Analysis of Retrofitting of RCC Building with Beam Design Criterion

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***Abstract*: Reconstruction is a technical intervention that optimizes structural strength, ductility, and seismic loads by evaluating and improving the design of all three components. A building's strength comes from its size, material, form, and the number of structural parts. This building's ductility is due to clever features, types of materials utilized, seismic resilience, and the like. Seismic loads are created by the site's seismic activity, the building's construction, the building's significance, and how well it can withstand earthquakes. Due to the high expenses and shortage of land, multi-story structures are developed in India. High-rise building design arrangements, particularly in areas with the greatest land area, are used in order to take use of the most extensive and area. In an earthquake-prone location, these structures may be damaged. As a natural phenomenon, earthquakes are capable of causing the greatest damage to the building. To have a flexible failure form, the structure has to be safe with the right design and structural component specifications. This design idea means buildings are built to survive the force created by the design earthquake with only little damage, and they must also sustain the additional force derived by taking into mind the greatest possible earthquake impact. This study focuses on the city of Delhi in NCR, a place that is in an earthquake zone V. The findings of this investigation demonstrate how simple it is to give an analytical assignment that is capable of accurately estimating the seismic resistance of existing or changed systems. A non-linear, complex investigation of one component of the building was conducted in order to do damage assessments. This particular investigation has nonlinear payment functions as one of its greatest benefits.**

***Keywords*: RCC Building, Reconstruction, Beam Design Criterion**

I. INTRODUCTION

India is one of the most earthquake prone country in the world and the recent devastation caused due to earthquake has exposed the seismic vulnerability of structures in our country. About 50-60% of the total geographical area comes under earthquake prone region. Almost, 4 out of 5 structures are non-engineered made up of earthen walls, stone walls, brick masonry walls etc. These structures cannot even sustain earthquake of minor intensity and result in heavy loss of life and property. Earthquake engineers learnt a lesson from recent Nepal earthquake (2015) that seismic activity is not just a subject of earthquake prone zones but it may also affect the less prone region of north India including the Himalyan region.

Retrofitting Process

Figure 1.1-1.13 shows the design stages of remodeling projects, with rigorous research as the first phase, followed by fact discovery, analysis, detailed design, and construction. Homeowner coordination and design entrance meetings are necessary for a successful remodeling project. In the end, homeowners will be open to changing their outdated and potentially unsanitary habits and products. Thus, every effort should be made to accommodate their worries and preferences into the final result. The full procedure is shown in Figure 1 and the following phases explain it.

Step 1 Step 1: Motivation of the homeowner: Deciding to embark on the renovation project requires motivation on the part of the homeowner. Their motivation might be that the renovation project will make their building more resilient, and they will benefit if their building withstands future floods or non-flood related disasters. The improvements yielded the following results. Homeowners may look for house retrofit information, financial and technical help, and other possibilities among their peers, local authorities, contractors, and design specialists.

Step 2. When developing or selecting improvements, the project team has to do a field survey, regulatory review, and preliminary technical evaluation to identify approaches that are suitable and viable.

Step 3. Determination of Threats: In this stage, flood hazards are comprehensively examined and prioritized areas and buildings to be renovated are selected.

Step 4. A benefit-cost analysis, or BCA, is an objective economic examination of each retrofit consideration that is often done by homeowners or other interested parties. Make connections with the key factors.

Step 5. Remediation design: During this stage, concrete methods for remediation were planned, building specifications were provided, and cost estimates were created.

Step 6. The final design approval marks the beginning of construction; choose a contractor to retrofit the solution once it is complete.

Step 7. The effectiveness of the project is enhanced by well-designed operations and maintenance strategies.

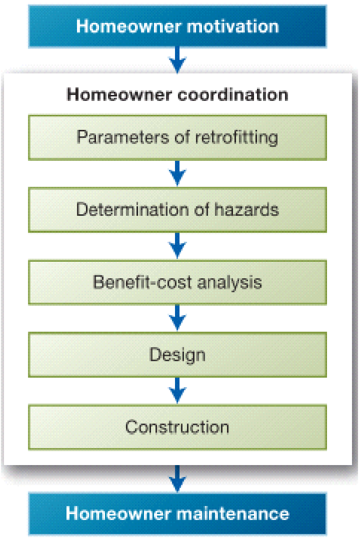

Fig. 1: main steps of the conversion process.

Reinforced Concrete Construction

It is not just the outcome of structural design to build reinforced concrete structures. The firm incorporates clients, architects, structural engineers, construction engineers, and contractors as coworkers. In the event of consulting with specialists for all other types of services for the ground, including soil assessments, water supply, sanitation, fire protection, transportation, heating, ventilation, air conditioning, acoustics, electrical services, and so on, you must coordinate with others. There are three stages to a building project: planning, design, and construction.

- **Planning Phase:** The architect/planner's job is to think and plan the architectural layout of the building to the client's functional requirements, taking into account aesthetic, environmental and economic factors. Structural feasibility is also an important consideration and structural designers need to be consulted for this purpose.
- **Design Phase:** Once the project's original strategy has been accepted, multiple consultants must begin drafting the project's specifics (on paper). As for a structural engineer/consultant, the task will include I determining the choice of structural system and starting member proportions, (ii) calculating the structural load, and (iii) different load combinations. corrosion engineering other components include the real size and reinforcing details of the structural design, as well as material grade needed for safety and compatibility under structural strength. receipt of preliminary designs "It is enough detailed to indicate that it's 'usable for building.'"
- **Construction Phase:** Once a design has been created on paper, it becomes reality. Structure is meticulously planned, yet a structure that is not well built cannot be properly used. Contractor and construction engineer are both responsible for the completion of the project. Proper resource management is required in this activity. It takes people, resources, machinery, money, and time to get things done. Additionally, it should have a solid working knowledge of numerous construction processes and criteria. Skilled concrete workers are also important to the quality of concrete since they must handle, position, compress, and solidify concrete. Also, crucial construction project factors are effective contracts, adequate processes, and good systems and paperwork, although these factors are beyond the focus of this book and must be modified in the event of an accident. While it may be true that... During a time of crisis, if the base has many building blocks, specific building materials are not an option.

Structural Systems

Nonstructural components include anything that isn't part of the structural framework, such as supports like beams and columns (dividers, suspended ceilings, doors, etc.). The "structural system" is created by connecting the structural pieces. It is used to resist the effects of gravity and external stresses and to transmit the produced force to the ground. This allows the building to remain functional even if the supporting ground is disturbed.

Overall, the structural components that remain after taking into consideration their simplifications may be seen as two-dimensional or one-dimensional (skeletal elements, beams, columns, arches, truss components, etc.) It is especially important to verify structural features such as shell side beam joints, perforated shear walls.

The reinforced concrete top tank structure is one example of this kind of construction. Eleven. It mainly comprises of three subsystems: the structural system. While designing, building, and installation are distinct phases, water tanks, sections, and foundations are generally different from one another in terms of design and construction. The container here is domed-shaped with cylindrical side walls (with reinforcing ring beams at the top and bottom), flat circular bottom plates, and circular ring beams, which are all arranged in segmented rows. It is ready to be customized. The "fixed" 3D beam and column frame is the fundamental principle of segmentation. The foundation is built out of an annular ring-shaped plate strengthened at the top with an annular beam, and then sits on the ground with another annular ring-shaped plate below it. Because of this, it is static load (because it is the weight of its own objects), water weight (because of the water in the tank), maintenance of the roof (as long as there is no leakage, the roof is held up by the water), wind load (as long as the surface area of the part of the building affecting the tank is taken into consideration, the building experiences wind) and seismic load (because of earthquakes). Due to the force applied to the tank, a connection is made to the main ring beam, and this in turn connects to the segment to pass the effects of the load to the foundation and subsequently to the ground.

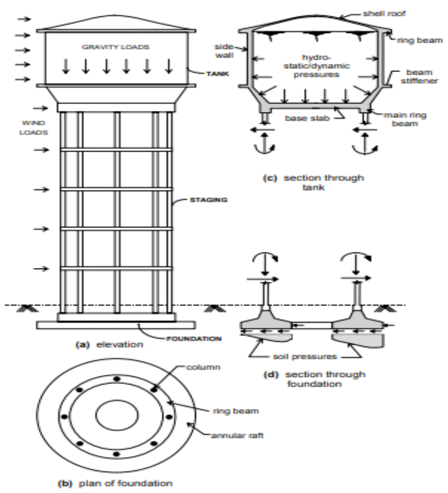

Fig. 2: Elevated water tank structure system

When it comes to how we design and plan buildings, they are regarded to be three-dimensional structures, yet they are usually planned and evaluated using two-dimensional (planar) subsystems in the horizontal and vertical planes (eg floor, roof, wall, flat frame). As may be seen in Figure, and the like." This layout of systems is especially effective for examining construction components that bear weight.

Fundamental of Retrofitting RC Building

Concrete is often added to the covering and jacketing construction outside approach, and this corresponds to (1) in the diagram, in the picture.

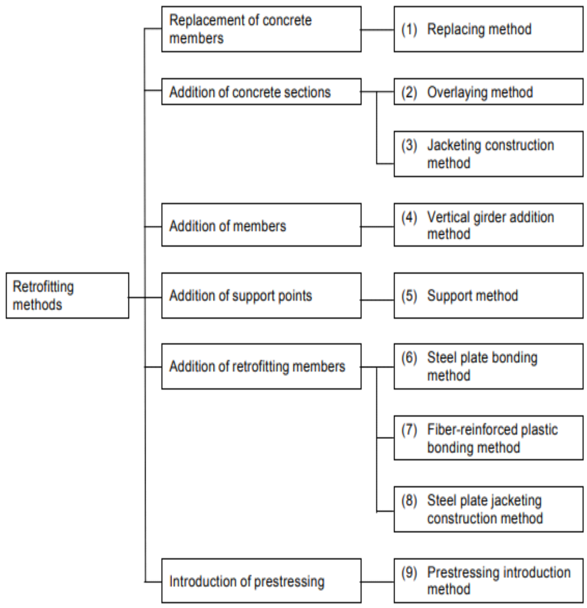

Fig. 3: sample correction method

The Japan Society of Civil Engineers issues design and construction standards (1) and (2) to define the principles of general design and construction of concrete structures. Seismic design-related items are included in the standard (3). Concrete structure construction guidelines (Draft) released by the Japan Society of Civil Engineers may be used as the criterion for the maintenance of concrete structures. This is meant to serve as a supplement to the current texts and to offer a foundation for applying more and more concrete structures in the years ahead. Design and structural standard specifications and maintenance recommendations that successfully integrate retrofit members with existing structures and techniques are removed in order to validate the operation of the retrofit-specific and integrated retrofit structure.

The “reconfiguration”, “functional recovery”, and “functional improvement” methods outlined in the maintenance guide are all included in these (draft) recommendations. The recommendations adjust the mechanical features of the structure to enhance its performance. It will be put into action as you grow. This document includes guidelines as well as content that supplements the guidelines. The (Draft) Guide addresses the main concerns that arise throughout the transformation process, as well as the steps to follow. You will also find reference materials like as instruction sheets, example designs, and other things to help with the repair. This refit design and setup handbook is full with useful tips based on previous art. The example application in the (Draft) Guide and Manual illustrates the application of the information contained in the (Draft) Guide and Manual.

Several different remedies are being used. The categorization of conversion techniques is presented in Figure above in the (Draft) Maintenance Guide. The performance outcomes and configurations of the structural transformation technology that various approaches utilize are not consistent at this time. New approaches are likely to be created in the future, and new ways of looking at current approaches will be offered. These recommendations focus on both the fundamental retrofitting techniques as well as the most often used ways that have been discovered based on previous work. These recommendations, which give precise procedures for constructing exterior cables, include instructions for bonding and coating techniques, as well as rules for cover and jacket construction.

Although these recommendations do not cover all types of construction, they provide a good foundation for designing and building any structure. It is also envisaged that with new building technologies, retrofit design and construction would be achievable. There is no need to adopt the approaches outlined in these (draft) recommendations in this instance. However, these standards will have to be followed, as well as their underlying concepts, to ensure consistency and effectiveness.

Structure modification methods are still in the research stage, and hence there are numerous problems that still to be discovered. It is vital to undertake thorough maintenance following reassembly when reusing equipment according to these (draft) rules.

II. TECHNIQUES

Alternatively, for instance, it might be performed through the removal of one or more floors as shown in the diagram. Easier. When it removes the bulk, the period will decrease, and hence the needed strength will rise

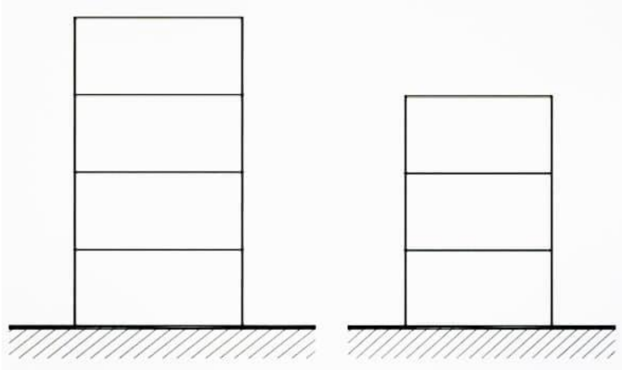

Fig. 4: strength of floors

III. FORMULATION OF PROBLEM

Building modeling is completed in this chapter using E-View and stadpro, as well as building analysis. The design of the rebar and shearwall is completed by analysis. Leakage and environmental behavior during construction is not a viable solution when it comes to these structures, which are older than 35 years and located in an older part of the city. A building inspection is done to assess the structural integrity of the structure. While the base and slab are secure, the beam and column reinforced by corrosion are compromised. The building is strengthened by implementing several modifications. It has been retrofitted.

Load Calculation

According to official records, the structure is believed to be situated in the Srinagar district, a district of the Srinagar municipality. Preliminary data on heavy data

- Self-weight of the slab = 25 × 0.125 = 3.125kN/m2
- Weight of floor finish = 1kN/m2
- Weight of terrace water proofing = 1.5kN/m2
- Total slab weight on roof = 5.625kN/m2

• Floor load

- Self-weight of the slab = 25 × 0.15 = 3.125kN/m2
- Weight of floor finish = 1kN/m2
- Weight of furniture = 1knm2
- Total slab weight on floor = 5.125kn/m2

• Wall load including plaster

- Parapet weight of wall = 1.6 × 0.270 x 31 = 13.395kN/m
- Weight of wall = 19 × 0.23 x 4= 19 kN/m

• Live Load Data

- Live load on roof = 3kN/m2
- Live load on floor = 3kN/m2

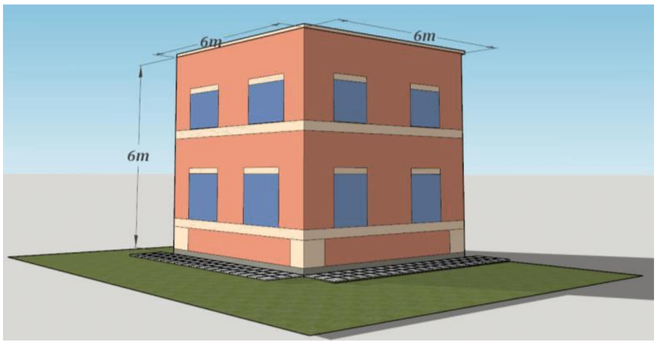

Fig. 5: 3D view of building

IV. RESULTS

By looking at the graph, it can be seen that the building moves much less when the seismic loads are applied in the X and Z directions, because of the use of shearwalls.

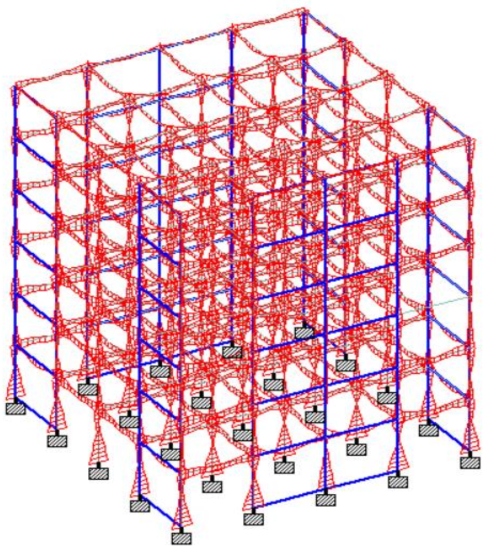

Fig. 6: Bending Moment Diagram

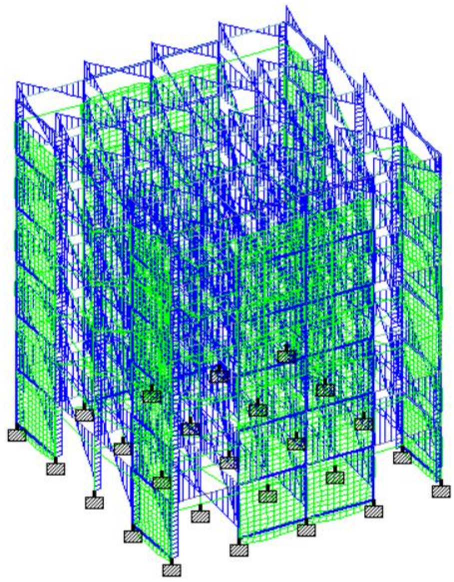

Fig. 7: Shear Force Diagram

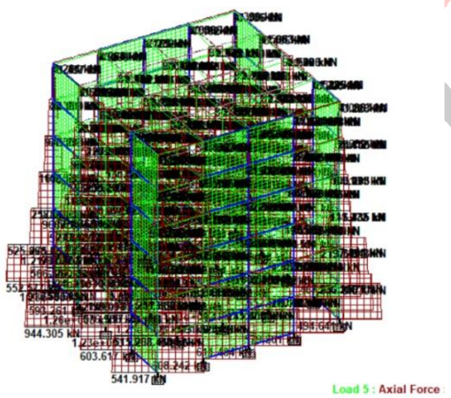

Fig. 8: Axial Force Diagram

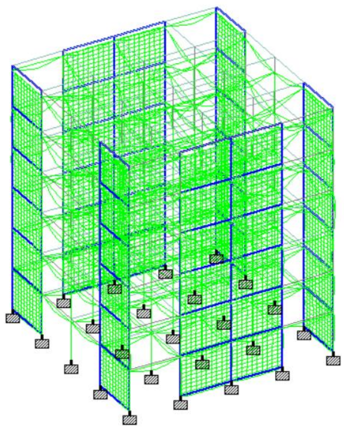

Fig. 9: Deflection Diagram

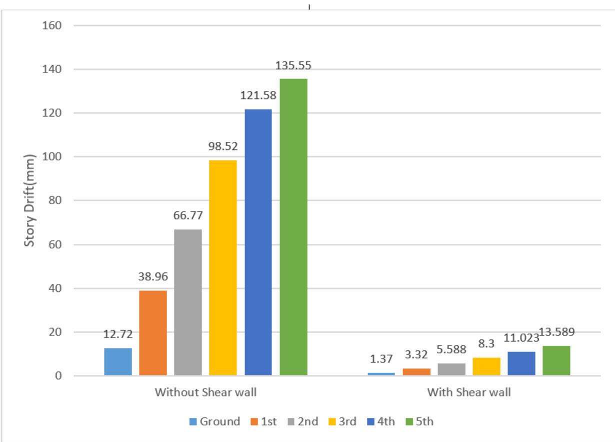

Fig. 10 : Graph showing Story Drift (mm) in X direction for G+5 building.

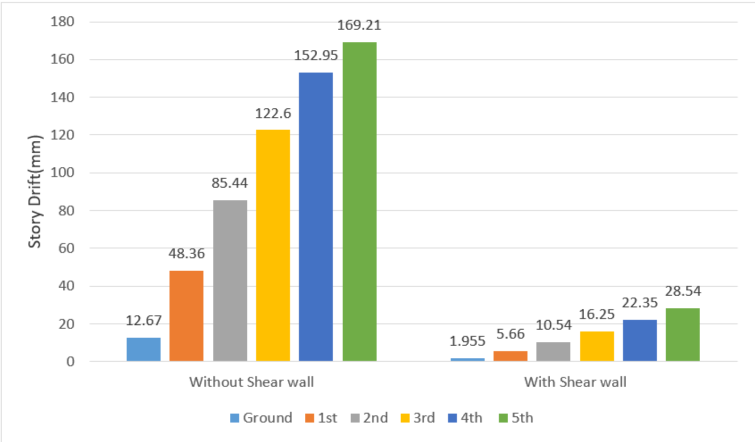

Fig. 11: Graph showing Story Drift(mm) in Z direction for G+5 building.

The construction of the R.C.C building

The inset image depicts column heads exhibiting considerable deformation, resulting in several soft-story failures, as shown. If buildings had consistent deflections of insert, they would have withstood the earthquake without loss of life.

Of the column head and the base, the crushing is done. Column heads were exposed to substantial vertical and lateral seismic stresses due of infill masonry walls with big apertures. The eccentric and compressive extreme stress levels were considerable.

The linkage between major bars was not close enough, which resulted in concrete spalling off the bars due of column heads and high shear deformations. Column head damage depends to a significant degree on the bond strength of the infill wall panels to the columns. Unsurprisingly, many column-head and base difficulties emerged from insufficient detailing. Shear link spacing was too large (often 200-300mm), and therefore not providing enough confinement for the main bars, thus the concrete began to fall out. 6mm sized links were utilized; Shear-loading reversal could not be resisted by the beam and column connections, as the main bars were not bent back into the ground or floor beams. A number of beam/column joints were fated to fail.

V. CONCLUSION AND FUTURE WORK

Analysis may be used to assess the current and changed systems' seismic resistance. linear and non-linear analyses are used while working on the overall structure as well as small sections of the structure. One of the most notable benefits of a nonlinear payment scheme is that you may make far more complex payment sequences. An opportunity to measure damage may be found in analyses that go beyond linear. No difficult work Useful information on what to anticipate from future building performance during an earthquake may be found in the analysis. Due to the high price and scarcity of land, multi-story structures are often constructed. In order to get the most out of available land, architects will design a project from high to medium in height. This may be assumed as these structures were erected in earthquake-prone zones. This earthquake may create the greatest devastating forces in the building since it is a natural phenomenon. In order to establish long-term safety, the design and structural elements of the members must meet safety standards. The earthquake-resistant design concept is that buildings must be designed to withstand the forces caused by earthquakes, which are used in earthquake-based design, while only experiencing minor damage and forces. In addition, these small forces and forces from an upper-scale earthquake (called an earthquake of a higher magnitude) should be tolerable, but structures should not collapse.

- In the recent years, the technology has developed to a very trustworthy level.
- However, the necessary competence is not readily accessible at the lowest level.

- It is the major problem to get a certain performance level while incurring the lowest possible cost, which may be done by making use of nonlinear analysis.
- to find the best retrofit for a given building, optimization methods are required

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