Retrofitting of Existing Building in "Sapar Industrial Area- Rajkot"

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***Abstract*- Earthquake is considered as a most vulnerable activity for buildings. In this study, the existing building is considered which was not designed by consideration of earthquake, so as a part of a safety this building will be analysed by considering earthquake load and a new design will be given for retrofitting. The traditional method of seismic retrofitting is reviewed and their weak points are identified. Modern method and philosophies of retrofitting and energy dissipation devices are reviewed. The presentation is illustrated by case studies of actual buildings where traditional and innovative retrofitting methods have been applied. RC Jacketing of structural member is most suitable method for strengthening of building. Retrofitting is used to increase the load carrying capacity, increasing the current structure's stiffness, strength and ductility. The construction would therefore lead in secure and stable structures.**

***Index terms*- Retrofitting, RC-Jacketing, Earthquake Load.**

I. INTRODUCTION

→ Earthquake creates great devastation in terms of life, money and failures of structures.
→ Earthquake Mitigation is an important field of study from a long time now.
→ Seismic Retrofitting is a collection mitigation technique for Earthquake Engineering.
→ It is of utmost importance for historic monuments, areas prone to severe earthquakes and tall or expensive structures.
→ Need of retrofitting: - The two circumstances are: -
1. Earthquake damaged buildings, and
2. Earthquake-vulnerable buildings (with no exposure to severe earthquakes)

II. RETROFITTING

→ It is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes.
→ The retrofit techniques are also applicable for other natural hazards such as tropical cyclones, tornadoes, and severe winds from thunderstorms.
→ Factors that should be considered in selecting the retrofitting method- includes required performance improvements, the viability of execution of the retrofitting work, the impact of the retrofitting work on the surrounding environment, the ease of maintenance after retrofitting, economy and other factors.
→ RC Jacketing: - in this method the entire height of the column section is increased and a cage of additional main reinforcement bars with shear stirrups is provided right from the foundation as per the requirement of additional load, etc.

→ The enlargement should be bonded to the existing concrete to produce a monolithic member.
→ Cement mortar is used for these enlargements. The section enlargement method is relatively easy to construct and economically effective.

Fig. 1 – Front Elevation of Industrial Building

III. NEED OF RETROFITTING

→ If buildings not designed according to IS codes.
→ Buildings have been designed according to a seismic code, but the code has been upgraded in later years.
→ Buildings designed to meet the modern seismic codes, but deficiencies exist in the design and/or construction.
→ Essential buildings must be strengthened like hospitals, historical monuments and architectural buildings.
→ Important buildings services are essential just after earthquake like hospitals.
→ Buildings, the use of which has changed through the years.
→ Buildings that are expanded, renovated or rebuilt.

IV. PRINCIPLE OF RETROFITTING

→ Strengthening of individual member versus strengthening of the structural system. Increasing the strength and stiffness.
→ Local strengthening versus global strengthening
→ Temporary strengthening versus permanent strengthening
→ Earthquake demand reduction by base-isolation or supplemental energy dissipation.

V. METHODS OF RETROFITTING

→ Methods to be used for the strengthening of the structure can be decided after the several investigations and evaluations, then suitable method ensuring the safety of the structure and protection from the further deterioration.

→ Various methods for the retrofitting of the structure are as follows:

- ✓ Jacketing of beams
- ✓ Jacketing of columns
- ✓ Jacketing of beam-column joints
- ✓ Strengthening of individual footings
- ✓ Adding shear walls
- ✓ Adding infill wall
- ✓ Adding bracings
- ✓ Adding wing wall
- ✓ Wall thickening

VI. LAYOUT OF BUILDING

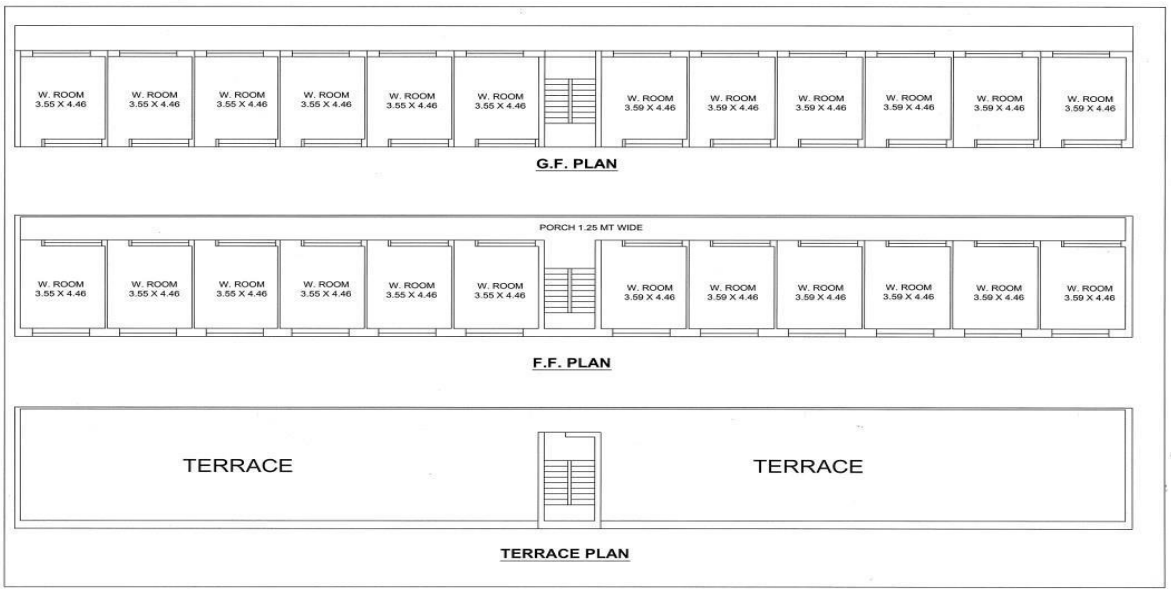

Fig. 2 – Architectural Plan of Building

VII. PRELIMINARY INFORMATION

→ general instructions of work:

→ Year of construction: - 1994

→ Year of Investigation: - 2018

→ Type of structure: - G+1 RCC frame structure

→ Location: - Mahindra CIE. Ltd Shapar plot no. 01, 31 to 34, Galaxy industrial estate, kotdasangani, Rajkot, shaper, Gujarat 360024

VIII. VISUAL OBSERVATION

→ Corrosion of reinforced bars.

→ Concrete reinforcement cover seemed to be not enough.

→ At few places the reinforcement is exposed and corroded.

→ Many cracks are visible in building.

IX. BUILDING MODELLING IN SOFTWARE

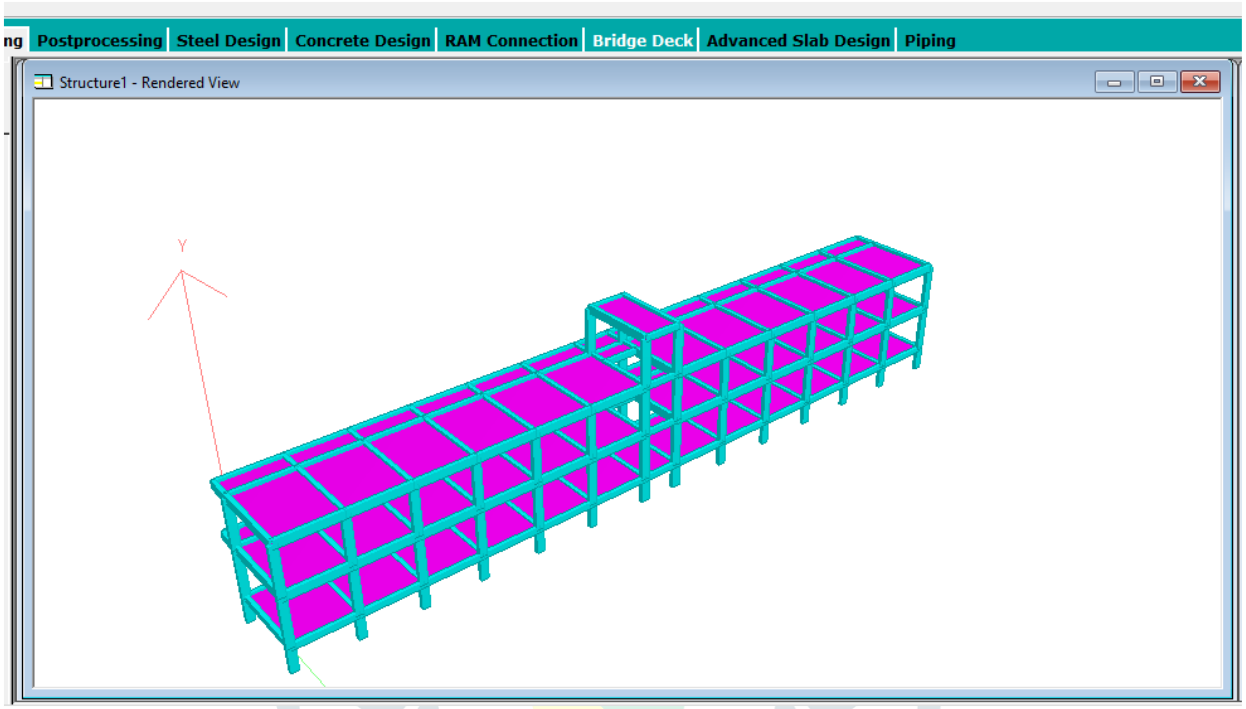

Fig. 3 – Building Modelling

X. COLUMN RESULTS

As Per IS 15988-2013	Jacketed Section
Assume Asc = 0.8% of Ac	Provide 8-12 mm dia.
Pu = 0.4 fck Ac + 0.67 fyAsc	Jacketed Section
Ac' = 104953.62 mm2	460 mm X 230 mm
As' = 846.40 mm2	

Fig. 4 – Column Results

XI. SOFTWARE RESULTS

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         C O L U M N   N O.     31  D E S I G N   R E S U L T S

      M25                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3000.0 mm   CROSS SECTION:  230.0 mm X  460.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    1  SHORT(Z)        /BRACED LONG(Y)


REQD. STEEL AREA    :      846.40 Sq.mm.
REQD. CONCRETE AREA:   104953.62 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.86%,    904.78 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
-----------------------------------------------------------
Puz :   1444.17   Muz1 :     57.37   Muy1 :     25.80

INTERACTION RATIO: 0.29 (as per Cl. 39.6, IS456:2000)
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Fig. 4 – Software Results

XII. CONCLUSION

→ Here Manual as well as Software results are similar hence software is been validated.

→ Modeling of G+ 1 story building is carried out in STAAD PRO.

→ The existing G+1 design of the building without considering Seismic loads has 6-12mm ∅ and 6mm ∅ stirrups @300mm c/c.

→ As per the results obtained from the analysis of the existing design, the building is strengthened using Retrofitting method.

→ In Second Phase we have considered Seismic Effect on Building and also provisions added in Software. Hence we got new design results of G+1 storey building which are 8 -12mm∅, and the equivalent design from STAAD PRO obtained is 8-12mm∅ and 8mm∅ stirrups @190mm c/c.

→ If Retrofitting will be provided to this structure than it can defintly withstand the Seismic Load.

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