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Multistoried and Multi Bay Steel Building Frame by using Seismic Design

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ABSTRACT:

The seismic design of the frame building proposed in this project is based on IS l893-2002 and IS 800. The aim of the present project is to determine the multi-storey and multi-bay (G+5) building frame according to seismic forces. It was designed according to IS l893 and later IS 800: 2007. The frame is six-fold, with three partitions in the horizontal direction and five partitions in the horizontal direction. The selection of a segment depends on a number of criteria. The two methods used for analysis are the equivalent static charge method and the response spectrum method.

The results obtained from the two methods were compared in terms of storey displacement, storey displacement and foundation shear. Frames were also analyzed with P-Δ analysis and time to correct for IBC code. Then, based on this analysis process, a time-resistant steel frame was designed according to IS-800:2007. Check the design again and compare the results by material.

The cost-effectiveness of the two methods was compared. Finally, the connection between the inside and outside of the frame is created and calculated. In addition, the construction of the base plate foundation conforms to IS 800:2007. The software used for analysis and design is STAAD PRO.Adequate bibliography and comparisons have been made during both design and review.

KEYWORDS: Frame, Seismic Load, Multi-storey, Multi-bay.

1. INTRODUCTION

1.1. General

Today, the first floors of many urban multi-storey buildings in India are open as a defense mechanism. This is important to prevent me from writing the main story's entree. Although all seismic patterns during an earthquake have a negative period, the seismic cycle is not independent of the magnitude and spread of the earthquake.

The behavior of structures during an earthquake foundation depends on the overall shape, size and geometry, regardless of how the earthquake force is transmitted to the ground. Earthquake force occurs in different floors and structures and should be brought to the ground in the easiest way; any variation or combination or movement will cause its structure to show a dangerous result.

A model with a vertical view (like the service model, has a wider story than the others) will cause an earthquake, feature shaking in size. A structure that has no cracks or splits in a certain past will create damage and destruction in every past. During the 200l Bhuj earthquake, many buildings in Gujarat were prepared to prevent collapse or serious damage. In the middle of the story, there is a structure with a part that is floating or floating on the ionic line, and this structure is wrong, there is an inconsistency in that structure.

The Indian Subcontinent has earthquakes marked in the background.

The reason behind this is the intensity and frequency of seismic tremors as the Indian plate slammed into Asia at 47mm per year. Another study noted that the earthquake had a magnitude of 8.5 or greater when it hit the focal point of the Himalayas.

Such a seismic tremor could murder or harm a huge number of individuals separated from causing never-seen annihilation in Uttarakhand and Himachal Pradesh. Quakes far and wide are without any help in charge of the decimation to life and property in enormous numbers. So as to alleviate such perils, it is critical to consolidate standards that will improve the seismic presentation of structures.

As indicated by the Seismic Zoning Map of IS l893:2OO2, India is isolated into five seismic zones, in climbing request of a specific zone factor which is appointed to them based on their seismic power..

The 4-story RC Structure being broke down in this specific venture is the private structure ofRoorkee which is under development, which is situated at all defenseless zone for example zone IV.Subsequently, it might bomb in case of any respectably solid structural action in its region. Contemplating the exhibition of the structure and recommending appropriate retrofit measures for the structure would in this manner be a need.

l.2 iProposed iWork iand iObjective

My research project is seismic assessment of structures. Part is probably because it was created somewhere in Ireland 5O years ago, so I won't be disappointed in the first place. After learning that its structure will collapse forever when subjected to seismic loads. Before using the Equivalent Static Method, an idea taken from the found that the structure would collapse immediately when the i was subjected to seismic thrust loads.

The Demand Capacity Ratio (DCR) is determined in the initial history of its axis and segment. We see an infinite axis and cross section at the bending limit. But most of these people are what I see when I hear it. Section

Considering my conclusions, I focus on to - Section

STAAD has developed a plan to guide the analysis of the seismic representation of the structure.Pro v8i

l.3 iOutline iof ithe iWork

Part l is a short presentation about quakes, the need to examine execution of structures when exposed to seismic powers. It likewise condenses the goal to be accomplished in this specific undertaking.

Part 2 contains an outline of all the writing which has been surveyed to pick up information about the different sorts of retrofitting estimates which can be connected to structures and features the examination territory for the equivalent.

Part 3 contains the fundamental hypothesis and strategy which has been utilized to break down the structure and the plan.

Part 4 ties together every one of the outcomes acquired from the examination, which aides in pointing out which individuals will flop in flexure and additionally shear and recognize an example. Therefore, certain ends have been determined and scope for future work has likewise been expressed.

METHODOLOGY:

1) 3.2.l. Geometry and Section specification

The structure is an under-development building situated in Roorkee. This is to be utilized for private reason as it were. There the estimation has been taken from structure. At that point the arrangement is drawn utilizing AutoCAD Software. This is a G+3 structure. The size of structure is 42' x 3l'. The stature of the structure is 4O ft and each floor is of lO ft.

Figurel demonstrates the Plan of the structure at Ground Floor. Figure2 demonstrates the Plan of the structure at first floor. Figure3 demonstrates the Plan of the structure at second floor. Figure4 demonstrates the Plan of the structure at third floor. There are 3 room on each on second and third floor.

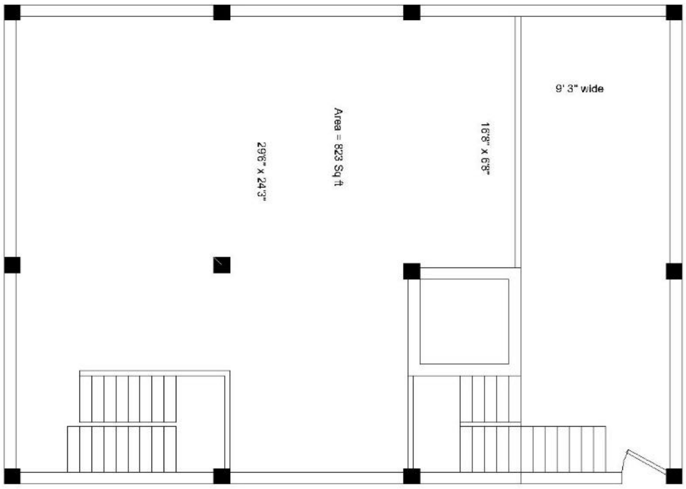

Figure 1- Plan of building on ground floor

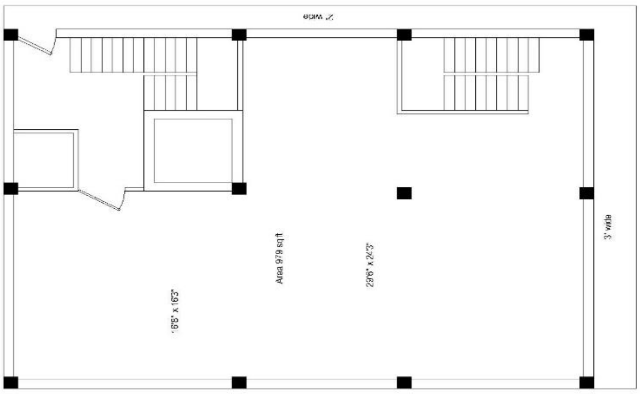

Figure 2 - Plan of building at lst floor

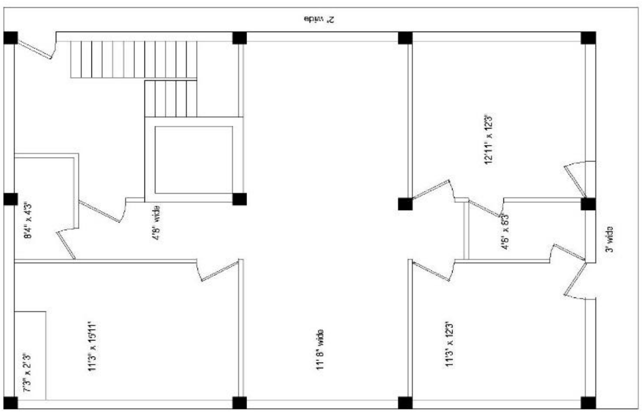

Figure 3 - Plan of building at 2nd floor

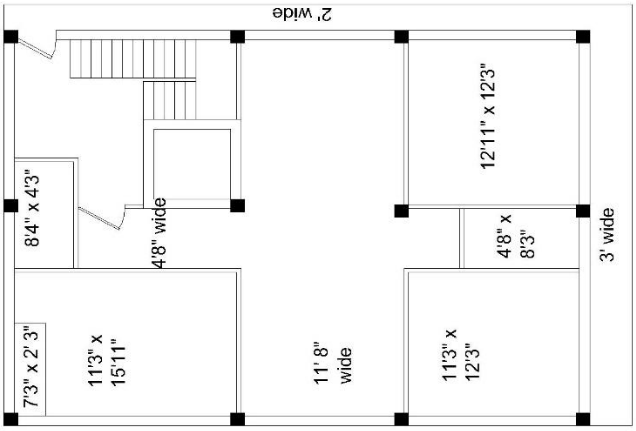

Figure 4 - Plan of building at 3rd floor

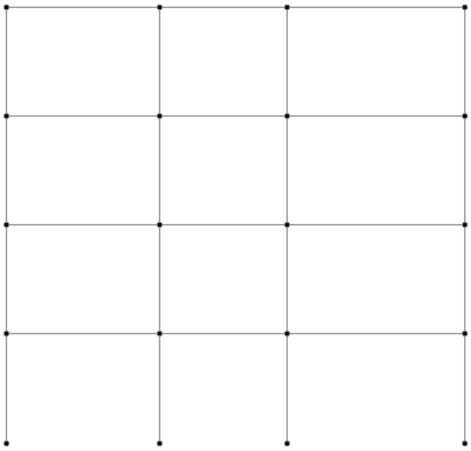

Figure 5 - Elevation view of structure in Staad.Pro

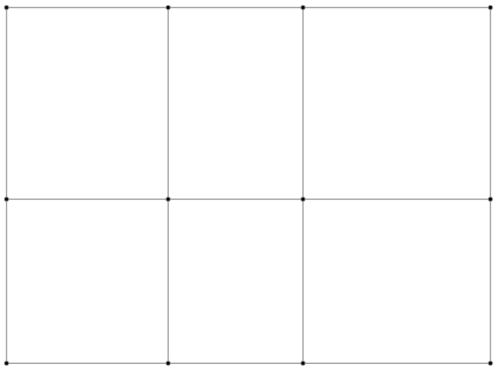

Figure 6 - Plan view of structure in in Staad.Pro

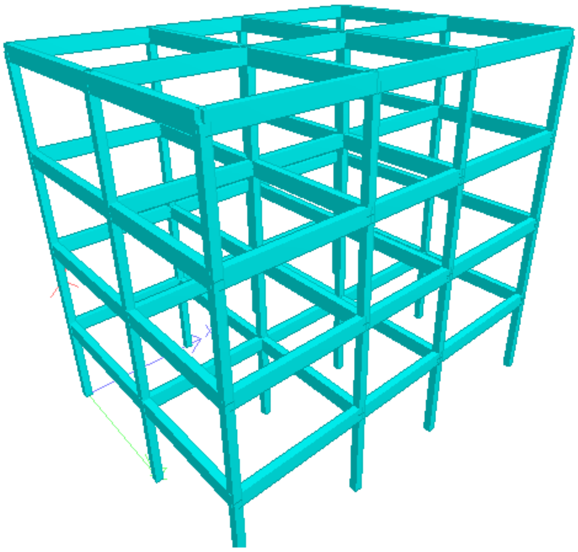

Figure 7 - 3D rendered view of the geometry

The width of the structure is 30 ft which have two inverse room. Each room have the width of the 15 ft. Figure 3.4 demonstrates the arrangement perspective on the structure of pillar course of action. So length of bar in this structure is 12 ft along the length and 12 ft along the width of the structure.

Section of the beam = 0.23 m X 0.45 m

Section of column = 0.23 m X 0.23 m

LOADS CALCULATION

When earthquake forces are considered on a structure, these shall be combined where the terms DL, IL and EL stand for the response quantities due to dead load, imposed load and designated earthquake load respectively. In the limit state design of reinforced and pre-stressed concrete structures, the following load combinations shall be accounted for:

1) 1.5(DL+IL)
2) 1.2(DL+IL+EL)
3) 1.5(DL+EL)
4) 0.9DL* 1.5EL

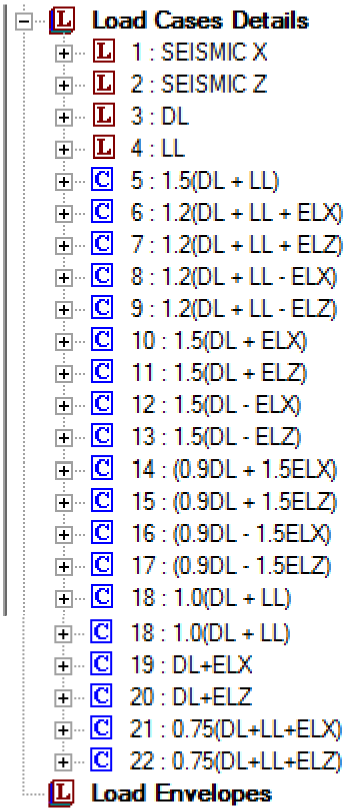

Figure 8- Load combination as per IS 1893: 2002: Part 1

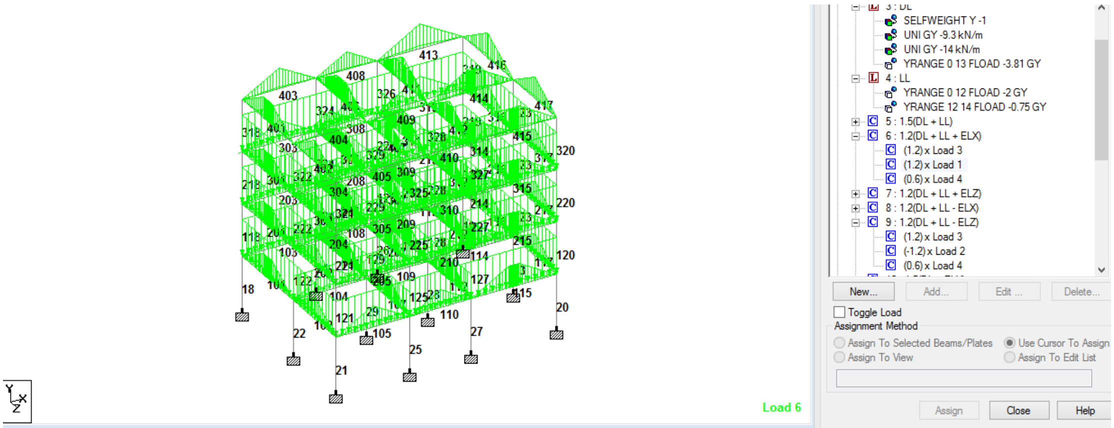

Figure 9- Load combination in Staad.Pro

CONSTRUCTION FEATURES

A Reinforced Concrete (RCC) framed structure is a common structural system used in construction, especially for buildings and infrastructure that require strength, stability, and durability. This construction approach involves a framework of columns and beams made of reinforced concrete to provide structural support. Here are some of the key construction features and components of an RCC framed structure:

1.1 Foundation:

The construction begins with the foundation, which is designed to transfer the loads from the structure to the ground. Foundations may include isolated footings, strip footings, raft foundations, or piles, depending on soil conditions and structural requirements.

10.2 Columns:

- Vertical concrete columns are constructed to support the load of the building above. Columns are typically reinforced with steel bars (rebar) to enhance their strength and ductility.
- Column sizes and reinforcement are determined by structural engineers based on the loads they need to carry and the building's design.

10.3 Beams:

- Horizontal concrete beams connect the columns and provide support to the slabs and other components of the structure. Like columns, beams are also reinforced with rebar.
- Beams help distribute the loads from the slabs and walls to the columns and ensure even load transfer.

10.4 Slabs:

- Concrete slabs are used for floors and ceilings. Slabs can be one-way or two-way, and their thickness and reinforcement depend on the span, load, and use of the floor.
- Slabs are often cast on top of formwork that provides the desired shape and finish.

10.5 Walls:

- Concrete or masonry walls can serve dual functions within a building, either as integral components of the structural system or as internal partitions. Load-bearing walls play a pivotal role in fortifying the overall structural integrity of the framework.
- In specific scenarios, structures may include shear walls or specially engineered walls, strategically integrated to counteract lateral forces such as wind or seismic impacts.

10.6 Reinforcement:

- Reinforcement in the form of steel bars (rebar) is placed within the concrete elements, including columns, beams, slabs, and walls. Rebar provides tensile strength and ductility to the structure.
- The proper placement and spacing of rebar are crucial to ensure structural integrity and prevent cracks.

10.7 Formwork:

- Temporary formwork is used to Mold the concrete into the desired shapes of columns, beams, and slabs during construction.
- Formwork can be made from timber, plywood, steel, or other materials and is removed after the concrete has cured.

10.8 Concrete Mix Design:

- The selection of the concrete mix design, including the type and proportions of aggregates, cement, water, and admixtures, is crucial to achieve the desired strength, durability, and workability of the concrete.

10.9 Construction Joints:

- Construction joints are planned locations where concrete work is temporarily halted and then resumed. Proper construction joints are important for maintaining structural integrity.

10.10 Curing:

- Adequate curing, which involves keeping the concrete moist and protected from drying out, is essential to achieve the desired strength and durability of the concrete elements.

10.11 Quality Control:

- Quality control measures are implemented throughout the construction process to ensure that materials and workmanship meet the specified standards and design requirements.

10.12 Finishes:

- After the structural components are in place, finishes such as plaster, paint, flooring, and cladding are added to the building as needed for aesthetics and functionality.

TESTING

Testing in the context of a research paper on R.C.C. framed structure design and analysis using STAAD Pro involves verifying the accuracy, reliability, and efficiency of the software in simulating real-world structural behaviour. The testing phase aims to ensure that the results obtained from STAAD Pro align with established engineering principles and standards. Here's a breakdown of the testing process:

1. **Model Verification:**
   - Validate the accuracy of the 3D models created in STAAD Pro by comparing them with architectural and engineering drawings.
   - Check the consistency of the modelled geometry, member connectivity, and boundary conditions against the intended design specifications.

2. **Material and Design Code Compliance:**
- Verify that the material properties assigned to concrete and reinforcement elements align with the specified design codes and standards (e.g., ACI, Eurocode).
- Ensure that STAAD Pro correctly implements the selected design codes in its analysis and design calculations.

3. **Load Application Testing:**
- Apply a range of loads to the structure, including dead loads, live loads, wind loads, and seismic loads.
- Validate the correct application of loads in STAAD Pro by comparing them with manual calculations based on relevant design codes.

4. **Analysis Method Verification:**
- Test different analysis methods available in STAAD Pro, such as static, dynamic, and nonlinear analyses.
- Verify the consistency and accuracy of results obtained from different analysis methods for a given set of input conditions.

5. **Comparison with Analytical Solutions:**
- Compare the results obtained from STAAD Pro with analytical solutions for simplified structural configurations.
- Validate STAAD Pro's ability to accurately predict structural responses under basic loading scenarios.

6. **Benchmarking Against Empirical Data:**
- Benchmark STAAD Pro results against empirical data from well-documented case studies or real-world structures with known performance.
- Evaluate the software's performance in predicting deflections, member forces, and overall structural behaviour against observed outcomes.

7. **Sensitivity Analysis:**
- Conduct sensitivity analyses by varying input parameters, such as material properties, loading conditions, and support conditions.
- Assess how changes in input parameters affect the output results and ensure that STAAD Pro provides consistent and logical responses.

8. **Comparative Analysis with Alternative Software:**
- Use alternative structural analysis and design software to analyse the same R.C.C. framed structures.
- Compare the results obtained from STAAD Pro with those from other software to identify any discrepancies or variations.

9. **Case Study Validation:**
- Validate the results of the case studies conducted within STAAD Pro against observed behaviours of actual structures with similar configurations.
- Confirm that the software accurately predicts the performance of R.C.C. framed structures in real-world scenarios.

10. **Documentation of Testing Procedures:**
- Document the entire testing process, including input parameters, software settings, and step-by-step procedures.
- Provide a transparent account of the testing methodology and results for reproducibility and peer review.

CONCLUSION

STAAD PRO has the ability to compute the support required for any solid area. The program contains various parameters which are planned according to Seems to be: 456(2000). Shafts are intended for flexure, shear and torsion.

Plan for Flexure:

Most extreme hanging (making malleable worry at the base essence of the pillar) and hoarding (making tractable worry at the top face) minutes are determined for all dynamic burden cases at every one of the previously mentioned areas. Every one of these areas are intended to oppose both of these basic drooping and hoarding minutes. Any place the rectangular area is insufficient as separately strengthened segment, doubly fortified segment is attempted.

Plan for Shear:

Shear support is determined to oppose both shear powers and torsional minutes. Shear limit computation at various areas without the shear support depends on the genuine ductile fortification given by STAAD program. Two-legged stirrups are given to deal with the parity shear powers following up on these areas.

Shaft Design Output:

The default configuration yield of the bar contains flexural and shear support gave along the length of the bar.

Segment Design:

Segments are intended for hub powers and biaxial minutes at the finishes. All dynamic burden cases are tried to figure fortification. The stacking which yield most extreme support is known as the basic burden. Segment configuration is accomplished for square area. Square segments are structured with fortification circulated on each side similarly for the segments under biaxial minutes and with support appropriated similarly in two appearances for areas under uni-pivotal minute. Every single significant foundation for choosing longitudinal and transverse fortification as stipulated by Seems to be: 456 have been dealt with in the segment plan of STAAD.

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