load and wind load. ETABS (Extended Three-Dimensional Analysis of Building System) is a software which is incorporated with all the major analysis engines that is static, dynamic, Linear and non-linear, etc. and especially this software is used to analyse and design the buildings. Load analysis of structural members like beams, columns, and slabs of any structure is a time-consuming process if we do it manually so we can use software's for the load analysis of the members of the structure for the loads acting on them even before the construction which helps in choosing the appropriate design considerations required the structure to be safe for the loads acting on the structural members of the structure we are considering. Using ETABS for design and analysis of any structure gives the shear force and bending moment and shear-force of the members of the structure like of the beams and columns due to the load acting on them even before the construction of the structure which helps in considering the design properties of the structure like grade of concrete, grade of steel, size of column, and size of beams as required for the loads acting on the structure. Our project is generally based on Analysis of Multi-Story Building using ETABS software. Planning of any type of building is done according to the specifications of national building code (NBC) in India, Hence the Multi-Story building is properly planned in accordance with the national building code of India using AutoCAD software. Design and Analysis of Multi-Story Building is done according to IS-Code provisions. The reinforcement and the concrete of Multi-Story Building is designed according to the specifications of IS 456- 2000.All the structure members like slabs, beams and columns are designed with reference of IS:456-2000. Different load active on the member like beam, column and slabs are considered according to the IS Standards.designing and analysis of the building for loads (dead load, live lode, wind load) and as per is codes and all the structural members are designed as per IS 456 andIS:875.

I. INTRODUCTION

A number of reasons may necessitate the need to retrofit existing structures. It may be rehabilitation of a structure damaged by seismic loads or other causes, or the strengthening of an undamaged structure made necessary by revisions in structural design or loading codes of practice. The deterioration in RC structures can be due to environmental effects like reduction of strength with ageing, corrosion of steel, temperature variations, freezing-thawing effects. Earthquake around the world is one of the reasons responsible for destruction to life and property in large numbers. In order to mitigate such hazards, it is important to incorporate norms that will enhance the seismic performance of the structure.

RETROFITTING is the process of addition of new features to older buildings, heritage structures, bridges etc……. It increases the strength, resistivity and overall lifespan of the structure.

As total reconstruction (or) replacement of an existing structure will be cost effective. Hence retrofitting is one of the effective ways to strengthen the existing RC structure.

A number of methods can be used to retrofit concrete structures. Retrofitting may be carried out on basis by extra adding load-resisting elements such as steel frames, steel bracings to an existing structure. Or it can be performed on local basis by retrofitting the existing structural elements such as column, beam

The goal of retrofitting is to improve seismic performance and correct deficiencies by increasing strength, stiffness, and to create a more sustainable environment within the context of an existing urban form

Retrofitting is one of the best options to make an existing inadequate building safe against future environmental effects like earthquake. Now-a-days, retrofitting has become increasingly important as structures lose their strength in due course of time, some structures are important in view of public, social or past importance.

1.1 CLASSIFICATION OF RETROFIT TECHNIQUES:

1) Local retrofit strategies.
2) Global retrofit strategies.

- Local retrofit strategies: to avoid failure of the components, and also thereby enhance the overall performance of the structure.

Example: concrete jacketing, steel jacketing, fibre-reinforced polymer (FRP) sheet wrapping.

- Global retrofit strategies: to provide increased lateral stiffness and strength to the building as a whole. And, to ensure that a total collapse of the building does not occur.

Example: addition of infill walls, addition of shear walls, addition of steel braces.

1.1.1 TECHNIQUES OF RETROFITTING:

1.1.2 RC JACKETING OF COLUMNS:

RC jacketing has been used extensively for strengthening and repairing deficient and damaged RC columns, respectively. In traditional reinforced concrete jacketing, the section of the column is enlarged by casting a new reinforced concrete/mortar section over a part or the entire length of the column.

1.1.3 STEEL JACKETING:

confining RC columns in steel jackets is also an effective method to increase basic strength capacity. Steel jacketing not only provides enough confinement but also prevents deterioration of shell concrete, which is the main reason of bond failure and buckling of longitudinal bars

1.1.4 STEEL BRACINGS:

Bracings provides an excellent approach for strengthening and stiffening existing buildings for lateral forces.

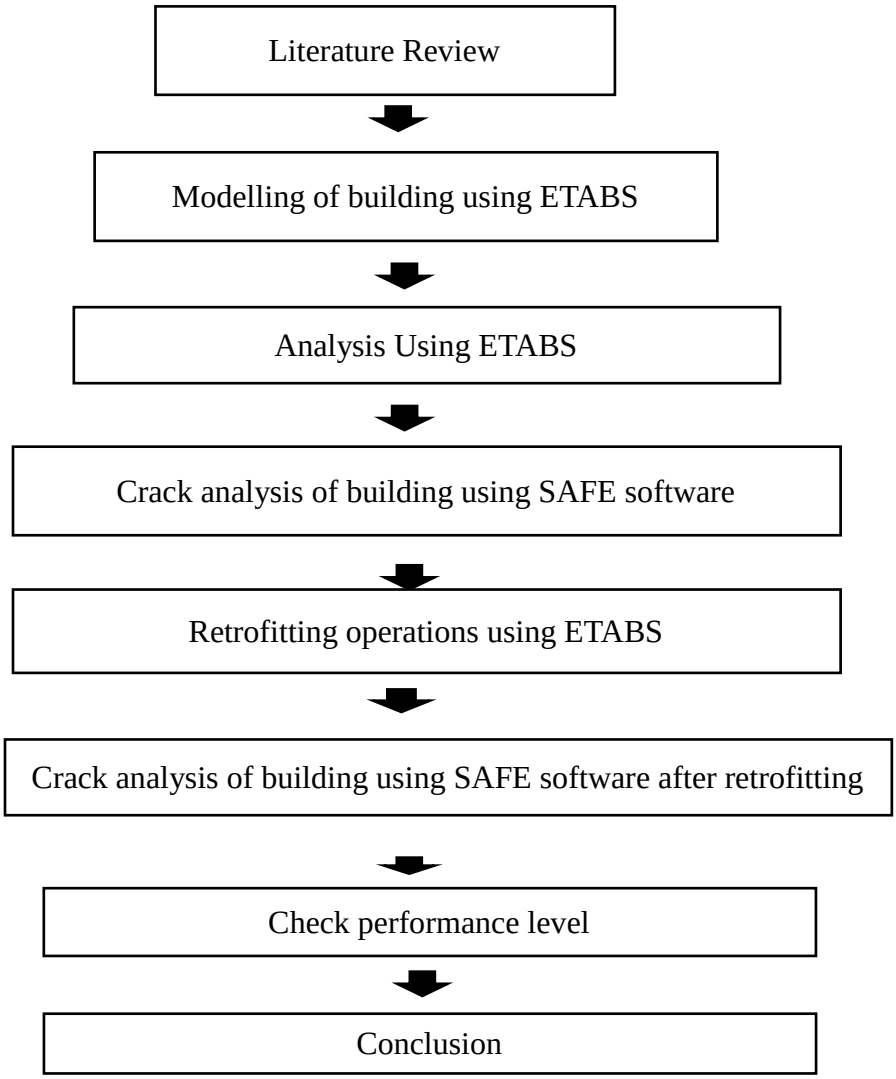
1.2 OBJECTIVES:

- ❖ The main objective of this study is to analyze and design a G+3 commercial building using ETABS software.
- ❖ To perform crack analysis on the proposed building using SAFE software.
- ❖ Suitable retrofitting methods are adopted as remedies.
- ❖ Retrofitting is conducted using ETABS.
- ❖ To compare structural stability of building before and after retrofitting of building.
- ❖ Comparison of results obtained from crack analysis before retrofitting and after retrofitting.
- ❖ Suitable remedies are adopted after retrofitting.

1.3 SCOPE:

- ❖ Helps in identifying future cracks to be developed in future.
- ❖ Suitable retrofitting methods according to severity of crack can be adopted.
- ❖ Deflection of beams can be reduced by retrofitting.
- ❖ Severity of cracks can be analyzed.
- ❖ Suitable deflection values are obtained from the analysis using etabs.

II. METHODOLOGY:



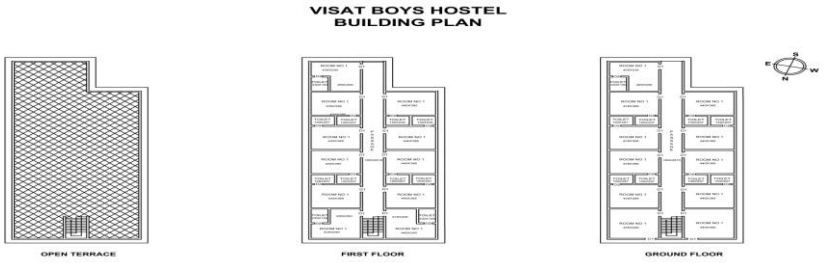


Figure 1: Existing typical floor plan.

Existing typical floor plan developed in AUTOCAD: A design of R.C building of G+2 Storey frame work is taken up.

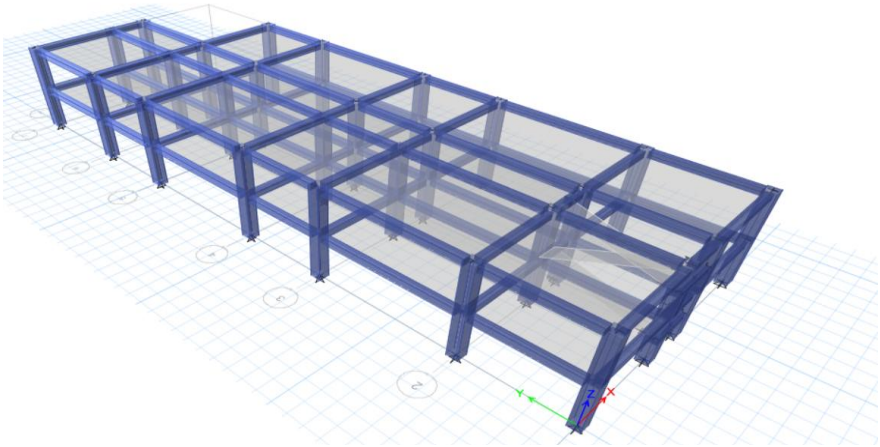


Figure 2: G+6 existing building

2.1: MODELLING AND ANALYSIS IN ETABS:

- In this present study, existing structure is modeled as a 3-diminesional frame at different soil conditions using ETABS, figure 2 shows 3D model of an existing structure.
- Figure 3 shows 3D model of 3 floors added on an existing building.
- The present study is carried out to understand the retrofitting techniques.

2.2: LOADS ON THE STRUCTURE:

1) DEAD LOAD: The dead loads are taken from IS 875 Part 1(Dead Loads). The dead loads comprise the weights of walls, partitions, floor finishes, false ceilings, false floors and other permanent constructions in the buildings.
2) LIVE LOAD: The live loads are taken from IS 875 Part II(Live Loads).

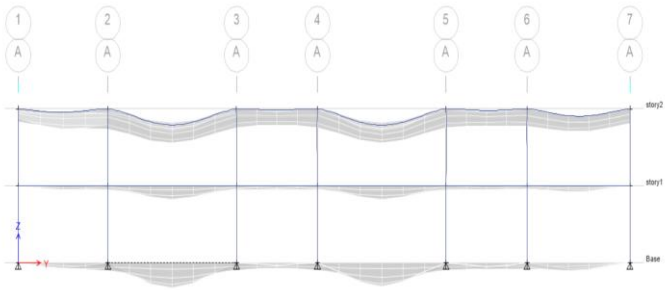


Figure3: Deformation of building

Figure4: Shear force diagram

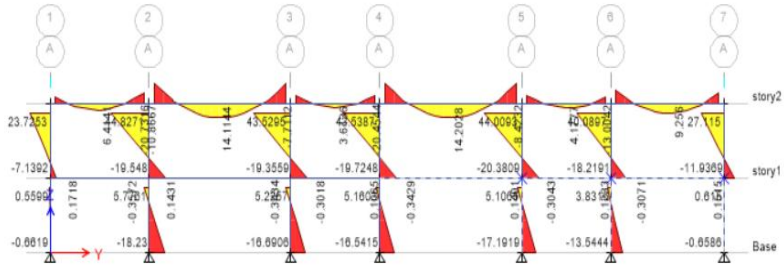


Figure5: Bending moment

2.4 CRACK ANALYSING RESULT USING SAFE SOFTWARE

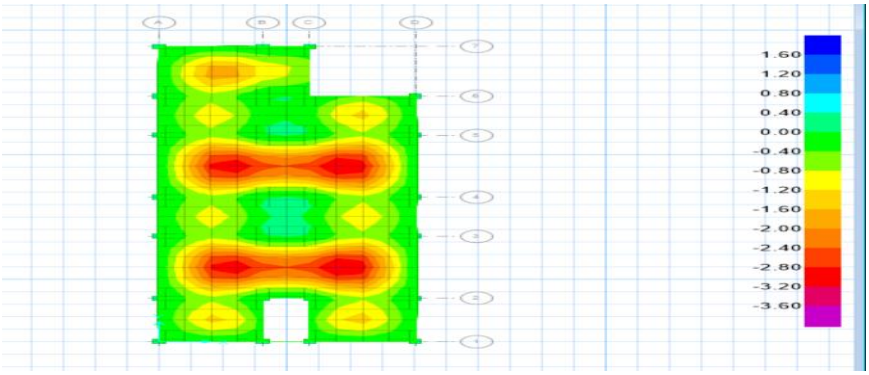


Fig 6: Cracked Section Due To Elastic Load Combination

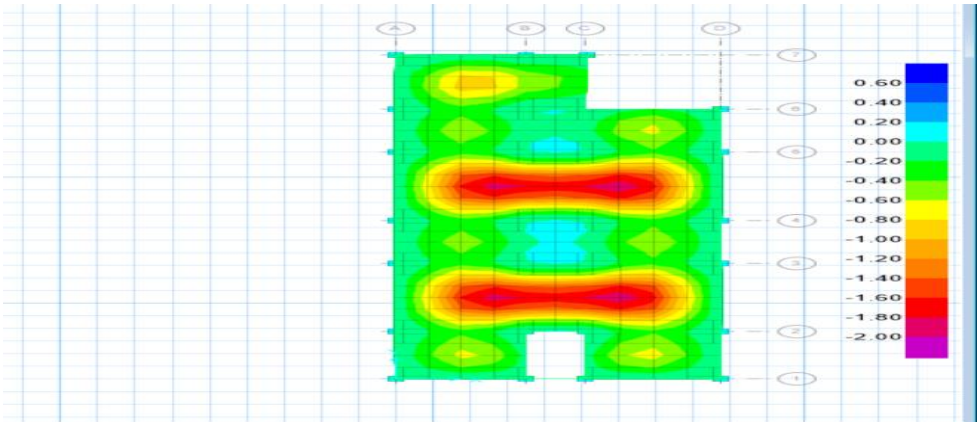


Fig 7: Immediate Sustained Load

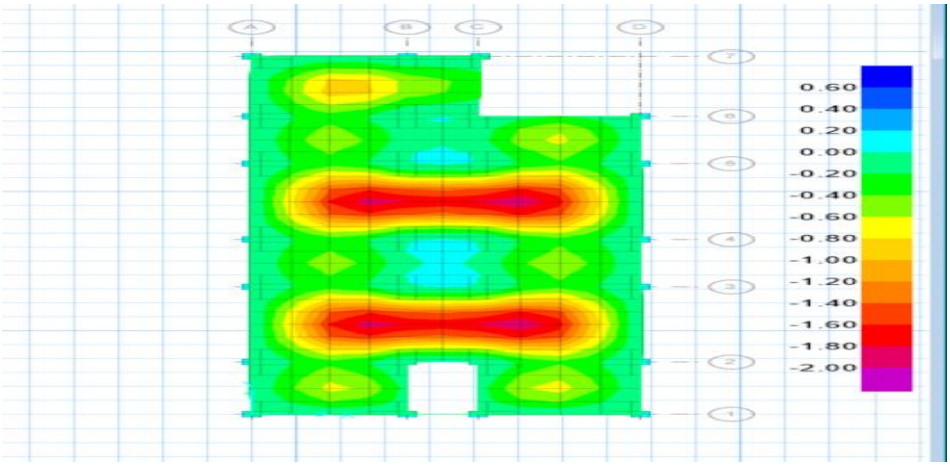


Fig 8: Immediate All Loads

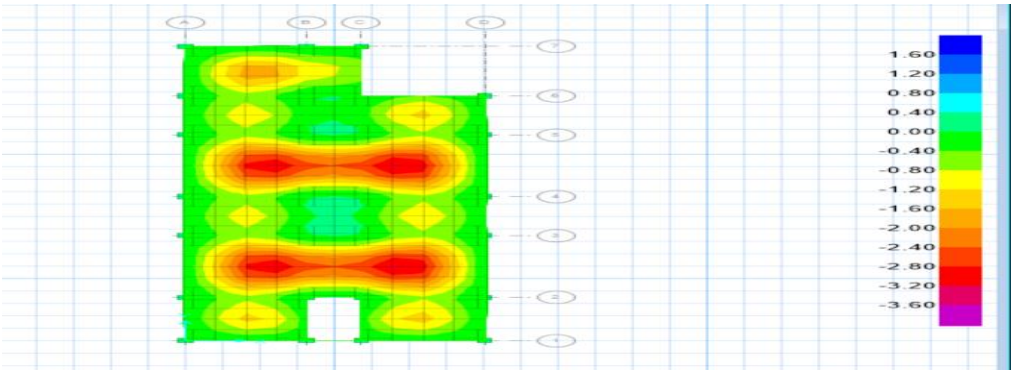


Fig9: Long Term Sustained Loads

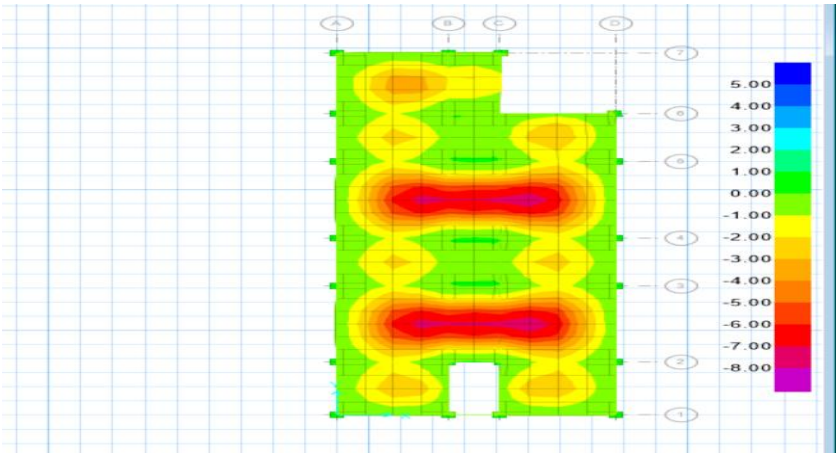


Fig 10: Crack Due to Long Term Loads

2.5 Retrofitting Using ETABS

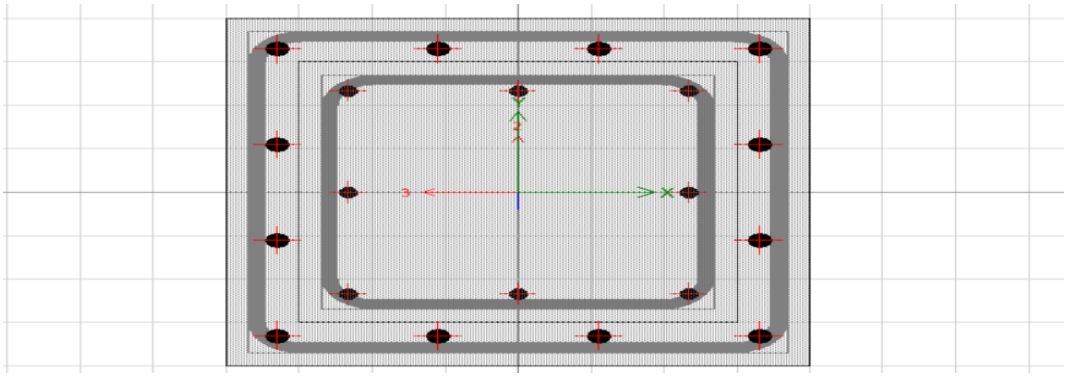


Fig11: Column Jacketing

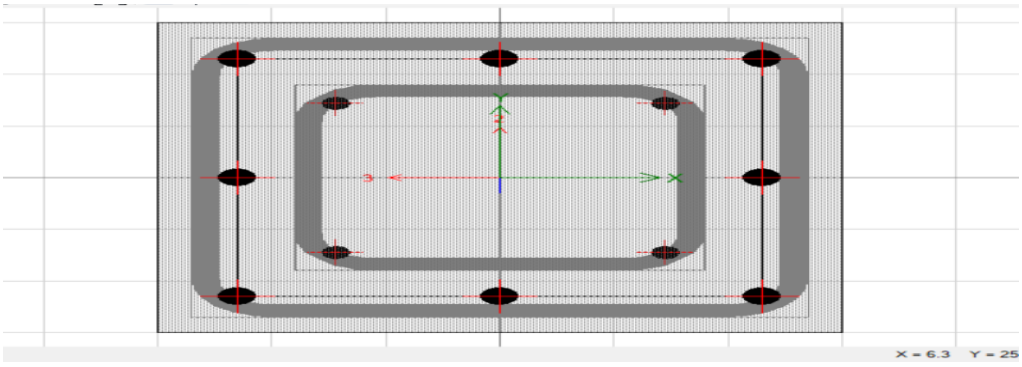


Fig12: Beam jacketing

2.6 Reinforcement Details

Dimensions of beam	**270mmx270mm**
Corner bar	**4,16mmdia@150mmc/c**
Tie bar	**12mm dia @150mmc/c**
Jacketing	**300mmx300mm**
Area	**804.2sqmm**

Dimensions of column	**370mmx370mm**
Corner bar	**4,25mmdia@150mmc/c**
Tie bar	**12mm dia @150mmc/c**
Jacketing	**300mmx300mm**
Area	**2065.6sqmm**

III. RESULTS AND DISCUSSIONS

3.1crack Analysis After Retrofitting Using SafeSoftware

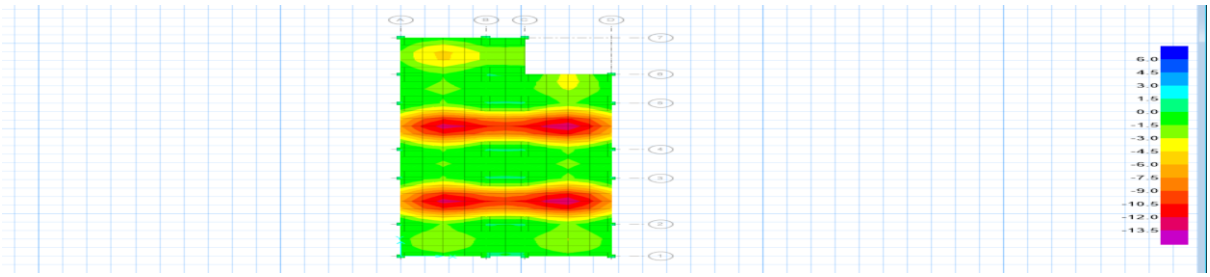


Fig13: Immediate All Loads

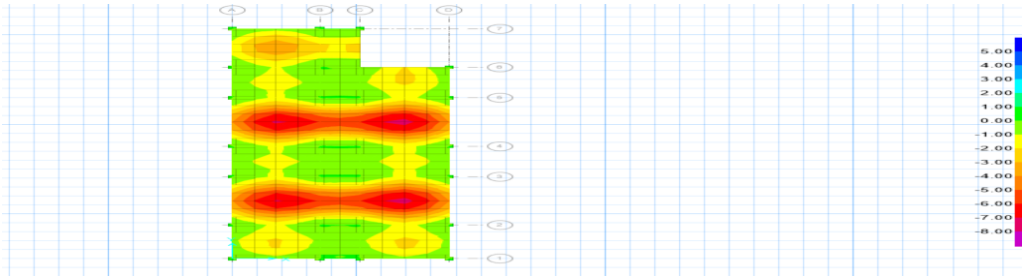


FIG14: Immediate Sustained Loads

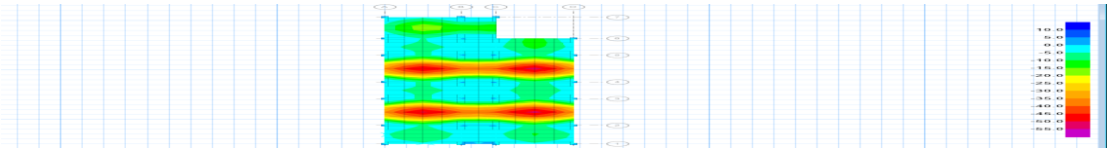


FIG15: Long-term Sustained

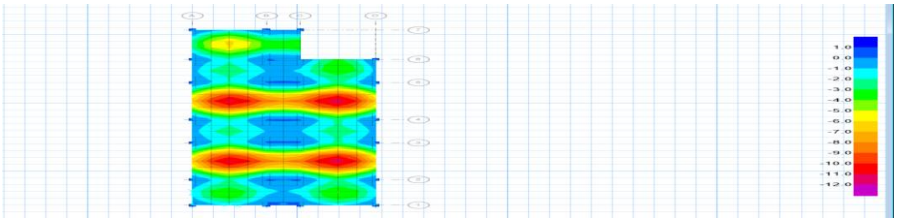


FIG16: Elastic Load Combination

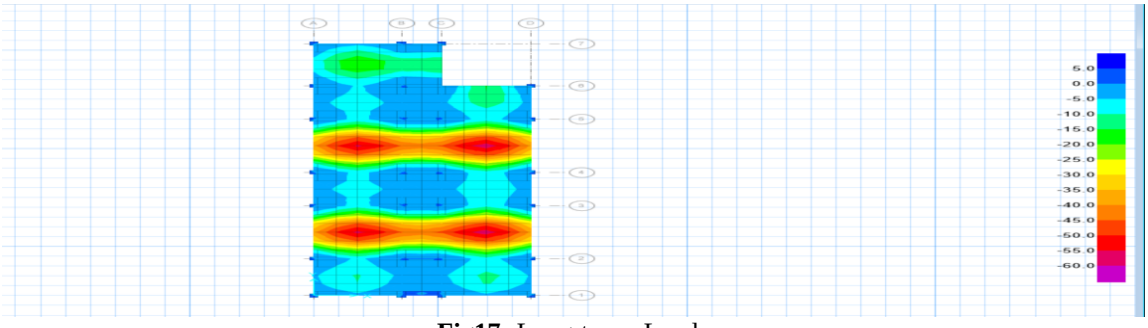


Fig17: Long-term Loads

3.2 Crack Analysis Result After Retrofitting

LOAD COMBINATION	MAX DEFLECTION
Elastic load combination	0.04mm<2.7mm
Immediate sustained loads	0.028mm<2.7mm
Long term load	1.216mm<2.7mm
Long term sustained load	1.24mm<2.7mm
Immediate all loads	0.23mm<2.7mm

IV. CONCLUSION:

electing an appropriate retrofitting method for concrete structures is significantly important especially from cost optimization point of view.

• Thus, the analysis, design, and implementation of the optimization method should provide maximum P and M along with safety.

• since it leads to better performance under various Ps and Ms. The analysis can also help engineers to identify the effects of various materials on the P and M.

• In the case study of the salt factory, two types of retrofitting methods were applied to a %20 critically-corroded column.

• The results are as follows:

• Considering 'merely' safety factors, applying externally-bonded steel plate yields about %40 growths in comparison to concrete jacketing retrofitting which means implementing steel plates are safer than using concrete jacketing retrofitting.

• However, considering all parameters involved in design procedures for the constants P and M, the concrete jacketing retrofitting shows approximately %70 decrease in total cost which makes it more economical comparing to the other method.

• Finally, these optimization methods are applicable to any types of retrofitting methods which simultaneously include both safety and minimum costs.

• Decrease in deformation of each member after retrofitting process

• Max deflection value has decreased from 0.4mm to 0.067mm.

• Crack depth is within the limits after retrofitting.

• It can be concluded that the Retrofitting techniques have a great influence on the service life as well as on the efficiency of structure

• Therefore, selection of proper strengthening technique should be given a proper consideration.

• Non-linear analysis gives more accurate and precise results than static analysis

REFERENCES

Journals:

[1]. Kiran Kammath and Jose Camlio (2016), Study on a " An Analytical study on performance of a diagrid structure using non linear static pushover analysis using ETABS" Int J Sci Eng Res 2016 ,7(10).

[2]. Yimeng Yang (2017) , Study on " High –rise structure with oblique columns by ETABS" J. of Structural Engg.ASCE,116(2017) (5),1423-1439.

[3]. Hamid Eskandari-Naddaf and Hossein Bakhshi(2017), Study on " Optimal methods for retrofitting corrosion-damaged reinforced concrete columns" Int J Sci Eng Res 2017,pages 262-271.

[4]. Tushar Donga and Dr.Vinay Agarwal(2021), "A study of nonlinear static pushover analysis of RCC building with shear wall and without shear wall"Int J IJERMCE Vol 6,Issue5,May 2021.

[5]. Spurthi D and AjithaB(2016), " Vulnerability Analysis Of RC Buildings Using Pushover Analysis" Int J International Research Journal of Engineering and technology Vol 3 Issue 11(2016).

[6]. Abide Asukoglu and GracaVascomcelos(2020) Study on "Pushover analysis of unreinforced irregular masonry building" International Research Journal of Engineering and technology Vol 3(2020).

[7]. Jyothi J Nair and Biju Mathew(2019) Study on " Comparative study between conventional and adaptive pushover analysis using ETABS software" International Research Journal of Engineering and technology Vol 14(2019).

[8]. PreranaNampalli and PrakarshSangave(2015) "Linear and Non Linear Analysis of reinforced concrete frames with members of varying inertia" IOSR Journal of civil engineering Vol 12 50-59

[9]. P Velumani and K Mukilan(2020) Study on " Analysis of cracks in structures and buildings" International conference on advances in physical science and materials 1706(2020)012116

[10]. Nilesh Bharat Vidhate (2021) Study on " Pushover Analysis Of Building Using Soft Story At Different Level"IOSR Volume 6 Issue 7 (2021)