SEISMIC PERFORMANCE ASSESMENT AND RETROFITTING OF AN EXISTING BUILDING

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ABSTRACT: The older buildings that were constructed with little or no seismic design considerations represent the largest risk to most communities. In the recent years, mass destruction has seen in India due to Failure of the structures hit by earthquakes and consequently lost a lot of lives. Hence, it is of utmost importance that attention is to be givento the evaluation of the adequacy of strength in framed RC structures to resist strong ground motions. These buildings must be evaluated by for the level of risk due to earthquake. In the past decade, interest has increased to retrofit the damage existing buildings for reducing economic losses and safeguard life.

In this project, an existing G+4 reinforced concrete school building situated in Pune, wasaccessed and redesigned, and an extension of 3 floors with steel structure designed for seismicloading. To access the present condition of the building structural audit was carried out. The analysis and design of the existing building, and the extended steel portion was done in accordance with IS 456-2000 and IS 1893:2016 using software STAAD.Pro v8i.

KETWORDS: Seismic Analysis, Risk Assesment, Retrofitting,Response Spectrum

I. INTRODUCTION

The buildings generally show signs of distress during their service period and due to natural calamity like earthquakes, etc. In the past decades loss of life during collapse of the buildings has been reported, hence the safety of the buildings is of great concern. Most of the old buildingsmade of stone masonry/ brick masonry are in existence and require adequate maintenance. Today, most of the buildings are constructed with Reinforced Cement Concrete, which is assumed to be more durable and stable. The new materials and techniques in the field of construction and maintenance are developed and adopted in a strengthening of existing buildings so that the safety of the public may be ensured.

In the project work, G+4-storey RC school Building located in Pune was analysed and designfor seismic risk.

II. RELATED WORK

As the Existing school building Are G+4, the necessary Structural Audit process is carried Outwhich forms an integral part formulating the existing condition of the building. The old buildings Which are constructed is developed with little or no significant approach of present-day codes that lack design provisions. Hence, it may fail in the event of any moderately strongtectonic activity in its vicinity. Studying the performance of the Structure And suggesting suitable retrofit measures for the building would therefore be a necessity.

A case study of such an existing school building is taken for the project purpose which Motivated me to carry out the thesis situated in Pune. As the Client requirement was to constructthree more additional floors over the existing (G+4) R.C.C structure due to increase F.S.I. Thebuilding was inspected with a preliminary survey including the visual inspection along with the necessary Structural Audit. Based on the built-in conditions of the existing structure, the architectural and structural drawings were prepared. Also, to check the efficiency of the failing members in sustaining the demanded Moment or maximum shear generated and to provide a feasible retrofit method to satisfy the strength, serviceability, durability if the proposed steel structure is to be adopted on the existing R.C.C structure. A combination of the lateral load resisting system with a suitable retrofit method was the scope of the project. Test results regarding the analysis and design of the existing structure and the same with the retrofitted structure are presented and to get the effective lateral load resisting system.

III. METHODOLOGY

1. Carrying out the ‘Structural Audit’ of the existing school building (Non-Destructive tests).

2. Testing of the Cylinder core cutting specimens to obtain the compressive strength.

3. Preparation of built-in drawings as per existing conditions and the drawings of the proposed steel structure.

4. Modeling of building in STAAD PRO V8i software which includes the preparation of geometry of the existing proposed structure, defining the material, section and assigning ofloads and load cases, and identifying the deficiency developed in the structure.

5. Carrying out-static linear analysis of the building model and response spectra analysis on the model for the various cases.

6. Defining the proper load cases as per IS code provisions.

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7. Calculate the Demand Capacity Ratio of the members of the existing building.

8. Check the efficiency of the failing members in sustaining the demanded moment or maximum shear generated due to the earthquake forces, after retrofitting.

9. Preparation of various trial and error models on STAAD for the building of retrofitted sections and the possible addition of shear walls to counter the actions of the seismic forcesdeveloped.

10. Checks are done:

- Footing and column design for the existing and retrofitted structure.
- Comparison of base shear values of the existing and proposed retrofitted structure.
- Comparison of the story shears and story displacement based on response spectra.

11. Results and discussion

12. Conclusion

IV. STRUCTURAL GEOMETRY

The existing building is of height 19.4m (G+5) Structure. The plan dimensions of the structure are 34.700 X 14.200 m respectively. The total number of columns of the existing structure is 35 nos. The existing column sizes of the structure are as follows: (230 x 530), (230x 600), (300 x 600), (230 x 680), (300 x 750), (230 x 1350).The existing present conditions of the building were studied and as the available set of drawings of building were not available, so preparation of AUTOCAD drawings was made as shown in the following manner:

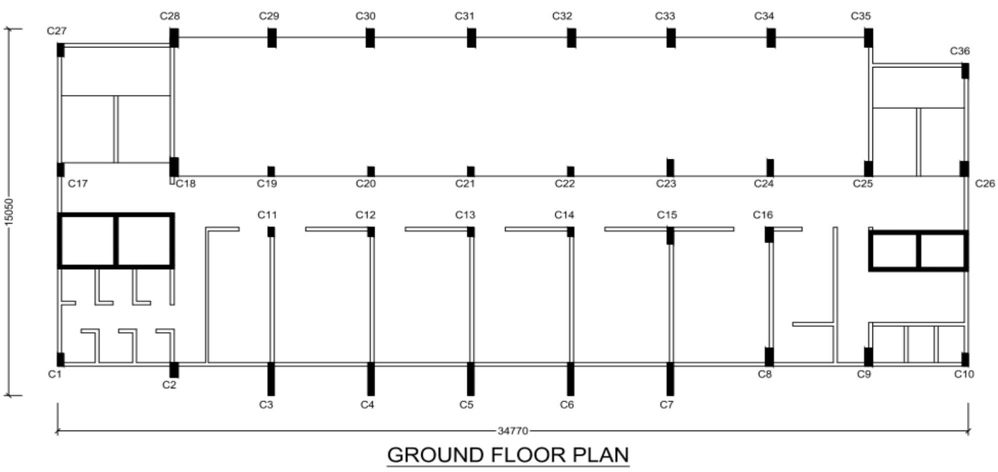

Figure 1: Ground floor plan

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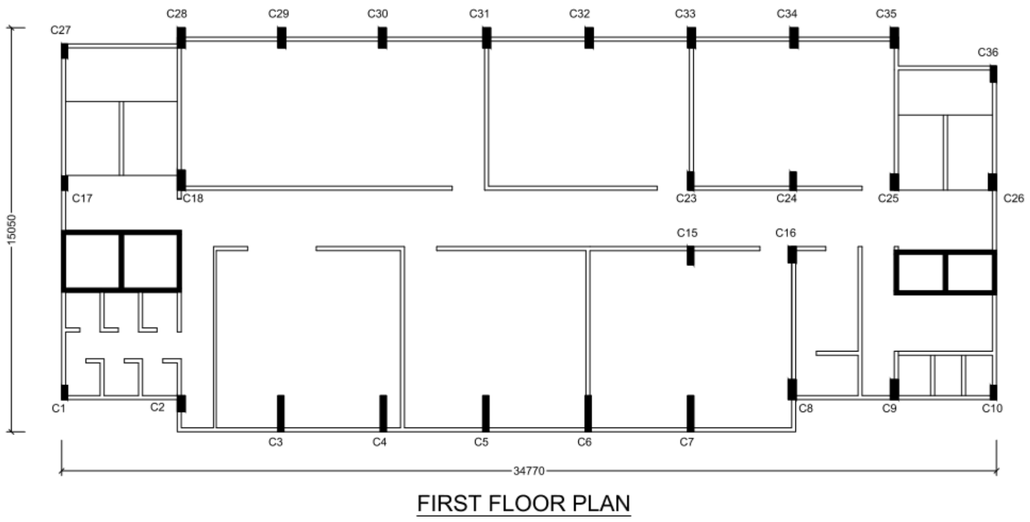


Figure 2: First, second, the third-floor plan

V. EXPERIMENTAL RESULTS

5.1 Maximum Base Shear.

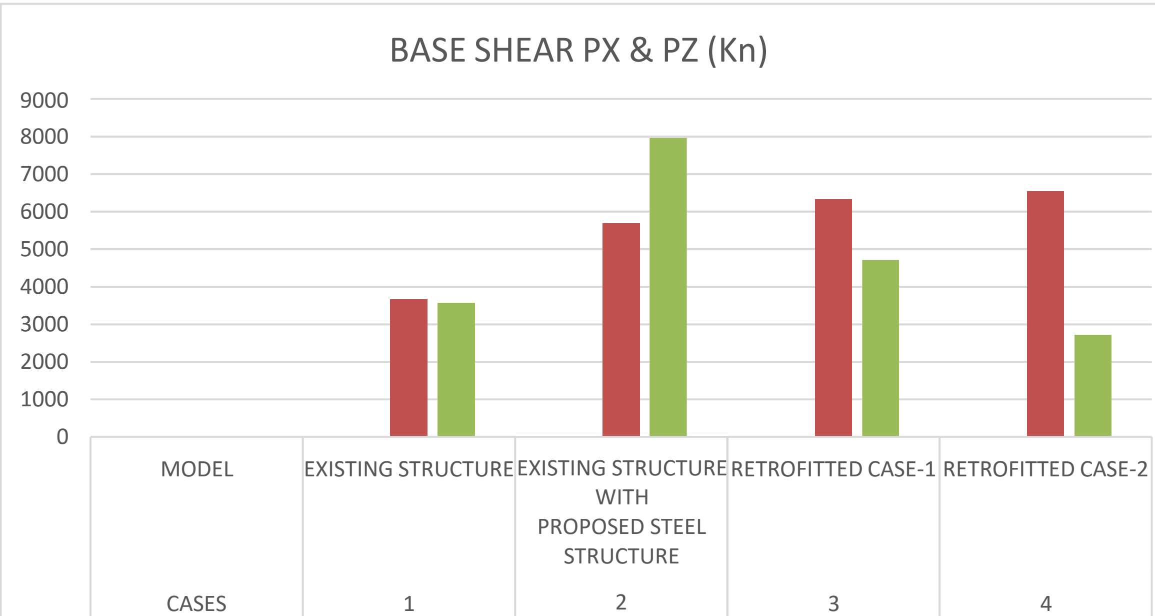
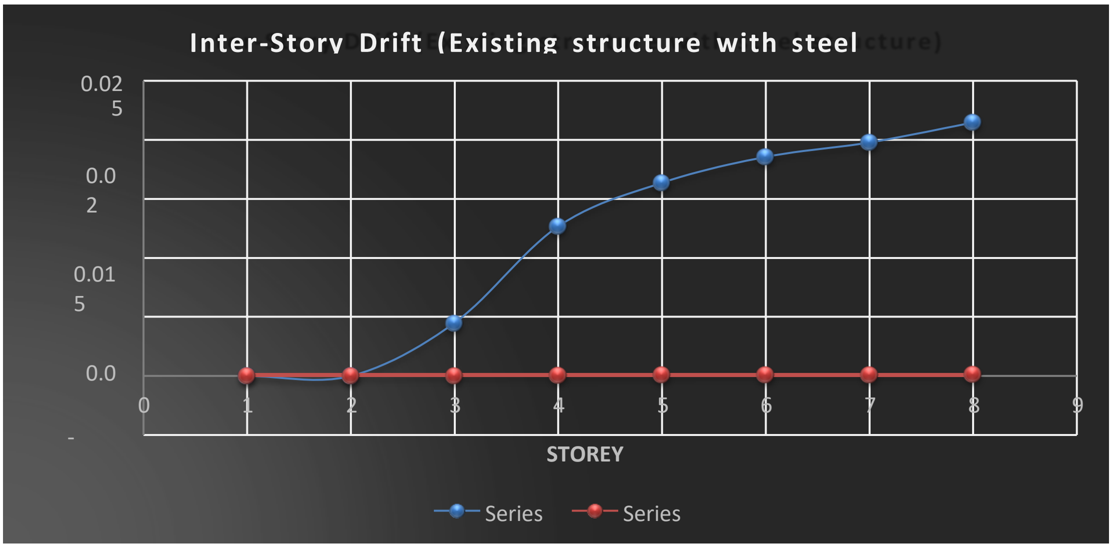
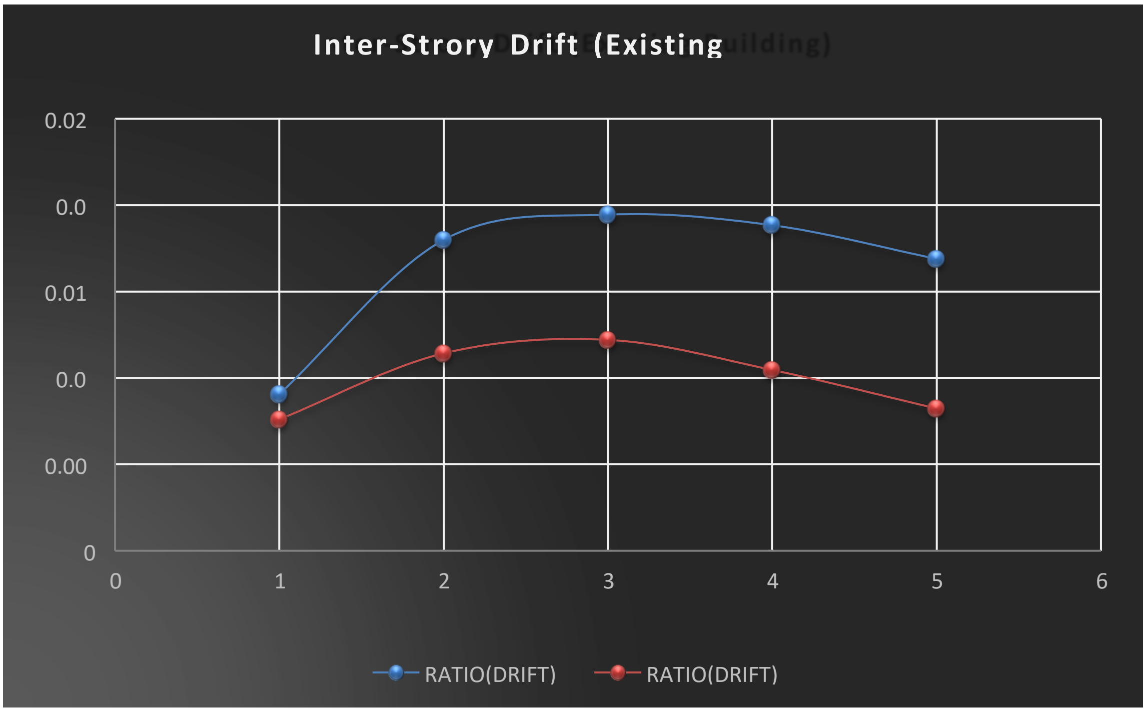


Table 1 – Results for Base Shear

5.2 Maximum Storey Drift.



Graph 1 – Inter-story drift graphical representation (Existing structure with proposed)



Graph 2 – Inter-story drift graphical representation

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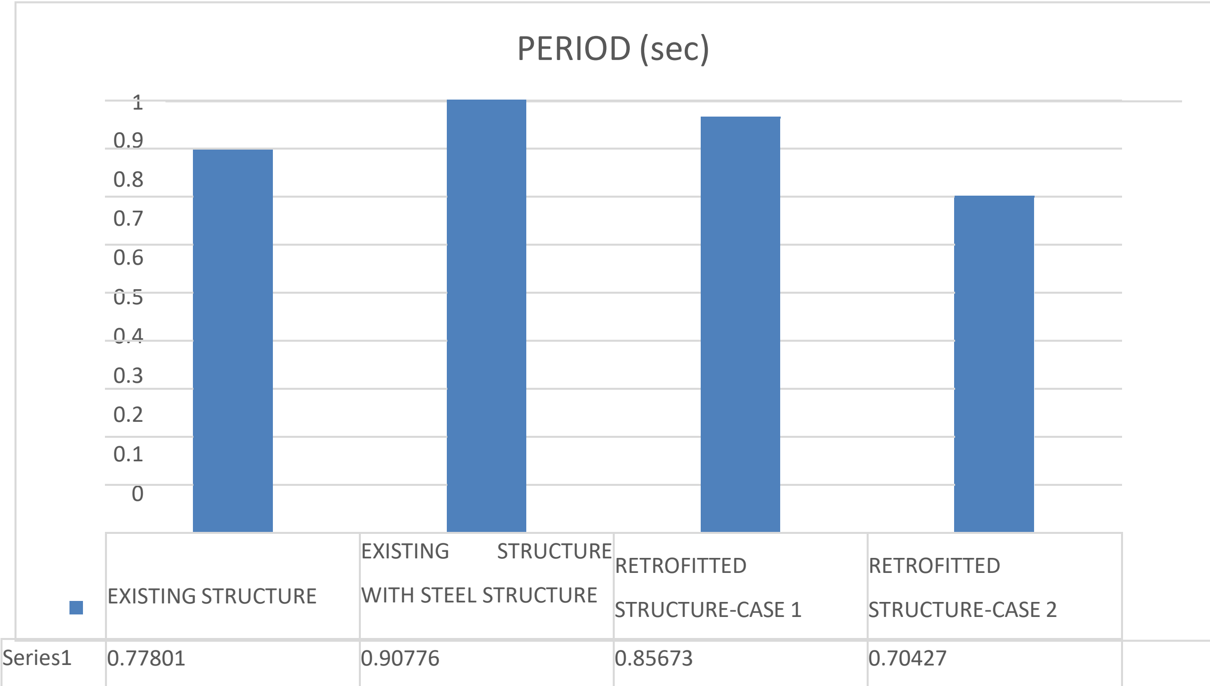
5.3 Time Period.



Graph 3 – Graphical representation for the time period

6.5 Soft Storey.

STORY	FL. LEVEL IN METE	STATUS X	STATUS Z
1	3.00	OK	OK
2	6.60	OK	OK
3	10.20	OK	OK
4	13.80	OK	OK
5	17.40	OK	OK
6	21.20	OK	OK
7	25.00	OK	OK
8	28.80	OK	OK

NOTE : NO SOFT STOREY IS DETECTED.

Table-2 – Soft-storey results from STAAD pro for retrofitted structure

VI.CONCLUSION

The behavior of an existing building has been studied for seismic analysis parameters and based upon the design results a suitable retrofitting method was adopted. The following are the conclusions of the study.

1. The study comprises carrying out structural audits and carrying NDT tests to know and examining the conditions of the building. Also, the building is analyzed and designed in STAAD pro V8i softwareand after design results, it was found that some of the structural columns are not feasible in taking the large seismic forces.

2. This study concludes that as observed from the existing building conditions, it was contributing less than 65% showing less in both X & Z direction, whereas the retrofitted case-1 structure contributed to 76% in the respective X-direction and 78% in the respective Y-direction. Similarly for case-2, 69% in X-direction and 76% in Z-direction.

3. This Study concludes that the base shear and the lateral stiffness for the case-2 structure were comparatively more than other cases about 5683.43Kn (X-direction) & 7967.32Kn (Z-direction). For retrofitted conditions, it was 6535.35kn (X-direction) & 2713.36kn (Z- direction).

4. This study Concluded that as per the clauses of IS 1893:2016, the story drift should not exceed 0.004 times the height of the story under the action of design base shear. The existing structure Almost failed in Z-direction for the inter-story drift calculations, while the other three Cases were within the criteria.

5. This study concludes that the use of strip footing was suggested to strengthen the existing footing as the footings for the steel column overlapped with the existing footing.

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