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SEISMIC ANALYSIS AND RETROFITTIG ON RESIDENTIAL BUILDING

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Abstract: Earthquakes are the most destructive of natural hazards, Earthquake occurs due to sudden transient motion of the ground as a result of release of energy in a matter of few seconds. The impact of the event is most traumatic because it affects large area, occurs all of a sudden and UN-predictable. Vibrations induced in the Earth's crust due to Internal (or) External causes that virtually shake up a part of the crust and all the structures and living and non-living things existing on it they can cause large scale loss of life, Property and disrupts essential services such of water supply, sewerage systems, communication, power and transport etc.

Index terms – ETABS software, residential building, 3D analysis

I. INTRODUCTION

1.1SEISMIC RETROFITTING

Earthquake creates destruction in terms of life, property and failure of structures. In order to protect from the risk triggered by seismic disaster to the life and property, the performance of the structure must be improved and thus Seismic Retrofitting plays its role. Retrofit involves modifications to existing structures that may improve energy efficiency or decrease energy demand. Seismic retrofitting is the modification of existing structures so as to improve the seismic behaviour or its components repair or strengthening up to the performance it is expected. Retrofitting also proves to be a better option catering to the economic considerations and immediate shelter problems rather than replacement of seismic deficient buildings. Two alternative approaches are conceptually adopted and implemented in practice for seismic retrofitting. The first approach focusses on upgrading the structure to resist earthquake induced forces (i.e. modifying the capacity) and is called Conventional method of retrofitting. The second approach focusses on reduction of earthquake induced forces (i.e. modifying the demand) or Unconventional approach.

Seismic retrofitting is the collection of modern techniques for earthquake resistant structure. The presence of soft and weak storey at the open ground floor, in-plane discontinuity out-of-plane offset of the ground floor columns and eccentric mass are commonly observed irregularities in the studied buildings. In absence of collector elements in the slab and proper detailing of the connections with the building frame, there is lack of integral action of the lateral load resisting elements, techniques for earthquake resistant structure. The seismic performance of beam-column joints in an RC framed structure has long been recognized as a dominant factor that affects its overall behaviour when subjected to earthquake forces, as indicated in earlier version of design codes and standards. Unsafe designs and deficient detailing that does not conform to seismic codes within the joint region may result in extra inelastic story drift and excessive 1post-yield rotation, which

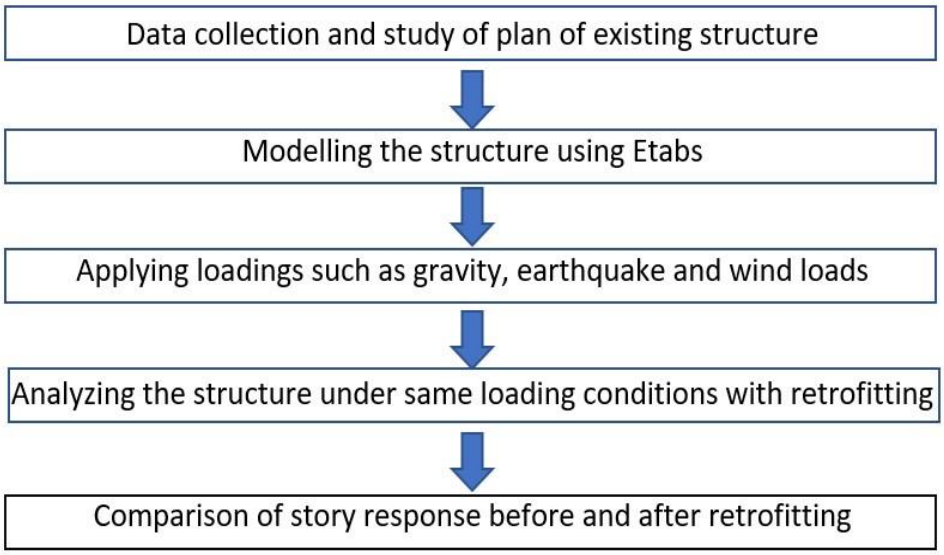
likely causes local failure, and may even lead to progressive collapse. The potential problems associated with the design deficiencies of the beam-column joints have been identified in many catastrophic

structural failures reported in past major earthquakes. Four major objectives are identified to understand the feasibility of seismically retrofitting existing structures. The first objective is to investigate how building location affects the annual probability of attaining or exceeding specified performance levels. The second objective is to develop a framework to determine the economic feasibility of seismic retrofitting. The third objective is to study the effects that achievable loss reduction, investment return period and retrofitting. The final objective is to determine the impact of a modest retrofit strategy applied to identical example buildings.

structure damage due to earthquake

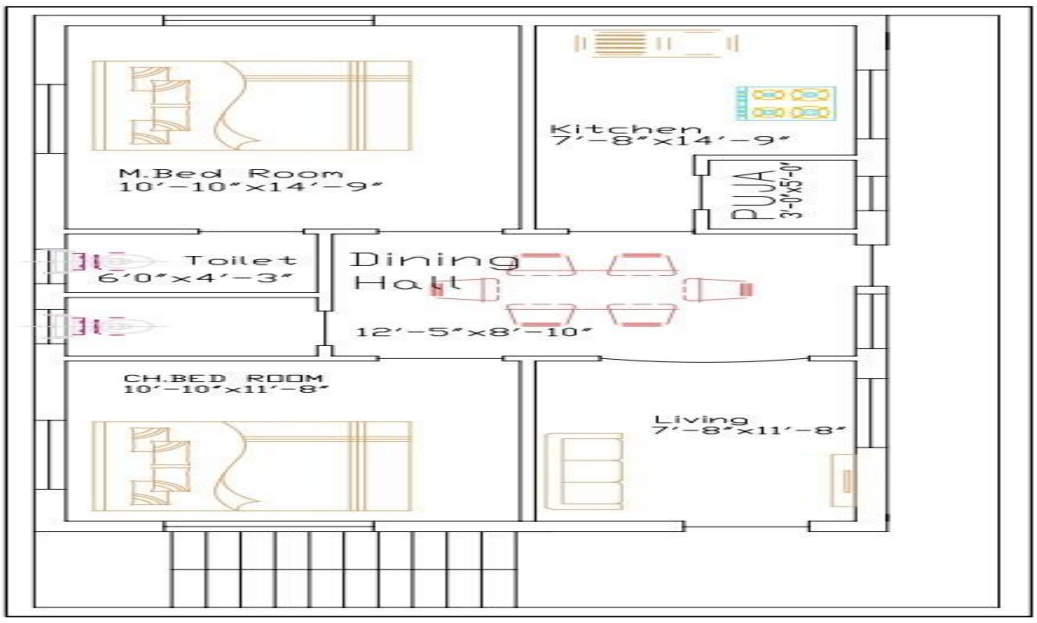
1.2 ETABS SOFTWARE: ETABS stands for Extended Three-Dimensional Analysis of Building Systems. ETABS offers a user interface to perform Modelling, Analysis, Design and Reporting. TABS provide sophisticated analysis and design for steel, concrete and masonry structure.

1.3 METHODOLOGY:



DATA OF EXISTING STRUCTURE

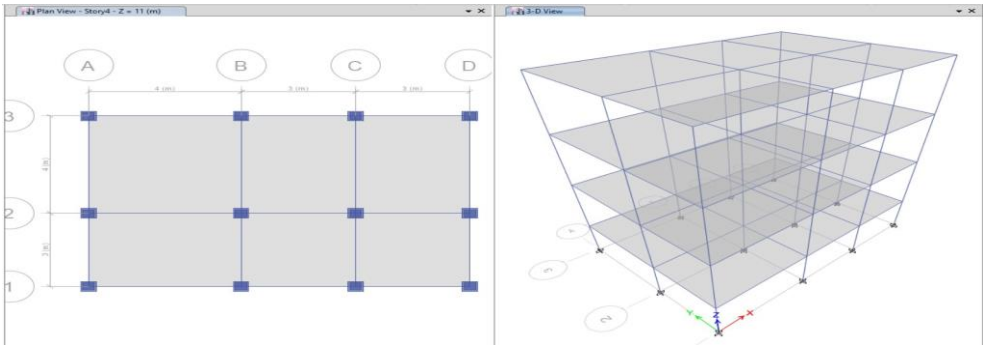
Variable	Data
Type of structure	Residential building
Number of storeys	4
Floor height	3m
Base height	2m
Live load	2 kN/m²
Dead load	2.25 kN/m²
Wind load	Zone – 4 (44 m/s)
Seismic zone	Zone -2
Earthquake load	1.5 kN/m²
Column dimensions	350 mm x 350 mm
Beam dimensions	250 mm x 250 mm
Slab thickness	150 mm x 150 mm



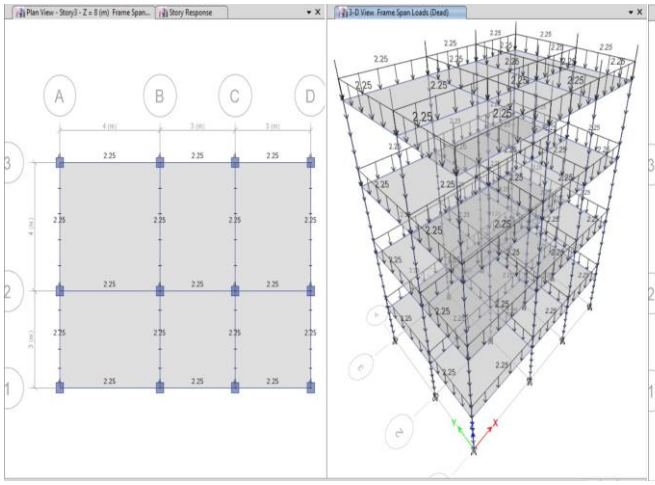
PLAN OF STRUCTURE

MODELLING

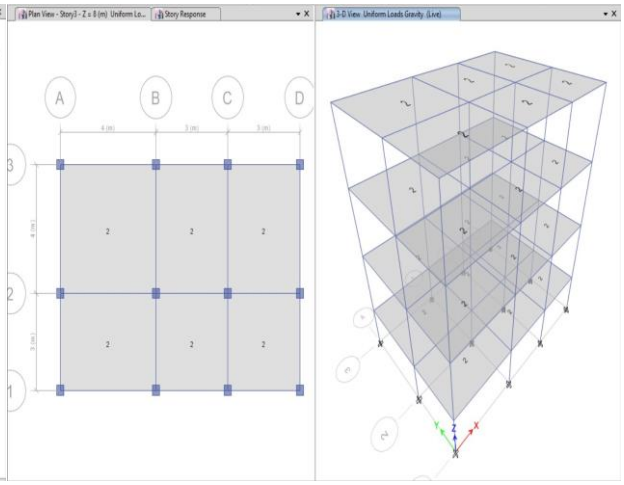
ETABS has a user-friendly interface and commands for easy and fast modelling, editing, rectifying the errors and warnings. Modelling begins with the setting of grid lines, defining of material properties, defining of frame and area element sectional properties, etc.



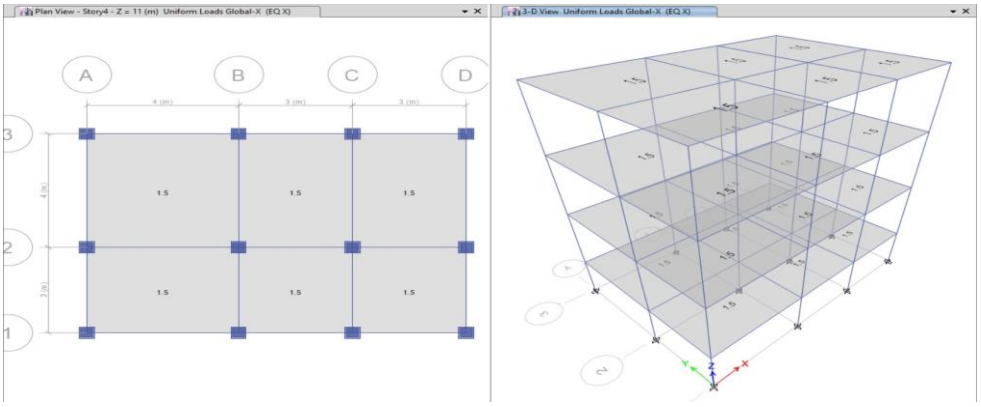
Plan view and 3D view of structure



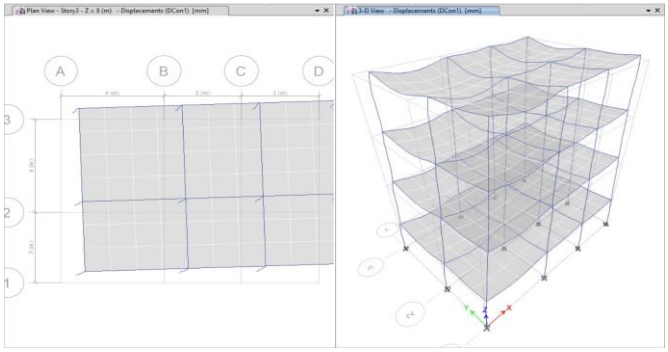
Assigning of dead loads



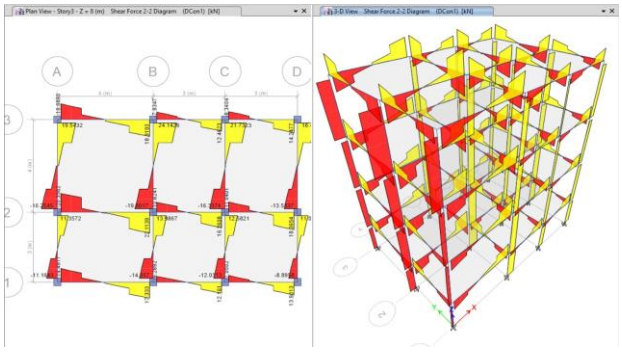
Assigning live loads



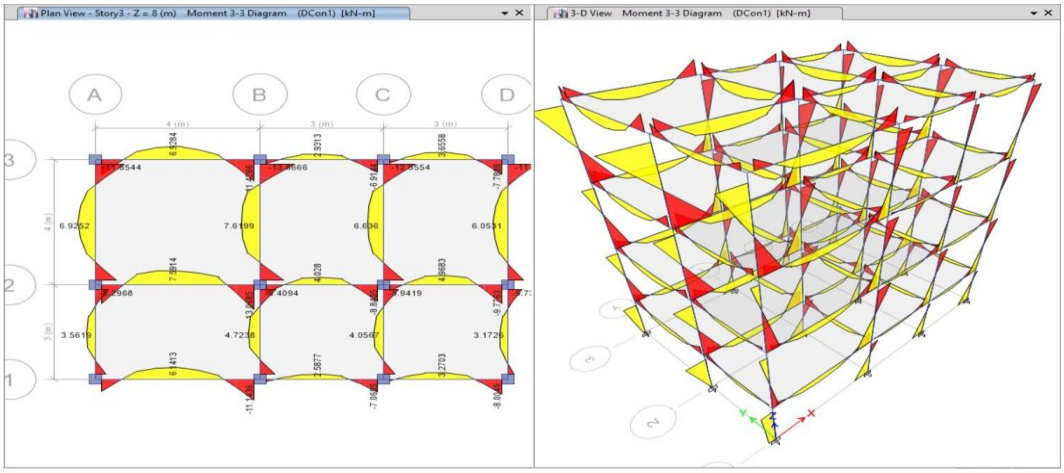
Assigning seismic loads



Displacements



Shear force diagram



Bending moment diagram

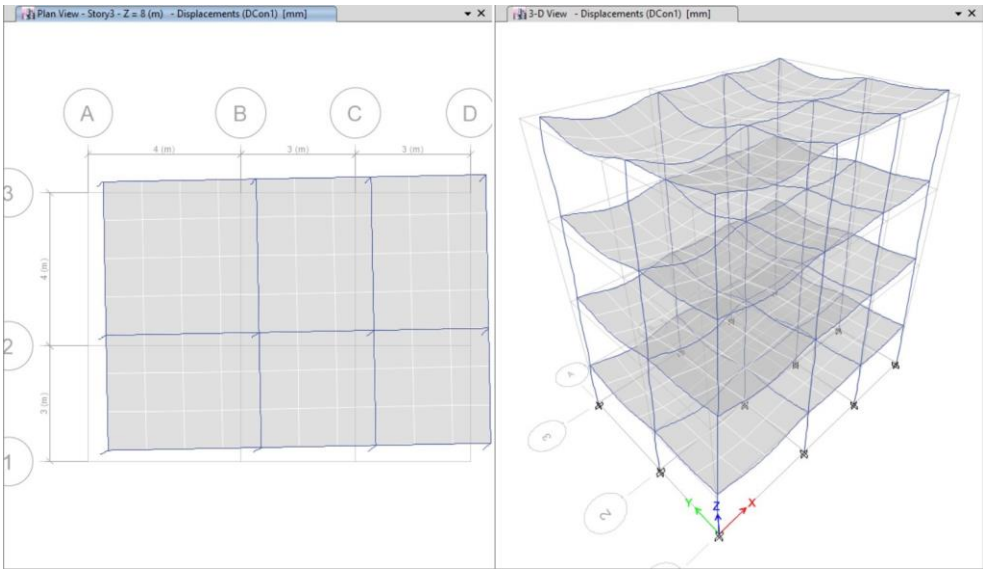
STRENGTHNING BY CONCRETE JACKETING

Concrete jacketing is one of retrofitting structures used to the columns and beams of the building. The demand for using concrete jackets to strengthen or repair reinforced concrete has been increasing in the past few decades. Reinforced concrete jacketing is a common method for retrofitting existing columns with poor structural performance. Jacketing implemented by enlarging the column and beam section by increase the amount of reinforcement.

Jacketing of Beam

Column Jacketing

RESULT AFTER JACKETING



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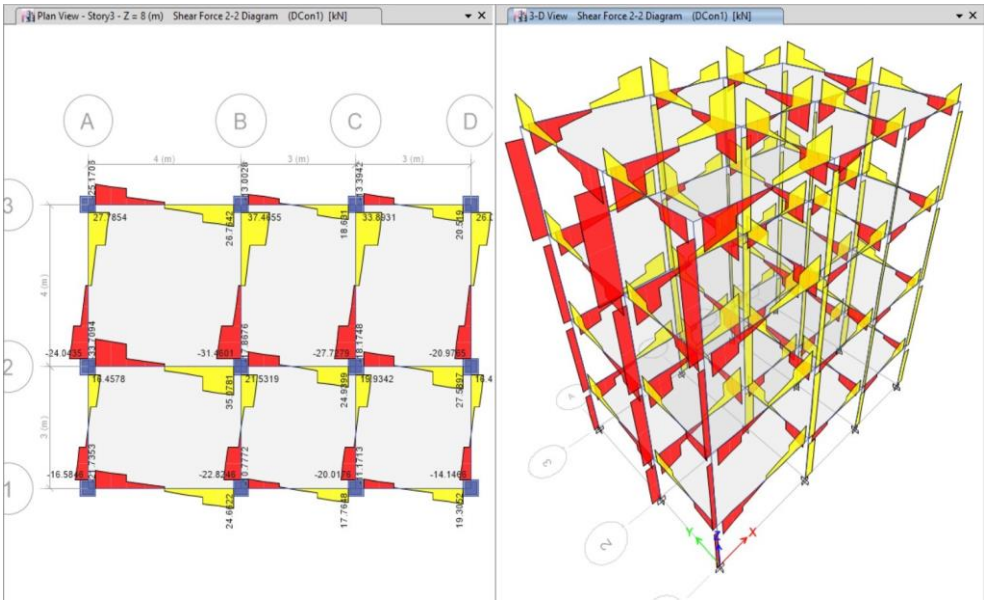
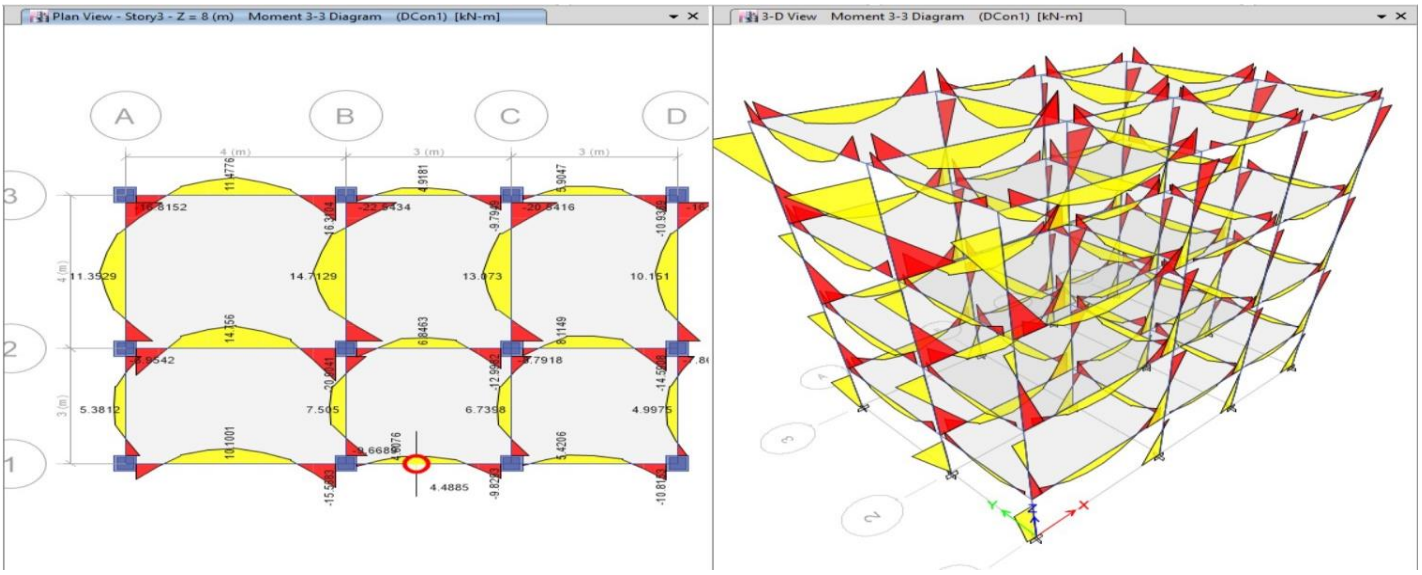


Shear Force Diagram



Bending Moment Diagram

RESULT AND DISCUSSION

- Displacement

The use of concrete jacketing was indirect effect to the building displacement. The lateral displacement has been calculated for both X and Y-directions, for effects of the earthquake in both directions.The displacement on x-direction and y-direction has reduced in the range of 60% to 65%.

- Load-bearing capacity

The capacity of the columns and beams can be increased by the concrete jacketing method so that the structure is capable of carrying axial and bending moments. Table shows the percentage of increase in load-bearing capacities (bending and shear) on the story. After retrofitting by concrete jacketing, there is a significant increase in capacities, especially the bending moment. Bending moment and shear capacity increased compared to the existing structure. Based on the analysis, the increase of capacity is enough to carry the working loads that occurred.

Story	Load Case	Location	Shear Force,kN		Increase	Moment,kN-m		Increase
			Retrofitting	Existing	(%)	Retrofitting	Existing	(%)
Story4	DCon1	Top	1137.9	1070.0	6.35	3938.6	3705.4	6.29
Story4	DCon1	Bottom	1569.8	1407.5	11.53	5432.4	4884.3	11.22
Story3	DCon1	Top	2707.7	2477.6	9.28	9370.9	8589.8	8.99
Story3	DCon1	Bottom	3139.6	2815.0	11.53	10918.7	9822.6	11.15
Story2	DCon1	Top	4277.5	3885.1	10.1	14857.3	13528.1	9.83
Story2	DCon1	Bottom	4709.5	4222.5	11.53	16459.1	14815.0	11.09

Percentage of increase in the capacity

CONCLUSION

- Strength of the structure is increased by increase in reinforcement.
- Retrofitting by concrete jacketing is effective in building structures that are unable to withstand working loads.
- Displacement of the structure is reduced which attains the stability of the structure.
- Shear forces and moments got increased by application of jacketing technique.
- Finally, it is more economical in terms of cost.

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