DOI: 10.53469/jpce.2024.06(11).04

STAAD Based G+2 Single-Column Residential Analysis

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Abstract: ***The principle cause of this study is to layout a whole building relaxation on a single column. The rapid increase in population and scarcity of land tends to the development of construction technology and high- rise commercial structures. The building plays a vital role in improving various activities in the late world. The Aim of present study "Analysis and design of high rise building by staad pro is to define proper technique for creating Geometry, cross sections for column and beam etc, developing specification and supports conditions, types of Loads and load combinations. In this study a 30- storey high rise structure is analyzed for seismic and wind load combination using staad pro and comparison is drawn. Currently, there are four mosques on Java Island recognized as Saka Tunggal Mosques, which employ a single wooden column as the main column, placed at the center of the prayer hall to support the roof. This unique structural system, when compared to the traditional four-column system, is remarkable even if its style is exceptional for mosques on Java Island. This study aims to provide scientific data and promote the local government's understanding about the importance of the Saka Tunggal Mosques by focusing on the one in Banyumas, which is placed at a cultural heritage site, founded in 1871. The rapid increase in population and scarcity of land tends to the development of construction technology and high-rise commercial structures. Building plays a vital role for improving the various activities. In the late world, prompt to action of peoples from one place to another is of great extent mainly for earnings. In building more facilities like financing section, computer section, administration section, design section and drawing section are provided. The aim of the project is to analyse and design of multi-storey building resting on the single column by using different code provisions. A lay out plan of the proposed building is drawn by using AUTO CADD. The structure consists of ground floor plus five floors, each floor having the one house. Staircase must be provided separately. The planning is done as per Indian standard code provisions. The building frames are analyzed using the various text books. Using this so many standard books analysis of bending moment, shear force, deflection, end moments and foundation reactions are calculated. Detailed structural drawings for critical and typical R.C.C. members are also drawn. Recent studies regarding progressive collapse resistance of buildings considered only single critical column removal scenario. However, limited investigations have been conducted so far to assess multi-column removal scenarios. Hence this study is made to compare progressive collapse resistance of a multi-story building under both single and multi-column removal scenarios. An eight-storey reinforced concrete building was analyzed by using linear static analysis procedure and DCR values of the members are calculated to investigate the potential of progressive collapse as per GSA guideline.***

Keywords: G+2, Stadd Pro, Building, Construction

1. Objective of Study

- Study on Analysis and Design of a Multi-Storey Building with a Single Column using Staad Pro.
- Analysis and Design of High-Rise Building Frame using Staad Pro.
- Historical Assessment of the Saka Tunggal Mosque in Banyumas: Study on the Single Column Mosque on Java Island, Indonesia.
- Design of a Structure Supported on Single Column Office.
- Design of Multi Storey Building Resting on Single Column.
- Progressive Collapse Analysis of multi-story building under the scenario of multi-column removal.
- Higher Modes in Simplified Inelastic Seismic Analysis of Single Column Bent Viaducts.
- Analysis of a RCC frame Tall Structure using Staad Pro on Different Seismic Zones Considering Ground Slopes.
- Research on Mechanism of Overturning Failure for Single-column Pier Bridge.
- Analysis of Residential Building with STAAD. Pro & ETABS.

2. Literature Survey

The seismic loading analysis is very important for designing high-rise buildings in the most seismic ground motion zone. The major objective is to study seismic resistance of soft storey buildings and compare deflections under forces on similar high-rise building structures located in central India under such lateral forces with different bracing systems.

Chen and Constantinou (1998) studied that the practical system deliberately introduces flexibility to the sloping ground storey of structures was described. The system utilizes Teflon sliders to carry a portion of the superstructure. Energy dissipation is provided by the ground story ductile column s and by the Teflon sliders. Utilizing this concept, the seismic response characteristics of a multistory frame are analyzed a discussed. The results show that it is possible to provide safely to the superstructure while maintaining the stability of the ground storey. Chandrasekaran and Rao (2002) investigated analysis and the design of multi- storied RCC buildings for seismicity. Reinforced concrete multi-storied buildings re very complex to model as structural systems for analysis. Usually, they are modeled as two-dimensional or three- dimensional frame, systems are in to plane and slope with different angles 5 10, and 15. Analyze multistoried buildings in the country for seismic forces and comparing the axial force, shear force, moment, nodal displacement, stress in beam and support reaction compared to current version of the IS: 1893 –

3. Problem Formulation and Methodology

The supporting condition of structural members determines their stability during their lifetime. A structure is said to be

stable when it satisfies all stability requirements. Structures will be more stable when all the sides proportionally to balance the static and dynamic loads support it; the structure has supposed to be supported. For aesthetic appearance we create our building supported by a single column. Satisfying t and may cause failure of structure is very critical condition.

The purpose for taking in this project is to design a whole building rest on single column and how the different components are designed are given below in detailed.

Design of the Foundation:
The type of foundation suitable for this multistorey building is adopted based on the SBC, value assumed. And it is designed by using standards of Indian codes and other.

Design of the Column:
One of the important tasks in this is design of Column because only mono column is assumed. The Column is designed by taking required dim he requirement of stability conditions for a single column structure will be a complicated one, compare with the structures supporting in all the sides depends upon their configuration; single column structure is a critical one when it is being to a symmetrical and eccentric loading condition. Eccentric loading will cause the structure to twist in any direction tensions according to Design of Beam:

The desired specifications of the beams are assumed according to Code Provisions And the checks are made according to that.

Design of the Slab:
The required slab is assumed and it is designed with required specifications The walls are construct in English bond. The specifications are lintel for various works. The limit state of design is adopted for designing all the RCC members. There no existing structure practically but the design is comparing between various papers as references.

4. Background

A large number of structures that are being constructed at present tend to be wind-sensitive because of their shapes, slenderness, flexibility, size and lightness. Added to these are the uses of materials which are stressed too much higher percentage of their ultimate strength than the in earlier days because of better assurance of quality of materials. In the social environment that is developing world over , the ancient philosophy of accepting continuing disasters due to wind as ordained by ‘fate’ and gods is giving place to demands for economical wind resistant Updating of some international codes of practice, notably the British, Australian, Canadian , American and French has been effected fairly frequently over the last two decades and the present versions incorporate most of the advances made in understanding the wind characteristics and its effect on structures. The new discoveries are such that it is clear mere issue of amendments to the earlier code IS 875:1964 will not be justifiable. The recently issued wind code of practice for design loads (other than earthquake) for buildings and structures IS875 (part 3):1987 differs in many ways from the previous code first issued in 1964 and attempts not only to rectify the shortfalls of the 1964 code but incorporates recent knowledge of wind effect on structures. The height up to which velocities are given has now been raised to 500m and the loadings on as many of the commonly encountered buildings and structures, for which there are no other Indian standards , have been included .Although not explicitly stated , the code recognizes the fact that most of the high winds in India occur due to short duration rotating winds like tropical cyclones along the coasts or tornadoes elsewhere, and nearly rectilinear winds of short duration like thunderstorms at many places.

Horizontal dimension of the building measured normal to the breadth of the structure. Breadth for wind along the longitudinal reference axis and BB’ for wind perpendicular to it, for other wind direction, such as at angle ‘Ɵ’ it is the maximum width seen along the wind such as the projection of AB’ on a plane perpendicular to the direction of wind. Depth Horizontal dimension on the building measured in the direction of wind is the depth for wind along reference axis and BA for wind perpendicular to the reference axis.

Table 1: Design of the members in detailed

S. No	Name of the Member	Details of Design	Remarks
1.	Footing	DESIGN OF MAT FOUNDATION: Size of the building =9x12m Service load transmitted by each column =7250 KN Size of the column =2mx2m Safe bearing capacity of the soil =120KN/m2 M20, fck =20 KN/m2 and fy 415 HYSD bars. And then continuous slab over Raft slab is designed.	According to the code provisions check is ok.
2.	Column	COLUMN DESIGN: Design of Column is done as per IS:456-2000 Section Property: 2000 x 2000, Storey height = 16.500 m rectangular section: Width= 2000 mm, Depth= 2000 mm, Cover = 40 mm Member Detailed IS456 Main Reinforcement, Critical Combination: C4 And all other manual design is done by used standard code.	All the checks are ok hence it is safe.
3.	Beam	BEAM CALCULATIONS: Assume the thickness of the beam is 450x600 Imposed load = 3 KN/m2 Live load is for all rooms& Kitchens, toilet and Bath rooms= 2 KN/m2 and self-weight is calculated as 3 KN/m2 (According to IS 456 part 2) Provide 10mm dia 240 mm centre for long span direction and the other manual required design is done by using codes and other reference books for all other rooms in the multi -storey building.	All the checks are ok hence it is safe
4.	Roof slab	DESIGN OF ROOF SLAB [14,17] ly = 5m, lx = 3m, f ck =20 N/ mm2 and f y=415 N/ mm2 Where ly / lx ratio is <2. Design as a two-way slab. As the span is more than 3.5m adopt Span/depth =25 (Condition according the IS 456) Depth = span/25 = 3.5/25 = 114.85m, say = 120mm Adopt effective depth (d) =95 mm and Overall depth (D) =120m EFFECTIVE SPAN: Effective span = (clear span+ effective depth) = 3.00+0.095 = 3.095m	All the checks are ok hence it is safe

		Loads are taken from codes and Ultimate load = 8.4 KN/m2. And the shear force and ultimate bending moments are designed. Hence the effective depth selected is sufficient to resist the design of ultimate moment. Adopt 10mm dia @300 mm in shorter span direction.	
5.	Stair case	STAIR CASE DESIGN Type of the stair case is straight flight stair case No. of steps in straight flight is 12 Tread (T)= 250mm, Rise (R)=150mm Width of the landing beams =400mm and Materials M20 and fy 415 EFFECTIVE SPAN: Effective span l= (12x250) +400 =3400mm Thickness of the waist slab is (span/20) = 3400/20=170mm, say =200 mm and all necessary checks are done by using code provisions. Provide 12mm of diameter and Spacing =160mm Distribution of the reinforcement =0.12% bD =0.0012x1000x200 =300 mm2 Provide 8mm 0f dia of bars at c/c.	All the checks are ok hence it is safe.

5. Structural Elements Loads

All loads acting on the building except wind load were considered. These are 1. Dead Load 2. Live load 3. seismic load III 4. wind load It was assumed that earthquake load will not govern the demands on the members. Dead Load The dead load itself indicates self-weight of the beams, columns, floors and slabs. The unit weights of some materials are given from Table1, IS 875 (part-1):1987.

Dead load due to external walls = 0.23*3.2*20=14.72KN/m2
Dead load due to internal walls = 0.16*3.2*20=10.24KN/m2
Unit weight of Reinforced concrete, γc = 25.0 kN/m3
Unit weight of standard brick = 20KN/ m3
Live load on floors Live load on floors= 3KN/m2
Live load on roof slab= 2KN/m2

Lateral loads due to Wind load The lateral loads were calculated in X and Z directions according to IS 875 (part - 3):1987 and applied at the nodal points in directions considered. The lateral load along X and Z directions is denoted as WLX and WLZ respectively.

Each floor consists of height 3m which is taken as per municipal corporation rules for single column buildings. The building is not designed for increasing the number of floors in future. So, the number of floors is fixed for future also for this building due to unavailability of the permissions of respective authorities. Also, special materials like fly ash and self-compacted concrete were also used in order to reduce the dead load and increase life of the structure and also improve economy. But these materials were not considered while designing in STAAD Pro to reduce the complexity and necessary corrections are made for considering the economy and safety of the structure.

Table 2: Code book provisions

S.no.	Types of the structural member	Specifications of member	Design provisions used
1.	Foundation (Isolated square footing)	9m X 12m	IS:456-2000
2.	Column (SHORT, COMPRESSION MEMBER)	2mx2m	IS:456- 2000
3.	Beam (Fixed beams)	450mmx675mm	IS:456- 2000
4.	Slab (Two-way slab)	Thickness=150mm	IS:456- 2000
5.	Stair case (straight flight stair case)	Tread (T)= 250mm Riser(R)= 150mm	IS:456- 1978

Advantages of STAAD pro

1) Extremely Flexible Modeling Environment.
2) Broad Spectra of Design Codes.
3) International Best Seller.
4) Interoperability and Open Architecture.
5) Covering All Aspects of Structural Engineering.
6) Quality Assurance.
7) Extremely Scalable.
8) Easy Reports and Documentation.

Design Note Single Supported Column Building

1) Foundation depth =2.5m
2) Supports = All are fixed Supports
3) Number of stores = G+2
4) Height of each floor = 3.5m
5) Total height of the building = 10.5m
6) Cross section of the beam = 300 mm x 230 mm
7) Diameter of the column = 450mm x300mm, central column: 900mm x750mm
8) Height of the parapet wall = 1.2 m
9) Thickness of the wall = 160 mm
10) Density of the brick = 20 KN/ m3
11) Density of the concrete in the members except walls = 25KN/m3
12) Floor finish = 1 KN/m3
13) Slab thickness = 0.15 m
14) Seismic zone: zone -II
15) Wind load: zone-3

6. Result

1) In this project a multi-storey building resting on single column designed by using of STAAD PRO.
2) Using of this software analysis of bending moment, shear force, deflections, end moments and foundation reactions are calculated.
3) Using this calculated Bending moment, shear force, and reactions the beams, columns and footing are designed.
4) By using the AUTO CAD we can design the footing.
5) Detailed drawings of all R.C.C. members such as slabs, beams, columns, and footings are also shown.
6) Results shows that as the slope is increasing bending moment is also increasing also as the effect of soil and seismic zones shows their impact.
7) Shear force is increasing as seismic zones are increasing also the soil is also showing its effects.
8) As the slope is increasing displacement is increasing.
9) Since the investigation gone through alive project, in details of conclusion the analysis and designing of structural members are similar either ETABS or Staad Pro. Whereas the inputs analysis and designing is same

the results are obtained and the values of Shear force, Bending moment for both ETABS & Staad Pro.

10) Deflection and shear bending is more in dynamic analysis compare static analysis.
11) In lower beams more reinforcement is required for dynamic loads compared to static loads.
12) For columns, area of steel and percentage of steel is always greater for dynamic load combination compared to static load combination.
13) In an advancement of building two essential issue considered are security and economy. If the piles are adjusted and taken higher then economy is affected.
14) In case economy is considered and stacks are taken lesser then the security is bartered. So, the estimation of various weights acting is to figured unequivocally.
15) Indian Standard code IS: 875-1987: Minimum Design Loads for Buildings and Other Structures decides distinctive layout loads for structures.
16) Sorts of weights falling up on the structure are:
    a) Dead loads
    b) Imposed loads
    c) Wind loads
    d) Snow loads
    e) Earthquake loads
    f) Special loads
17) A single mono column building consumes less concrete in comparison to a multi column building.