International Journal of Research

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 08 Issue 03
March 2021

Design And Analysis Of Residential Building By Using STAAD PRO

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ABSTRACT

In every aspect of human civilization, we needed structures to live in or to get what we need. But it is not only building structures but to build efficient structures so that it can fulfill the main purpose for what it was made for. Here comes the role of civil engineering and more precisely the role of analysis of structure. There are many classical methods to solve design problem, and with time new software's also coming into play. Here in this project work based on software named "STAAD. Pro" has been used. The main aim of structural engineer is to design the structures for a safe technology in the computing field; the structural engineer can dare to tackle much more large and complex structure subjected to various type of loading condition. Earlier the loads acting on the structure are considered as static, but strictly speaking, with the exception of the self-weight (dead load) no structure load is static one Now a day large number of application software's are available in the civil engineering field. All these software's are developed as the basis of advanced. Finite element analysis which include the effect of dynamic load such as wind effect, earth quake effect bets etc. in the present work, an attempt has been made to study the efficiency of certain civil engineering application software's. In this present we work with residential building with G+2 and analysis was done with software called Staad Pro.

INTRODUCTION:

In every aspect of human civilization we needed structures to live in or to get what we need. But it is not only building structures but to build efficient structures so that it can fulfill the main purpose for what it was made for. Here comes the role of civil engineering and more precisely the role of analysis of structure.

There are many classical methods to solve design problem, and with time new software's also coming into play. Here in this project work based on software named staad pro has been used. Few standard problems also have been solved to show how staad pro can be used in different cases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis of problems.

Following points will be covered in project work

- Study of design of various elements of building
- Planning of various components of a building with column positioning
- Introduction of STAAD.Pro
- Modeling of the building in the STAAD.Pro giving all boundary conditions (supports,

loading etc…)

- Analysis and Design of various structural components of the modal building
- Study of analysis Data of the software
- Detailing of beams, columns, slab with section proportioning and reinforcement.

This project aims for relearning of concept of structural design with the help of computer aids. Briefly we have gone through following points through out of the project work.

Understanding of design and detailing concept.

Main objective i.e. learning of STAAD.Pro software package.

Learning of analysis and design methodology which can be very useful in the field.

Understanding of earthquake resistance design concept.

Approach for professional practice in the field of structural engineering

Analysis : Analysis of the structure means to determination of the internal forces like axial compression bending moment, shear force etc. in the component member for which the member are to be designed under the action of given external load.
Design : The design is process of section percussion from the analysis results by using suitable analysis method.
The aim of design is to achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life.

LITERATURE REVIEW

Sreeshna K.S (2016) this paper deals with structural analysis and design of Multistoried apartment building. The work was completed in three stages. The first stage was modelling and analysis of building and the second stage was to design the structural elements and the final was to detail the structural elements. In this project STAAD.Pro software is used for analysing the building. The IS:875 (Part 1) and (Part 2) were referred for dead load and live load. Design of structural elements like beam, column, slab, staircase, shear wall, retaining wall, pile foundation is done according to IS Codes. Aman et al., (2016) has discussed that the aim of the structural engineer is to design a safe structure. Then the structure is subjected to various types of loading. Mostly the loads applied on the structure are considered as static. Finite part analysis that exhibit the result of dynamic load like wind result, earthquake result, etc. The work is conducted using STAAD.Pro software.

Madhurivassavai et al., (2016) he says that the one of the major problem country facing is the growing population. Because of the less availability of land, multi-storey building can be constructed to serve many people in limited area. Efficient modelling is performed using STAAD.Pro and AutoCAD. Manual calculations for high rise buildings are tedious and time consuming. STAAD.Pro provides us a quick, efficient and correct platform for analysing and coming up with structures.

STRUCTURAL ANALYSIS

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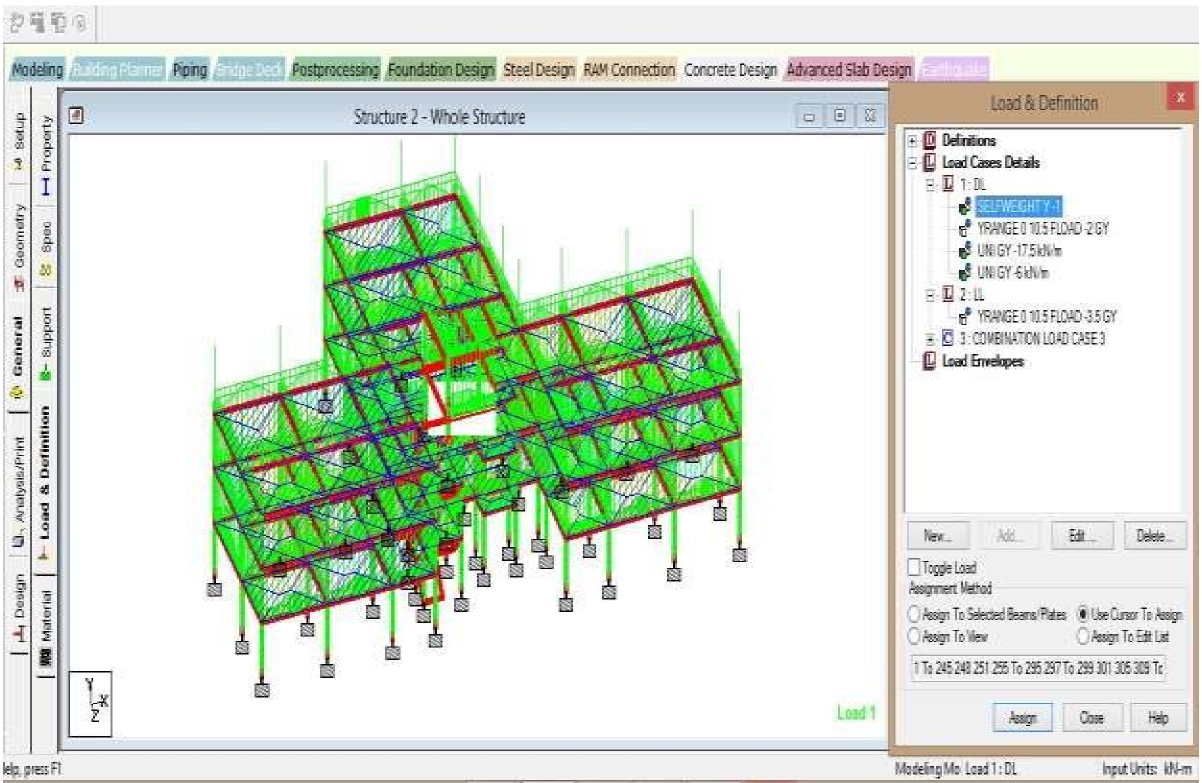
The procedure of structural analysis is simple in concept but complex. In detail. It involves the analysis of a proposed structure to show that its resistance or strength will meet or exceed a reasonable expectation. This expectation is usually expressed by a specified load or the demand and an acceptable margined of safety that constitutes a performance goal for a structure. The performance goals structural design is multifaceted. Foremost, a structure must perform its intended function safely over its useful life.

The concept of useful life implies consideration of durability and established the basis for considering the cumulative exposure to time varying risks (i.e. corrosive environments, that performance is inextricably linked to cost, owners, builders, and designer must considers economic limit to the primary goal of safety and durability.

In the view of the above discussion, structural designer may appear to have little control over the fundamental goals of structural design except to comply with or exceed the minimum limits established by law.

While this is generally true, a designer can still do much to optimize the design through alternative means and methods that can for more efficient analysis techniques, creative design detailing, and the use of innovative construction materials and methods.

In summary the goal of structural design are defined by law and reflect the collective interpretation of general public welfare by those involved in the development and local adoption of building could. This project is mostly based on software and it is essential to know the details about these Software's.



1.1. Figure 3.2 ASSIGNMENT OF LOADS

2. DESIGN CONSIDERATIONS:-

TABLE3.1 : DESIGN PARAMETERS OFBEAM

S. NO.	DETAILS	VALUES
1	FC	25000 KN/m^2
2	Fy main	415000 KN/m^2
3	Fy sec	415000 KN/m^2
4	Max main	20mm
5	Max sec	16mm
6	Min main	12mm
7	Min sec	8mm
8	Ratio	4

TABLE 3.2:- DESIGN PARAMETERS OF COLUMN

S. NO.	DETAILS	VALUES
1	FC	25000 KN/m^2
2	Fy main	415000 KN/m^2
3	Fy sec	415000 KN/m^2
4	Max main	20mm
5	Max sec	16mm
6	Min main	12mm
7	Min sec	8mm
8	Ratio	4

TABLE 3.3: DESIGN PARAMETERS OF SLAB

S.NO.	DETAILS	VALUES
1	FC	25000 KN/m^2
2	Fy main	415000 KN/m^2

FOUNDATION:-

TABLE 3.4: DESIGN PARAMETERS FOR CONCRETE AND REBAR PROPERTIES

S.NO.	DETAILS	VALUES
1	MINIMUM BAR SIZE	6 mm DIA
2	MAXIMUM BAR SIZE	32mm DIA
3	MINIMUM BAR SPACING	50 mm
4	MAXIMUM BAR SPACING	500mm
5	P, CL	50mm
6	F, CL	50mm

TABLE 3.5: SOIL PROPERTIES FOR FOOTING

S.NO.	DETAILS	VALUES
1	SOIL TYPE	DRAINED
2	UNIT WEIGHT	22.000KN/m^3
3	SOIL BEARING CAPACITY	100.000KN/m^2
4	SOIL SURCHARGE	0.00KN/m^2
5	DEPTH OF SOIL ABOVE FOOTING	0.00mm
6	COHESION	0.00KN/m^2
7	MIN PERCENTAGE OF SLAB	0.00

RESULTS AND DISCUSSIONS:-

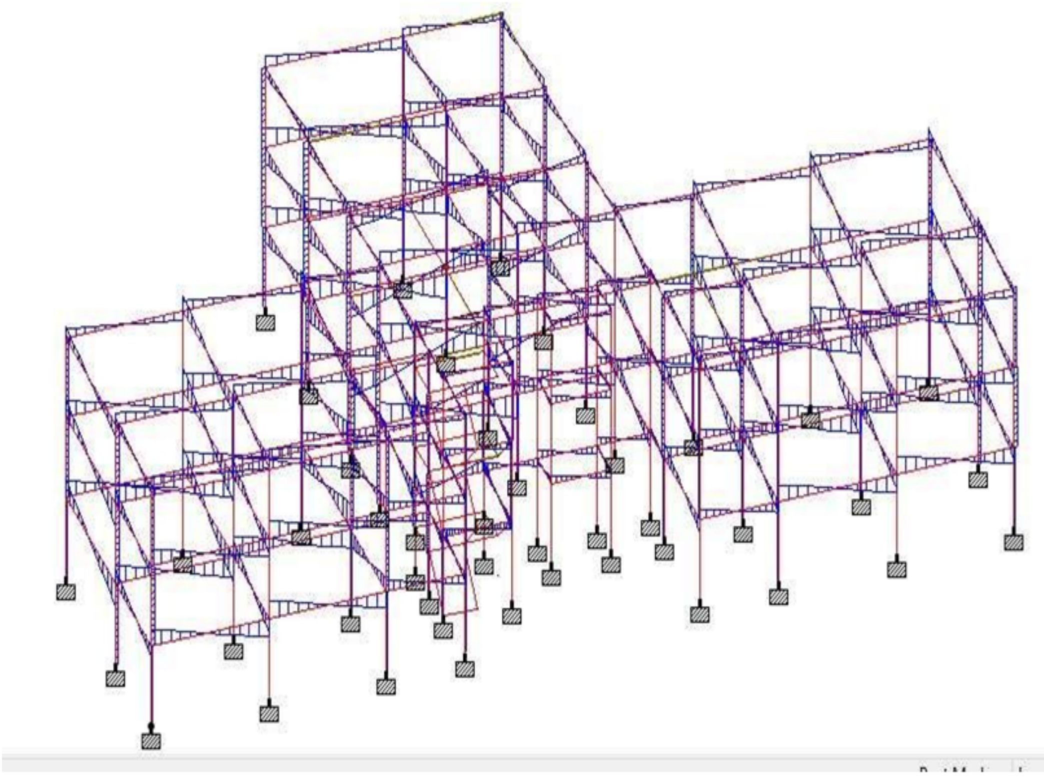


Figure 4.1 SHEAR FORCE DIAGRAM

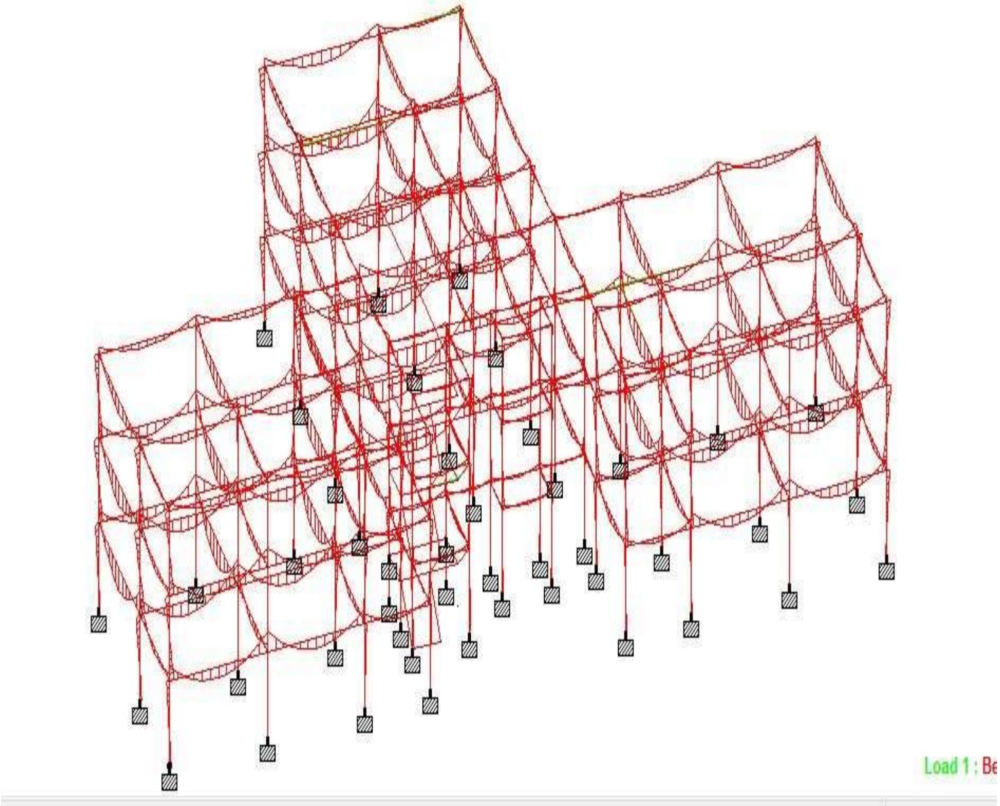
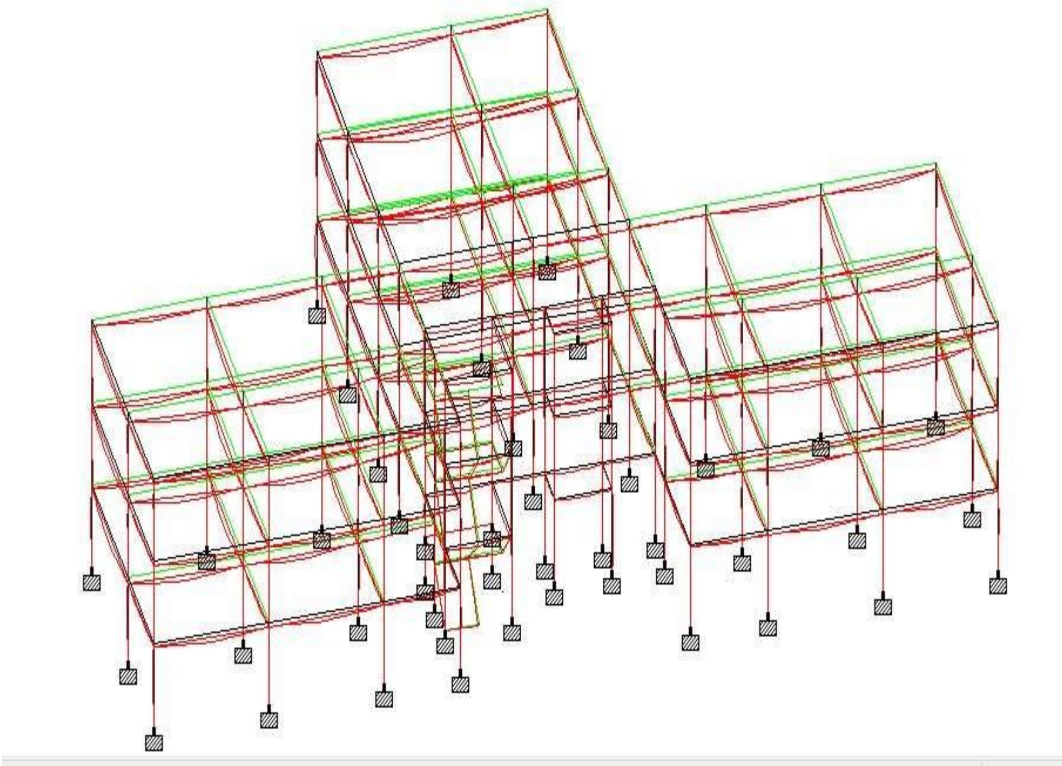


Figure 4.2 BENDING *MOMENT* DIAGRAM



2.1. Figure 4.3 DEFLECTION DIAGRAM

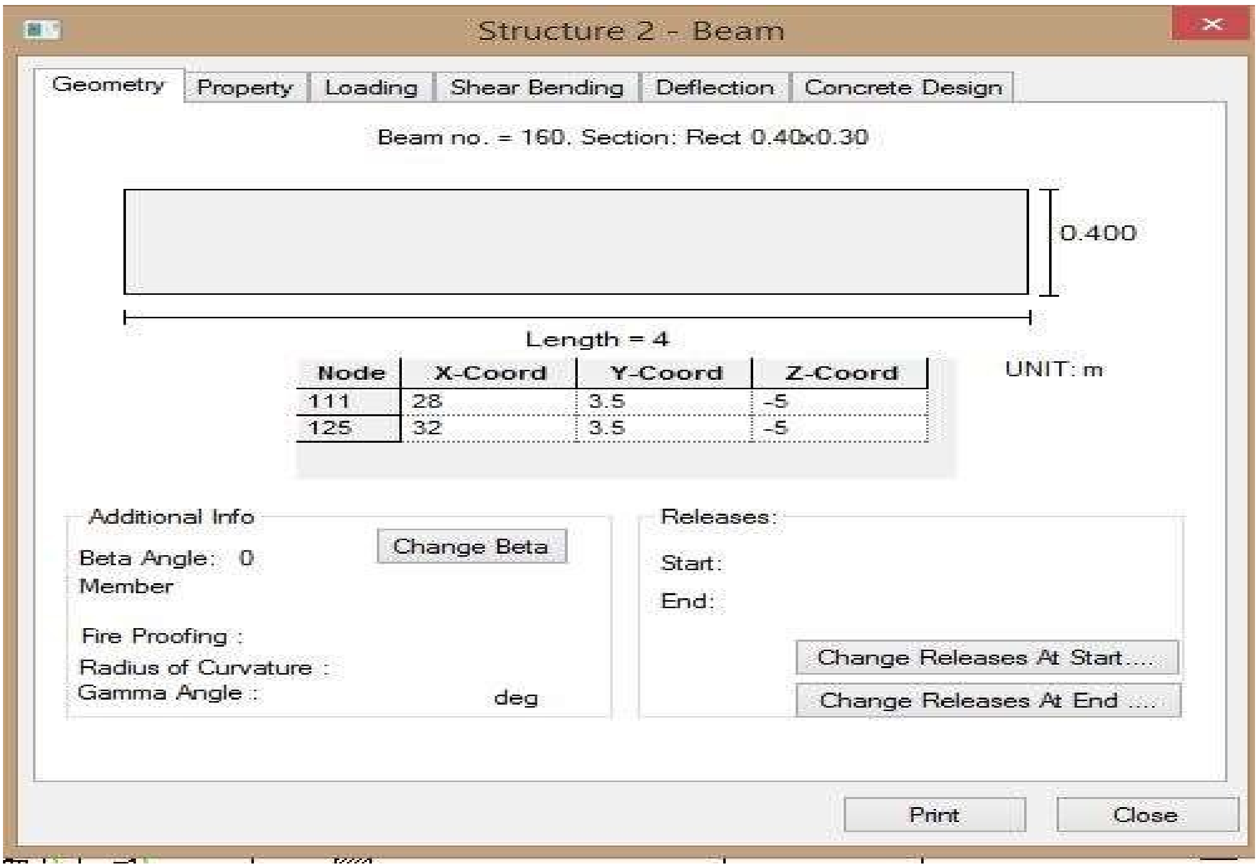


Figure 4.4 GEOMETRY OF A BEAM

p-ISSN: 2348-6848
e-ISSN: 2348-795X
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B E A M N O. 56 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 7000.0 mm SIZE: 300.0 mm X 700.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1750.0 mm	3500.0 mm	5250.0 mm	7000.0 mm
TOP REINF.	649.09 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	1173.74 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	607.12 (Sq. mm)	1079.93 (Sq. mm)	411.07 (Sq. mm)	0.00 (Sq. mm)

-------------------------------< PAGE 193 Ends Here >-------------------------------

STAAD SPACE -- PAGE NO. 194

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1750.0 mm	3500.0 mm	5250.0 mm	7000.0 mm
TOP REINF.	4-16í 1 layer(s)	3-16í 1 layer(s)	3-16í 1 layer(s)	3-16í 1 layer(s)	6-16í 1 layer(s)

Figure 4.5 DESIGN DETAILS OF A BEAM

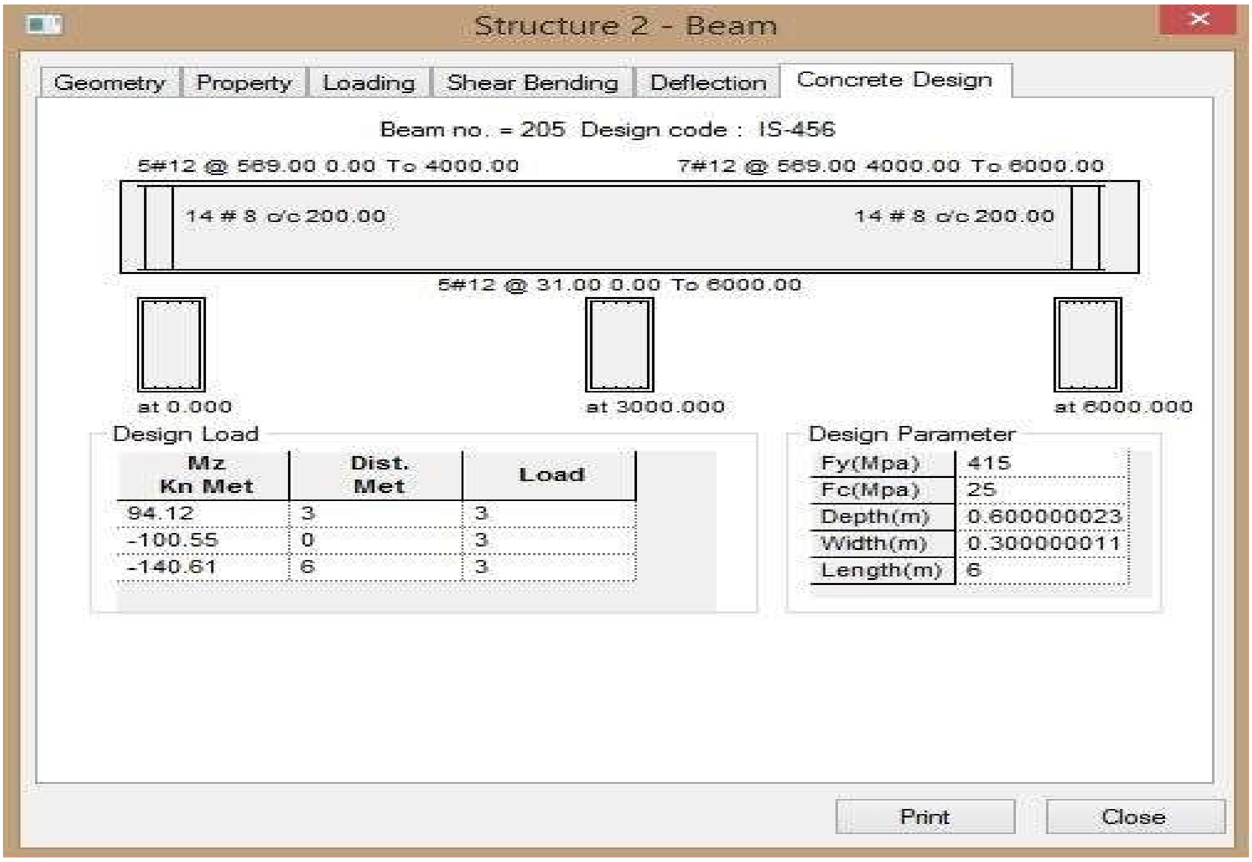

Figure 4.6 CONCRETE DESIGN OF A BEAM

```
C O L U M N   N O.   402  D E S I G N   R E S U L T S

     M25                    Fe415 (Main)            Fe415 (Sec.)

LENGTH:  1750.0 mm   CROSS SECTION:  300.0 mm X  420.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    3 END JOINT:   198  SHORT COLUMN

-------------------------------< PAGE 435 Ends Here >-----------------------
 STAAD SPACE                                                -- PAGE NO.   43

REQD. STEEL AREA   :       113.73 Sq.mm.
REQD. CONCRETE AREA:     14216.05 Sq.mm.
MAIN REINFORCEMENT : Provide    8 - 12 dia. (0.72%,    904.78 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c
```

Figure 4.7 DESIGN DETAILS OF A COLUMN

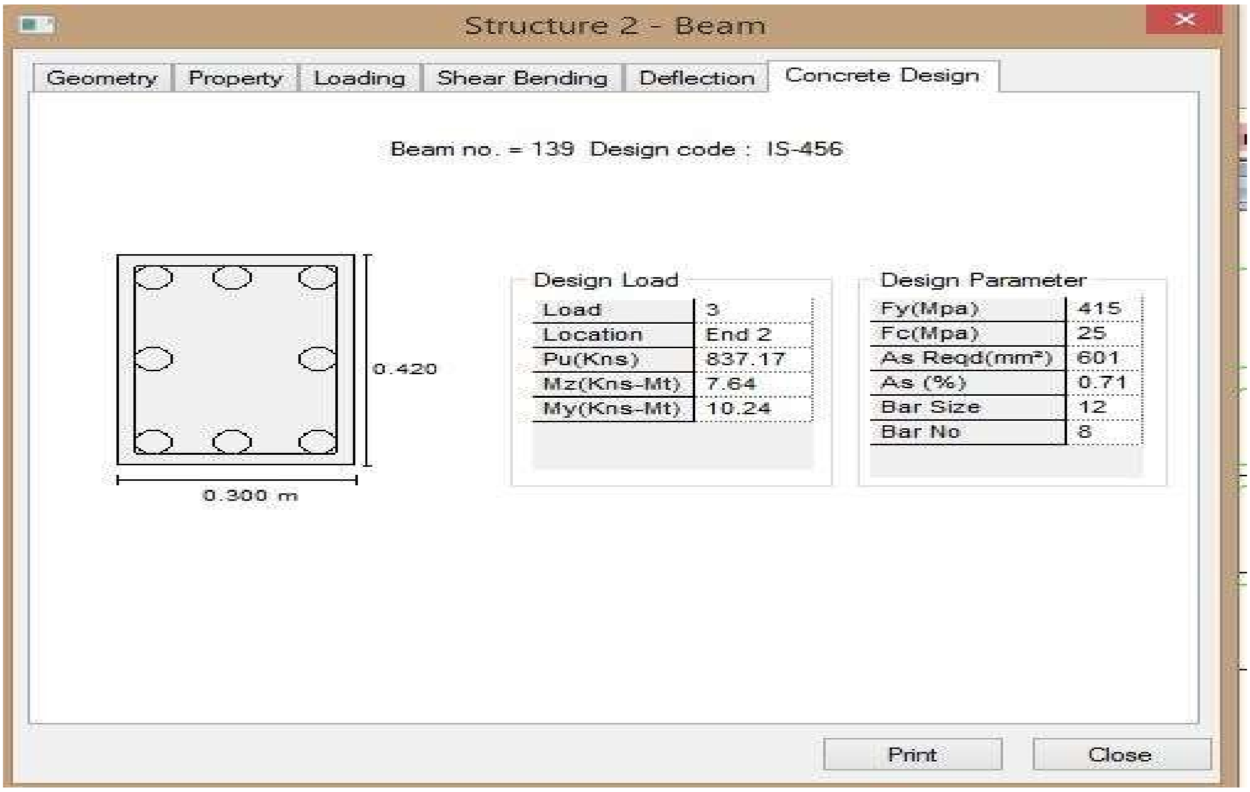

Figure 4.8 CONCRETE DESIGN OF A COLUMN

```
ELEMENT DESIGN SUMMARY
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ELEMENT     LONG. REINF      MOM-X /LOAD      TRANS. REINF      MOM-Y /LOAD
            (SQ.MM/ME)      (KN-M/M)          (SQ.MM/ME)       (KN-M/M)

  331 TOP :      156.         1.38 /    3         156.         2.45 /    3
     BOTT:      156.         0.00 /    0         156.         0.00 /    0

  332 TOP :      156.         1.40 /    3         156.         2.64 /    3
     BOTT:      156.         0.00 /    0         156.         0.00 /    0

  333 TOP :      156.         0.00 /    0         156.         1.03 /    3
     BOTT:      156.        -1.56 /    3         156.         0.00 /    0

  334 TOP :      156.         0.01 /    2         156.         0.60 /    3
     BOTT:      156.        -0.19 /    3         156.         0.00 /    0

  335 TOP :      156.         0.00 /    0         156.         0.00 /    0
     BOTT:      156.        -0.96 /    3         156.        -0.36 /    3

  336 TOP :      156.         0.99 /    3         156.         0.32 /    3
     BOTT:      156.         0.00 /    0         156.         0.00 /    0

  337 TOP :      156.         1.42 /    3         156.         2.45 /    3
     BOTT:      156.         0.00 /    0         156.         0.00 /    0

  338 TOP :      156.         0.00 /    0         156.         0.00 /    0
     BOTT:      156.        -1.17 /    3         156.        -2.60 /    3
```

Figure 4.9 DESIGN DETAILS OF A SLAB

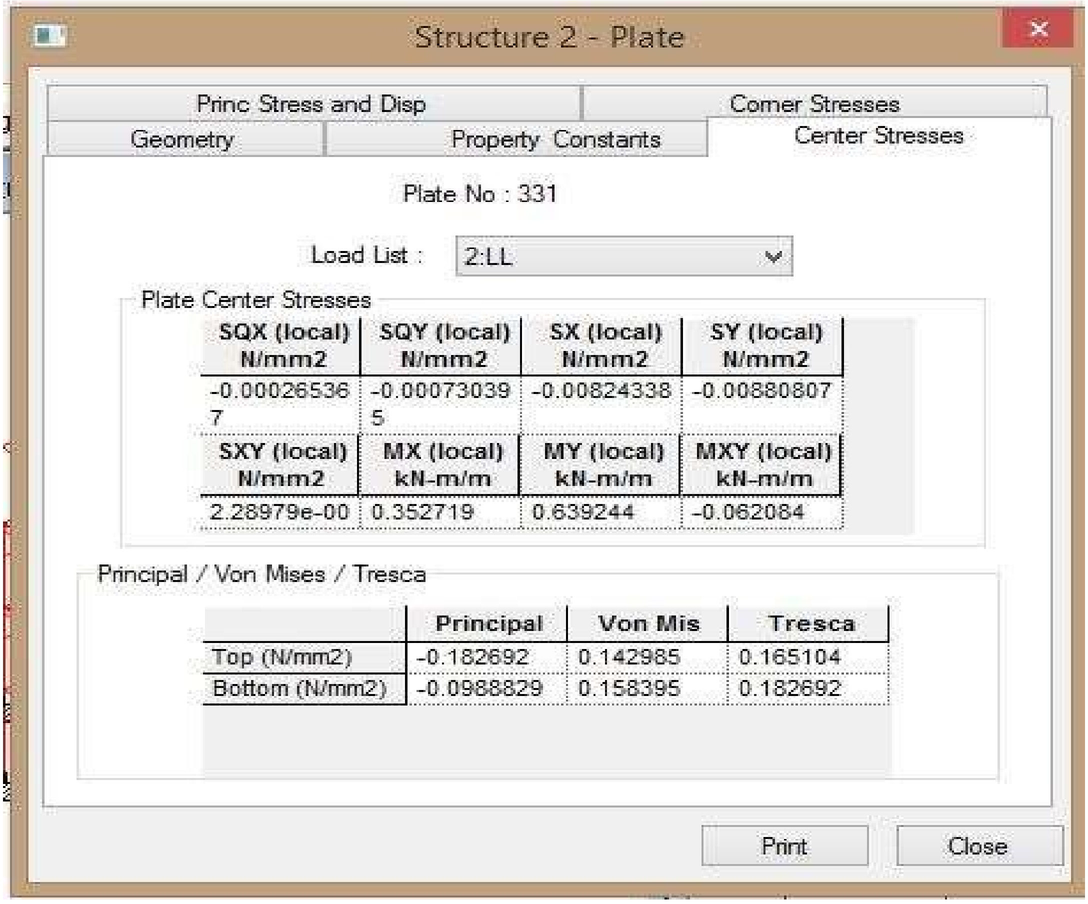

Figure 4.10 DESIGN DETAILS OF A SLAB

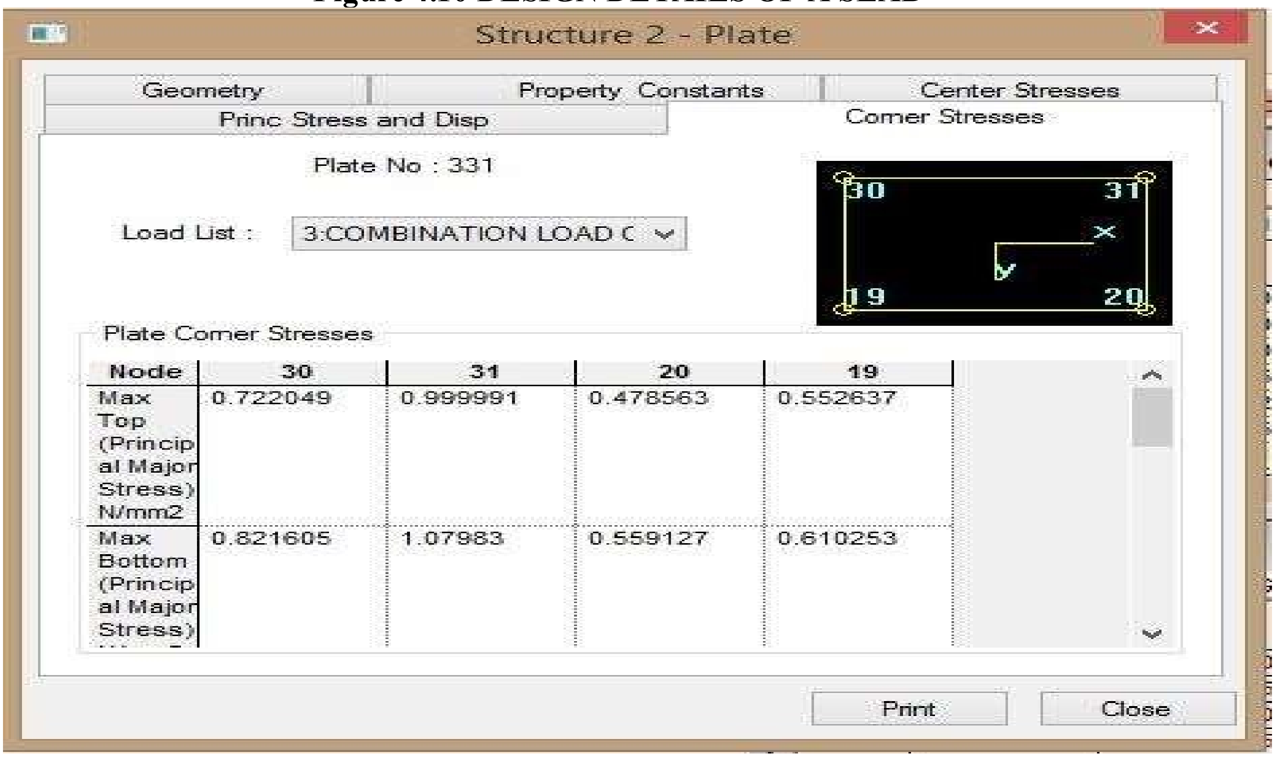

Figure 4.11 DESIGN DETAILS OF A SLAB

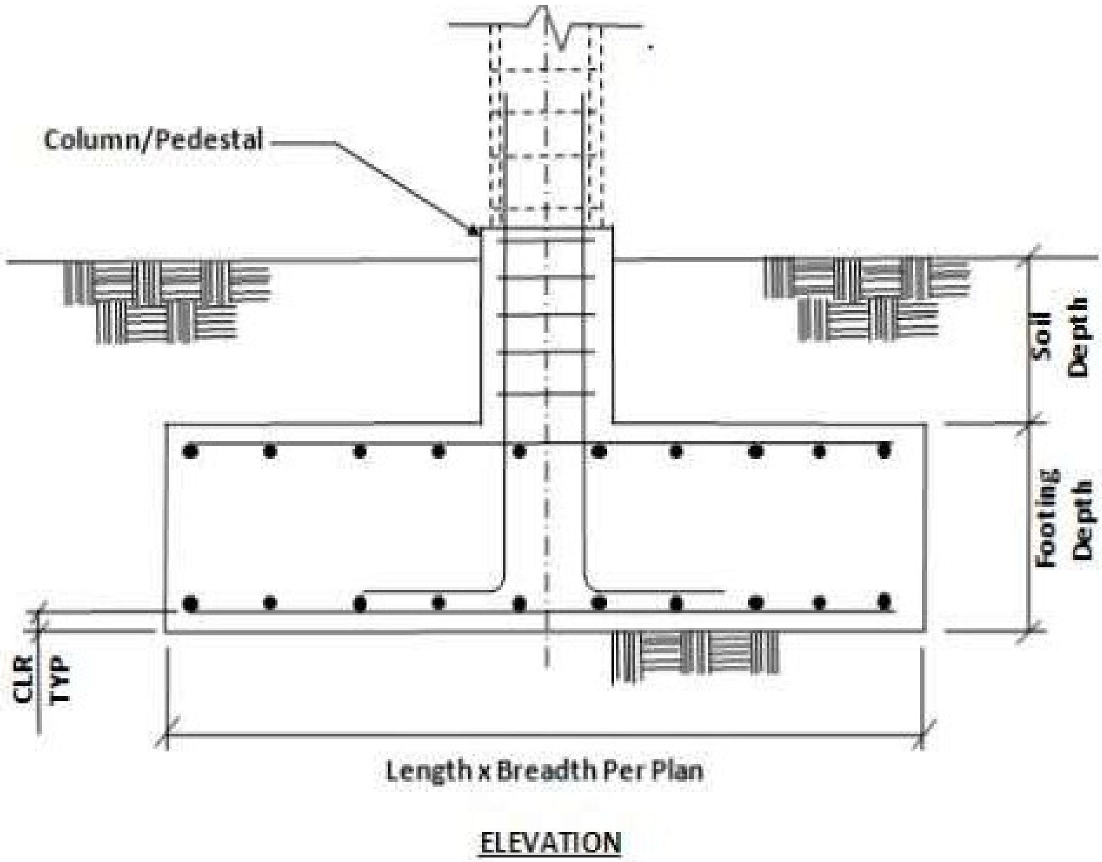

Figure 4.12 DESIGN OF AN ISOLATED FOOTING

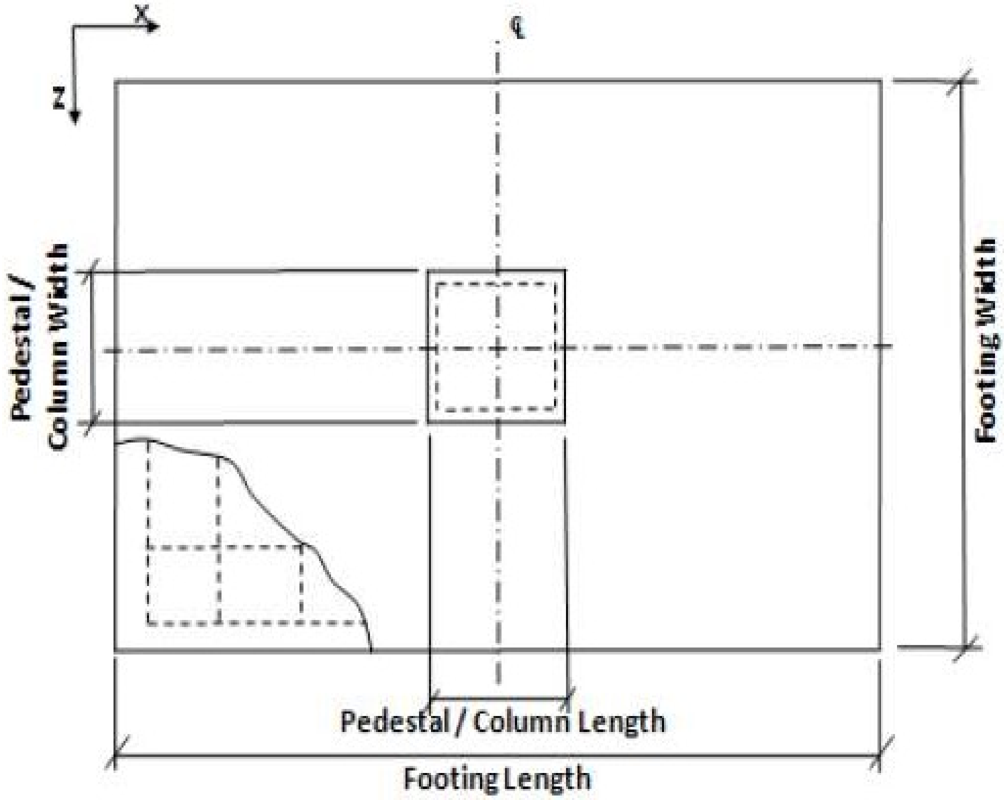

Figure 4.13 PLAN OF AN ISOLATED FOOTING

Figure 4.14 DEATAILING OF FOOTING

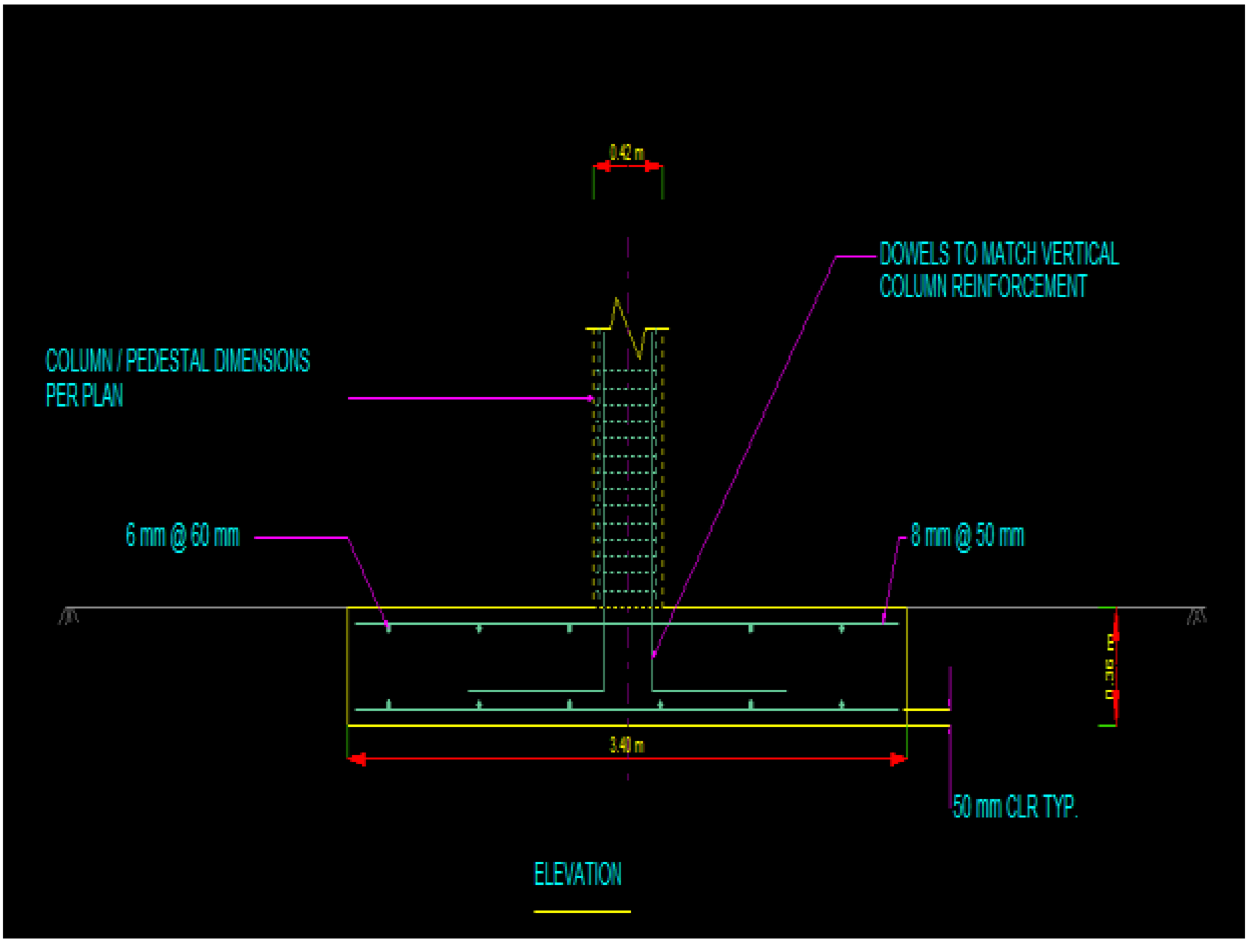

TABLE 4.1: APPLIED LOADS-SERVICE STRESS LEVEL OF FOOTING

LC	AXIAL(KN)	SHEAR X (KN)	SHEAR Z (KN)	MOMENT X (KN-m)	MOMENT Z (KN-m)
3	985.013	-15.078	6.310	7.186	17.458

TABLE 4.2: APPLIED LOADS-STRENGTH LEVEL OF FOOTING

LC	AXIAL(KN)	SHEAR X (KN)	SHEAR Z (KN)	MOMENT X (KN-m)	MOMENT Z (KN-m)
3	985.013	-15.078	6.310	7.186	17.458

TABLE 4.3: FINAL SIZE OF FOOTING

S.NO.	DETAILS	VALUES
1	L	3.4m
2	W	3.4m
3	D	0.356m
4	A	11.56m^2

```
************** CONCRETE TAKE OFF **************
      (FOR BEAMS, COLUMNS AND PLATES DESIGNED ABOVE)
NOTE: CONCRETE QUANTITY REPRESENTS VOLUME OF CONCRETE IN BEAMS, COLUMNS, AND PLATES DESIGNED ABOVE.
      REINFORCING STEEL QUANTITY REPRESENTS REINFORCING STEEL IN BEAMS AND COLUMNS DESIGNED ABOVE.
      REINFORCING STEEL IN PLATES IS NOT INCLUDED IN THE REPORTED QUANTITY.

TOTAL VOLUME OF CONCRETE =      207.4 CU.METER

                  BAR DIA       WEIGHT
                  (in mm)      (in New)
                  --------     --------
                     8            38384
                    12            88286
                    16            19656
                    20             4816
                            ------------
                   *** TOTAL=    151142
```

CONCLUSION

STAAD PRO has the capability to calculate the reinforcement neededfor any concrete section. The program contains a number of parameters which aredesigned as per IS: 456(2000). Beams are designed for flexure, shear andtorsion.

Design for Flexure:

Maximum sagging (creating tensile stress at the bottom face of the beam) and hogging (creating tensile stress at the top face) moments are calculated for all active load cases at each of the above mentioned sections. Each of these sections are designed to resist both of these critical sagging and hogging moments. Where everthe rectangular section is inadequate as singly reinforced section, doubly reinforced section istried.

Design for Shear:

Shear reinforcement is calculated to resist both shear forces and torsionalmoments. Shear capacity calculation at different sections without the shear reinforcement is based on the actual tensile reinforcement provided by STAAD program. Two-legged stirrups are provided to take care of the balance shear forces acting on these sections.

Beam Design Output:

The default design output of the beam contains flexural and shear reinforcement provided along the length of the beam.

Column Design:

Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design ofSTAAD.

Reference

1. Dr. S.R. Karve&Dr. V.L. Shah - "**Illustrated design of Reinforced concrete Buildings**"
2. 3.Reinforced concrete Structures by A.K. Jain and B.C. Punmia for design of beams, columnsand
3. Slab.
4. Fundamentals of Reinforced concrete structure by N. C.Sinha.
5. Reinforced Concrete Vol1DR.H.J.SHAH

a. Code Books

6. IS 456-2000 code book for design of beams, columns and slabs
7. SP-16 for design of columns.