

# Bangladesh University of Engineering and Technology



## CE 404 Capstone Project

### Executive Summary

#### **Comprehensive Redevelopment Project for Mohammadpur Government High School: Enhancing Academic Infrastructure and Sustainability**

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## Executive Summary

### 1. Introduction

The Mohammadpur Government High School redevelopment project heralds a transformative endeavor aimed at modernizing educational infrastructure while fostering inclusivity and innovation. With a vision to create a dynamic learning environment that meets the evolving needs of students and educators, this project represents a significant milestone in educational development within the region. Through meticulous planning, robust design, and sustainable practices, we endeavor to create a state-of-the-art educational facility that serves as a beacon of excellence and progress.

### 2. Project Description:

1	<b>Name of the Project</b>	:	Comprehensive Redevelopment Project for Mohammadpur Government High School: Enhancing Academic Infrastructure and Sustainability
2	<b>(a) Sponsoring Ministry/Division</b> <b>(b) Implementing Agency</b>	:	(a) Ministry Of Education (b) Education Engineering Department
3	<b>Project Objectives</b> <b>(Project to be taken based on the study)</b>	:	1. Modernize Infrastructure by fixing physical issues, and introduce digital classrooms for enhanced education quality. 2. Implementation of eco-friendly measures. 3. Upgrade facilities, prioritize health, and education to create a good learning environment
4	<b>Estimated Project Cost (Taka in Crore)</b>	:	57 Crore
5	<b>Sector &amp; Sub-Sector</b>	:	Educational Infrastructure
6	<b>Project Category (Based on Environment Conservation Rules 2023)</b>	:	Red

7	<b>Project Geographic Location</b> (a) Countrywide (b) Division (c) District	:	(a) Bangladesh (b) Dhaka (c) Dhaka North City Corporation (d) Mohammadpur Thana (e) Humayan Road, Dhaka 1207
8	<b>Project Duration</b>	:	12 months
9	<b>Floor Numbers</b>	:	5 floors

### **3. Survey & Data:**

<b>Survey and Data Source</b>	<b>Data Collected</b>
Archeological Survey	To ensure whether it is a historical building or not. It is not a historical site.
Google Earth Survey	To find the location, projected area, and adjacent road map.
Reconnaissance Survey	To evaluate the existing situation.
Soil Condition Survey	The Sub-surface Soil Investigation Report was collected from a nearby (within 200 meters) residential building project “Madhobilata” by Monico Ltd.
Questionnaire Survey	A survey was conducted among teachers, students, and guardians to assess present circumstances and anticipate future demand.
Traffic Survey	To estimate the parking area, sidewalk width, and demand for bicycle parking.
Engineering Survey	To find the existing plan and utility line layout.
School Office Survey	To find out the current students’ data and the classroom, lab, and teacher’s room demands.

### **4. Questionnaire Survey Summary:**

The questionnaire survey was conducted at Mohammadpur Govt. High School revealed significant concerns among parents, teachers, and students. Students expressed a desire for modern classrooms, while the current conditions were found to be highly congested with no notable building maintenance for the past 30 years. Moreover, there is a lack of laboratory and sports facilities. Parents expressed worries about the overall studying environment and their children's safety, prompting concerns about building conditions. Teachers and staff also echoed the need for improved conditions, with 95% believing that the current school design does not cater to students with special needs, and approximately 43% regularly facing noise issues in classrooms.

### **5. Soil Report Summary:**

From the Sub-Surface soil investigation report, data obtained for Location: Mohammadpur, Dhaka;

- Average SPT value = 18

- Allowable soil pressure= 6.34 ksf

## 6. Analysis of Alternatives

The analysis of alternatives revealed several critical factors that influenced the decision-making process.

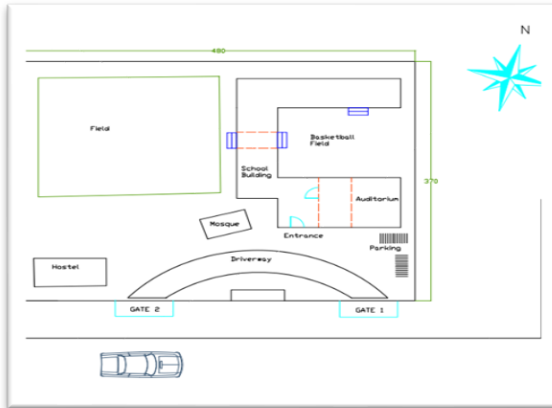


Fig – Layout Plan 1

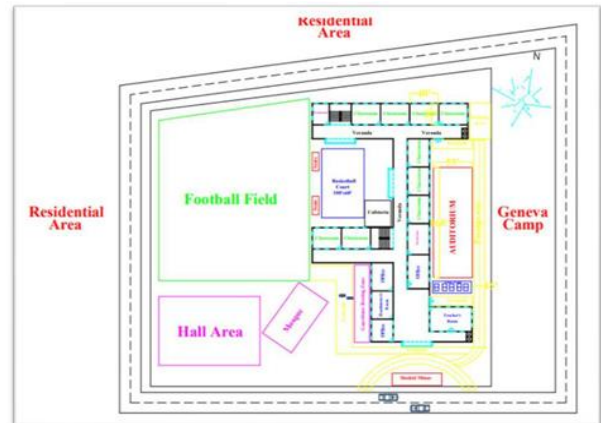


Fig- Layout Plan 2

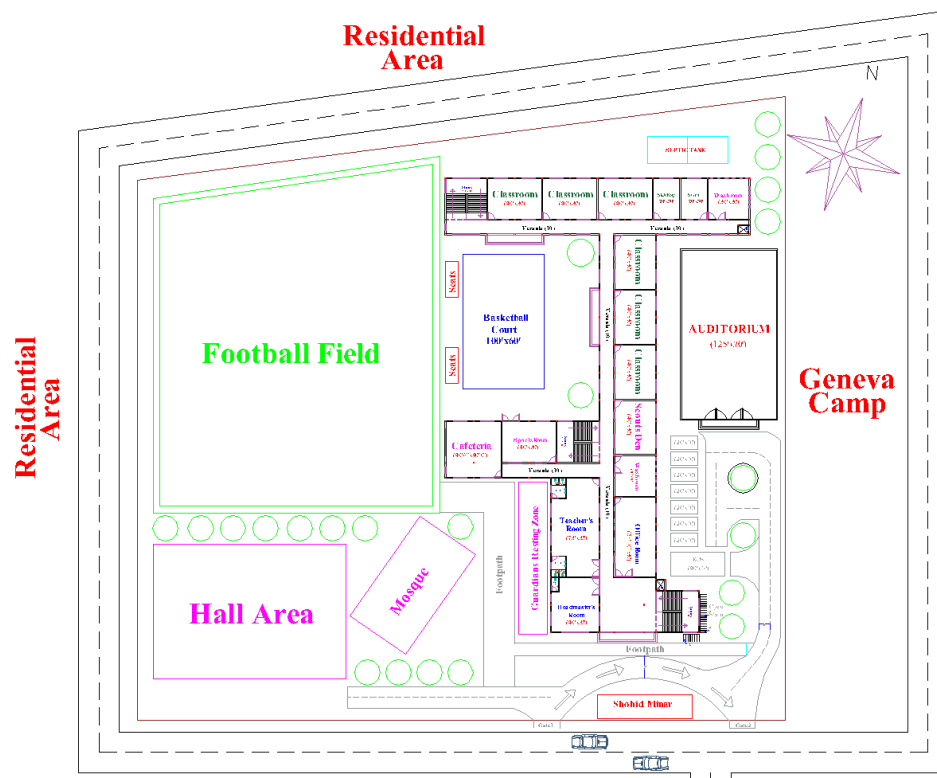


Fig- Final Layout

<b>Factors</b>	<b>Layout 1</b>	<b>Layout 2</b>	<b>Layout 3 (Selected Layout)</b>
Enhanced Student Capacity	×	√	√
Amplified Auditorium Capacity	×	×	√
Enhanced Classrooms and Labs	×	√	√
Utilization of The Floor Area	×	√	√
Ample Washroom Facilities	×	×	√
Aesthetic Consideration & View Optimization	×	√	√
Better Parking Facilities	×	×	√
Corridor View Towards Football Field & Not Geneva Camp	×	√	√
Teacher's Room Location in A Place Where No Disturbance Will Occur.	×	×	√
Stairs Positions in Entrances.	×	×	√

#### **Comparison of Existing and Proposed Layout**

<b>Factors</b>	<b>Old Building</b>	<b>New Building</b>
Floors	3	5
Classrooms	27	43
Students Accommodation	1350	2752
Labs	Almost in Shut down situation	Modernized
Washroom	3 Urinals and 3 Toilets	7 Urinals and 6 Toilets
Auditorium Accommodation	210	510
Sports Facilities	Football Field	Football Field, Basketball Field & Sports Room

## **6. Environmental, Transportation & Social Issues**

### **6.1 Transportation Issues and Their Solution:**

In this project transportation issues should be properly managed so that enrollment of about 600 more students doesn't create a hassle for the associates of the school and outsiders. The school is situated in the intersection of Humayun Road and Shahjahan Road.

#### **Transportation Challenges:**

- The current layout and configuration of Mohammadpur Govt High School present obstacles to smooth pedestrian and vehicular traffic flow, exacerbated by the lack of a well-designed parking facility.
- This situation can disrupt school activities and hinder student mobility.

#### **Proposed Solutions:**

- Introduction of well-designed entrances and pathways to enhance safety and efficiency.
- Establishment of organized parking areas to regulate traffic flow, optimize space, and minimize construction costs.
- Stakeholders will benefit from a positive parking experience, with accessible options for all, including designated spaces for school buses and bicycles.
- These measures aim to create a campus where traffic is effectively managed, ensuring safety and convenience for everyone.

#### **Enrollment Management and Roadway Capacity:**

- A comprehensive approach to addressing transportation challenges to seamlessly accommodate approximately 600 more students.
- The school's location at the intersection of Humayun Road and Shahjahan Road is taken into account when determining roadway capacity.
- Calculated capacity: 1262 PCU/hr; Estimated capacity: 883 PCU/hr.
- The existing roadway capacity outside the school remains adequate, eliminating the need for modifications and ensuring efficient traffic management despite the increased student population.

### **6.2 Environmental Mitigation /Social Issues and Their Solution**

#### **Pre-Construction Stage:**

- Concerns: Potential disruptions to ecosystems during land clearing and vegetation removal.
- Solution: Phased site clearing to minimize disruption, and conserve local flora and fauna.
- Mitigation: Offset vegetation loss with native tree planting, and create green buffers.
- Preservation: Assess archaeological and cultural heritage pre-site preparation.
- Community Engagement: Address concerns, foster positive relations, and reduce conflicts.

#### **Construction and Operational Phases:**

- Concerns during construction: Airborne particulate matter and noise disturbance to the local community.
- Mitigation strategies: Employ dust control methods such as water spraying, schedule noisy activities during permitted hours, and install noise barriers.
- Environmental measures: Prevent runoff pollution and implement a biodiversity conservation plan.
- Operational phase initiatives: Implement traffic management plans, install noise barriers, incorporate water-efficient fixtures, and utilize renewable energy sources.
- Ensure responsible and sustainable development, minimizing socio-cultural impacts, promoting positive community relations, and preserving cultural heritage.

## **7. Structural Design Considerations and Codes:**

Significant structural design work was undertaken for both the academic building and auditorium, utilizing reinforced concrete (RCC) structures. Adherence maintained to the Bangladesh National Building Code (BNBC) of 2020 and American Concrete Institute (ACI) code 318-14 for meticulous design and structural integrity.

### **Foundation System:**

- Shallow foundations (Isolated footing and Combined footing) were selected for both buildings due to high soil-bearing capacity.

### **Seismic and Site Details:**

- Seismic Zone: Zone II
- Site Class: SC
- Occupancy Category: Academic Building - III; Auditorium – III
- Seismic Design Category: SC

### **Choice of Structural System:**

- For Academic Building and Auditorium: Intermediate Moment Resisting Frame (No Shear Wall)

### **Choice of Materials:**

- RCC for Academic Building and Auditorium:



- Concrete Strength:  $f_c' = 4 \text{ ksi}$
- Reinforcement Strength:  $f_y = 60 \text{ ksi}$

## 8. Plumbing

Water distribution within the academic building is meticulously planned, ensuring a continuous water supply for all floors. The system begins with water pumped from the municipal main to two underground water reservoirs (UGWR), each with a volume of 122.5 m<sup>3</sup>, providing a two-day water supply. From there, an overhead tank, with a volume of 61 m<sup>3</sup>, draws water via a pump from the UGWR twice a day to meet the needs of the school's 4000 students. Waste disposal is managed through soil and wastewater pipes directing effluent to a strategically positioned septic tank with a capacity of 40 cubic meters, requiring desludging every 3 years and designed for a 30-year lifespan. To prevent overflow, the septic tank is connected to a soakage pit situated 3 meters away, which is linked to the storm drainage system. These components ensure efficient water distribution and waste management within the academic building.

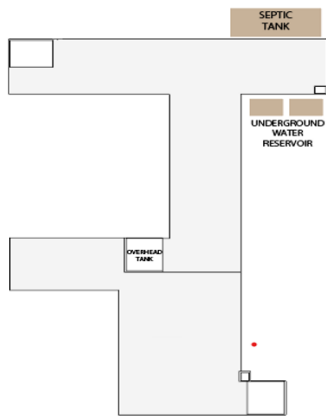


Fig -Position Of OHWT, UGWR & Septic Tank

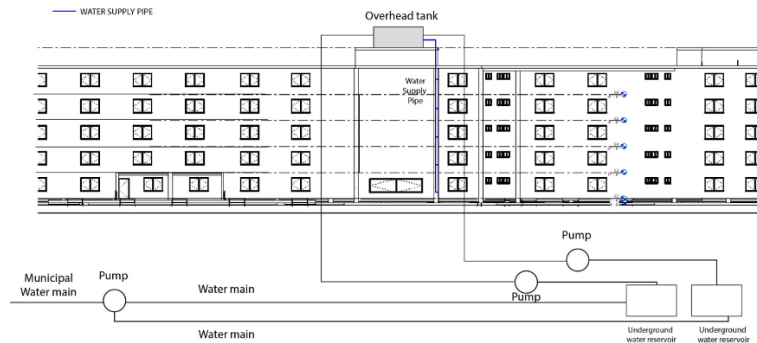


Fig-Plumbing Layout (East Side)

## **9. Bill of Quantity**

<b>Floor Wise Cost Breakdown</b>	<b>Area (Sqft)</b>	<b>Costs (In Lacs)</b>
<b>Sub-Structure</b>	<b>30864</b>	<b>188</b>
<b>Ground Floor Structural Cost</b>	<b>30864</b>	<b>566</b>
<b>1st Floor Structural Cost</b>	<b>30864</b>	<b>503</b>
<b>2nd Floor Structural Cost</b>	<b>30864</b>	<b>506</b>
<b>3rd Floor Structural Cost</b>	<b>30864</b>	<b>511</b>
<b>4th Floor Structural Cost</b>	<b>30864</b>	<b>533</b>
<b>Non Structural Cost</b>		<b>1493</b>
<b>Total Cost of Academic Building</b>		<b>4300</b>
<b>Per Sqft Cost (BDT)</b>		<b>2775 Tk</b>

<b>Cost Breakdown for Auditorium Building</b>	<b>Costs (In Lacs)</b>
<b>Total Structural Cost For Auditorium</b>	<b>162</b>
<b>Total Sub-Structural Cost For Auditorium</b>	<b>5</b>
<b>Non Structural Costs For Auditorium</b>	<b>49</b>
<b>Total Cost For Auditorium (8750 Sqft)</b>	<b>217</b>
<b>Total Cost Per Sqft For Auditorium (BDT)</b>	<b>2475 Tk</b>

## **10. Financial & Economic Analysis**

The financial and economic analysis of the project reveals contrasting outcomes. Financially, the project does not meet the threshold for viability, as indicated by a Benefit-Cost Ratio (BCR) below 1. This suggests that the project's costs outweigh the direct financial benefits, posing a financial challenge. However, economically, the project demonstrates viability with a BCR of 1.79 and an Internal Rate of Return (IRR) of 14%, surpassing the discount rate of 12%. This underscores its economic soundness, where benefits significantly outweigh costs, making it a wise and economically viable endeavor. Economic prices, derived from financial prices using

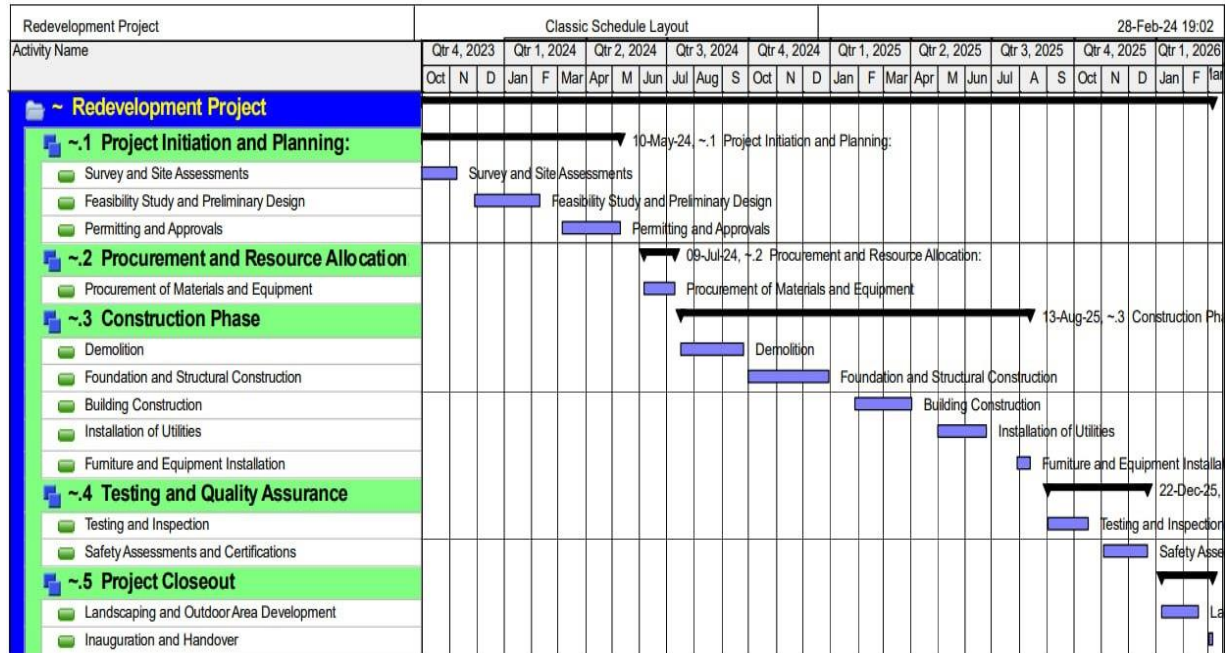
a standard conversion factor of 0.8, were considered for the economic analysis, which spanned over 30 years, while the project's lifetime was assumed to be 50 years. Additionally, a straight-line depreciation method was utilized to calculate the salvage value of investments, with a residual value of 50% assumed in the final year..

**Discount rate of 12%.**

Financial Analysis		Economic Analysis	
<b>FNPV</b>	<0	<b>ENPV</b>	>0
<b>FBCR</b>	0.1<1	<b>EBCR</b>	1.79>1
<b>FIRR</b>	<12%	<b>EIRR</b>	14% >12%

## **11. Implementation Schedule**

The implementation schedule for the Mohammadpur Government High School redevelopment project spans approximately 40 months and includes stages such as survey and data collection, stakeholder consultation and planning, design and approval, procurement and contracting, construction, monitoring and evaluation, completion and handover, and post-completion activities. Each phase involves meticulous planning, coordination with stakeholders, and adherence to quality and safety standards to ensure the successful completion of the project on time and within budget, ultimately delivering modernized facilities tailored to promote student success and community engagement.



## 12. Conclusion

The executive summary encapsulates the journey of the Mohammadpur Government High School redevelopment project. It begins with a clear introduction, detailing the project's objectives and significance. Surveys and data collection have provided valuable insights into community needs, guiding project direction. Thorough analysis of alternatives ensures the selection of the most suitable plan, while environmental, transportation, and social issues are addressed, emphasizing sustainability and inclusivity. Design prioritizes modern facilities, safety, and accessibility, including meticulous planning of the plumbing infrastructure to ensure efficient water distribution and waste management. Financial and economic analyses reveal economic viability despite financial challenges. The implementation timeline spans approximately 40 months, outlining phased project execution. Through meticulous planning and stakeholder engagement, the project aims to deliver enhanced facilities, fostering academic excellence and community engagement.