Analysis and Design of a Residential Building by Using STAAD Pro

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Abstract –

Computer Aided Design of Commercial cum Residential Building includes analysis of structure outlines by utilizing STAAD Pro and manual design of the casing components. Customary technique for analysis includes part of intricacies and dreary estimations such analysis is a tedious assignment. Analysis can be made rapidly by utilizing software's.

STAAD Pro is the main design programming in the market. Many design organizations utilize this product for their undertaking design purposes. Subsequently this venture basically manages the analysis of the structure by utilizing STAAD Pro. These analysis results will likewise be thought about by manual estimations of an example bar and segment of a similar structure and these components are design physically according to IS 456-2000.

Keywords: STAAD PRO, Design of RCC components, Analysis, multi-story building, chunk, shaft, segment, balance and stair case etc.....

1. Introduction

Auxiliary design is a craftsmanship and exploration of designing, with economy and polish, a protected, workable, and a strong structure. The whole procedure of basic arranging and design requires not just creative energy and applied reasoning (which structure craft of designing) yet additionally solid information of investigation of auxiliary building other than learning of down to earth perspectives, for example, applicable design codes and bye-laws, supported up by adequate experience, foundation and judgment.

The procedure of design starts with arranging of a structure, essentially to meet the utilitarian prerequisites of the client or the customer. The necessities proposed by the customer may not be very much characterized. They might be dubious and may likewise be impracticable on the grounds that doesn't know about the different ramifications associated with the way toward arranging and design and about the confinements and the complexities of basic science. The utilitarian necessities and the part of style are investigate ordinarily by a planner while the part of security, workableness, strength and economy of the structure for its expected use over life expectancy of the structure are gone to by the basic designers (commonly, a basic specialist is require to act in limits of both the draftsman and the basic designer

1.1. Stages in Structural Designs:

The procedure of basic design includes the accompanying stages: Structural arranging, Computation of burdens, Method of analysis, Member design and Detailing, drawing and readiness of timetables

1.2 About STAAD Pro:

It is generally utilized programming for basic analysis and design from research engineers universal it comprises of following.

It is a graphical UI, (GUI) it is utilized to create the model, which would then be able to be examined utilizing STAAD motor. After analysis and design is finished, the GUI can likewise be utilized to see results graphically.

The STAAD analysis and design motor:

It is a broadly useful figuring motor for basic analysis and incorporated steel, solid, timber and aluminum design. The documentation for STAAD star comprises of a lot of manual as portrayed.

1.3 Getting started:

This manual contains data on the substance of the STAAD Pro bundle computer framework prerequisites establishment process, duplicate security issues and portrayal on the best way to run the projects in the bundle. Instructional exercises that give point by point and well ordered clarification on utilizing the program are likewise given.

1.4 Graphical condition:

The manual contains a definite depiction of the GUI of STAAD Pro. The subjects secured incorporate mode age, auxiliary analysis and design, result check and report age.

1.5 Technical Reference:

This physically manages the hypothesis behind engg computations made by STAAD motor. It additionally incorporates a clarification of directions accessible is a STAAD order document.

1.6 Release report:

This physically manages the most recent improvement of program which is being provided to the clients as prepared reference. It incorporates all related specialized understanding and graphical changes from the last form

2. Modeling:

- Graphical work age offices accessible for creating components from complex shapes with gaps.
- Import of DXF documents, for 3D surface substances.
- Degree of opportunity at hubs can be discharged specifically.

2.1 Property and stacking

- Constant thickness just as directly changing thickness between hubs.
- New IBC 2003 code for programmed dissemination of seismic burden.
- New stacking for test use of complex stacking designs.
- New floor load generator which naturally refreshes the weight circulation if floor changes additionally takes into account disposal of floor individuals and making of floor gatherings.
- Automatically decreases the live loads named as live burden or rooftop load (live) according to UBC/IBC.
- Wind load on open cross section structure.

2.2 Analysis abilities:

Static, P-Delta, Non-straight Analysis.

- Liner, P-Delta analysis.
- Non-straight with programmed load firmness association.
- Multiple examinations in same run.
- True curvilinear bars (not piecewise straight).
- Plate components contain additional boring level of opportunity.
- Tapered forbidden cross segment, for example, Hexagonal octagonal, and so forth (superb for posts).
- Unidirectional support (pressure just/strain just) for age of soil springs.
- Master/slave capacities.
- I pillar twisting end limitation included a possibility for torsional solidness.
- Bulking analysis.

2.3 Concrete design:

- ❖ Two way section design to design unpredictable molded pieces full support form and fortification format plans are made.
- ❖ Rectangular solid shear divider design (with profound pillar design) and naturally work all current divider and give even, vertical and edge fortification, in light of pivotal minutes.
- ❖ Automatic count of split snapshot of dormancy for solid design.

OBJECTIVES

Computer aided design of commercial cum residential building by using STAAD PRO which includes.

- ❖ To generate structural framing plan
- ❖ To create model in STAAD PRO
- ❖ To define application of loads on the member
- ❖ To analyse of the structure

3. DESIGN PROCEDURE

A four floor commercial cum residential building is considered whose architectural plan and structural framing plans were prepared as shown in figure 1 to 4 below before it is modeled in STAAD Pro.

The entire analysis of building has been done in one stage keeping the IS code provision in view wherever necessary. The whole building has been split into its structural components viz., slab, beams, columns and footings. These components are designed for M20 grade concrete and Fe415 grade steel.

At first the slab have been classified into two types based on edge conditions, spans, dimensions, Lx and Ly ratios and typical analysis suggested. The loads of these slabs (dead load + live load) are transferred on the beam both in X and Y direction.

A preliminary design of typical beam had been carried out based on the loads carrying over through slab, their own dead weight (section assumed) all the wall loads coming as such. The column section has been proportioned to take the loads. The maximum positive and shear have been evaluated for beam and column plan.

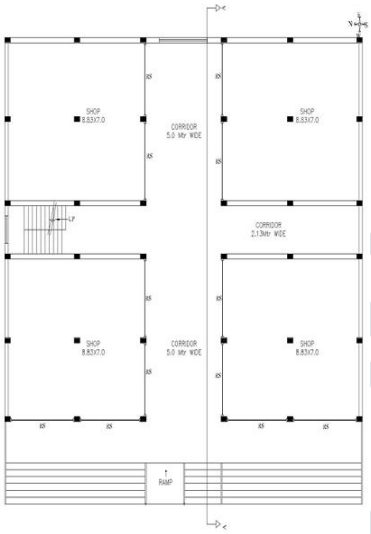

Fig 1. Plan of a building

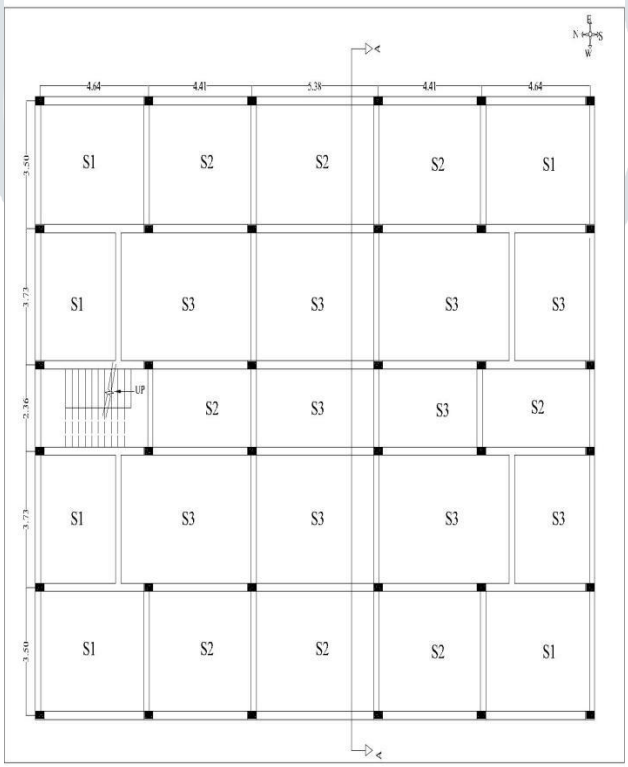

Fig 2. FRAMING

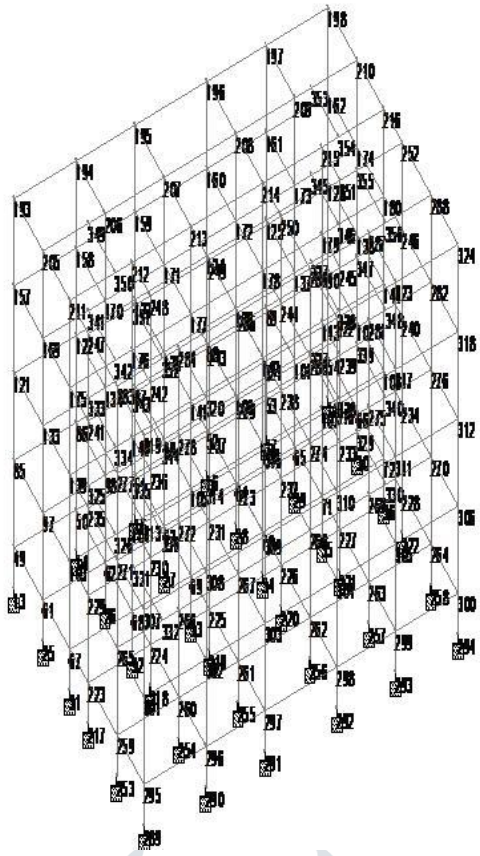

Fig 3. 3D modelling

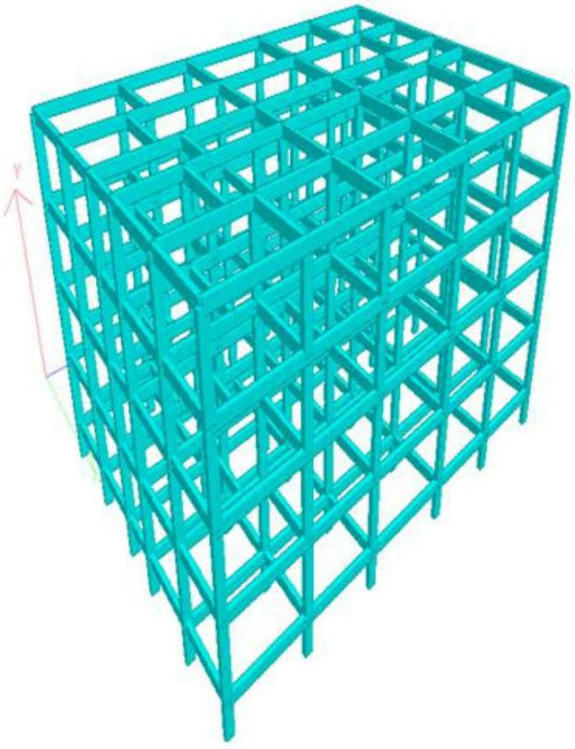

Fig 4. 3D rendering

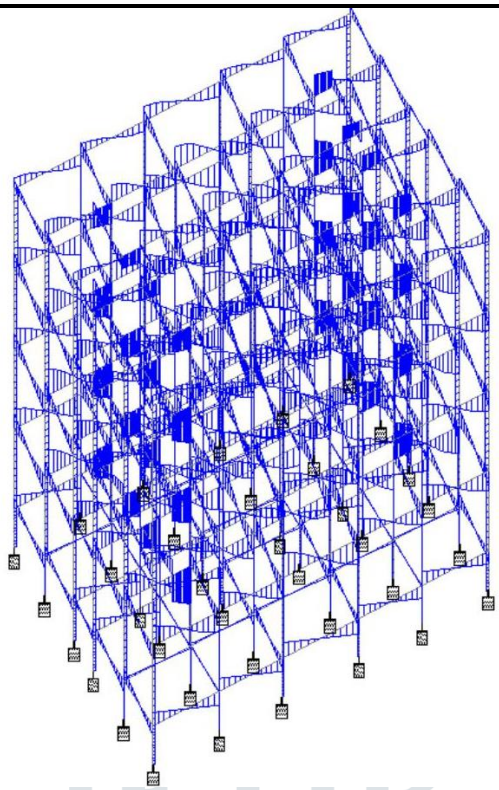

Fig 5. Bending moment diagram

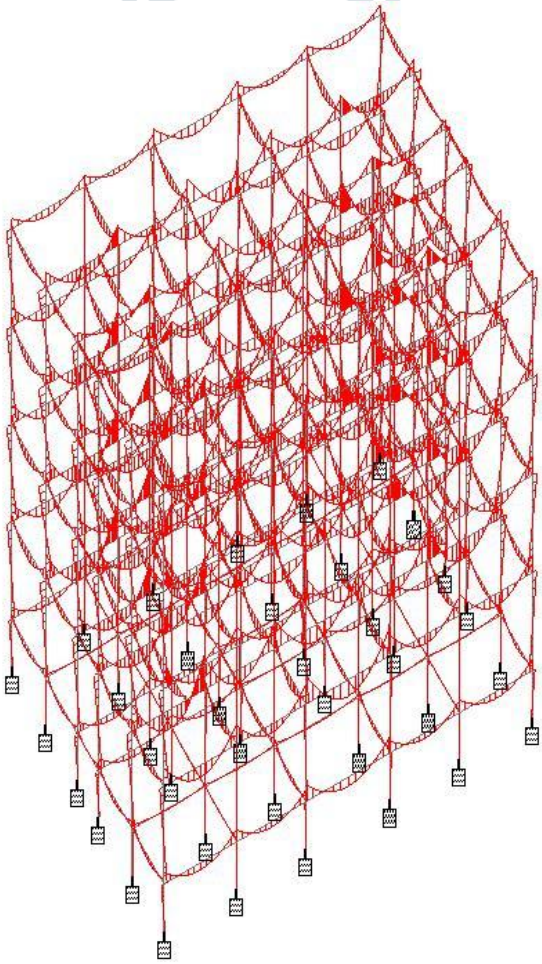

Fig 6. Shear force diagram

5. DESIGN OF RCC ELEMENTS

5.1 Design of slab

Short span S= 3.50 mts

Long span L= 4.64 mts

Assumed slab thickness t = 0.15mts greater than 'min. eff depth reqd'. Hence ok

Grade of concrete fck = 20N/mm^2

Grade of reinforcement fy = 415N/mm^2

5.3 DESIGN OF COLUMN

A column may be defined as an element used primarily to support axial compressive loads coming from the beam. All columns are subjected to axial force and some moments. The column is design as uniaxial column. The column is designed according to SP 16 Code practice. From the STAAD Pro output values, considering the column which is subjected to maximum axial load & moment.

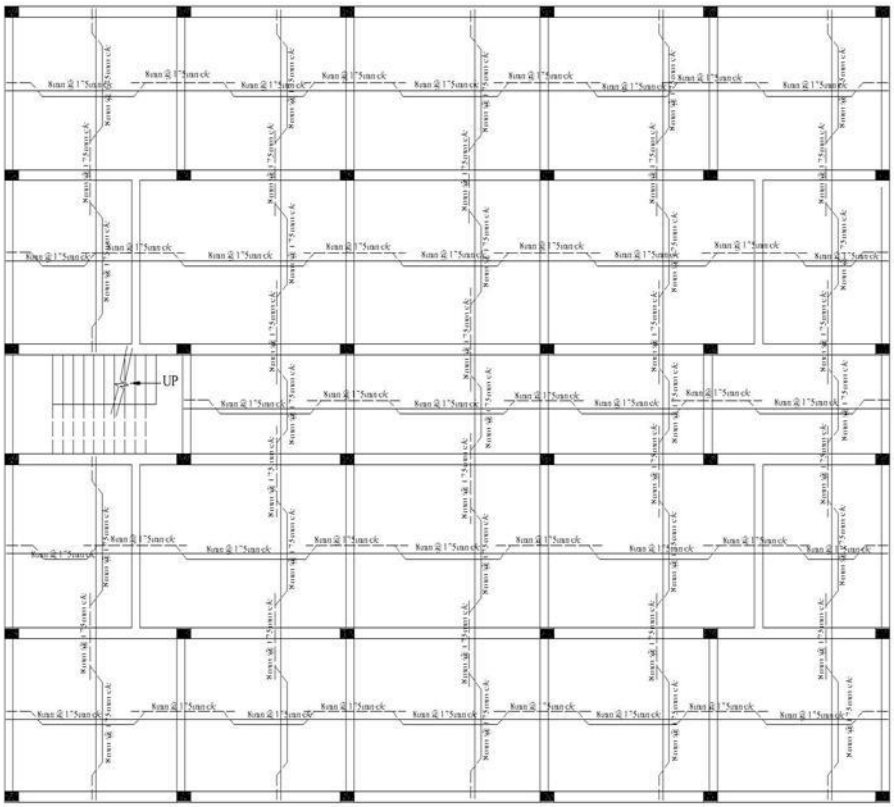

Fig 7. Slab reinforcement details

5.2 Design of beams

Design end section as rectangular Beam

b = 230mm

D = 450mm

f_{ck} = 20 N/mm^2

f_y = 415 N/mm$_2$

M_u = 93.77 KNm

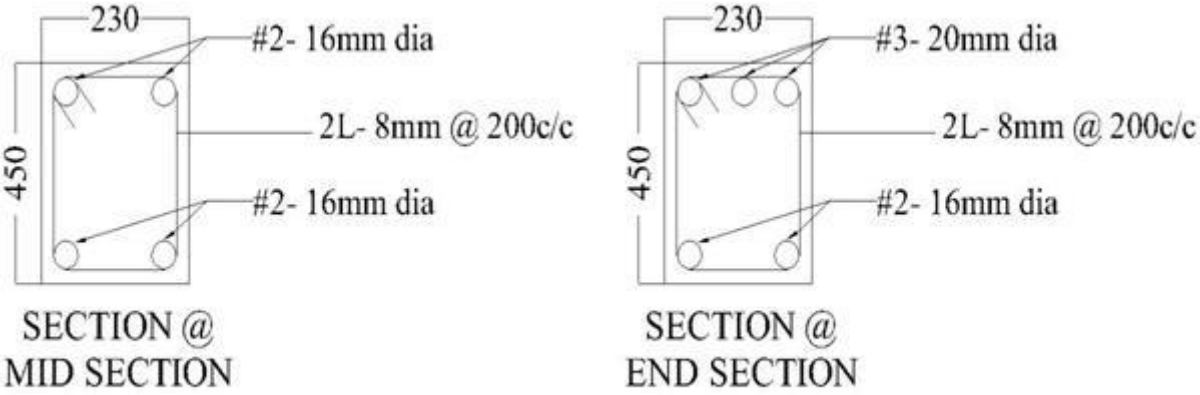

Fig 8. Beam reinforcement details

Table 1. Loads from STTAD Pro

Member Number	Axial Load KN	Moment KN.m
521	1.41X10$_3$	1.095

P_u = 1410KN

M_u = 1.095 KNm

f_{ck} = 20N/mm^2

f_y = 415N/mm$_2$

L = 1.5m

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$L_{eff.}$ = 0.65 l = 0.65x1.5 = 0.975m

5.4 DESIGN OF FOOTINGS

Consider the column member which is subjected to maximum axial load & moment.

Table 2. Loads from STTAD Pro

Member Number	Axial Load KN	Moment KN.m
521	1.41X10$_3$	1.095

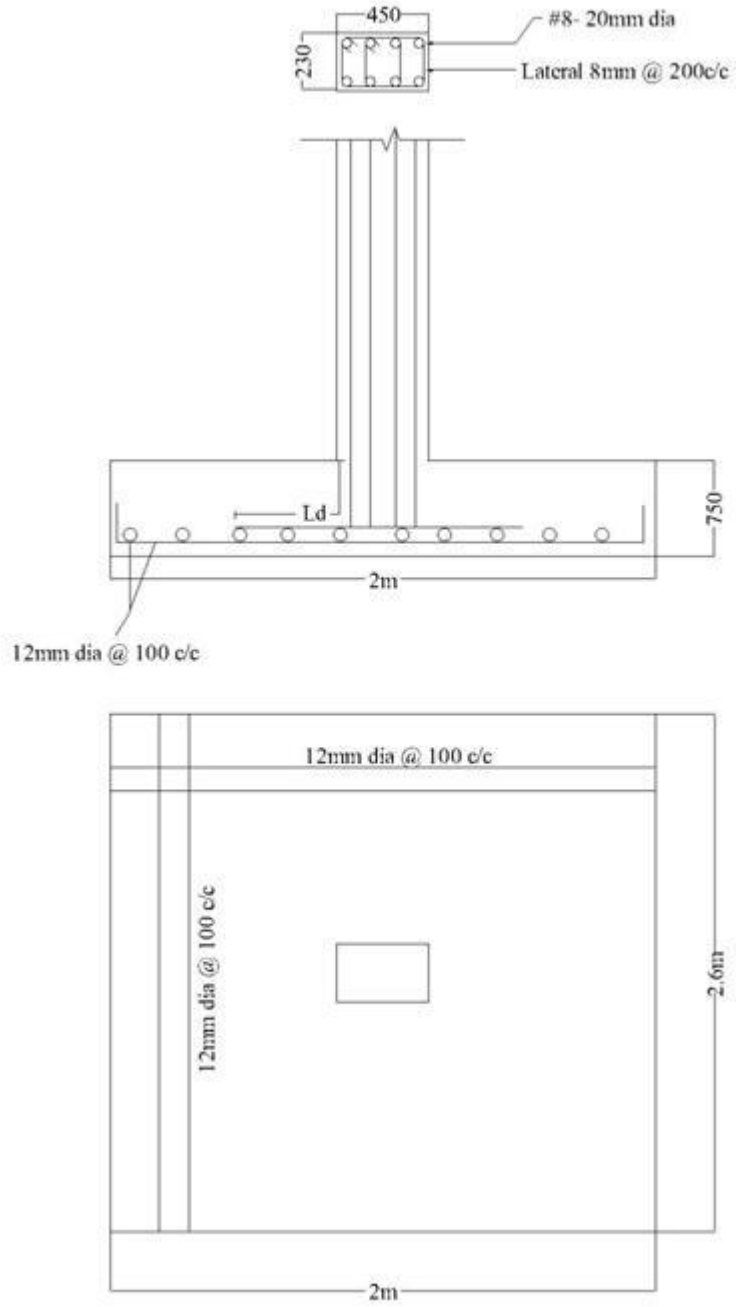

Fig 9. Column and Footing reinforcement details

5.5 DESIGN OF STAIR CASE

The purpose of a stair case to provide access to pedestrian in a building. The geometrical forms of staircase may be quite different depending on the individual circumstances involved. The shape and structural arrangement of a staircase would generally depend on two main factors.

1. Type of construction of structure around the stair case that is load bearing brick structure or reinforced concrete framed structure.
2. Availability of space.

Type of staircase provided for the proposed building is Bifurcated staircase, which consists of two flights. The first flight starts from plinth level to lintel level and second flight starts from lintel level to roof level.

Design of First Flight:

Size of Room = 2.36x4.64

Width of the flight = 1.2m

Assuming rise = 150mm

Tread = 250mm

Number of rise = 1500/150 = 10 Nos.

Number of tread = 10-1 = 9 Nos.

Providing landing width = 1200mm

Effective span = (9x250) +1200

= 3450mm

Assuming thickness overall = 400mm

Waist slab = 40x3.45 = 138 mm

= 150mm

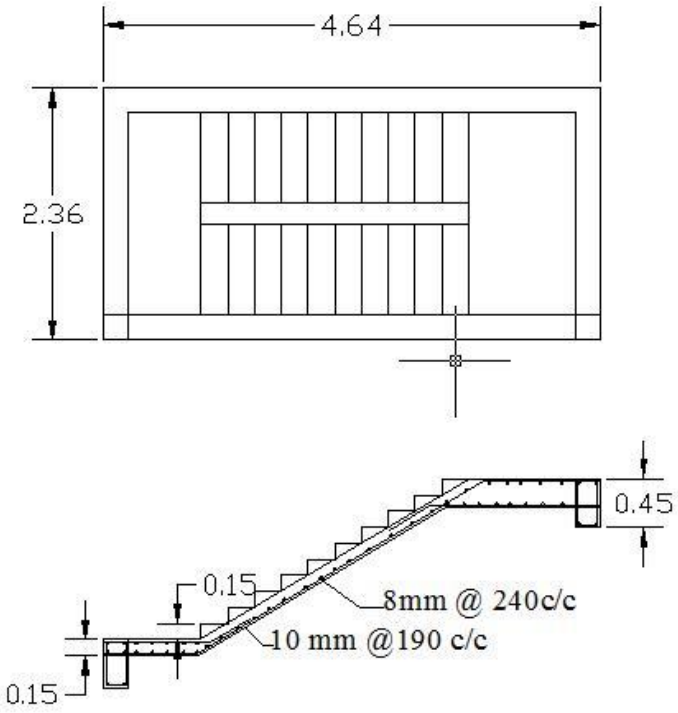

Fig 9. Stair case reinforcement details

6. CONCLUSIONS

1. Short term diversion of every single flat part is inside 20mm.
2. The auxiliary segments of the structure are sheltered in shear and flexure.
3. Amount of steel accommodated the structure is monetary.
4. There is no such vast distinction in analysis consequences of STAAD Pro and Kanis technique.
5. Proposed sizes of the components can be utilized in the structure.

REFERENCE:

1. Pabba Mounika, Maroju Navya and Syed Viqar Malik. "Design of Residential Building and Analysis with STAAD Pro." International Journal for Scientific Research and Development 3.11 (2015): 33-39.

2. IS CODES :

- IS 456-2000 (Design of RCC structural elements)
- IS 875-Part 1 (Dead Load)
- IS 875-Part 2 (Live Load)
- SP-16 (Depth and Percentage of Reinforcement)
- SP-34 (Detailing)