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Analysis, Design, and Cost estimation of School Building in Srinagar

[1]Mohammad Aatif Matoo, [1]Muhammad Daniyal Shah, [1]Deibormi Shullai, [2]Mr. Akshat Mahajan

[1]B-Tech students, [2]Assistant Professor
[1-2]Department of Civil Engineering,
[1-2]Lovely Professional University, Phagwara, India

Abstract : With an increase in the number of private schools in the past few years, Srinagar has proved itself to be the only district in Kashmir region where government run primary/middle schools are in the most lackluster condition where in the most basic facilities e.g., drinking water, toilets, proper seating arrangement, library, etc. are severely lacking in both quality and quantity. The reason being that there has been less development in the government run schools is due to the decline in the enrollment of students in the government schools. The lack of proper infrastructure in government schools forces the parents to spend more on their children resulting them in sending their wards to private schools with facilities like proper playgrounds, classrooms, library etc. that government schools can barely compete with.

The main objective of this project is to analyze, design and do cost estimation of G+1 primary school building with all the basic infrastructure and facilities as per the requirements mentioned in the IS:8827 and NBC codes. The school has been designed for a strength of students up to 400. The total plot area of the building is 3300 sq.meter. The Planning of the school building was done with AutoCAD software for drafting conceptual plans, structural plan, and architectural plans. The analysis and design was carried out in STAAD pro software, considering the seismic zone of the region seismic analysis was also performed in order to make sure to erect the building that is safe during the seismic activities that are prevalent in the region. In addition to this, other loads such as self-weight, dead load, live load, and load combinations were also considered during the design phase as per IS Codes. The design was optimized by performing various trials for beams and columns in order to make building economical. Foundation design was done with the help of STAAD foundation where all the parameters were taken as per Indian standard codes. Finally, the cost estimation of the project was done using Microsoft excel to find the approximated cost of the building using single line method.

***IndexTerms* -Analysis, Design, Cost Estimation, STAAD Pro, STAAD Foundation, MS-Excel, School building, Seismic Loads.**

I. Introduction

General

Buildings are considered as one of the indicators of social progress. Shelter is one of the most fundamental needs for humankind. Buildings shelter us, every human has desire to own a comfortable house that he could spend his life in[1].

In this project, the type of structure is G+1 school building in a seismic region with total plot area of 3300 sq.meter. It is a framed structure comprised of slabs resting on beams which are supported by a network of columns.

Software's used

This project is mainly based on software work, so it's essential to know the details of these software and how they work. Below is the list of software that were used in the project:

- AutoCAD
- STAAD pro(v8i)
- STAAD foundation
- MS Excel
- 3ds Max

Loads and load combination

Structural load can be defined as a force applied to structural elements. The various loads considered in this project are:

- Vertical Loads
  - Dead load (As per IS:875 Part-1)
  - Live load (As per IS:875 Part-2)

- Lateral Loads
  - Earthquake load (As per IS:1893 Part-1)
- Load combinations (As per IS:875 Part 5)

Codes followed

- IS:875(Part-1)1987: This part of the IS code specifies the minimum design loads which have to be assumed for the dead loads in a structure
- IS:875(Part-2)1987: This part of the IS code specifies the minimum imposed loads (live loads) which have to be considered for the design of a building in order to ensure the structural safety of a building
- IS:456-2000: This code specifies the general structural use of plain and reinforced concrete within buildings. It enables us to design various components of buildings according to specifications required[2].
- IS:1893(Part-1)2002: This code deals with the calculation of earthquake loads acting on buildings and design of earthquake resistant buildings.
- IS: 8827-1978: This code, "Recommendations for basic requirements of school buildings," covers the various spatial, functional, and environmental requirements of a general school building not including boarding or residential schools.

- National Building Code of India: A comprehensive building Code, providing guidelines for regulating the building construction activities across the country[3].

Table 1: Statement of Project

Total area of the plot	3300 m^2
Built-up Area	720 m^2
Utility of building	Educational building
Number of stories	G+1
Type of construction	R.C.C framed structure
Types of walls	Brick Masonry
Ground floor	3m
Floor to floor height	3m
Height of plinth	0.3m
Depth of foundation	1.5m
Concrete Grade	M25
All Steel Grades	Fe415
Location	Srinagar J&K, India
Type of soil	Type-II medium or stiff
Bearing capacity of soil	250 KN/m^2

II. Literature review

Komal S. Meshram et.al (2019) in their paper, "Seismic analysis of building using STAAD Pro" presented seismic analysis and design of G+7 RCC building located in zone-II district of India. This study deals with seismic analysis of multistoried residential building along with design of beams, columns, slab, and footing. In their study they have utilized STAAD Pro software for analysis and design of entire structure. The study involves methodology related to modeling, generation of nodal points, property definitions, assigning supports, load assignment, structural analysis, design of structure and output result generation. After all the steps of methodology were followed for analysis and design, the design base shear obtained was 1634.43 KN. This study made it clear that how STAAD Pro can be used to experience static as well as dynamic analysis of the structure to provide accurate results as the values of base shear that were obtained in STAAD Pro were compared with manual calculations and it was found that there was only slight variation between the results. It was concluded that STAAD Pro is a versatile software having the ability to analyze any type of structure based on its loading and determine deflections against lateral loads as well as reinforcement required.

Lakhwinder Kaur et.al in their paper "Bearing capacity mapping of Srinagar" presented a study on the bearing capacity of soil in over 39 locations in the area of Srinagar. They collected data on the SPT-N values required for calculating the bearing capacity at each of these 39 locations and then calculated the bearing capacity according to procedure given in IS:6403-1981. The bearing capacity data was then entered into The GIS tool and used to develop four colored maps showing bearing capacity across Srinagar. The four maps represented bearing capacity at depths 1.5m and 2m, for square foundations, and depths 2m and 3m, for rectangular foundations. It was concluded through the study that most areas of Srinagar have low bearing capacity of soils and were thus suitable for shallow foundations.

A.V Deepanchakaravathi et.al. in their paper, "Analysis and design of primary school building" had presented a study of primary school building having three meters height for each storey. The whole building design was carried out manually according to IS 475. The layout of the proposed building was drawn in AutoCAD by following IS 8827. After design was completed manually depth of slab was decided to be 5.14mm, dimension of column and beam were chosen 250mm * 250mm and 250mm * 450mm respectively. The study provides a step-by-step explanation of how to design beam, column, slab, and footing for a primary school building.

III. Aim and Objective

The aim of the project is to plan, design and analyze a G+1 school building in a seismic region by following all the codal provisions.

The objectives of the project are:

a. Planning of school building using AutoCAD
b. Analysis and design of school building using STAAD Pro V8i.
c. Design of footing using STAAD foundation
d. Cost Estimation of school building using MS-Excel

3D modeling of school using 3DS Max

IV. Methodology

- Planning
- Analysis
- Design
- Cost Estimation.

V. Planning

A. Data Collection

- Location: This school building is planned at 20th location of Srinagar area of Kashmir as shown in Map
- Soil Report: The bearing capacity of the soil was taken from the study "Bearing Capacity Mapping of Srinagar Kashmir" (Lakhwinder Kaur et.al)[5]. The bearing capacity to be used was averaged at 250KN/m^2.

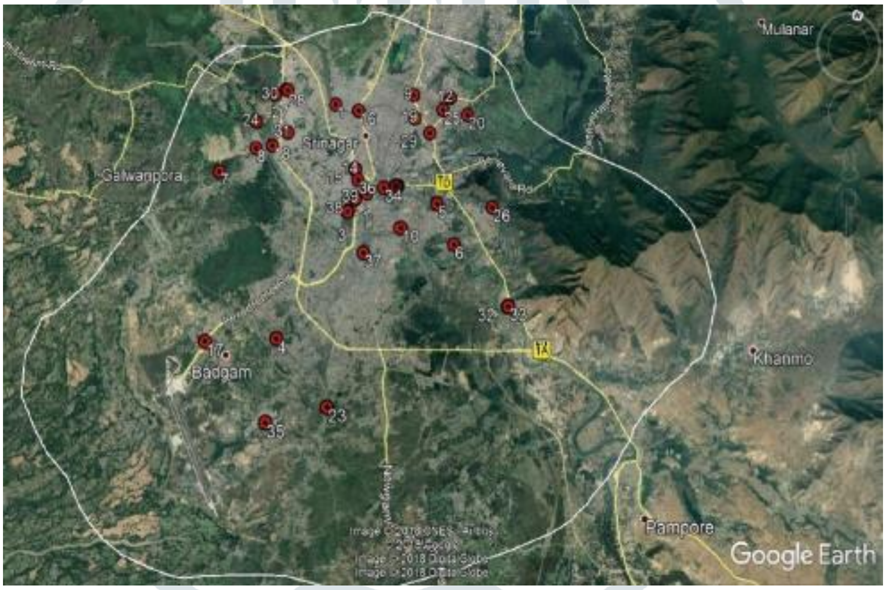


Fig.1. Location on map

B. Conceptual planning

- Codes followed: IS 8827-1978 and National Building Code
- Overall built-up area: 720 m^2
- Overall plot area (excluding playground area): 1440 m^2
- Geometry of building: U-shaped (U-shaped building is not having diagonal translation, torsion, opening-closing, or dog-tail-wagging during the initial modes of oscillation which are not acceptable as the initial modes of transition[7])
- Floor details:

  Ground floor
  - ➢ Classrooms (6 Nos) = 40 m^2 each
  - ➢ Arts/crafts room = 44 m^2
  - ➢ Library = 45 m^2
  - ➢ Toilets (2 Nos) = 16 m^2
  - ➢ Corridor = 2.75 meter wide
  - ➢ Staircase = 2.4 meter wide
  - ➢ Entrances = 1 to 2 meters wide
  - ➢ Ramp = slope provided 1 in 12

  First Floor
  - ➢ Classrooms (4 Nos) = 40 m^2 each
  - ➢ Principal's room = 15 m^2
  - ➢ Staff room = 28.8 m^2
  - ➢ Medical room = 30 m^2
  - ➢ General storeroom = 13.75 m^2
  - ➢ Computer lab = 40 m^2
  - ➢ Common room = 40 m^2

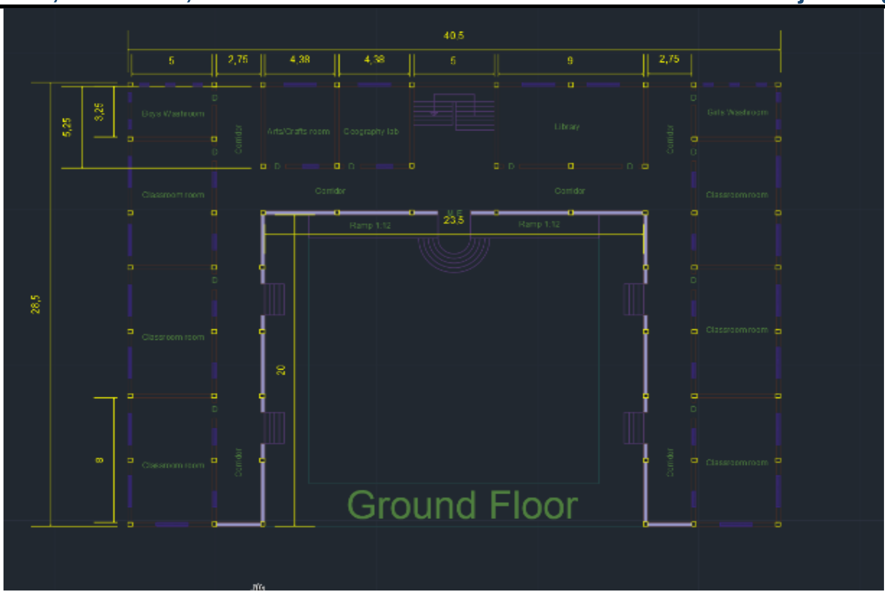


Fig.2. Ground Floor

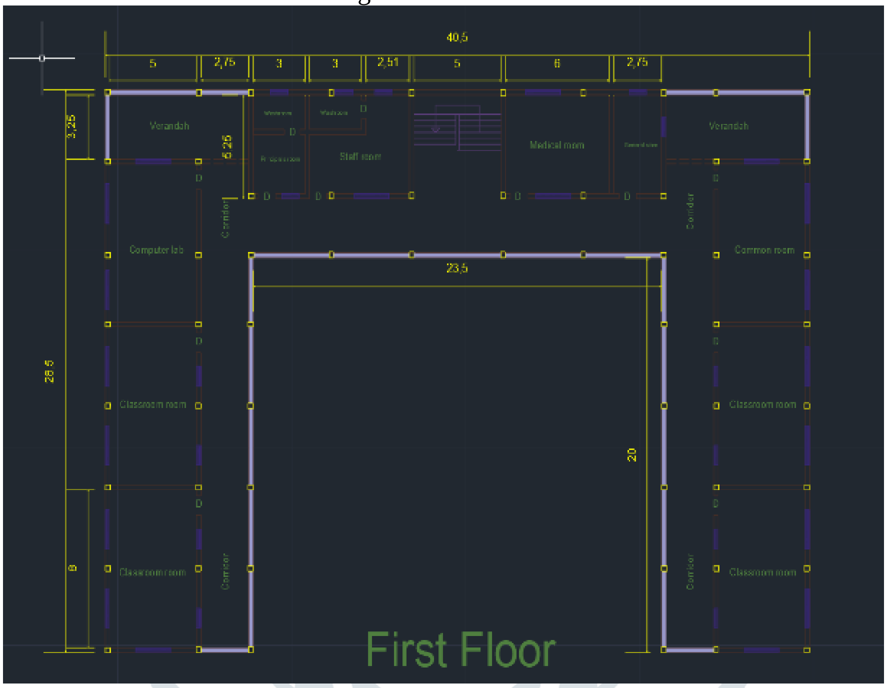


Fig.3. First Floor

B. Structural planning

Structural planning involved the determination of arrangement of structural components of the building given as under:

- Orientation and position of columns
- Positioning of beams

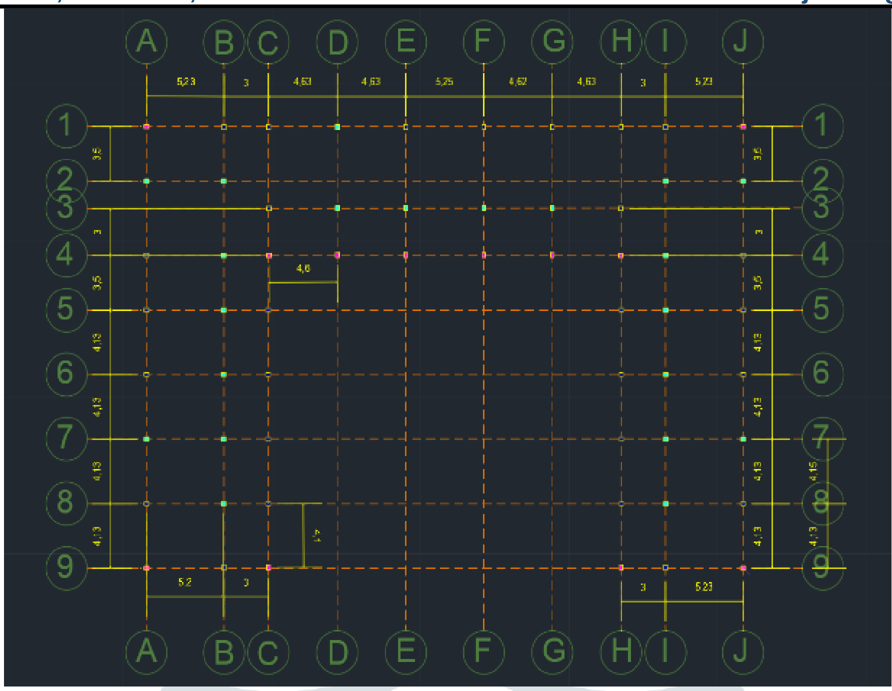


Fig.4. Column layout

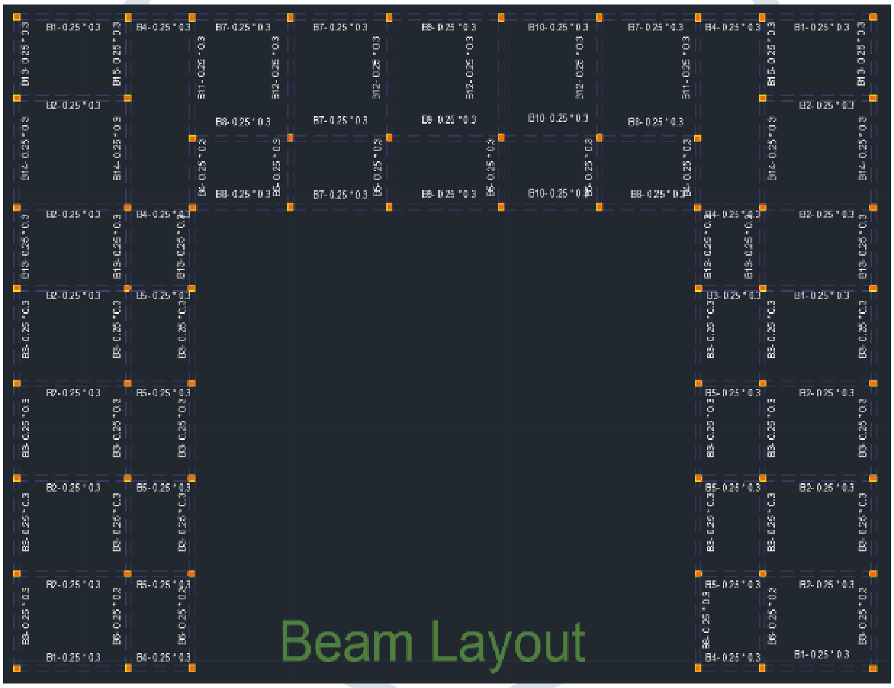


Fig.5. Beam layout

C. Architectural planning

Architectural planning refers to the design of architectural forms like projections, lawns, courts, porches, parking spaces, surrounding areas of building, shades, etc. Architectural plan has almost same importance as that of conceptual plan. It shows the relation of indoor spaces with outdoor areas like playgrounds, assembly areas, footpaths, parking areas, etc.

Outdoor areas provided as per IS:8827-1978 and NBC

- Playground = 656 m^2
- Open air assembly = 283.5 m^2
- Bus/car Parking area = 197 m^2
- Cycle/Scooter parking area = 94 m^2
- Setback = 6m

Fig.6. Ground Floor architectural drawing

In case of school building, architectural planning also includes the aesthetical appearance of the building and details of indoor spaces like furniture layout, fixtures, etc.

Fig.7. First Floor architectural drawing

D. 3D Model

Fig.8. Front view (left side)

Fig.9. Front view (right side)

VI. Analysis

Table 2: Data selected

Concrete Grade	M25
All Steel Grades	Fe415
Floor to floor height	3m
Number of stories	G+1
Column size	0.33x0.33m, 0.35x0.35m, 0.4x0.35m
Beam size	0.25x0.3m
Total no. of columns	60 on each floor
Total no. of beams	95 on each floor

The methodology followed for analysis using STAAD Pro in this project was divided into different stages, which are as under

A. Modelling/Creating of framed skeletal structure

The 3d framed skeletal structure was created by applying transitional repeat command to the whole plan. The repeat was given in positive Y-direction with spacing as 3m. The same procedure was used for creating depth of foundation by giving repeat command in negative Y-direction with spacing as 1.5m.

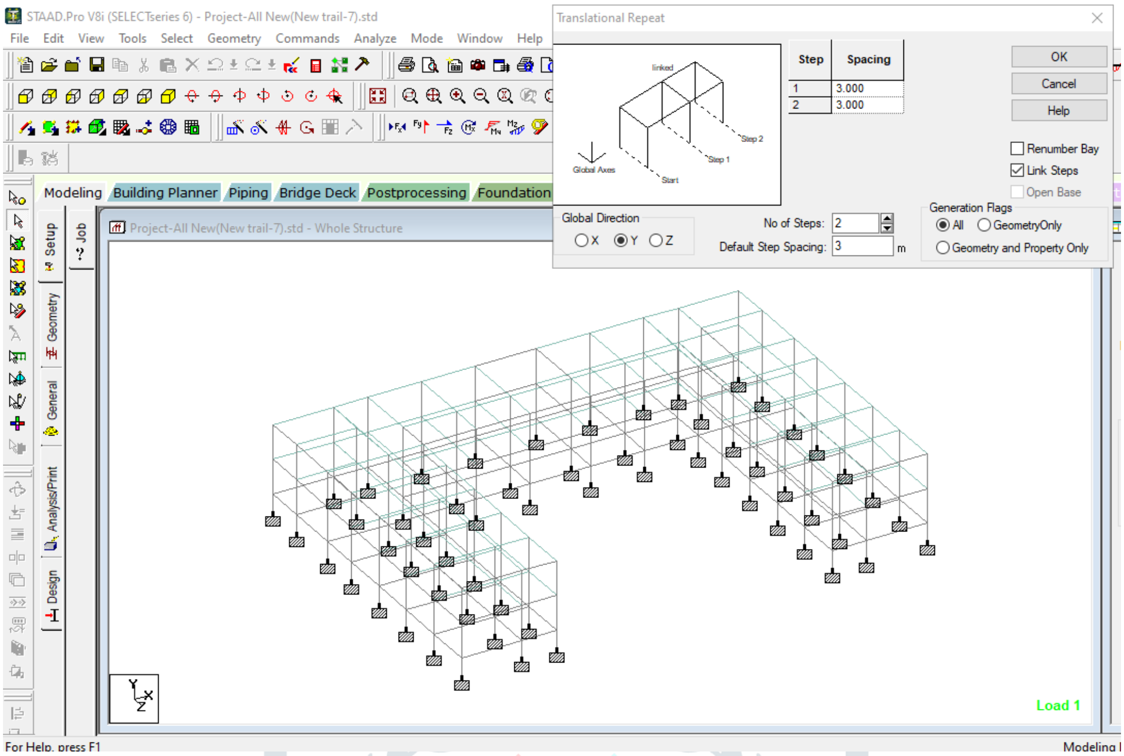


Fig.10. Skeletal structure using transitional repeat

B. Creating and assigning geometrical properties and supports

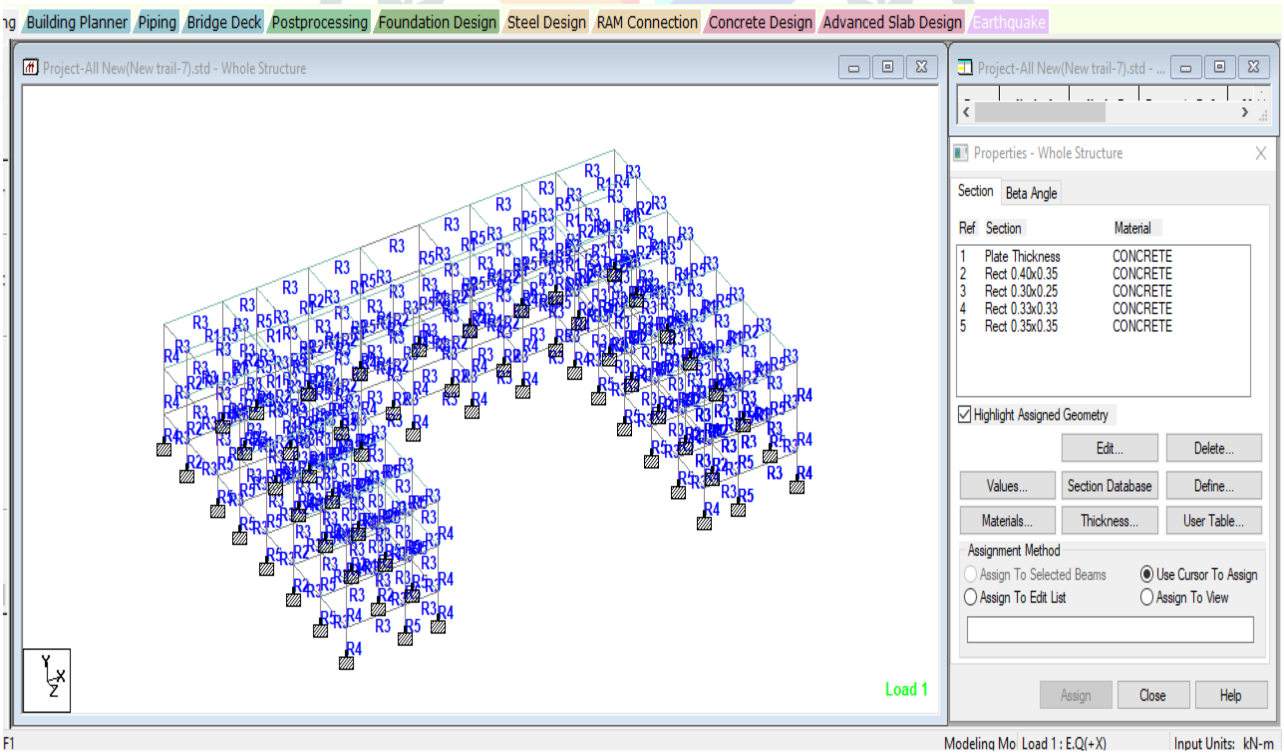


Fig.11. Geometrical properties and supports

C. Defining and assigning loads

Seismic definition:

The seismic definition was generated under definitions in load and definition as per IS-1893 2002/2005.

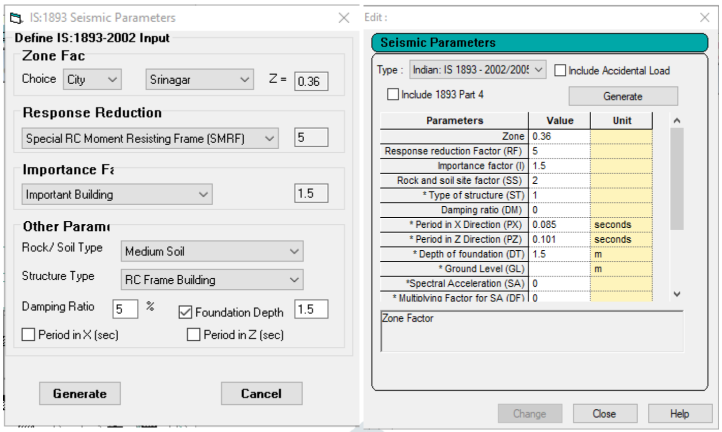


Fig.12. Seismic definition and parameters

Seismic load cases:

Under load case details four seismic load cases were added in +X, -X, +Z and -Z directions with factors as 1, -1 for positive and negative directions respectively.

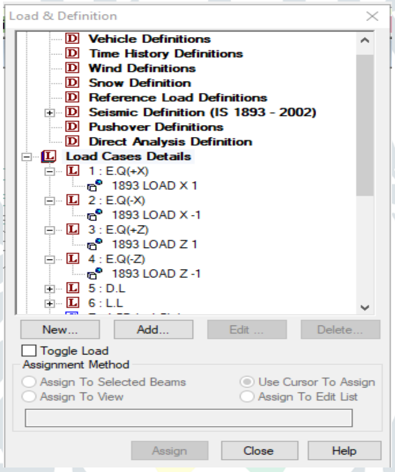


Fig.13. Seismic load cases

Dead Loads:

- Self-weight: This is the load of structure by its own weight such as weight of beams, columns, and plates.
- Member loads:
- These are the dead loads of the walls acting on the members. Wall load calculations were done for following parameters:
    - ➢ Thickness of wall: 0.25m
    - ➢ Density of brick masonry = 19 KN/m^3
    - ➢ Unit weight for plaster= 20 KN/m^3
    - ➢ Height of wall= 2.7m
    - ➢ Thickness of plaster= 15mm
    - ➢ Height of parapet wall= 0.92m
- Floor finishing:
  Floor finishing load of 1 KN/m^2 was taken as the finishing load on slabs of first floor and roof.

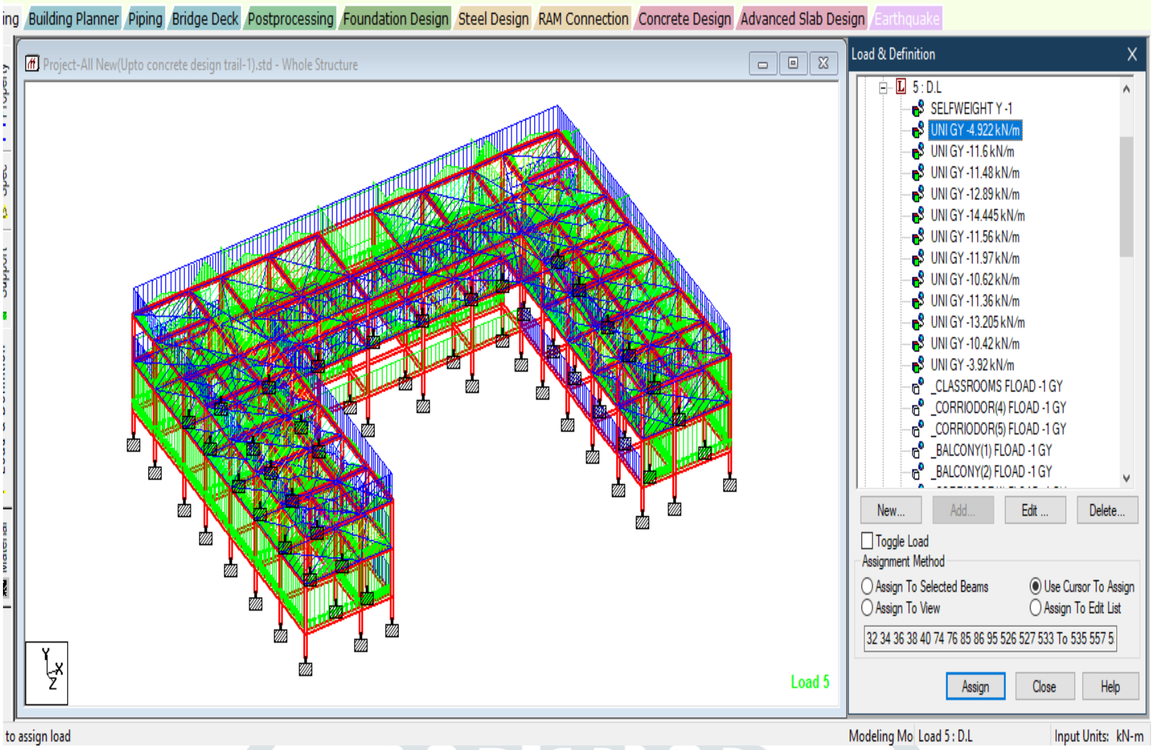
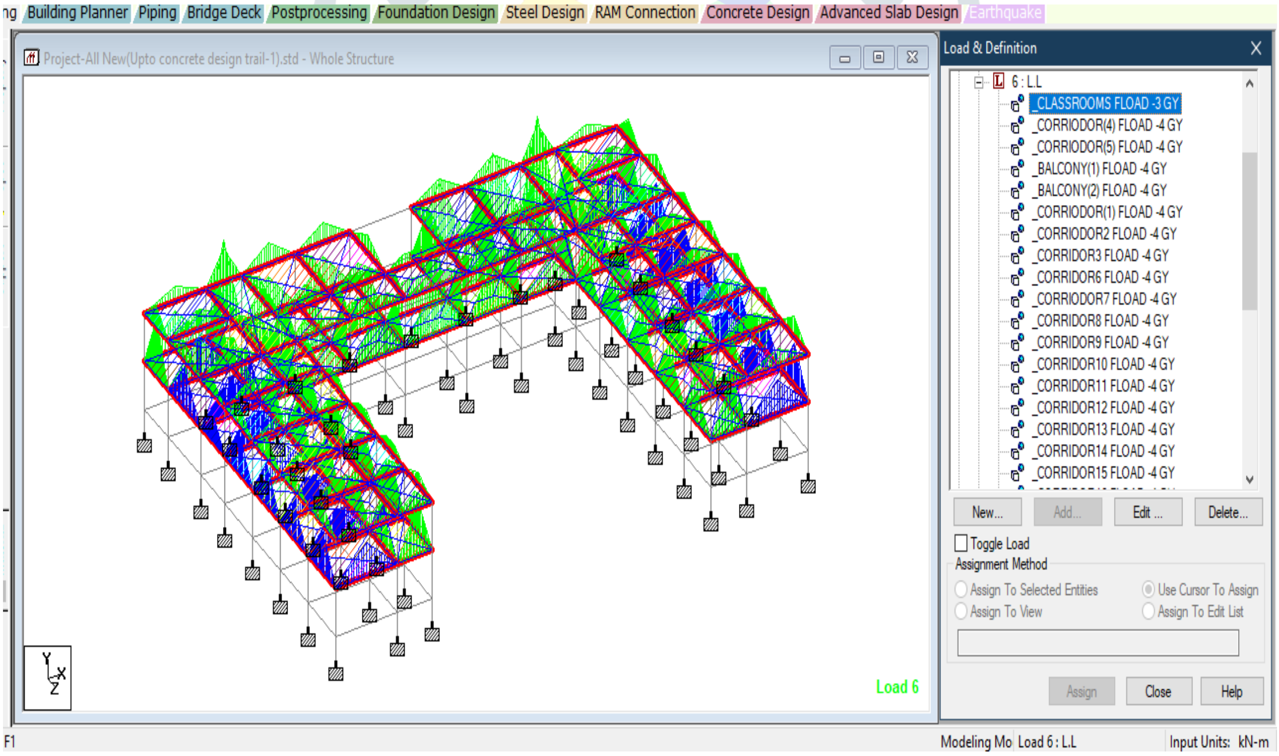


Fig.14. Self-weight, wall loads and floor finishing

Live loads

Live loads are the imposed loads that are variable over time like loads of people's weights, furniture, moveable equipment, etc. Live loads taken as per IS-875 part-ii table-1 for educational buildings are:

- Classrooms= 3KN/m^2
- Office/Staffrooms= 2.5KN/m^2
- Storeroom= 5KN/m^2



- Corridors/Stairways= 4KN/m^2
- Balconies= 4KN/m^2

Fig.15. Live loads

Load Combination

Load combination is when more than one type of load acts on the building. These are combinations of dead load, live load, wind load, earthquake load, etc. The load combinations defined for the structure are:

- D.L + 1.5 L.L
- 1.5 D.L + 1.5 E.Q(+X)
- 1.5 D.L + 1.5 E.Q(-X)
- 1.5 D.L + 1.5 E.Q(+Z)
- 1.5 D.L + 1.5 E.Q(-Z)
- 1.2 D.L + 1.2 L.L+ 1.2 E.Q(+X)
- 1.2 D.L + 1.2 L.L+ 1.2 E.Q(-X)
- 1.2 D.L + 1.2 L.L+ 1.2 E.Q(+Z)
- 1.2 D.L + 1.2 L.L+ 1.2 E.Q(-Z)
- 0.9 D.L + 1.5 E.Q(+X)
- 0.9 D.L + 1.5 E.Q(-X)
- 0.9 D.L + 1.5 E.Q(+Z)
- 0.9 D.L + 1.5 E.Q(-Z)

Here D.L= Dead load, L.L= Live load, E.Q= Earthquake load.

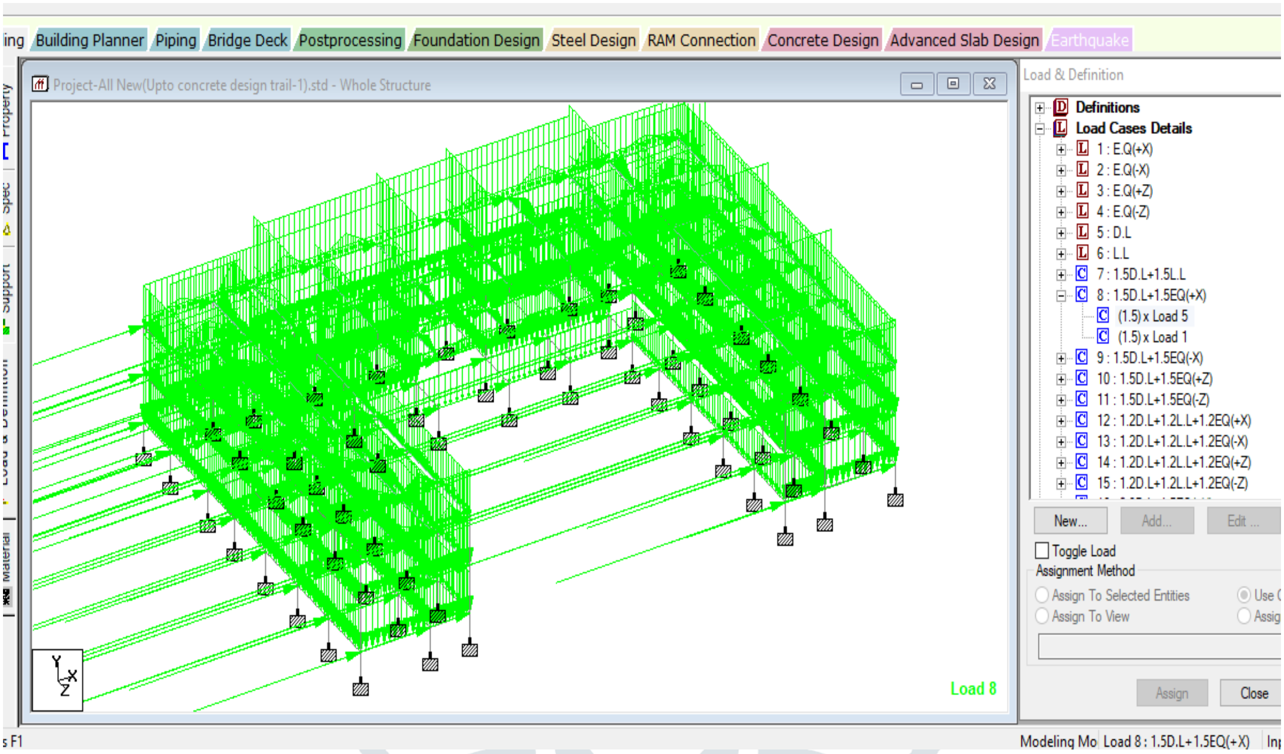


Fig.16. Load combination

D. Run analysis and Analysis results

Run analysis: The structure was analyzed by clicking on the Analysis/print option and all the options of print were checked on.

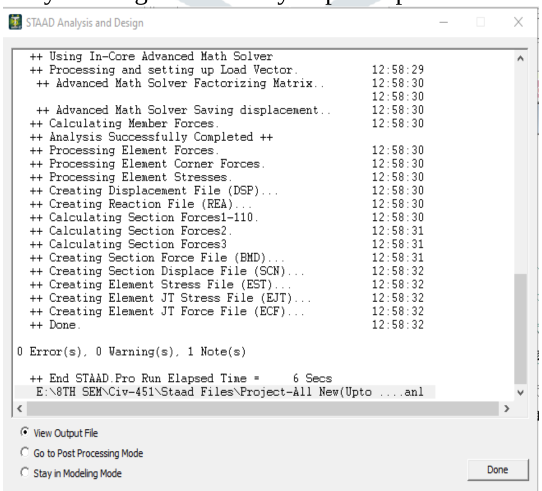


Fig.17. Analysis/Print and Run Analysis

Analysis Results

Static Seismic Analysis Results (Time periods and Base shear values)

TIME PERIOD FOR X 1893 LOADING =0.08500 SEC
SA/G PER 1893=2.275, LOAD FACTOR=1.000
FACTOR V PER 1893 AT GL=0.1800 X 18170.96
FACTOR V PER 1893 AT 30 M0.0902 X 18170.96
FACTOR V PER 1893=0.1755 X 18170.96

Post processing results:
The below results of diagrams, tables and contours are extracted from STAAD output file results and STAAD post-processing mode.

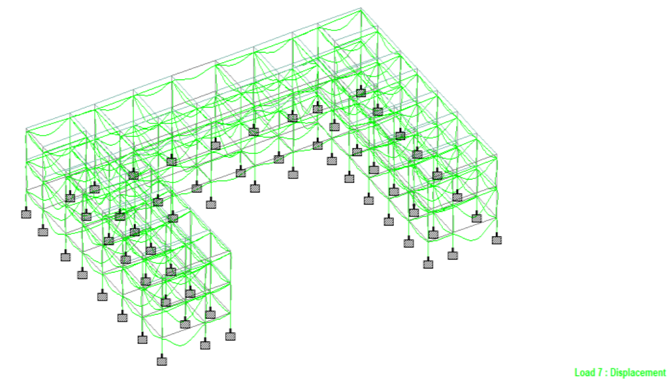


Fig. 18. Displacement of structure under load case 7

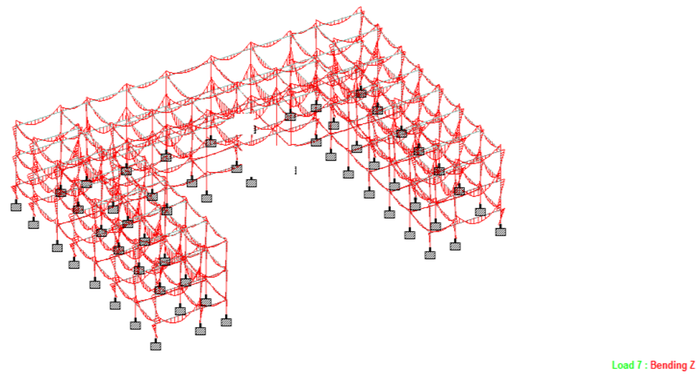


Fig. 19. Bending moment for load case 7

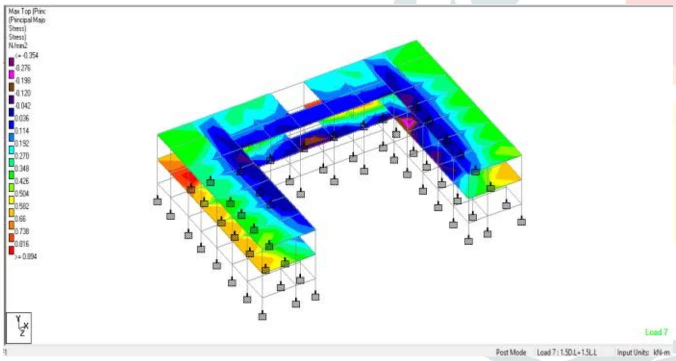


Fig. 20. Max Top major principal stresses for load case 7

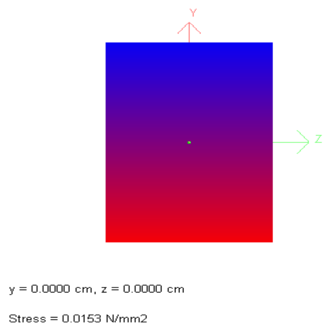


Fig. 21. 3D stress contour for beam-76

VII. Design

A. Beam and Column optimization

In beam optimization initial section of beam was taken as 0.25m x 0.3m and this section was successively increased to perform three iterations. After the iterations various properties of the beams were compared to determine the most optimal section.
The optimal section for beams was determined to be 0.25m x 0.3m. This section was chosen as the most optimal section because it has the least cross-section, least bending moment, and the least corresponding area of steel.
Similar to beam optimization several iterations were also performed by increasing the section of the column to find the most optimal section for the column. The most optimal section was then determined by comparing several properties of the columns.
The cross-sections in trial three were taken as the most optimal as it has the least sections for which all the columns pass, and the reinforcement detailing is also preferable in this trial.

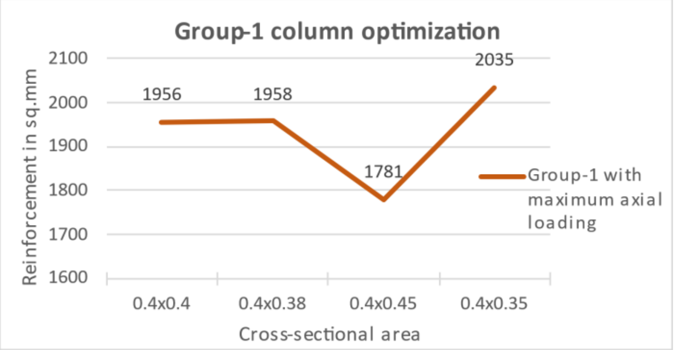


Fig. 22. Column optimization for group 1

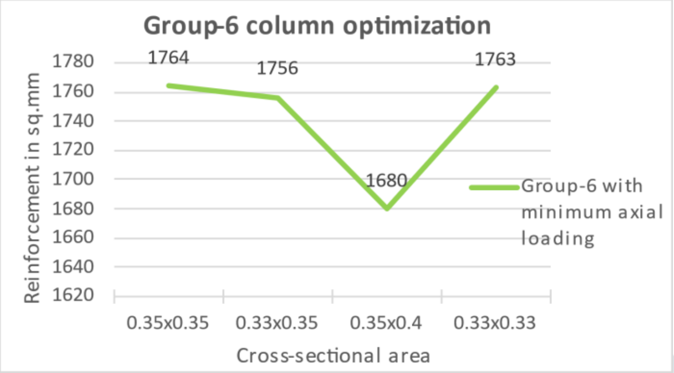


Fig. 23. Column optimization for group 6

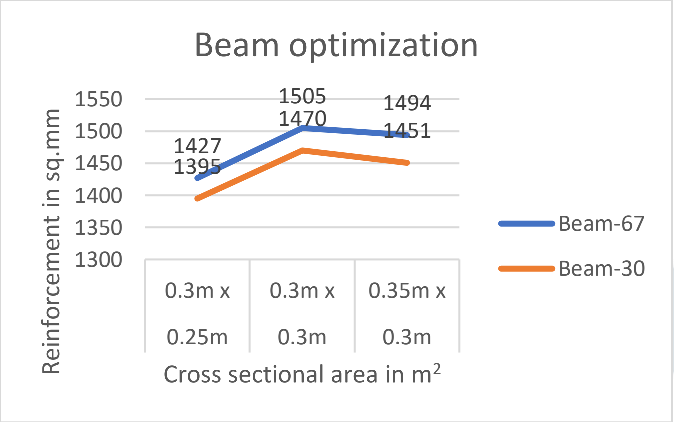


Fig. 24. Beam optimization for beam 67 and 30

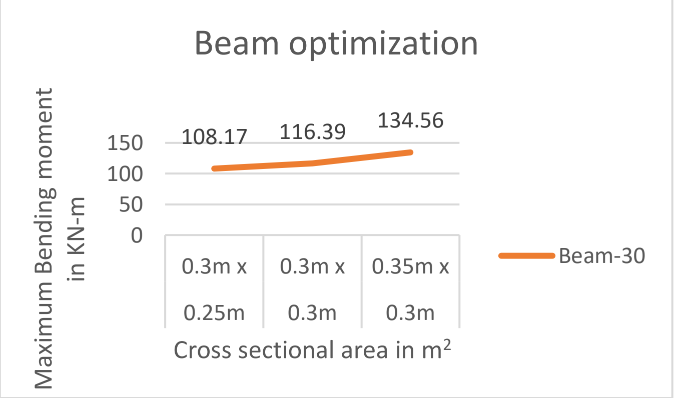


Fig. 25. Beam optimization for beam 30

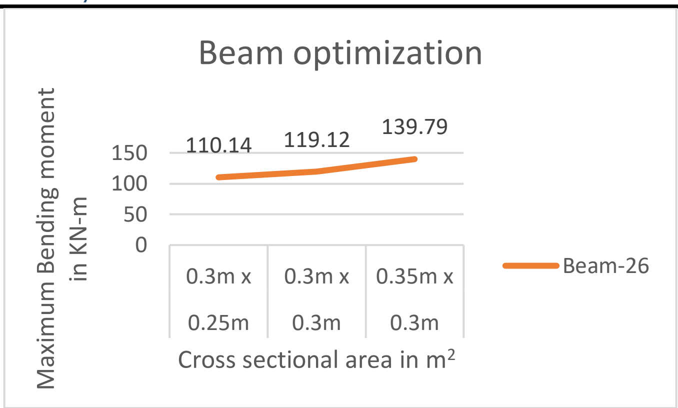


Fig. 26. Beam optimization for beam 26

B. Design of beams

Due to the large output file produced by the STAAD pro, results of one of the beams is shown as:

```
                  B E A M   N O.     76    D E S I G N   R E S U L T S

         M25                     Fe415 (Main)              Fe415 (Sec.)

       LENGTH:  4130.0 mm      SIZE:   250.0 mm X  300.0 mm   COVER: 25.0 mm

                           SUMMARY OF REINF. AREA (Sq.mm)
    ----------------------------------------------------------------------------
    SECTION      0.0 mm     1032.5 mm     2065.0 mm     3097.5 mm     4130.0 mm
    ----------------------------------------------------------------------------
     TOP         728.27        223.61        136.72        229.36        743.19
    REINF.     (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)

    BOTTOM       401.56        136.72        136.72        261.99        400.41
    REINF.     (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)
    ----------------------------------------------------------------------------

                           SUMMARY OF PROVIDED REINF. AREA
    ----------------------------------------------------------------------------
    SECTION      0.0 mm     1032.5 mm     2065.0 mm     3097.5 mm     4130.0 mm
    ----------------------------------------------------------------------------
     TOP         4-16í         2-16í         2-16í         2-16í         4-16í
    REINF.    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

    BOTTOM       2-16í         2-16í         2-16í         2-16í         2-16í
    REINF.    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

    SHEAR    2 legged  6í  2 legged  6í  2 legged  6í  2 legged  6í  2 legged  6í
    REINF.   @ 115 mm c/c  @ 115 mm c/c  @ 115 mm c/c  @ 115 mm c/c  @ 115 mm c/c
    ----------------------------------------------------------------------------

    SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT
    -----------------------------------------------------------------------------

    SHEAR DESIGN RESULTS AT    442.0 mm AWAY FROM START SUPPORT
      VY =     37.44 MX =      0.01 LD=    11
      Provide 2 Legged  6í   @ 115 mm c/c

    SHEAR DESIGN RESULTS AT    442.0 mm AWAY FROM END SUPPORT
      VY =    -37.73 MX =      0.03 LD=    10
      Provide 2 Legged  6í   @ 115 mm c/c
```

Fig. 27. Summary of reinforcement of beam-76

The details given above in Fig -21 shows the top and bottom reinforcement of beam-76 throughout its section along with its shear design results.

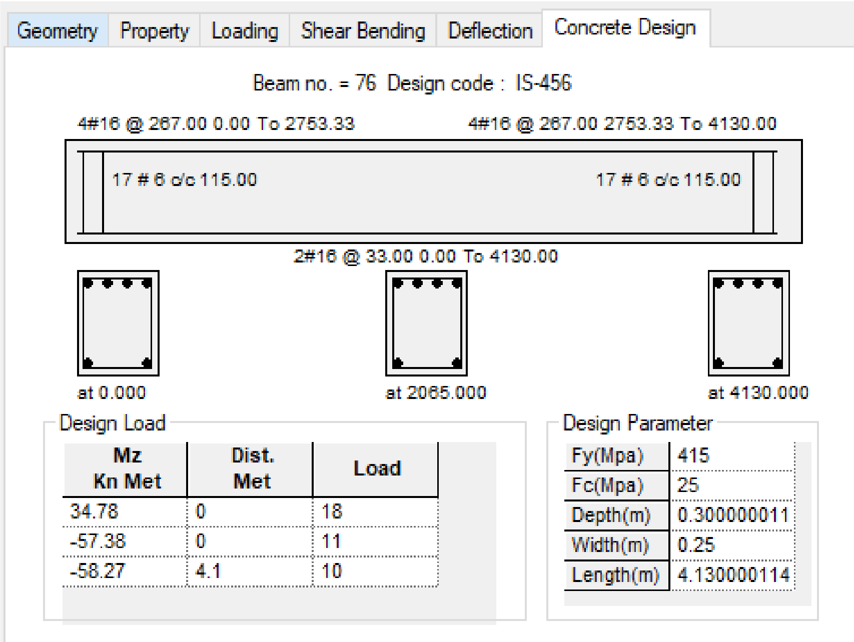


Fig. 28. Reinforcement details of beam-76

C. Design of columns

Due to the large output file produced by the STAAD pro, results of one of the columns is shown as:

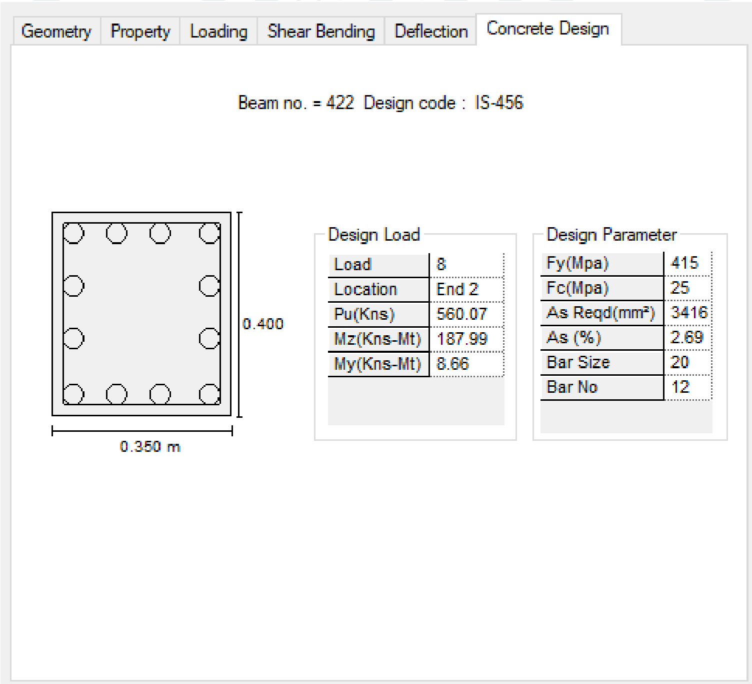


Fig. 29. Reinforcement details of column-422

```
C O L U M N   N O.   422   D E S I G N   R E S U L T S

     M25                   Fe415 (Main)            Fe415 (Sec.)

LENGTH:  1500.0 mm   CROSS SECTION:  350.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    8 END JOINT:   197  SHORT COLUMN

--------------------------------< PAGE 280 Ends Here >---------------------------
 STAAD SPACE                                            -- PAGE NO.  281


REQD. STEEL AREA   :     3415.69 Sq.mm.
REQD. CONCRETE AREA:   136584.31 Sq.mm.
MAIN REINFORCEMENT : Provide  12 - 20 dia. (2.69%,   3769.91 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2599.71   Muz1 :    201.00   Muy1 :    169.58

INTERACTION RATIO: 1.00 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:     8
END JOINT:    197 Puz :   2705.97   Muz :    212.97   Muy :    179.35   IR: 0.94
============================================================================
```

Fig. 30. Summary of reinforcement of column-422

D. Design of staircase

The design of staircase was done manually and the results from the manual calculation are as follows:

Staircase details

Type of stair = Dog-legged
Room size = 5m x 5m
Wall Thickness = 250mm
Height between each floor = 3m
Height of each flight = 1.5m
Total load on waist slab = 13575 N/m^2
Ultimate moment on waist slab = 50405 N-m
Effective depth = 230 mm
Main reinforcement = 10mm dia @120mm c/c
Distribution reinforcement = 8mm dia @ 180mm c/c
Development length = 600 mm

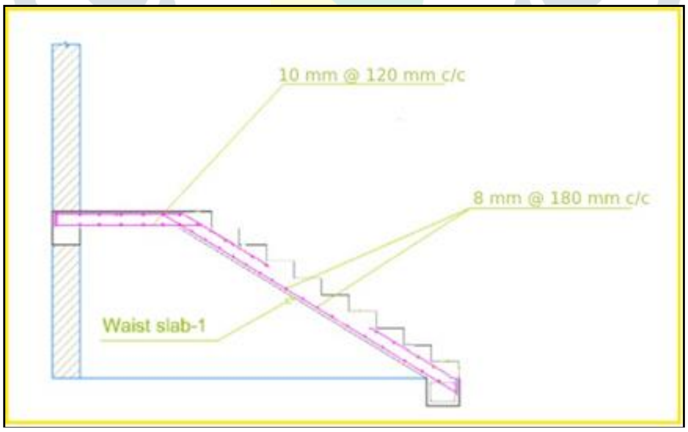


Fig. 31. Reinforcement details of staircase

E. Design of slab

The below figure shows the reinforcement of some of the plates of slab.

ELEMENT DESIGN SUMMARY

ELEMENT		LONG. REINF (SQ.MM/ME)	MOM-X /LOAD (KN-M/M)	TRANS. REINF (SQ.MM/ME)	MOM-Y /LOAD (KN-M/M)
776	TOP :	156.	1.16 / 12	156.	0.30 / 17
	BOTT:	156.	-0.09 / 17	156.	-1.09 / 8
777	TOP :	156.	0.40 / 16	156.	0.86 / 10
	BOTT:	156.	-1.07 / 9	156.	-0.51 / 19
778	TOP :	156.	0.75 / 13	156.	1.50 / 14
	BOTT:	156.	0.00 / 0	156.	-0.26 / 19
779	TOP :	156.	0.38 / 13	156.	1.82 / 10
	BOTT:	156.	-0.17 / 16	156.	-0.78 / 19
781	TOP :	156.	0.83 / 12	156.	2.16 / 14
	BOTT:	156.	-0.57 / 17	156.	-0.66 / 19
782	TOP :	156.	1.03 / 7	156.	1.95 / 14
	BOTT:	156.	0.00 / 0	156.	-0.11 / 19
783	TOP :	156.	0.36 / 17	156.	0.85 / 14
	BOTT:	156.	-1.04 / 8	156.	-0.50 / 19
784	TOP :	156.	1.16 / 13	156.	0.30 / 16
	BOTT:	156.	-0.09 / 16	156.	-1.09 / 9
785	TOP :	156.	1.40 / 7	156.	1.35 / 10
	BOTT:	156.	0.00 / 0	156.	0.00 / 0
786	TOP :	156.	1.53 / 13	156.	0.24 / 17
	BOTT:	156.	-0.46 / 16	156.	-0.94 / 8
787	TOP :	156.	0.09 / 19	156.	0.66 / 19
	BOTT:	156.	-0.98 / 10	156.	-1.35 / 10
788	TOP :	156.	1.66 / 13	156.	0.47 / 7
	BOTT:	156.	-0.32 / 16	156.	0.00 / 0
789	TOP :	156.	0.59 / 16	156.	0.22 / 8
	BOTT:	156.	-1.17 / 9	156.	-0.10 / 17
790	TOP :	156.	1.79 / 13	156.	0.30 / 13
	BOTT:	156.	-0.70 / 16	156.	-0.16 / 16

Fig. 32. Reinforcement of plate elements

D. Design of foundation

Design parameters chosen for the isolated footing were:

- Concrete and rebar
  - ➢ Unit Weight of concrete: 25 KN/m^3
  - ➢ Minimum bar spacing: 50 mm
  - ➢ Maximum bar spacing: 500 mm
  - ➢ Strength of concrete: 25 N/mm^2
  - ➢ Yield strength of steel: 415 N/mm^2
  - ➢ Minimum bar size: 12
  - ➢ Maximum bar size: 32
- Cover and soil
  - ➢ Soil type: Undrained Condition
  - ➢ Bottom clear cover: 50 mm
  - ➢ Unit weight of soil: 18 KN/m^3
  - ➢ Soil bearing capacity: 250 KN/M^2
- Footing Geometry
  - ➢ Footing type: Uniform thickness
  - ➢ Design type: Calculate Dimensions
  - ➢ Minimum Length: 1000 mm
  - ➢ Minimum width: 1000mm
  - ➢ Minimum thickness: 305mm
  - ➢ Maximum length: 12000mm
  - ➢ Maximum width: 12000mm
  - ➢ Maximum thickness: 1500mm
  - ➢ Plan dimension: 50mm
- Sliding and overturning
  - ➢ Coefficient of friction: 0.5
  - ➢ Factor of safety against sliding: 1.5
  - ➢ Factor of safety against overturning: 1.5

After completing the design for isolated type of footing, 6 types of footings were recommended by the STAAD foundation software which were 1.4x1.4x0.3, 1.45x1.45x0.3, 1.45x1.45x0.35, 1.5x1.45x0.35, 1.55x1.55x.04 and 1.5x1.5x0.4

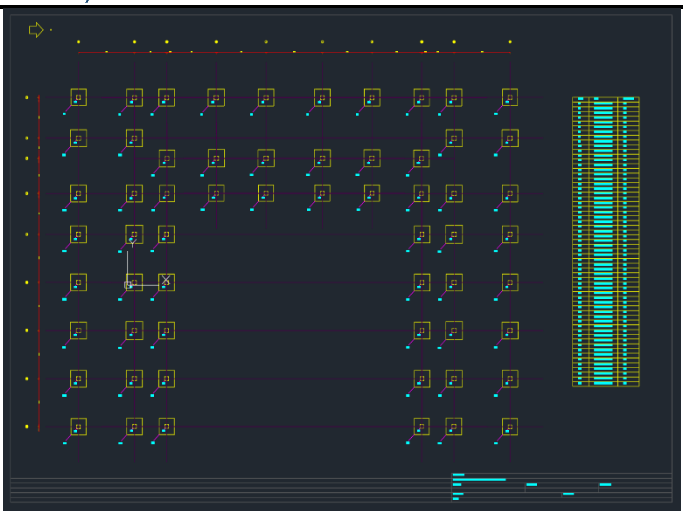


Fig. 33. Plan view of footings

Due to large number of footing reinforcement detailing, only one of the footings is shown below:

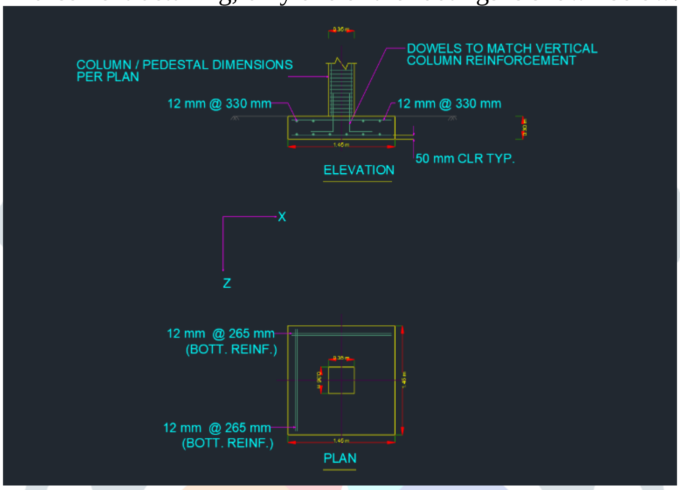


Fig. 34. Reinforcement detailing of footing-181

VIII. COST ESTIMATION

Microsoft Excel is one of the most powerful product from Microsoft. For civil engineers it comes in handy be it in surveying, planning, budgeting, quantity estimation etc. because of its easy-to-use interface and built-in formulas that help in construction work. In this project entire quantity estimation and cost estimation was done with MS Excel.

Abstract of estimated cost							
Sno		Quantity	Unit	Rate (Rs)	Per unit	Amount	Unit
1	**Description**		M^3		Rs /M^3		**RS**
2	**Earthwork in excavation**	169.08	M^3	188.75	Rs /M^3	31913.14219	
3	**Rcc in foundation**	42.2	M^3	8371	Rs /M^3	352976.8179	
4	**DPC(40 mm thick, 1:2:4)**	100.87	M^2	310.55	Rs /M^2	31325.39589	
5	**Ist Class brickwork in superstructure**	295.10	M^3	5615	Rs /M^3	1657003.513	
6	**Rcc work in superstructure**	165.05	M^2	8371	Rs /M^2	1381668.206	
7	**Concrete Floor**	607.55	M^2	505	Rs /M^2	306812.75	
8	**15mm thick plastering inside (1:6) walls (Cement, sand mortar)**	2256.12	M^2	278.6	Rs /M^2	628555.032	
9	**15mm thick plastering outside(1:4) walls (Cement, sand mortar)**	798.64	M^2	300.45	Rs /M^2	239951.388	
10	**6mm thick plastering in ceiling (1:3)**	1187.225	M^2	221.5	Rs /M^2	262970.3375	
11	**12mm thick plastering for floors**	1187.225	M^2	241.75	Rs /M^2	287011.6438	

12	**Water proofing for roof slab**	634	M^2	581.6	Rs /M^2	368734.4	
13	**White Wash inside**	2256.12	M^2	27.55	Rs /M^2	62156.106	
14	**White Wash outside**	798.64	M^2	27.55	Rs /M^2	22002.532	
15	**White Wash ceiling**	1187.23	M^2	27.55	Rs /M^2	32708.04875	
16	**Steel Reinforcement**	30609.817	Kgs	78.55	Rs/Kg	2404401.127	
				Total		**8070190.441**	
		Add Contingency	**3%**			**242105.7132**	**RS**
		Add work charge establishment	**2%**			**161403.8088**	**RS**
					Overall cost	**8473699.963**	**RS**

- **The expected cost of the construction is 8473699.963 Rupees.**

IX. Conclusion

The project "Analysis, design and cost estimation of school building in Srinagar" presents the idea of planning, analysis, design, and cost estimation. The planning of the school building was done in AutoCAD to prepare all the drawings like Conceptual plans, structural plan, and architectural plans. The 3D model of the same school building was made using 3DS max. The analysis of the building was carried out in STAAD pro taking into consideration the seismic zone of the region to perform the seismic analysis on the building in order to make sure structure can be made safe during seismic activity. The design of the building was done with STAAD pro only, keep all the parameters and requirements for school building as per Indian standard codes. The design was optimized for various trials for beams and columns in order to make building economical. Foundation design was done with the help of STAAD foundation where all the parameters were taken as per Indian standard codes. The choice of footing was selected as isolated on the basis of bearing capacity of soil and spacing between columns. Finally, the cost estimation was done with Microsoft excel using single line method. The overall approximate cost was coming out to be **8473699.963 Rupees.**

X. ACKNOWLEDGEMENT

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