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Planning, Designing and Analysis of Proposed Classroom Complex at GHSS Porur, Malappuram

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Abstract

This project involves the comprehensive planning, analysis and design of a four story(G+3) classroom complex located in GHSS Porur, Wandoor, Malappuram district. The planning phase of the building is done as per National Building Code of India (NBC) and Kerala Panchayat Building Rules (KPBR). The structural elements like beam, columns, slab, foundation and staircase are designed manually in accordance with IS codes, using IS 456:2000 and IS 875:1978 using limit state method. The drawing is prepared using AutoCAD. The analysis is done using ETABS software. A detailed cost estimation is conducted, covering material, labor, and construction expenses to ensure budget feasibility. The project prioritizes functionality and safety while maintaining a minimal environmental footprint.

Keywords: ETABS, AutoCad, Classrooms

1. Introduction

Planning, analysis and design are essential steps in construction. Firstly, feasibility assessment is fundamental and examining factors like location, land availability, regulatory compliance and financial viability. Structural integrity is ensured through analysis of soil conditions, environmental factors, ensuring the safety and durability of the building. Functional design is prioritized to set up the layout of classrooms, laboratory, libraries, staffrooms and circulation spaces for optimal comfort and convenience. Moreover, adherence to regulatory standards is ensured, acquiring necessary permits and approvals.This project focuses on the planning, layout preparation, design, structural analysis and cost estimation of a G+3 school building located in Porur, Wandoor. The building adheres to the Kerala Panchayat Building Rules (KPBR) and the National Building Code (NBC). Structural analysis and design follow the limit state method, ensuring a safe, functional, and viable learning space for students.AutoCAD is indispensable for planning, designing multi-storeyed buildings. It helps architects and engineers create detailed plans, comply with regulations and optimize designs for structural integrity, energy efficiency and safety. With its drafting and modelling tools, AutoCAD enables efficient collaboration and integration of building systems, ensuring successful project execution from start to finish.

The advanced new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. ETABS offers a single-user interface to perform modelling, analysis, design, and reporting. There is no limit to the number of model windows, model manipulation views, and data views. Design of steel frames, concrete frames, concrete slabs, concrete shear walls, composite beams, composite columns and steel joists can be performed based on various US and international design codes.

Revit is a powerful Building Information Modelling (BIM) software developed by Autodesk, widely used in architecture, structural engineering, and MEP design. Unlike traditional CAD software like AutoCAD, Revit enables parametric modelling, where all elements in a building model are interconnected, ensuring that any modifications automatically update across the entire project. It allows to create 3D models that integrate with structural analysis tools such as ETABS making it highly effective for designing and analysing buildings.

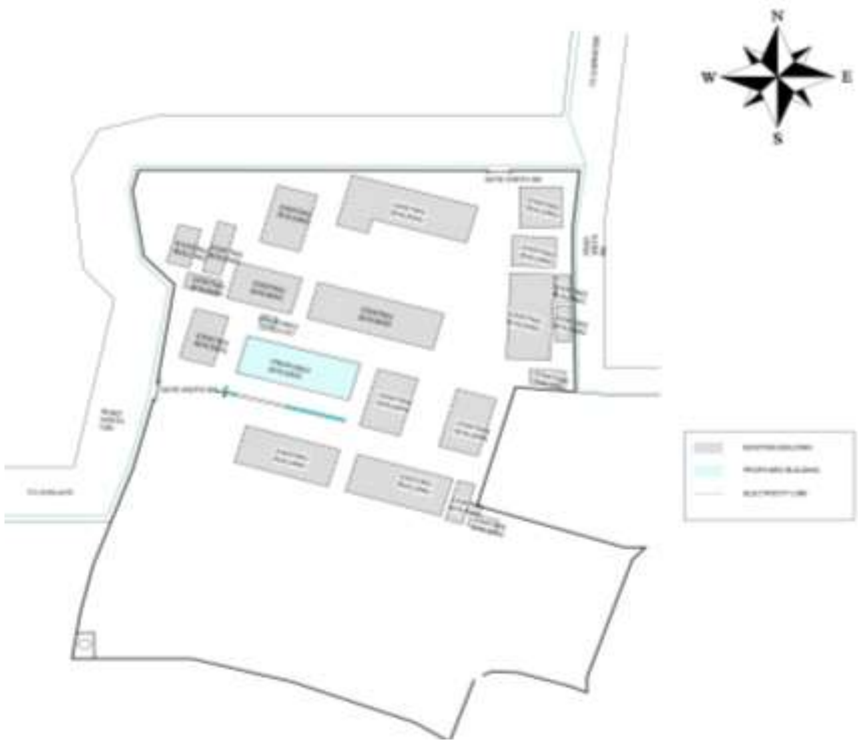
2. Objectives

The project aims to develop a proposed classroom complex at GHSS Porur, Malappuram. The objectives include planning, analysis, designing and cost estimation of the proposed classroom complex at GHSS Porur located at Pandikkad Panchayat.Before you begin to format your paper, first write and save the content as a separate text file.

3. Planning

A well-planned and properly analyzed site is crucial for the successful construction of any building project. Site recognition, data collection, and analysis are fundamental steps that provide essential information about the site's topography, soil conditions, environmental factors, and accessibility. These aspects influence design decisions, structural considerations, and overall project feasibility. This chapter discusses the process of site recognition, the methodology of data collection, and the importance of site analysis. This site plan illustrates the arrangement of both existing and proposed structures in a specified area. The existing buildings are shown with diagonal hatching, while the proposed building is highlighted in blue for clarity.

Figure 1: Site Plan



Two Boreholes of 15 cm diameter were drilled at the proposed new building site using rotary-boring equipment, to collect maximum possible information regarding the soil. Bore hole 1 is at a depth of 10m and bore hole 2 is at a depth of 10.5m. The details of bore hole is shown in table 4.1&4.2.

Table 1: Bore hole 1

Depth in meters	Soil profile	Visual description	Thickness of layer(metres)	Standard penetration test data				
				Depth (m)	15	30	45	N value
0		Laterite soil with sand	2.70 m	1.00 2.00	5 2	4 3	5 3	9 6
2.70		Medium lateritic soil	3.2 m	3.00 4.50	5 1	8 1	10 2	18 3
5.90		Silty laterite	0.90 m	6.00	4	4	10	14
6.80		Clayey silt with sand	1.50 m	7.50	34	>50		>50
8.30		Silty sand	1.40 m	9.00	6	7	11	18
9.70		Weathered rock	0.30 m	10.00	11	>5		>50
10.0		Hard strata						>50

Table 2: Bore hole 2

Depth in meters	Soil profile	Visual description	Thickness of layer (metres)	Standard penetration test data				
				Depth (m)	15	30	45	N value
0		Lateritic soil	1.15 m	1.00	2	8	12	20
1.15		Medium lateritic soil	1.65 m	2.00	8	12	16	28
2.80		Lateritic soil yellowish brown	2.50 m	3.00 4.50	5 5	6 6	10 9	16 15
5.30		Silty clay	3.70 m	6.00 7.50	2 3	3 6	4 9	7 15
9.00		Clayey silt	1.50 m	9.00	4	6	9	15
10.50		Hard strata						>50

From the standard penetration test result, the ultimate pile capacity was calculated which requires angle of internal friction and concluded that pile foundation is to be adopted for the building as the N value varies in each layer. The maximum permissible depth of shallow foundation is 3 m.

4. Details of proposed classroom complex

The proposed school building is 4 storied building with following details
Area of proposed classroom complex = 218.45 sq.m
Number of class rooms = 8
Class room area =37.21 sq.m
Number of stories = 4
Storey height = 3.6 m
Type of stair = Dog-legged
Tread = 0 .3 m Rise = 0.15m
Width = 1.4 m
No of flight = 2

Total occupant load for sanitary calculations shall be computed at the rate of not less than 1 person 5.9 sq. m. of build-up area and 2/3 of occupant load is considered as male and 1/3 as female as per KMBR/KPBR

Table 3: Sanitary Calculations

Build-up area	Occupational load			Closet		Urinal	Wash basin	
981.91sqm	Male	Female	Total	Male 1 for 40 boys	Female 1 for 25 girls	1 for 50 persons	Male 1 for 40 boys	1 for 40 girls
	111	55	166	3	3	3	3	3
Provided				4	8	8	4	4

5. Planning and preparation of building layout using AutoCad

Figure 2: Plan of Proposed Building (Ground Floor)

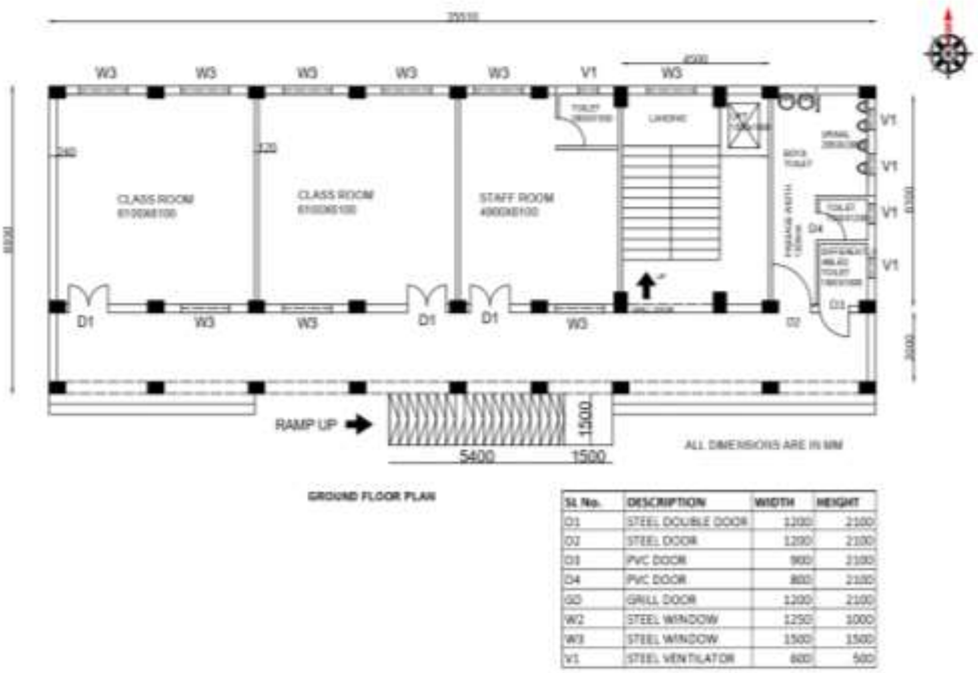
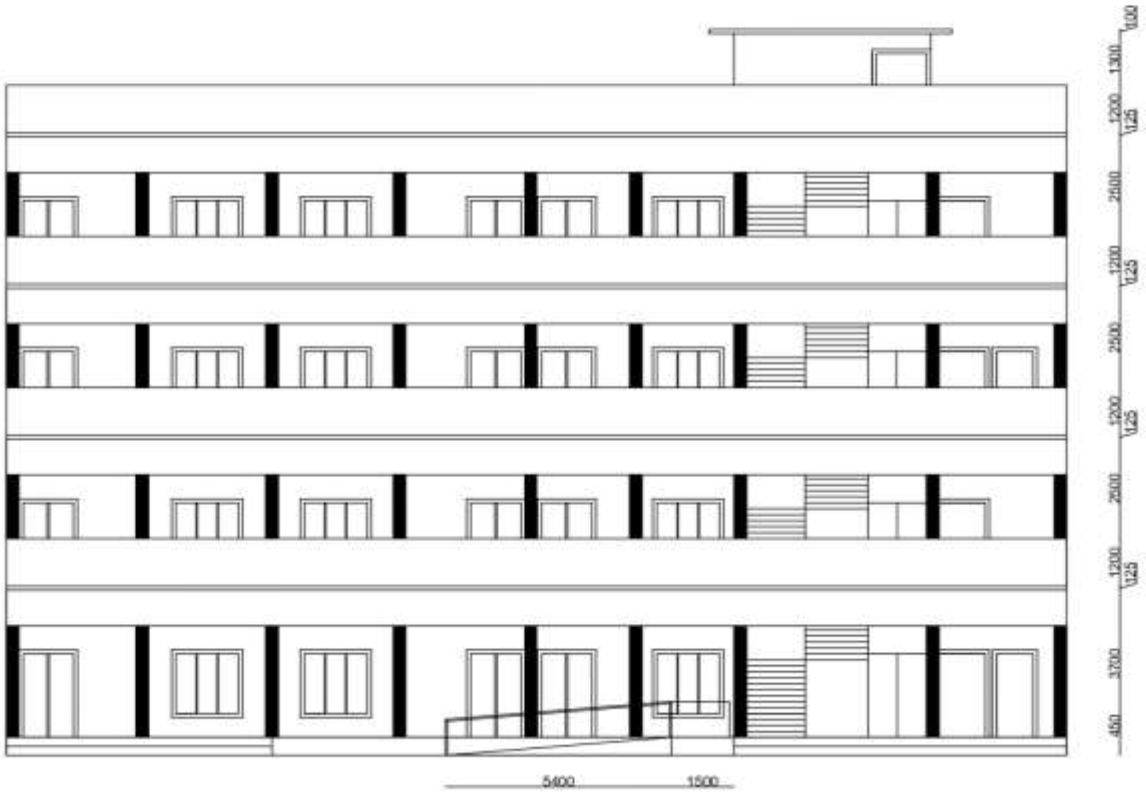


Figure 3: Elevation of Proposed Building



6. Structural details of the building

Table 4: Structural Properties

Column size	350X500 and 400X600mm
Primary Beam Size	250X500mm
Plinth Beam Size	300X400mm
Slab Thickness	125mm
Main wall Thickness	240mm
Partition wall Thickness	120mm

7. Structural Analysis

Structural analysis is the prediction of the response of structures to specified arbitrary external loads. ETABS (Extended Three-Dimensional Analysis of Building Systems) is a software program used for the design and analysis of building structures.

Table 5: Dead load case Details

Total building height	19.15m
Storey height	3.6m
Earthquake Zone	II
Seismic Zone factor	0.16
Terrain Category	3
Importance Factor	1.5
Response Factor	3

Table 6: Live **load case Details**

Full wall load	14.592KN/m
Wall with opening	10.214KN/m
Parapet Wall	3.192KN/m
Floor Finish	1.5KN/m2
Staircase	1.976KN/m2

Figure 4: 3 Dimensional view of Proposed Building

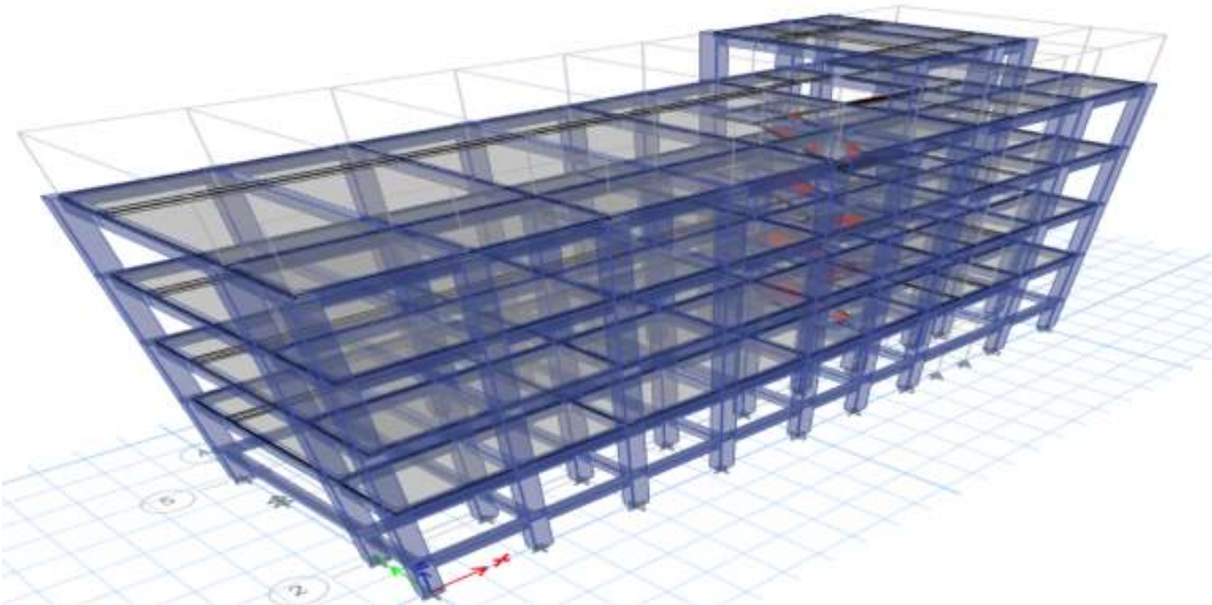


Figure 5: Bending Moment Diagram

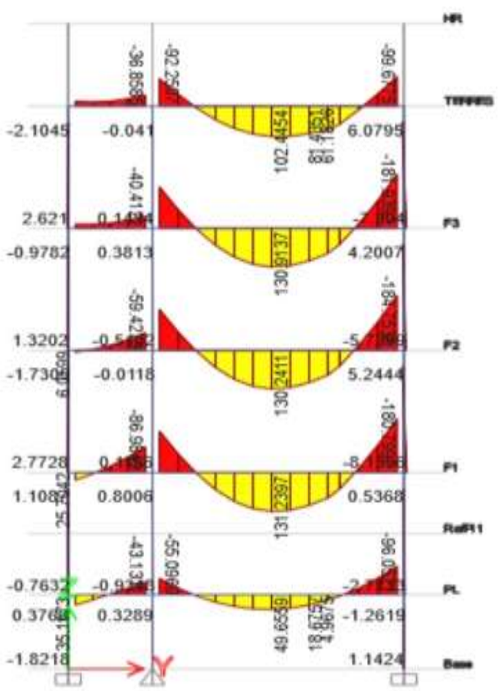
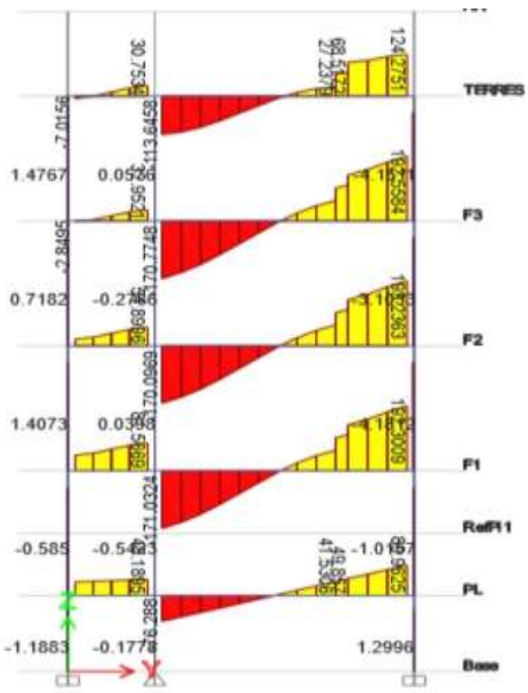


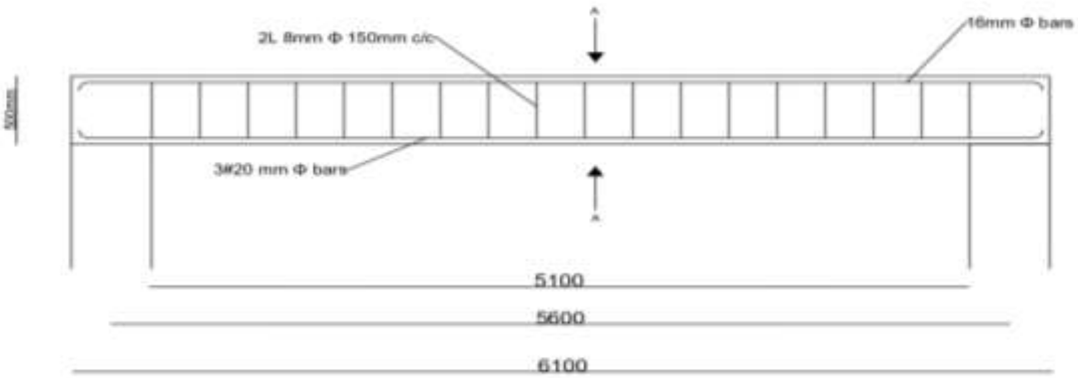
Figure 6: Shear Force Diagram



8. Design of Critical Structural Elements

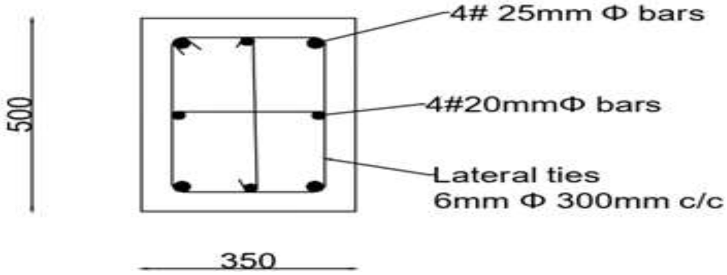
DESIGN OF BEAM,
Beam size = 250x500mm
Moment details
Mu =149.803 kNm2
Vu =213.009 kN
Min Reinforcement = 0.85bd/fy =191.25 mm2
Max Reinforcement = 0.04bD = 4500 mm2
Provided
3# 20mm dia bars as main reinforcement
2# 16mm dia bars as anchor bars
Provided 8mm dia bar 2-legged stirrup at 150 mm c/c spacing throughout the beam

Figure 7: Beam Detailing



DESIGN OF COLUMN,
Column size : 350x500mm
Depth (D) = 500mm
Breadth (b) = 350mm
Provide 4# 25mm dia bar and 4# 20mm dia bar as main reinforcement
6mm dia bar @300mm pitch as lateral ties

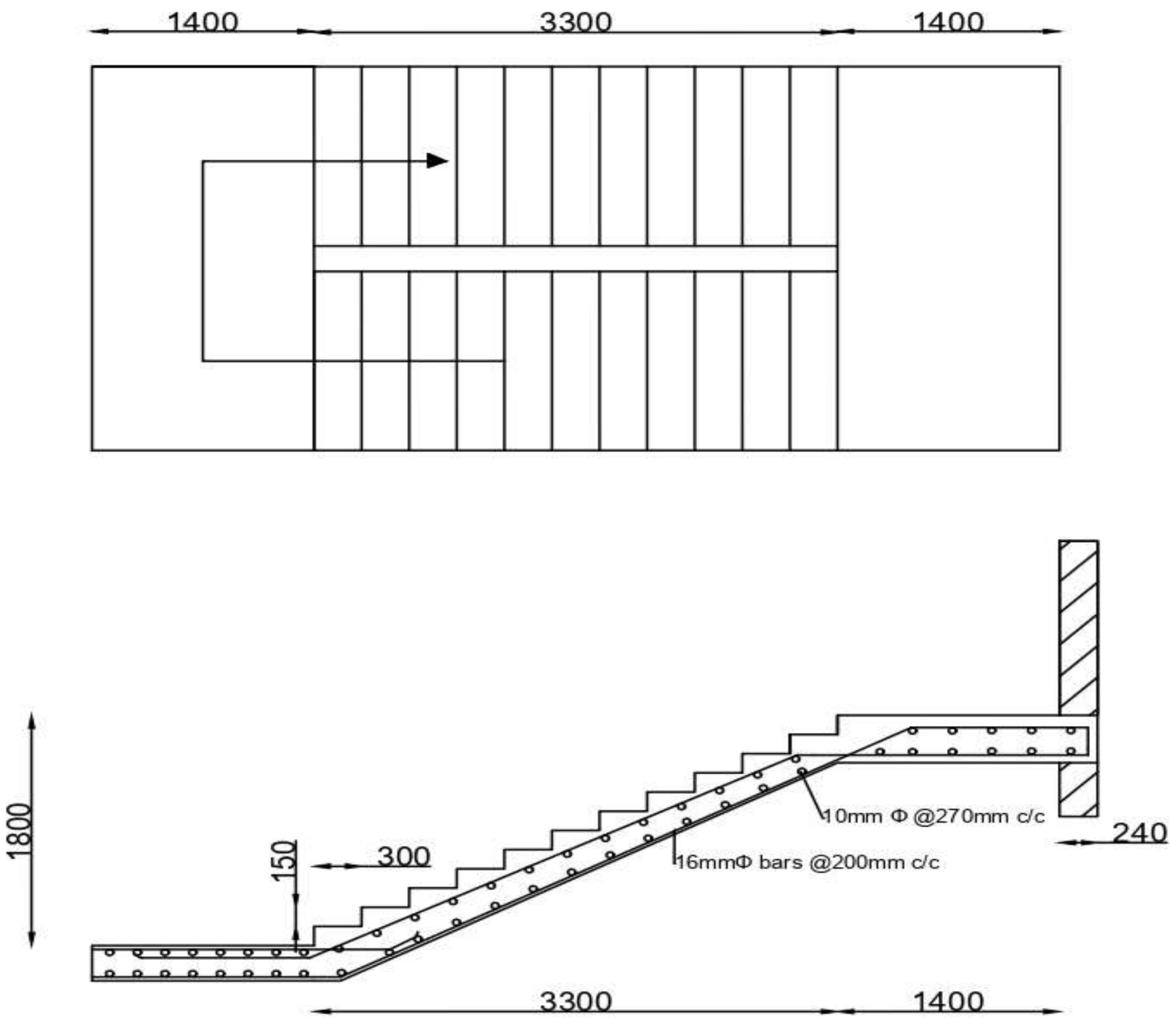
Figure 8: Column Detailing



DESIGN OF STAIR,
Rise - 150 mm
Tread - 300 mm

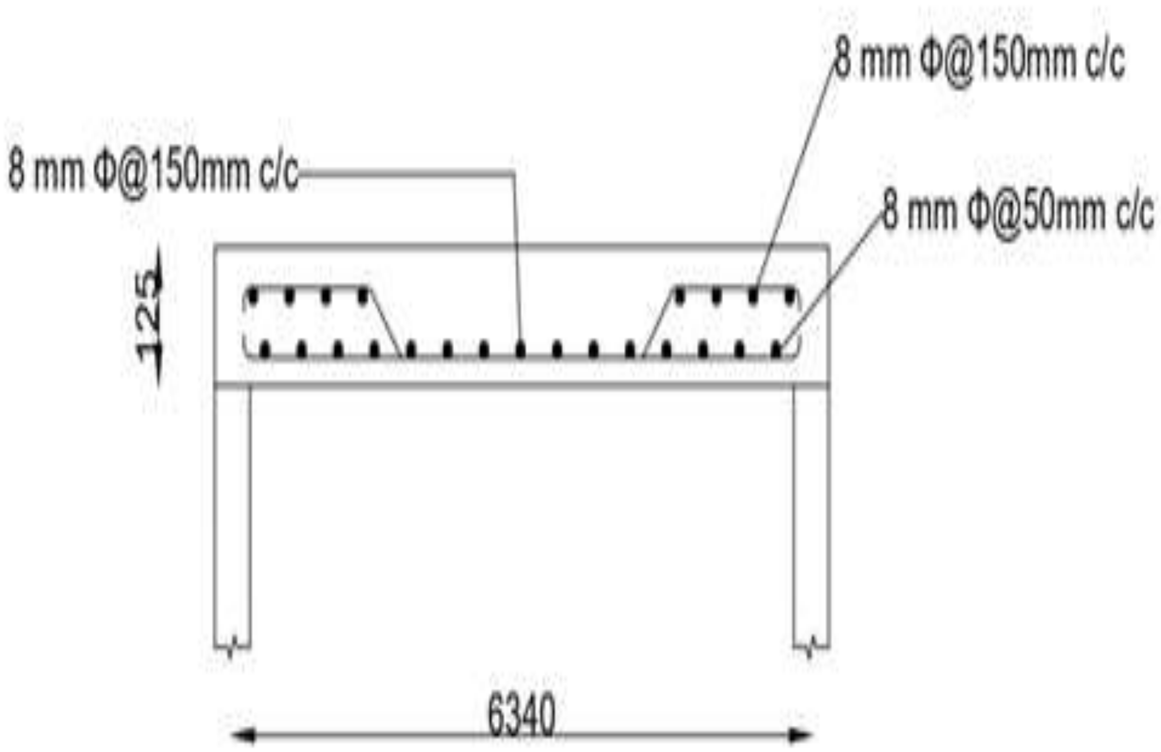
Width of each flight - 1.5 m
Height of each flight = 3.6/2 = 1.80 m
No of riser required = 1.80/0.15 = 12 in each flight
Provide 16mm dia bars @ 200 mm c/c spacing as main bars
Provide 10mm dia bars @ 270 mm c/c spacing as distribution bars
Development length = 725 mm

Figure 9: Staircase Detailing



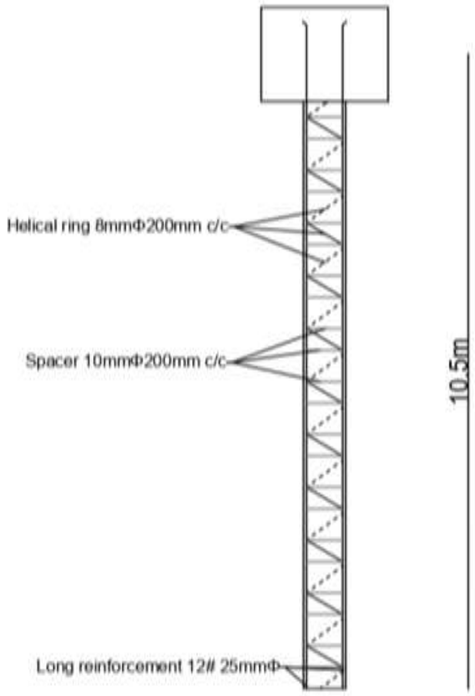
DESIGN OF TWO WAY SLAB
Depth of slab = 125mm
Size 6100x6100mm
Provide 8mm dia bar @150mm c/c spacing
as main reinforcement
Provide 8mm dia bar @ 50mm c/c spacing

Figure 10: Two way slab Detailing



DESIGN OF PILE CAP,
Pile type - Bored pile
Pile Diameter- 0.5m
Pile length - 11m
Projection beyond pile face – 150mm
Dimension of pile cap
Length (AB) - 2.3m
Width (CD) - 0.8m
Axial load -1254.976KN
Reaction per each pile - 941.23 kN
Provide 2 pile 500 mm dia.
DESIGN OF PILE,
Length – 11m
Pile cap depth - 0.5m
Since the length of pile is less than 30 times the width,
minimum reinforcement at 1.25% of gross C/S area
1.25/100 (π/4 x .52) = 2454.3mm2
Provided 12 bars of 25mm dia bars
Using 8mm dia bars as spiral reinforcement at a pith of 200mm
10mm dia spacer at 200mm c/c along the length

Figure 11: Pile Detailing



9. Conclusions

This project highlights the importance of constructing a safe and structurally sound G+3 classroom complex at GHSS Porur, Malappuram through functional planning and advanced structural analysis. By prioritizing structural stability, safety, and efficiency, this project aims to deliver a well-designed educational facility that meets the needs of students and educators.

In the planning phase, we identified the requirements and constraints of the school building, considering functional space allocation, accessibility, and safety measures to provide a conducive environment for learning. Strategic planning ensured optimal land use and compliance with building regulations. During the analysis stage, we evaluated the structure under various loading conditions to ensure its safety and stability. Utilizing advanced tools like ETABS, we identified critical stress points and optimized the design for load distribution, factoring in wind loads, seismic forces, and other environmental considerations. The design phase emphasized creating a robust and efficient structure while adhering to architectural aesthetics. Detailed attention was given to the structural elements—beams, columns, slabs, stairs and foundations—ensuring they meet both safety standards and functional requirements.

10. References

1. Alhamdany, A. M. A., & Dilsiz, A, 2025, “Comparative evaluation of shear walls and fluid viscous dampers in seismic retrofitting of RC public school buildings.” *Structures* (Vol. 72, p. 108231). Elsevier.
2. Betti, M., Galano, L., & Vignoli, A, 2014, “Comparative analysis on the seismic behaviour of unreinforced masonry buildings with flexible diaphragms.” *Engineering Structures*, *61*, 195-208.

3. Bothara, J. K., Ingham, J., & Dizhur, D, 2024, “Innovative earthquake resistant school building typologies for earthquake-hit areas of Nepal. In” *Structures* (Vol. 70, p. 107641). Elsevier.
4. Haque, M. F., Rahat, M. M. H., & Hoque, M. M, 2025., “Seismic performance evaluation of multi-storied RC structures by nonlinear static analysis.” *Results in Engineering*, *25*, 104105.
5. IS 8827: 1978
6. IS 875 (Part 1) -1987
7. IS 875 (Part 2) -1987
8. IS 875 (Part 3) -2015
9. IS 456:2000
10. IS 1893 (Part 1)- 2016
11. IS 2911(Part 1):2010
12. IS 13920: 2016
13. Kavitha, R., Sundarraja, M. C., Vivekananthan, M. R., Vinodhini, C., Thiruvishnu, P., & Deepan, P. ,2022, “Seismic analysis and design of multilevel car parking using ETABS.” *Materials Today: Proceedings*, *62*, 2351-2356.
14. Kerala Panchayat Building Rules (KPBR)
15. Kumar, K. S., Lingeshwaran, N., & Jeelani, S. H. , 2020, “Analysis of residential building with STAAD. Pro & ETABS.” *Materials Today: Proceedings*, *33*, 1221-1228.
16. National Building Code (NBC) of India, 2016
17. Puskás, A., & Moga, L., 2016, “Sustainability of masonry and reinforced concrete frame structures. Case studies.” *Procedia Technology*, *22*, 304-311.
18. SP:16 -1980