



EXECUTIVE SUMMARY

Bangladesh University of Engineering and Technology



CE 404: Capstone Project

Project Topic

Reconstruction of Green-Road Staff Quarter

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Group 02, Section B1

1.Introduction: Accommodation of Government officials is a crucial problem for densely populated cities like Dhaka. As a result, Government officers are compelled to hire flats or houses at a higher rate. In most cases, it becomes difficult for them to afford, so they hire a substandard house. In most cases, a design prototype is created and it is clone stamped around the complex, without any consideration of site and context. Visually these projects are densely packed clusters of concrete structures. In most cases, these groups of concrete structures, lack an adequate amount of open space, recreational spaces, and greeneries. Our proposed site, Green Road staff quarter the current condition of this residential area is indifferent to it. Though it is a huge area, the condition and capacity of the buildings are not satisfactory. There is a lack of recreational spots and green zones. Due to the small number of flats, every year there is a huge demand for accommodation but a few applications can be granted. So, we addressed this problem and proposed improvements to reduce the scarcity of accommodation and enhance the quality of living standard.

2.Project Description: The "Reconstruction of Green Road Staff Quarter," in Dhanmondi, Dhaka-1205, Bangladesh, is spearheaded by the Public Works Department and sponsored by the Ministry of Housing and Public Works. The project will replace 27 aging, 6-story buildings with 16 new,13-story structures(B+G+12), each containing four 1,500,1200,1000,800 sq ft units respectively in four zones. This will increase capacity from 500 to 700 families. The project targets government employees (Grades 8-20) while removing unauthorized residents to improve overall living standards. Additionally, the project will address drainage, waste management, and overall infrastructure, including 3 entrances/exits, 3 sports fields, a mosque, a community center, off-site parking, pumping stations, a pond, and a flowering garden.



Figure: Master Plan of the area

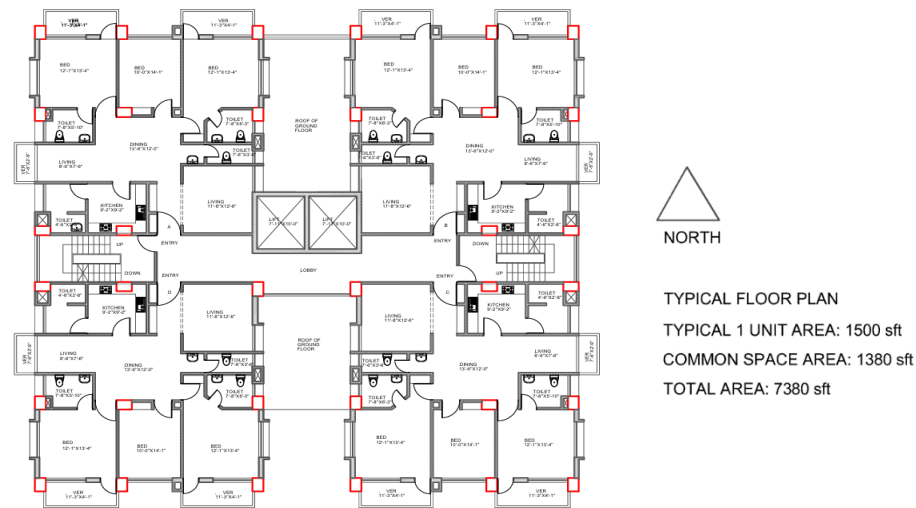


Figure: Floor plan for a typical floor

3. Survey and Data: We have conducted and obtained survey data in five categories: -

1. **Water Demand Calculation:** The future population is estimated to be 1650, resulting in a domestic water demand of 0.74Mlpd. The capacity of the mosque is calculated to be 3000 persons. The community center has a total capacity of 1050 people. Firefighting demand in the supply line is 15292 liters.
2. **Current Traffic Data Collection and Analysis:** The current traffic is measured. The vehicle distribution and flow fluctuation curves (using ADT%) for gate 1,2,3 is calculated for both entry and exit.
3. **Soil Test Report Collection, Summarizing and Analysis:** Uniform soil profile (clay to silty sand) found down to 18m. Stiff soil in stress zone. Bearing capacity likely controls shallow foundation design. Shear strength was observed below 3m in clay, 9.5m in sand.
4. **Questionnaire Survey:** We have conducted the survey among 100 families. 80% of the people are not satisfied with the current residential facilities of the quarter. And 90% of the people think reconstruction and improvement of this facility is required.
5. **Topographic Survey and Layout Information:** This data originates from a physical features and topographical survey conducted using a Total Station. The survey was completed on November 1, 2021.

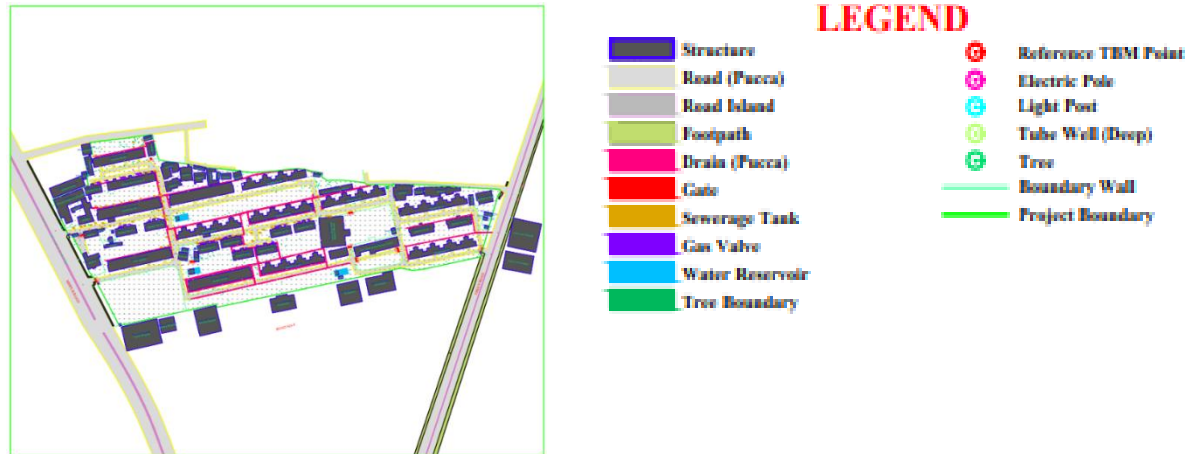


Figure: Topographic Location

4. Analysis of Alternatives: Two types of structural systems were used. Mat foundation and beam-supported slab were used in one system whereas flat plat and pile foundation were used in another system.

Topic	Beam Supported Slab	Mat Foundation	Flat Plate	Pile Foundation
Cost	Budget-friendly.	Budget-friendly.	Higher cost (High Thickness)	Higher cost (Complex Design)
Preliminary Cost	42 Crore for a Building		46 Crore for a Building	
Design	Intricate Design and Construction	Easier Design	Simple Design and Construction	Complex Design
Materials	Readily Available Material	Readily Available Material	Readily Available Material	Readily Available Material
Aesthetics	Visible beams can impact the visual appeal.	N/A	Offers a clean, modern look with a flat ceiling	N/A

Qualitative comparison	Higher Strength, Earthquake resistance.	Lower Strength and Earthquake Resistance	Suitable for good soil conditions, offering lower cost and simpler design.	Ideal for poor soil conditions but comes with higher costs and complex design.
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Decision Matrix:

1=Less Suitable	2=Equally Suitable	3=More Suitable
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Type A: Beam-supported slab; Mat foundation;

Type B: Flat slab; Pile foundation

Alternatives	Cost		Design		Material Availability		Aesthetic		Qualitative Comparison		Total
	Weightage	Score	Weightage	Score	Weightage	Score	Weightage	Score	Weightage	Score	
Type A	0.3	80	0.2	80	0.15	80	0.2	70	0.15	80	78
Type B	0.3	60	0.2	70	0.15	80	0.2	80	0.15	90	73.5

5. Environmental/ Transport/ Social Issues:

1. Environmental Issues:

Reconstruction of Green Road Staff Quarter along with other facilities involves a considerable amount of construction activities that have both negative and positive impacts on the environment. The construction process is in the “RED” category. So, to mitigate the negative environmental impacts and enhance the positive environmental impacts due to the construction of the quarter, EIA is required. During the pre-construction stage, underground gas pipelines will be affected and cutting of trees will be necessary. During the construction stage, air can be polluted, and noise will be generated by heavy traffic for construction, excavation for foundation, demolition, and construction may create a blockage to the drainage system. Solid waste will create hazards for workers. Ecological impact can be seen as loss of habitat and loss of local flora and fauna. To avoid or minimize all these environmental issues, proper mitigation measures will be taken.

2. Transportation Issues: Construction transport may create congestion on the busy Mirpur Road. During the construction stage, transportation of construction materials would increase

traffic flow in the project area. The increased traffic could create traffic congestion on the road, especially in peak hours. Traffic congestion may get worse if the construction materials are stored on the street instead of secured sheds inside the project area. To minimize traffic congestion, Restrictions will be given to materials deliveries during non-peak periods (night) to minimize traffic disruptions. Also, Restriction will be given to the transport of oversized loads.

3. Social Issues:

Before constructing the project, demolition is needed. So, the current residents are to be shifted from the site. So, the resettlement issue arises. For the resettlement of the current residents, the residents will be given money for relocation near the area as the facility of the school, college, and working places they are having near it. They will be given above 50,000 BDT, 40,000 BDT for home rent, and 10,000+ BDT for others. They will have legal consideration from the government for renting a home if required and transportation facilities.

6.Design Consideration:

a. Basis of Design:

Building Type	High Rise Building (B+G+12)
Occupancy Class/Sub-Class	Residential (A3)
Structure Type	Flexible (T>1s)
Exposure Category	A
Occupancy Category	2
Site Class	SC
Seismic Zone	2
Seismic Design Category	SDC C
Seismic Force Resistant System	Dual System: Intermediate Moment Frame with Ordinary Reinforced Concrete Shear Wall.
Code Followed	BNBC (2020)

b. Material Properties:

Concrete	Compressive Strength, $f'_c = 4\text{ksi}$
Rebar	Yield Strength, $f_y = 60\text{ksi}$
Mix Ratio	1:1.5:2

c. Section Properties:

Beam Size	15"x 24"
Column Size	C1:18"x24" ; C2:20"x30"
Slab Thickness	FloorSlab:7" ; Stair Slab:9"
Mat Foundation	Thickness=41"
Basement Wall	Thickness=15"
Tank	UGWR (Daily Use):22'x15'x10' UGWR (Firefighting):15'x8'x10' OHWT:15'x12'x10'

d. Modeling Basis:

- i. Software Used: Etabs
- ii. Load Consideration:

Dead Load: In Etabs modeling process, the dead load was assigned through sectional properties. Floor finishing was considered as 25 psf and partition wall load was calculated from the floor plan.

Live Load: For floor slab 40 psf live load was considered and for stair slab 100 psf live load was considered.

Wind Load: Assigned using ASCE 7-05 provision.

Earthquake Load: Defined as mass source where full DL and 25% of LL were considered.

- iii. Factors Considered for EQ and WL Analysis:

Wind Load	Topographic Factor	1
	Wind Directionality Factor	0.85
	Gust Factor	0.837
	Wind Speed (mph)	147
Earthquake Load	Response Reduction Factor	5.5
	Building Height Exponent	1.1961
	Building Period, T (s)	1.37

	Lateral Seismic Force Coefficient	0.0469
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iv. Analysis and Design Steps:

Serviceability Analysis: Check for beam deflection, slab deflection, wind drift, wind sway, earthquake drift, and torsional irregularity were performed and satisfied. Appropriate stiffness modifiers were used for the analysis purpose.

Design Analysis: Design checks and analysis were performed in Etabs to determine the adequacy and rebar area for the structural sections.

v. Plumbing and Drainage System:

Plumbing System	Drainage System
a. Three down feed zones are provided	a. Soil Vent Stack diameter is 75mm
b. Down feed pipes are provided through 2 shafts	b. Waste vent Stack diameter is 100mm
c. Shaft A requires 3 sizes of pipes: 3", 2.5", 2"	c. Waste Stack diameter is 125mm.
d. Shaft B requires 3 sizes of pipes: 3", 2.5", 2"	d. Soil Stack diameter is 100mm
e. Riser pipe: For velocity, 8ft/sec, the corresponding diameter of the pipe is 3.5 inches.	

7. Financial and Economic Analysis:

Financial analysis:

- **Cost:** The total construction cost of the facility is 512 crores. The maintenance percentage of total cost is considered 1%. Total relocation cost is 165 lakh tk.
- **Benefit:** Total rent per year is 3114 lakh tk and increase of rent=60% of the previous rent in every 10 years. From the convention center, the profit per year is 192 lakh tk. Salvage value is considering 10% of construction cost is 513.6 lakh tk.
- **Net present worth:** For discount rate 8%, NPV = 1459.65 Lakh

For discount rate 9%, NPV = -5834.73 Lakh

- **Internal rate of return:** For NPV = 0, IRR = 8.2%

Economic analysis:

Things are considered for economic analysis:

- **Construction and maintenance cost:** We used a conversion factor of 0.8 to convert the financial cost into economic cost of construction.
- **Increased Property Values:** we approximate that the property value has increased by 10%.
- **Earthquake Risk Reduction:** We used 10% of the total cost.
- **Fire Safety Enhancement:** We used 20% of the construction cost.
- **Saving Electricity:** Savings on Energy are considered .35 Kwh/sqft.
- **Increased Tax Revenue:** New developments raise property values, boosting property tax revenue. They also create jobs, stimulate spending, and generate tax revenues.
- **Improvement in Waste Management System:** Better waste management boosts livability, attracts residents, cuts cleanup costs, enhances public health, and indirectly benefits the local economy.
- **Net present worth:** For discount rate 13%, NPV = 2529.19Lakh

For discount rate 15%, NPV = -3000.61Lakh

- **Internal rate of return:** For NPV = 0, IRR = 13.8%

8.Bill of Quantity:

Total Cost of One Building	369,751,051.7
Cost Per Square Feet	3225 Tk

TOTAL COST OF THE PROJECT (IN BDT) = 510 crore

SUMMARY OF COSTING			
TOTAL COST OF ONE BUILDING		369,751,051.7	
Serial	Item	Cost	% of Total Cost
1	Superstructure	210,647,513.38	69.50
2	Substructure	33,833,884.05	11.16
3	Plumbing	4,555,143.98	1.50
4	Tank	15,643,868.00	5.16
5	Miscellaneous cost	37,887,246.03	12.50

9. Implementation Timeline: The Gantt Chart is attached on the last page

10.Conclusion:

This report shows a brief description of our construction project. This project will minimize the housing problem of Government employees as well as ensure the betterment of their lifestyle. Moreover, this will be a model project for a public-fund-based housing project. In addition, after completion of the construction phase, it is important to maintain the project area to function properly. The authority and the dwellers must ensure the proper maintenance and operation of the project facilities.

RECONSTRUCTION OF GREEN ROAD

STAFF QUARTER

TASK	DURATION (Days)	START	END
Bidding Phase			
Advertisement of Tender	7	2/26/24	3/4/24
Bidder Queries and Classification	10	3/5/24	3/15/24
Site Visit and Pre Bid Meetings	14	3/16/24	3/30/24
Bid Submission	28	3/31/24	4/28/24
Bid Evaluation	14	4/29/24	5/13/24
Contract Award	7	5/14/24	5/21/24
Pre Construction Phase			
Ground Cleaning	7	5/22/24	5/29/24
Electricity and Water Supply	7	5/26/24	6/2/24
Temporary Structure Construction (Labor's Quarter, Material Storage)	10	6/3/24	6/13/24
Structural Works for Engineering Office &	14	6/8/24	6/22/24
Construction Phase- Sub Structure			
Excavation	21	6/23/24	7/14/24
Shore Protection	10	7/15/24	7/25/24
Foundation- Rebar and Formworks	21	7/23/24	8/13/24
Foundation- Concrete Works	14	8/14/24	8/28/24
Basement(Rebar and Formworks)- Column	7	8/29/24	9/5/24
Basement(Concrete Works)- Column	35	9/6/24	10/11/24
Basement(Rebar and Formworks)- Beam, Slab	14	10/12/24	10/26/24
Basement(Concrete Works)- Beam Slab	56	10/27/24	12/22/24
UGWT	35	9/7/24	9/11/24
Construction Phase- Super Structure			
Column- Reinforcement & Formworks	70	12/23/24	3/3/25
Column- Concrete Works	336	12/29/24	11/30/25
Slab & Beam - Reinforcement Works	140	1/28/25	6/17/25
Slab & Beam - Concrete Works	370	2/4/25	2/9/26
Masonry Works	365	3/11/25	3/11/26
Water Supply Drainage & Gas Connction	40	4/15/25	5/25/25
Electrical Fixture Works	28	4/19/25	5/17/25
Plastering & Finishing	160	4/22/25	9/29/25
OHWT	35	2/14/26	3/21/26
Post Construction Phase			
Quality Control and Inspections	14	3/22/26	4/5/26
Site Beautification	28	3/24/26	4/21/26
Site Handover	3	4/21/26	4/24/26

Project start Mon, 2/26/2024

Display week: 1.1

Duration 2.2 Years

Feb 26, 2024						Jun 3, 2024						Sep 9, 2024						Dec 16, 2024						Mar 24, 2025						Jun 30, 2025						Oct 6, 2025						Jan 12, 2026													
26	11	25	8	22	6	20	3	17	1	15	#	12	26	9	23	7	21	4	18	2	16	30	13	27	10	24	10	24	7	21	5	19	2	16	30	14	28	11	25	8	22	6	20	3	17	1	15	29	12	26	9	23	9	23	6

