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Comparative Analysis and Design of a Building by Using STAAD

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Abstract- Staad is a software tool to design structural design of any plan and also it can give loads of that structure. We can mention about which material we are going to use and what is the strength of that ember, it all comes under this software.Auto-CAD is a software tool to design functional design of any plan. It includes outer appearance of the plan. In this project work, an attempt is made according to building bye laws and design of building as per IS: 456-2000, SP-34 specifications.

1. INTRODUCTION

To perform an accurate analysis structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior. The aim of design is the achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and adequate resistance to the effects of seismic and wind. Structure and structural elements shall normally be designed by Limit State Method. Account should be taken of accepted theories, experiment and experience and the need to design for durability. Design, including design for durability, construction and use in service should be considered as a whole. The realization of design objectives requires compliance with clearly defined standards for materials, production, workmanship and also maintenance and use of structure in service

AUTO-CAD 3DMAX STAAD

1.1 AutoCAD

Autocad was derived from a program begun in 1977 and released in 1979 was call Interact CAD, also referred to in early Autodesk documents as Micro CAD, which was written prior to Autodesk's formation by Autodesk cofounder Michael Riddle. **AutoCAD** is a commercial computer-aided design (CAD) and drafting software application. Developed by Autodesk, Auto CAD was first indroduced in December 1982 as a desktop app,which was running on microcomputers with the internal graphics controllers. AutoCAD was introduced, most commercial CAD programs which ran on mainframe computers or minicomputers, with each CAD operator or user working at a separate graphics terminal .since 2010, AutoCAD was released as a mobile- and web app as well, marketed as AutoCAD 360. AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals. It was supported by 750 training centers worldwide in 1994. The first version by Autodesk was demonstrated at the 1982 Comdex and released that December.[10] As Autodesk's flagship product, by March 1986 AutoCAD had become the most ubiquitous CAD program worldwide.[11] The 2019 release marked the 33rd major release of AutoCAD for Windows.

1.2 STAAD

stadd is The commercial version, now a days staad is one of the most widely used structural analysis and design software products worldwide. It supports several steel, concrete and timber design codes. It can make use of various forms of analysis from the traditional 1st order static analysis, 2nd order p-delta analysis, geometric non- linear analysis, Pushover analysis or a buckling analysis. It can also make use of various forms of Dynamic analysis from modal extraction to Time history and response spectrum analysis.
In recent years it has become part of integrated structural analysis and design solutions mainly using an exposed API called Open STAAD to access and drive the program using a Visual Basic macro system included in the application or by including Open

STAAD functionality in applications that themselves include suitable programmable macro systems. Additionally, STAAD. has added direct links to applications such as RAM Connection and STAAD.Foundation to provide engineers working with those applications which handle design post processing not handled by STAAD. itself. Another form of integration supported by the STAAD. is the analysis schema of the CIMsteel Integration Standard, version 2 commonly known as CIS/2 and used by a number modelling and analysis applications.

2.0Designe of slab

Slab is plane structural member whose thickness is small as compared to its length and breadth. Slabs are mosly used as roof coverings and floors in various shapes, such as rectangular, square ,circular, triangular etc.in the building. The slabs are supports mainly transverse loads and the load is transfered them to the supports in the form of the bending action in one or more directions. Beams and walls are the common supports for the slabs.

Slabs form floors and roofs of buildings. Generally they are assumes for carry uniformly distributed loads. In most cases slabs are analyses for flexure only. Usually slabs are the horizontal componant in the case of stair cases and ramps for storied car parks. Beams and wall are support to the slabs. The various types of slabs provided . which are as following.

1) Simply supported slabs spanning in the one direction (One way slabs).
2) Simply supported slabs spanning in the two direction (Two way slabs).
3) Continuous slabs
4) Cantilevering slabs.
5) Flat slabs.

Table No. 2.1 Detailing of slab

1	L_{xx}	3150mm
2	L_y	3150mm
3	Depth of slab	130mm
	Effective depth	105mm
4	Required area of steel	304.48mm^2
5	$V_u$max	20.81KN
6	Main reinforcement	8mmØ-150mm c/c
7	Distribution steel	8mmØ-150mm c/c

3.0 . Dsigne for beam

Concrete Is a fairly strong in compression, but very weak in tension. Due to this problem Plain concrete can not be used in situations where the considerable tensile stresses are develop. If the flexural members like beams and slabs are made of plain concrete then their load carrying capacity is very low because of its low tensile strength. Since steel is very strong in tension,the steel bars are used to resist tensile stresses at a place where the maximum tensile stresses are developed. In case of simply supported beam,the tensile stresses are induced in bottom layers because of positive bending moment, (sagging bending moment) due to this steel bars are provided closer to the the bottom of the beam. But in case cantilever beams steel bars are placed near the top of the beam, for resisting the tensile stress developed in top layers due the negative bending moment (hogging bending moment)

3.1 There are three types of reinforced concrete beams:

(A) Singly reinforced beams
(B) Doubly reinforced beams ,and
(C) Singly or doubly reinforced flanged beams

Table No. 3.1 Detailing of Beam

Detailing of Beam			
Sr.No	**Description**	**Manually results**	**Staad results**
1	Unsupported length	6390mm	6390mm
2	Breadth of beam	350mm	350mm
3	Depth of beam	750mm	650mm
	Effective depth	730mm	595mm
4	Required area of steel	2182.27mm^2	2731.83mm^2
5	$V_u$max	232.46KN	308.08 KN
6	s_v	250mm	230mm
7	Legs	2	4
8	Stirrups diameter	8mm	10mm
9	Shear resistance of stirrups v_{us}	102.2KN	180.79KN
10	T_V	1.41 N/mm^2	1.48 N/mm^2

Fig No. 3.1 Bending Moment Diagram

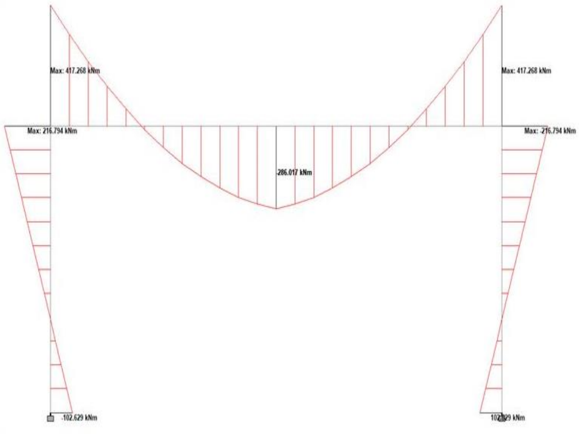


Table No.3.0 shear Design of Beam

Shear Design			
	Left	Mid	Right
Critical L/C - Analysis	3	3	3
Critical L/C - RCDC	1	1	1
Vu (KN)	394.27	190.8	394.27
Tu (KNm)	25.81	25.81	25.81
V_{Tu} (KN)	118.01	118.01	118.01
Vut (KN)	512.27	308.8	512.27
Tv (N/Sqmm)	2.46	1.48	2.46
Tc (N/Sqmm)	0.69	0.61	0.69
Vc (KN)	143.2	128.01	143.2
Vus=Vut-Vc (KN)	369.07	180.79	369.07
Asv Torsion (Sqmm)	1314.157	841.828	1314.157
Asv Reqd (Sqmm)	1718.005	841.565	1718.005
Legs	4	4	4
Stirrup Dia	10	10	10
SvCalc (mm)	115	230	115
SvPrv (mm)	115	230	115
Asv Torsion Prv (Sqmm)	1365.91	1365.91	1365.91
Asv Total Prv (Sqmm)	2731.83	1365.91	2731.83

4.0 DESIGN OF COLUMN

A vertical member whose effective length is greater than 3 times 0f its least lateral dimension which carrying compressive loads, is called as column. Column is transfer the loads from the beams or slabs to the footings or the foundations. The inclined member is carrying compressive loads as in the form of frames and trusses, this forms is called as struts. The Pedestal is a vertical compression member whose effective length is less than 3 times its least lateral dimension. Generally the column is taken as square, rectangular or in circular shape acourding to our perpose.

4.1Axially loaded column

An Axial load is a force which ia mannaged along the lines of an axis. Axial loading occurs when an object is loaded, at that time the force is normal to the axis that is fixed. Taking statics into consideration the force at the wall should be equal to the force that is applied to the part of Axially loaded columns. if a compression member, effective length least lateral dimension is called Column. Normally the columns are subjected to axial compressive force, but some times it may be subject to moments on one or both the axes.

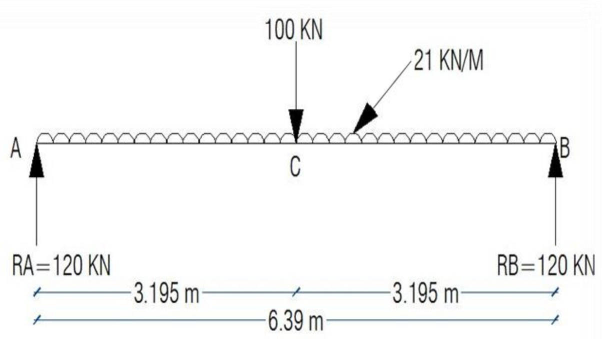


Fig No. 4.1.1 Detailing of axially loaded column

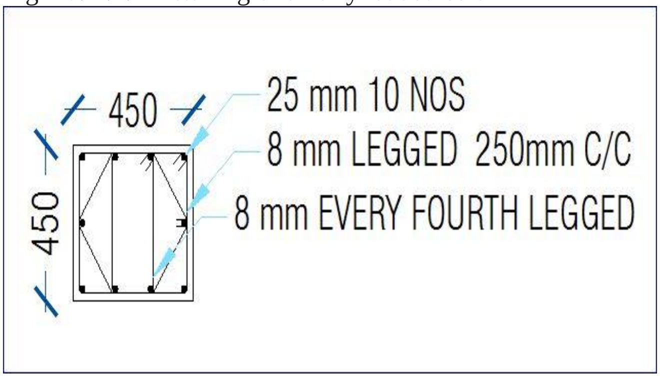


Table No.4.1 Axially Loaded Column Details

Detailing of Axially loaded column			
Sr.No.	**Description**	**Manually results**	**Staad results**
1	Grade of concrete	M20	M20
2	Grade of steel	Fe415	Fe415
3	Width of column	450mm	450mm
4	Breadth of column	450mm	450mm

5	Cover	40mm	40mm
6	Required area of steel	4665.80mm^2	3270.47mm^2
7	Main reinforcement	10 Nos – 25 mmØ	16mmØ – 20 Nos
8	Tie reinforcement	8mmØ-300mm c/c	8mmØ-250 c/c

4.1 Axially loaded column

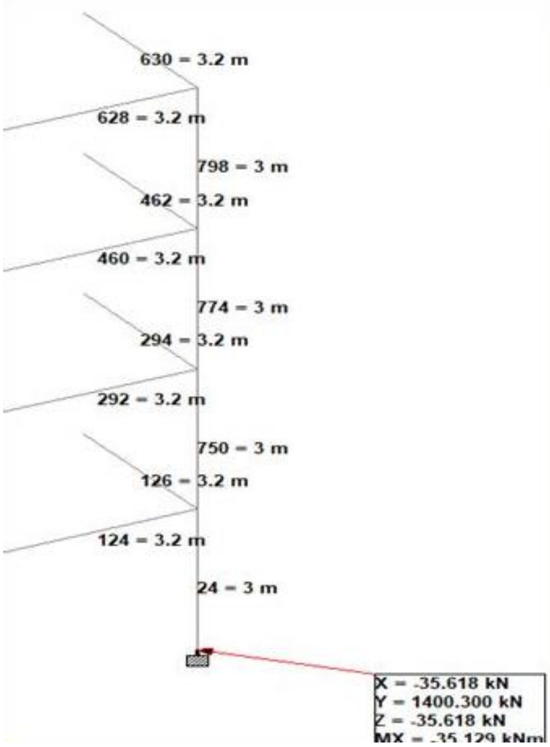


Figure 4.1 AXIALLY LOADED COLUMN

4.2Bi-Axially loaded column-

biaxial alternative technique is presented for the design and analysis of uniaxial loaded, reinforced-concrete columns. The technique is based on a simple transformation concept in which the components of the cross section are transformed into an equivalent homogeneous elastic material. The modulus of elasticity of concrete as defined by the ACI code is used as the base for transformation. The pertinent elastic properties of the transformed cross section are evaluated and thereafter the classical bending theory is applied. Furthermore, an interaction formula that could be used to assess the performance of uniaxially loaded column is presented. Also, the strength-reduction factor is reevaluated with reference to the available ductility expressed by the neutral-axis-to-depth ratio. The results obtained using the proposed technique are in total agreement with those obtained using the conventional ACI code approach. A flowchart showing the iterative process is presented.

Fig No. 4.2.1 Detailing of Uniaxially loaded column

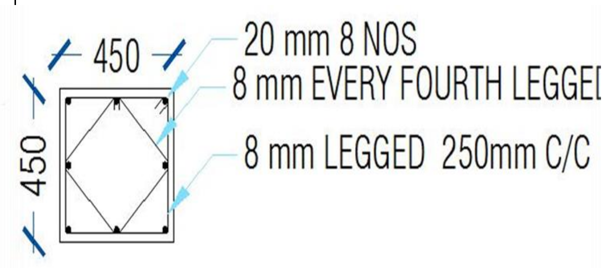


Table No.4.2.1Details of Biaxially loaded column

Detailing of Bi Axially loaded column			
Sr.No.	**Description**	**Manually results**	**Staad results**
1	Grade of concrete	M20	M20
2	Grade of steel	Fe415	Fe415
3	Width of column	450mm	450mm
4	Breadth of column	450mm	450mm
5	Cover	40mm	40mm
6	Required area of steel	2025mm^2	1255.87mm^2
7	Main reinforcement	8Nos–20mmØ	8Nos-16mmØ
8	Shear reinforcement	8mmØ-300mm c/c	8mmØ-250 c/c

4.2.2 Bi Axially loaded column

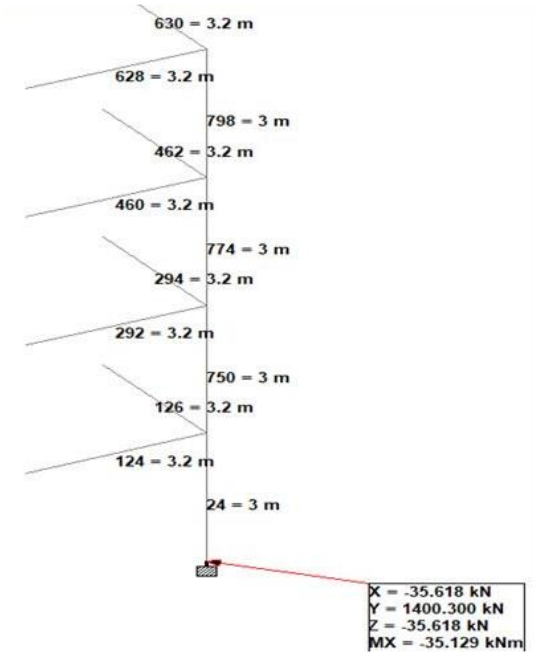


Figure 4.1 BIAXIALLY LOADED COLUMN

1	Grade of concrete	M20	M20
2	Grade of steel	Fe415	Fe415
3	Width of column	450mm	450mm
4	Breadth of column	450mm	450mm
5	Cover	40mm	40mm
6	Required area of steel	2908.35mm^2	887.98mm^2
7	Main reinforcement	10Nos–20mm Ø	8 Nos-16mmØ
8	Shear reinforcement	8mmØ-300mm c/c	8mmØ-250 c/c

4.3 Uni Axially loaded column

It is eccentric about one axis of the plane column then it is called **uniaxial** column. If the load is eccentric about both the axes in the plane of column then it is called bi axial column this can be easily understood by coordinate system.suppose x-y coordinate system, around the centre of the column.now simply if the force is acting in the x-axis only,with zero y coordinate,it is uni-axial column. again if both the x-coordinate and y coordinate exits the system is bi axial.

Fig No. 4.3.1 Detailing of Uniaxially loaded column

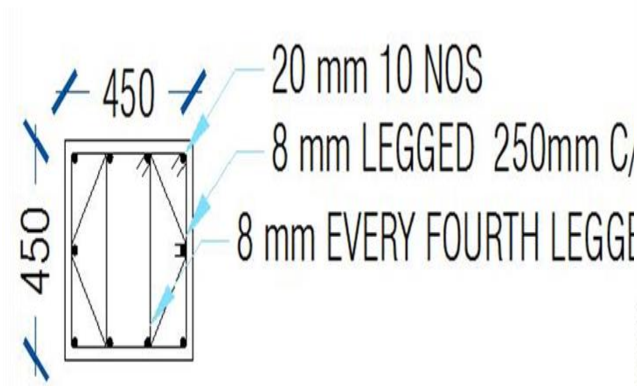


Table No. 4.3.1 details uniaxially loaded column

Detailing of Uni Axially loaded column			
Sr. No.	**Description**	**Manually results**	**Staad results**

4.2.2 Uni Axially loaded column

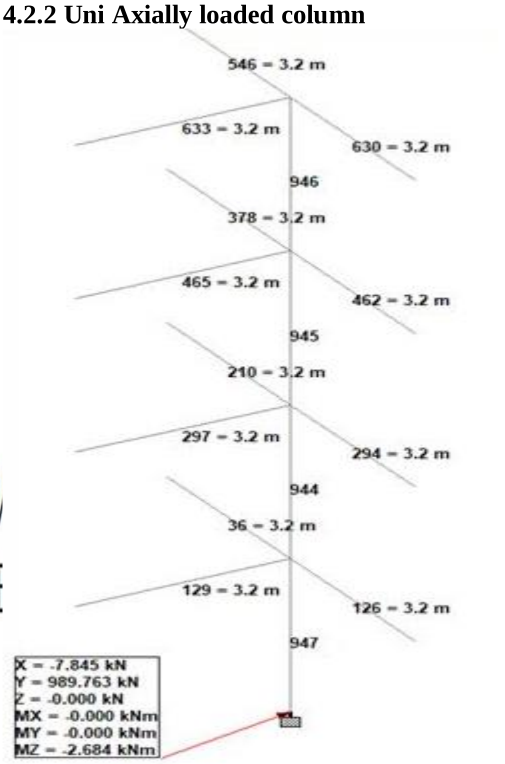


Figure 1 Uni axially loaded column

5.0 Difference axially loaded column &uniaxial loaded column - Uni axial means one axis. Bi axial means two axes. Bending in one axis means the beam is loaded on the top only , or on the side. Bending in two axes simultaneously (bi-axial) means the is some combination of the two at same time. The result of uni axial bending is that the edge of the beam nearest to the loaded surface goes into compression, and the opposite side into tension. In bi axial bending this happens twice, so that somewhere in the beam cross section there is tension resulting from both sets of bending.This is complicated, but there are approximate methods for working out both of these.

6.0RAFT FOOTING

A raft footing or mat is a combined footing that covers the entire area beneath a structure and support all the wall and column. When the allowable soil pressure is low , or the building load are heavy, the use of spread footing would cover more than one – half of the area and it may prove more economical to use mat or raft foundation. They are also used where the soil mass contains compressible lenses or the soil is sufficiently erratic so that the differential settlement would be difficult to control.

A design for a highly axially loaded column

1. No of column = 6
2. Column size = 450 × 450 mm
3. C1 Column carries a load of 1512 KN
4. C2 column carries a load of 2190 KN
5. C3 column carries a load of 2880 KN

Soil bearing capacity 300 KN/m^2

Area of foundation = 45.73m^2

Net upward pressure intensity = 122.33 KN/m^2

Onsidering one-half foundation in the longitudinal direction net upward reaction per metre run

= 122.32×3.7 = 452.48 KN/m

7.0 Design of stair case

1.size of stairs 4×3 m

2.crtical distance between floor 3m

3.allow a live load of 2000 N/m^2

4.M20 Fe 415(concrete and steel grade)

It is proposed to provide two flight for the stairway the height of each flight

$= \frac{Floor\ to\ floor\ distance}{2} = \frac{3000}{2} = 1500$ mm

Assuming 150 mm riser

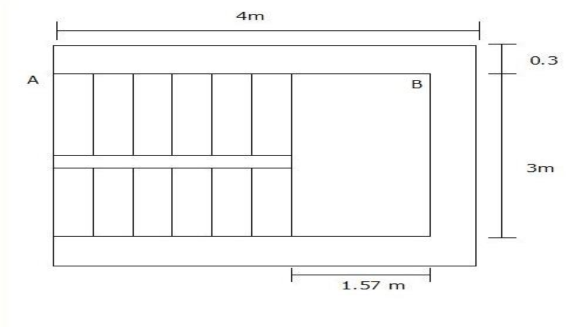
∴Number of risers required= $\frac{1500}{150}$ = 10 Nos

Hence the actual rise of each riser

$= \frac{height\ of\ each\ flight}{No\ of\ risers} = \frac{1500}{10} = 150$ mm

Hence, Number of treads in eacch flight

= Number of risers −1= 10 −1= 9 Nos



8.0 CONCLUSION

Construction of Residential building should be providing safety and it should be economical. This project describes detailed planning and designing of the G+3 residential building apartments. This project involves design of structures with various methods such as conventional method and by software. Getting familiar with civil engineering softwares Auto CAD and Staad .

9.0 REFERENCE

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