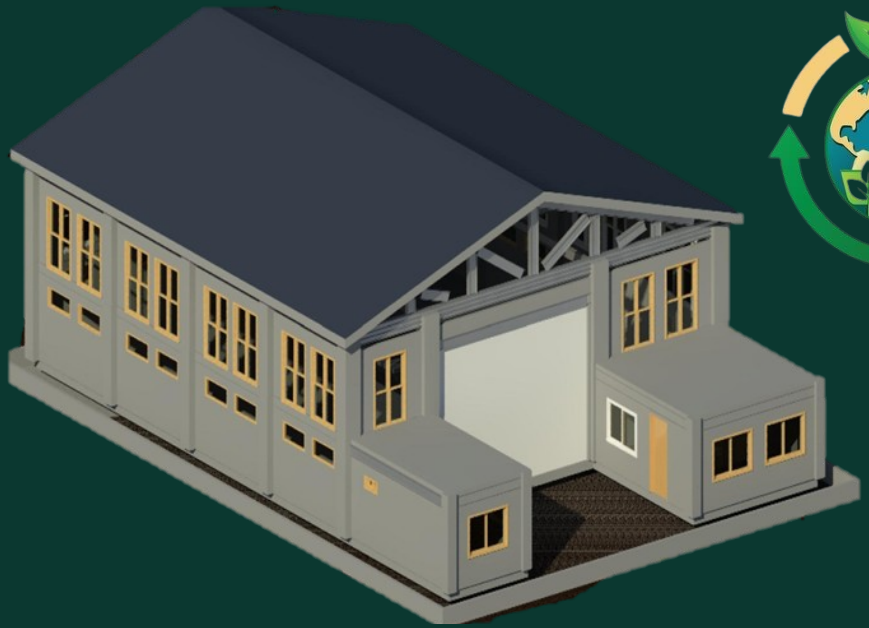
A MODEL SOLID WASTE MANAGEMENT SYSTEM AT COMMUNITY LEVEL



CE 404
Capstone Project

Presented By
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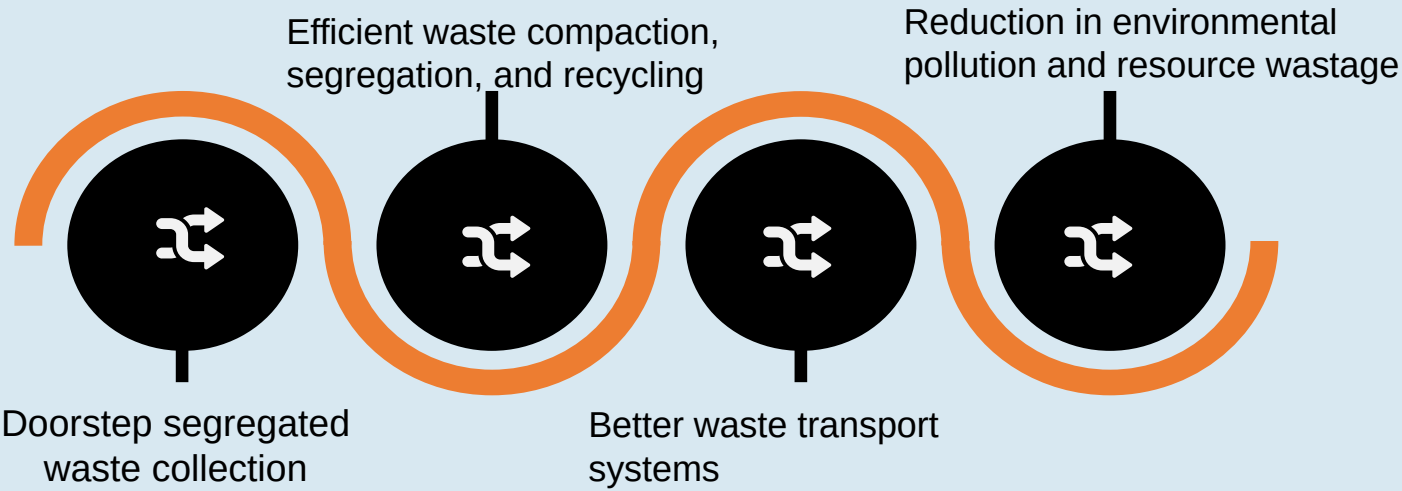
Background and Vision of the project

Problem of Statement :

- ❑ Rapid population growth in Dhaka has overwhelmed the current solid waste management system.
- ❑ Existing infrastructure is unsustainable, causing pollution, land wastage, and inconvenience to city life.

A redeveloped Secondary Waste Transfer Station will enable:



Project Description & Location

Project Background

(a)

(b)

(c)

Figure: Google Map: (a) Polashi Waste Transfer Station; (b)Disposal land, Matuali; (c) Effect of Present Solid Waste Management at Matuail

Dhakeshwari Road,
Ward No. 26
Dhaka South City Corporation.
Latitude 23° 72' 42" and Longitude 90° 38' 86"

Project Location

Basic Information

Sponsoring Ministry	Implementing Agency	Project Objective	Estimated Project Budget
Ministry of Local Government	Dhaka South City Corporation (DSCC)	Implement a Sustainable Solid Waste Management System	4.10 Crore (BDT)

Sector & Sub-Sector	Project Category	Geographic Location	Project Duration
Environment	Yellow	Dhaka South City Corporation, Lalbag, Dhaka, Bangladesh	1 Years

Feasibility Analysis

Field Visit and Conditional Survey

A. Existing Condition

B. Containers

- ❑ Number-7
- ❑ Volume- 5 tons
- ❑ Dimension- 10’x5.5’x6’

C. Vans

- ❑ Number-30
- ❑ Volume- 1500 kg
- ❑ Dimension- 2m x1m x 2m
- ❑ Collection points: Chawkbazar, Lalbagh, Azimpur Colony
- ❑ 2 trips per day per van

D. Trucks

- ❑ Number-2 (One container at a time)
- ❑ Time: 11:30 PM- 12:00 AM
- ❑ Transferred to Jatrabari

Feasibility Analysis

Case Study

	Star Square Ultra-Modern Mechanized Garbage Transfer Station at Indore, India	Jinxiang Wet Garbage Station at Changsha, China	Waste Compaction Station at the city of Kolkata, India	Secondary Waste Transfer Station at Lalbagh, Dhaka
Waste Collection Process	**Separate (Dry-Wet)**	**Separate (Dry-Wet)**	**Separate (Dry-Wet)**	**Mixed**
Waste Segregation System	**Both manual and Automatic**	**Automatic**	**Manual**	**Absent**
Waste Recycling Process	**Moderate**	**Full**	**Partial**	**No Recycle**
Compactor	**Auto Pilot mode**	**Full automatic computerized**	**Manual mode**	**Absent**

Feasibility Analysis

Traffic Impact Analysis

Table: Traffic Flow situation

Route	Time	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Dhakeswari road	8.00 Am to 12.00 Pm	light	light	moderate	light	light	light	light
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Lalbagh	8.00 Am to 12.00 Pm	light	moderate	moderate	moderate	moderate	moderate	moderate
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	heavy	moderate	heavy	heavy	heavy	heavy	heavy
Azimpur	8.00 Am to 12.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	12.00 Pm to 4.00 Pm	moderate	moderate	heavy	moderate	moderate	moderate	moderate
	4.00 Pm to 8.00 Pm	heavy	heavy	heavy	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Chowkbazar	8.00 Am to 12.00 Pm	heavy	heavy	heavy	heavy	heavy	moderate	moderate
	12.00 Pm to 4.00 Pm	heavy	heavy	heavy	heavy	heavy	heavy	moderate
	4.00 Pm to 8.00 Pm	heavy	heavy	heavy	heavy	heavy	heavy	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate
Palashi transfer Station to Matuali	8.00 Am to 12.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	12.00 Pm to 4.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	light
	4.00 Pm to 8.00 Pm	moderate	moderate	moderate	moderate	moderate	moderate	moderate
	8.00 Pm to 12.00 Am	moderate	moderate	moderate	moderate	moderate	moderate	moderate

Capacity
- 2424 PCU/hour

Demand
- 2041 PCU/hour

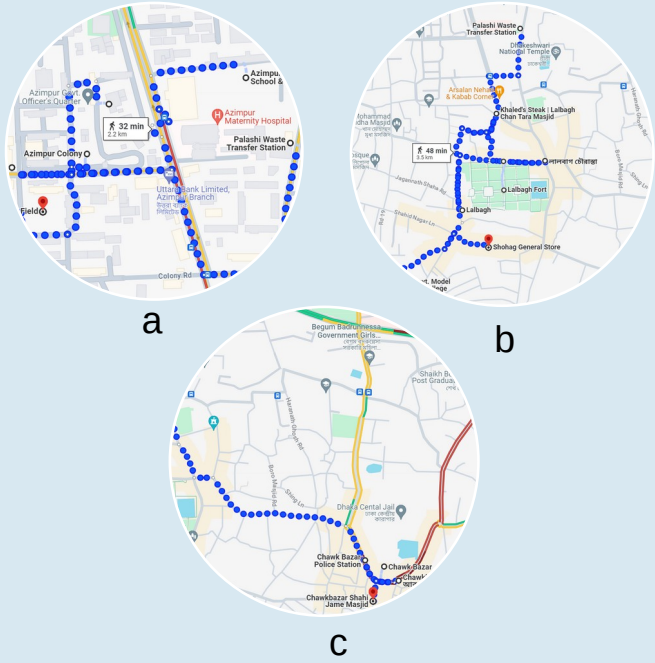


Figure: Collection routes: (a) Azimpur Colony; (b) Chawkbazar; (c) Lalbagh

Feasibility Analysis

Environmental Impact Assessment

Project Category

Yellow

Existing Environment

1. Surface Elevation : 15-20 meter
2. Temperature: Max 39° C, Min 18° C
3. Rainfall: 332 mm/month
4. Humidity: 64% - 73%
5. Wind Speed : 65.7 m/s
6. Air Quality : Good during rainy season but exceeds standard limit during dry season

Impact During Construction

1. Physiochemical : Air, water, soil, noise pollution
2. Ecological : Drainage pattern disruption
3. Socio-Economic : Worker health and safety

Impact During Operation

1. Physiochemical : Wastewater and leachate management
2. Socio-Economic : Job opportunities for equipment maintenance and waste management, reduce volume of waste and landfill dependency, and eventually improve air, water and soil quality.

Feasibility Analysis

A

Pre- Construction

- Community awareness
- Traffic & Access Planning

B

During Construction

- Noise Pollution Check
- Air Pollution Check
- Water quality Check
- Soil Pollution Check
- Worker health and safety

C

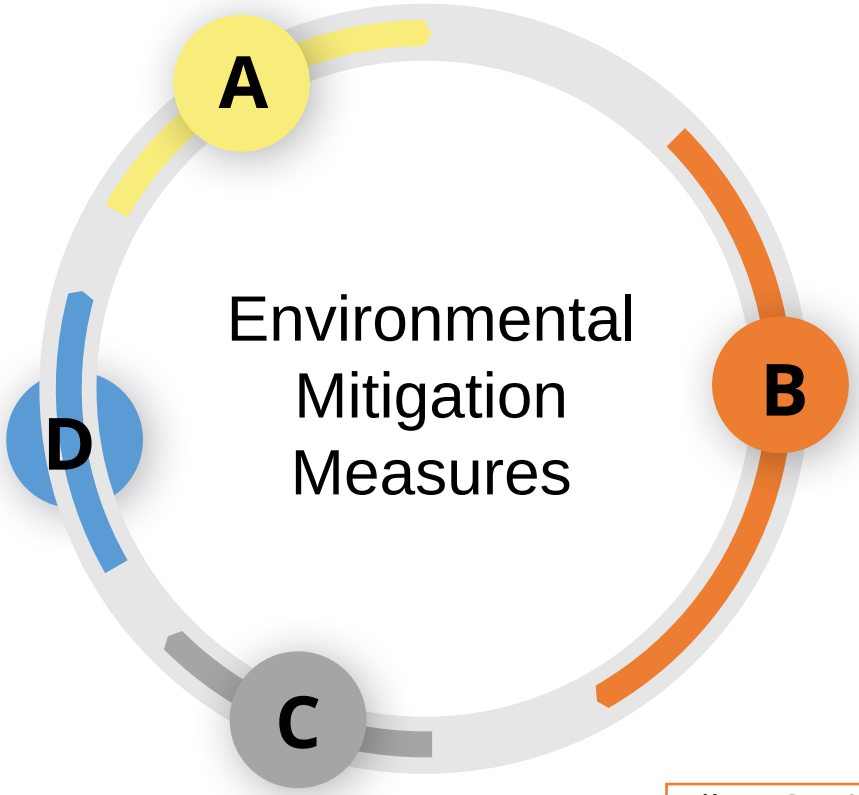
Post Construction

- Segregated waste collection system
- Adequate drainage for leachate
- Recycling of dry waste

D

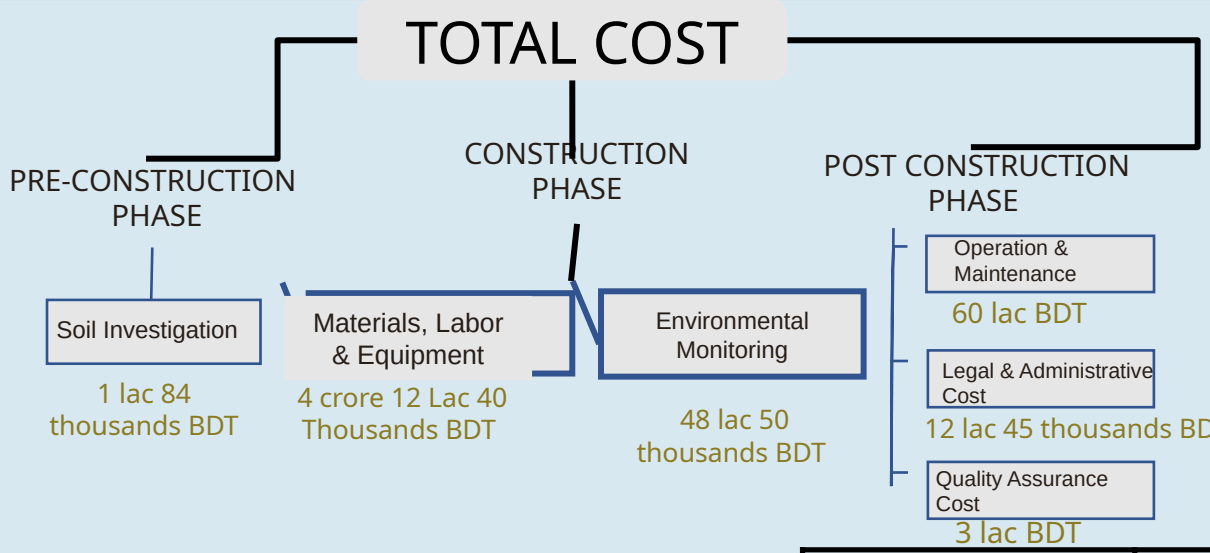
Environmental Management Plan

- Air, Noise, Soil, Water Quality Check
- EHS Officer Appoint
- Cost of Monitoring : **48,94,000 BDT**



Preliminary Cost Estimate	
Soil Investigation Cost	: 1.84 Lac BDT
Foundation Cost	: 37.43 Lac BDT
Super-structure Cost	: 109.32 Lac BDT
Additional Super-structure Cost	: 71.95 Lac BDT
Other Building Cost	: 27.52 Lac BDT
Equipment Cost	: 72.25 Lac BDT
Grand Total Construction Cost	: 463.03 Lac BDT

Feasibility Analysis

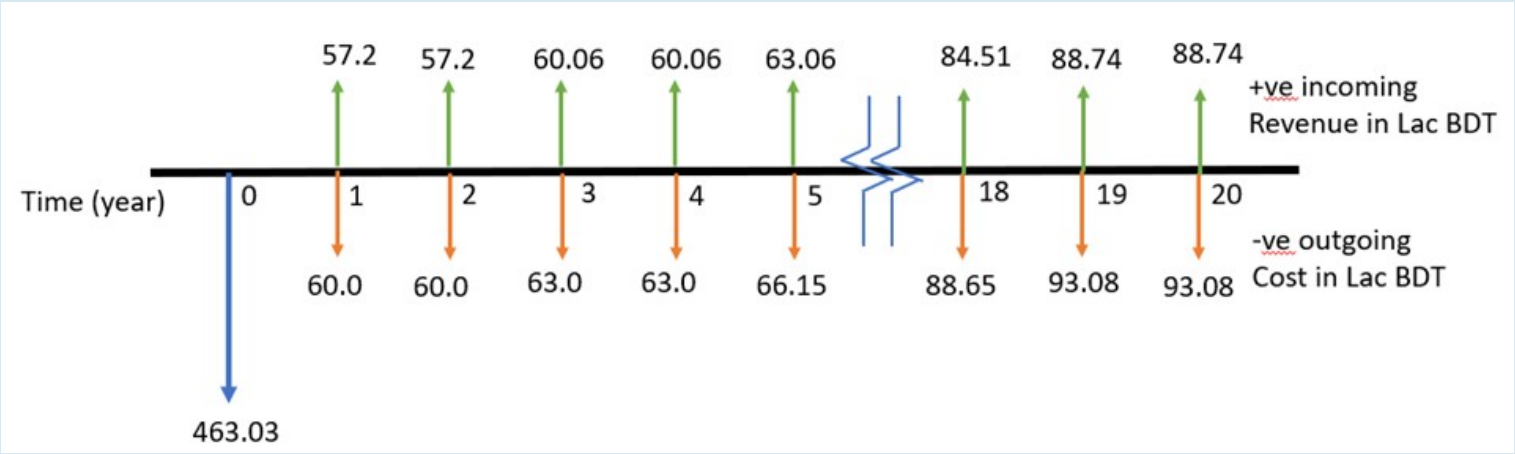


Cost Benefit Analysis

REVENUE BREAKDOWN

SOURCE	RATE	TOTAL REVENUE PER YEAR
Reuse/ Recycle	TK. 25,000 per ton	350 Lacs
Waste Collection Bill	TK. 60,000 per month	7 Lacs 20 Thousands

Feasibility Analysis



Cost Benefit Analysis

NPV	4 Crore 87 Lac BDT	DISCOUNT RATE	12%
IRR	0.2%	BENEFIT-COST RATIO	0.73

Basis of Design (BOD)

- **Design life : 20 years**
- **Design Standard: BNBC 2020, ACI 318-08, AISC 14**
- **Fire design Standard: ASCE 29, BNBC 2020, Part IV, Chapter 1**

Wind Load Provision

- **Exposure Category**: A
- **Occupancy Category:** III
- **Importance Factor:** 1.15
- **Basic Wind Speed**: 65.7 m/s

Earthquake Load Provision

- **Site Class**: SC Seismic

  Design Category: SDC C
- **Occupancy Category**: III
- **Importance Factor:** 1.15
- **Seismic Zone:** 2 (z=0.2)

Others

- **Damp proof course:**
  A 60mm C15 fine aggregate concrete layer is
- **Gravity load** :
  BNBC 2020, Part VI, Chapter 2
- **Wall construction:**
  190mm hollow concrete blocks with a density of 1,280kg/m³ and a strength grade of MU15
- **Doors & Windows:**
  Wooden door and sliding glass windows

Basis of Design (BOD)

Building Area:

- **Total Area:** 300 m²
- **Base Area:** 368 m²

Structural Style:
Foundation: Shallow and Square Foundation
Main Body: RCC Frame Structure

Building Dimension

1. Office Building :
Dimensions: 5.48 x 4.87 m and 5.48 x 3.2 m
Floor Area:
26.68 m² and 17.53 m²
Height: 3.048 m

2. Transfer Station:
Dimensions: 17.07 x 14.96 m
Floor Area: 255.36 m²
Height: 9.144 m

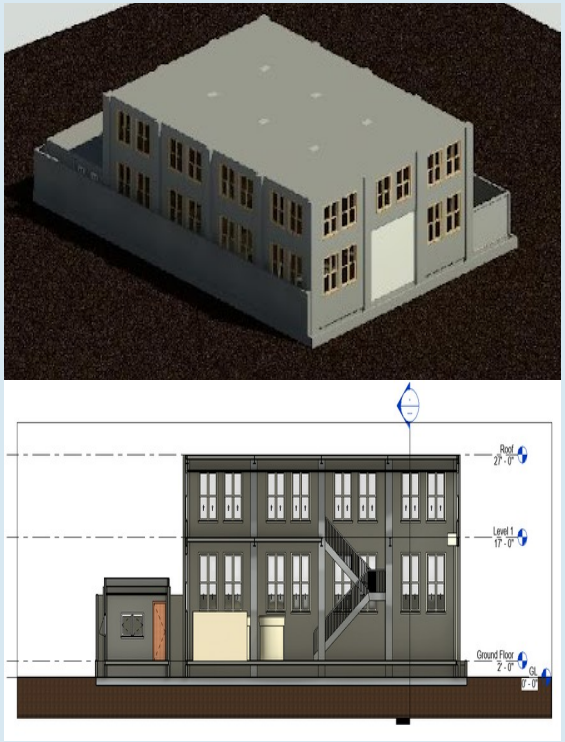
Building Construction

1. Wall Body: Brick Masonry
Roof:
- Office: RCC Roof
- Station: Steel Truss Roof

2. Floor: Cement mortar floor, tile floor

3.Windows & Doors:
Glass Window, Wooden Door for office
- Plastic door for bathroom
- Steel Shutter for station building

ARCHITECTURAL DRAWING WITH ALTERNATIVES



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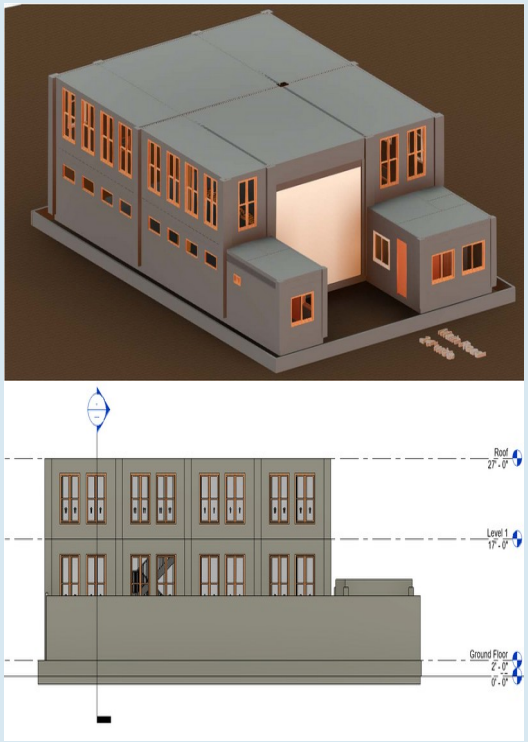

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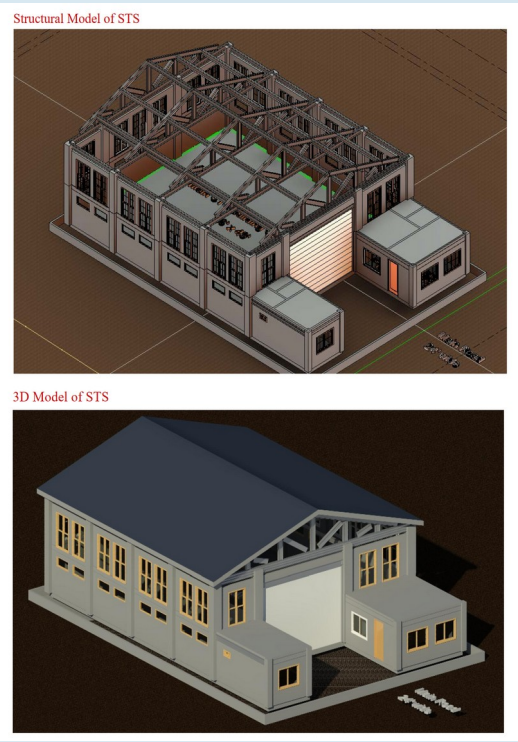

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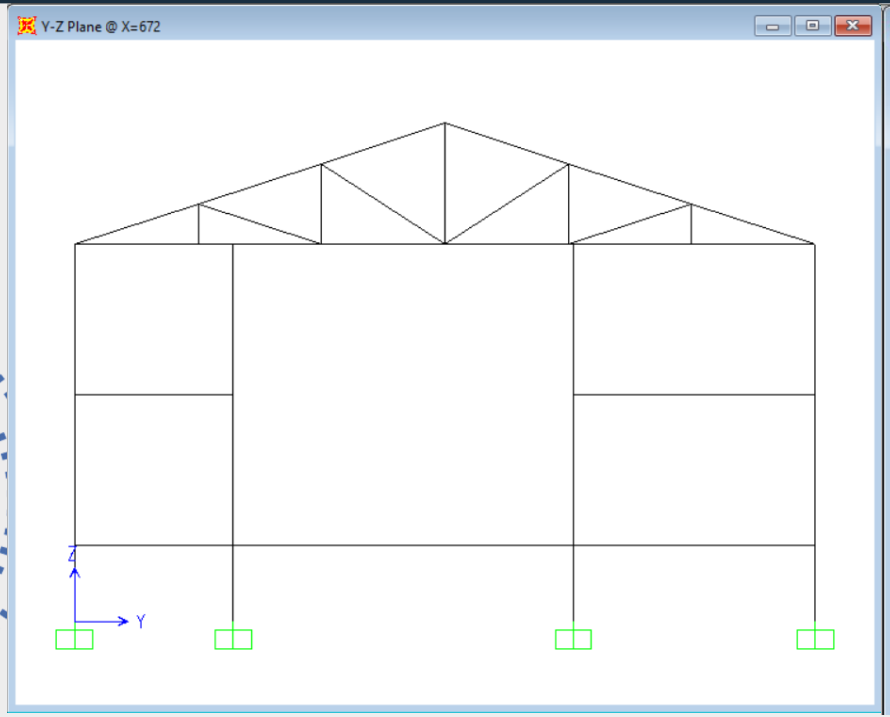
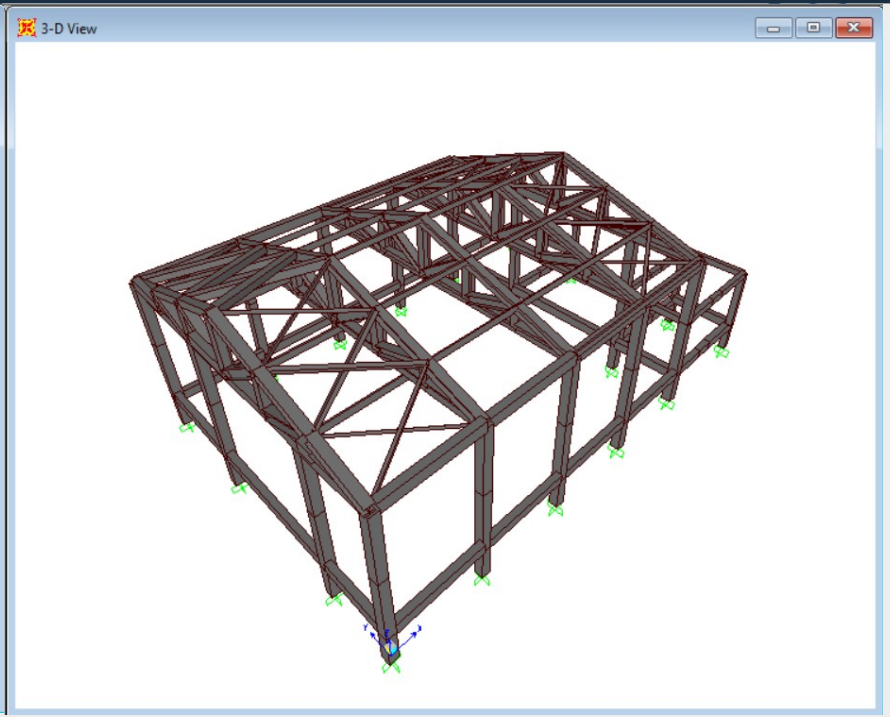
TECHNICAL AND ENGINEERING ANALYSIS





Design Load Combination

1. 1.4D
2. 1.2D + 1.6L
3. 1.2D + (Lor 0.8W)
4. 1.2D+ 1.6W + L
5. 1.2D+ E+ L
6. 0.9D+ 1.6W
7. 0.9D+ E

TECHNICAL AND ENGINEERING ANALYSIS

Finalized Design Sections

STS Building's Howe Truss	L 3x3x1/2
STS Building's Rafter	L 3x3x1/2
STS Building's Purlin	C 6x13
STS Building's Bracing	L 3x3x1/2
STS Building's Beam	12'' x 18''
STS Building's Graded Beam	12'' x 18''
STS Building's Column	16'' x 16''
Office & Dormitory Building's Column	12'' x 12''
Office & Dormitory Building's Beam	10'' x 12''
Office & Dormitory Building's Graded Beam	12'' x 18''
Office & Dormitory Building's Slab	5''

Details Drawing

Ground Floor Plan

- **Building Dimensions**:
- 16,800 x 14,700 mm

- **Key Sections**:
- **Office Room 1**: 2600 x 4600 mm
- **Office Room 2**: 3000 x 3000 mm

- **Staff Room**: 3300 x 3150 mm

- **Additional Features**:
- **Van Parking**: 1050 x 1300 mm

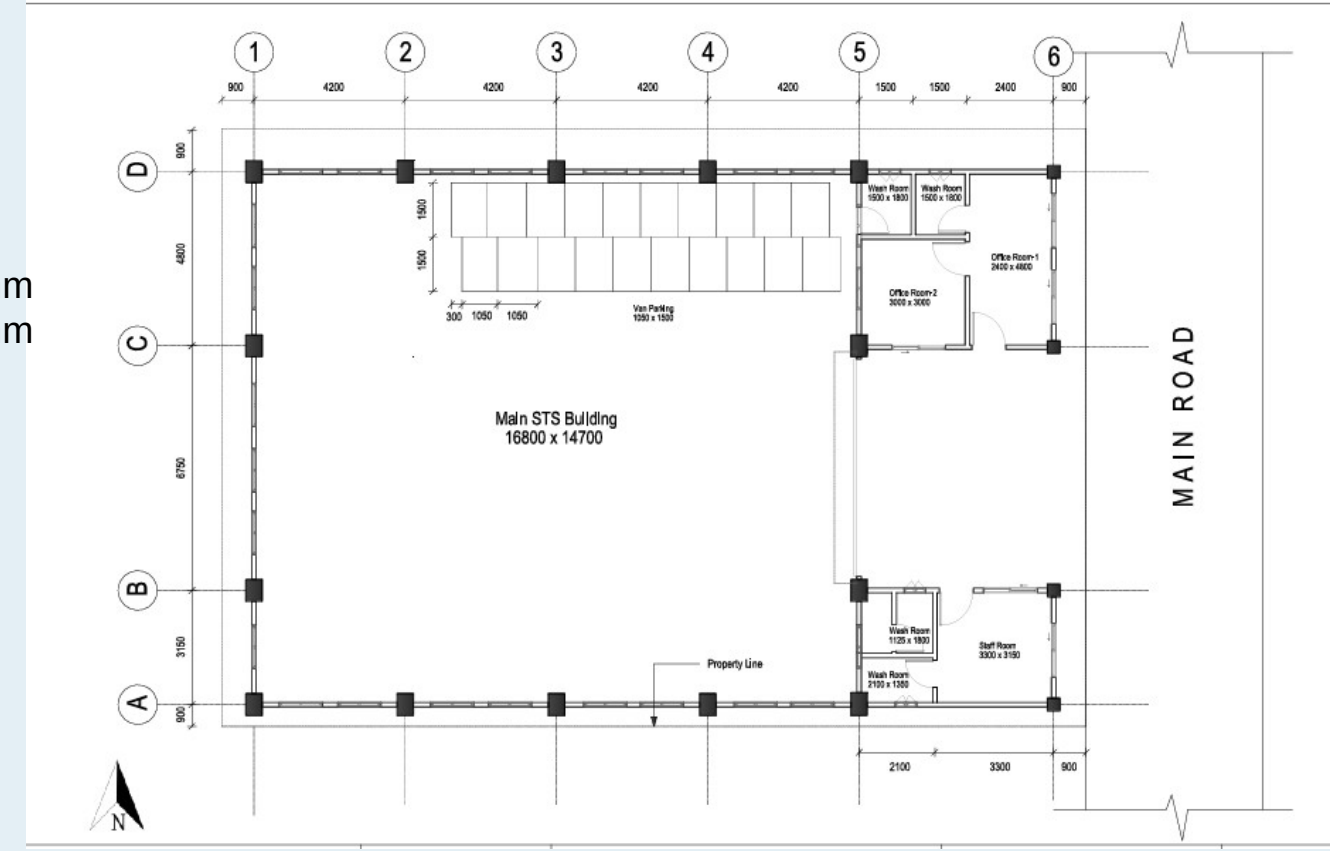


Fig: Ground Floor plan

Details Drawing

Grade Beam Layout
Type of Beam

- Rectangular Beam
- 12”x 18”

G1:
Section Near Column:
3-16 Ø Thru, 10 Ø @ 85 mm C/C.
Mid Span Section:
3-16 Ø Thru, 10 Ø @ 175 mm C/C.
G2:
Section Near Column:
3-16 Ø Thru, 10 Ø @ 85 mm C/C, 2-16 Ø Ext.
Mid Span Section:
3-16 Ø Thru, 10 Ø @ 175 mm C/C.

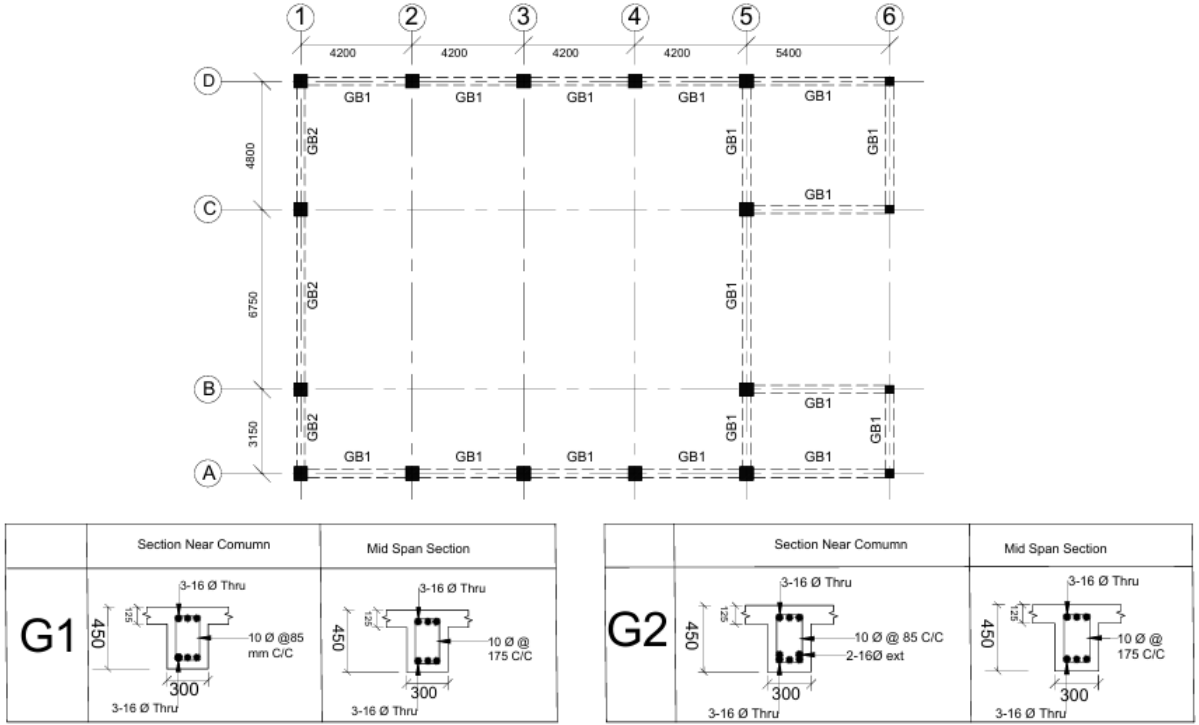


Fig: Grade beam layout

Details Drawing

Column Design Overview

Type of column

- ❖ Square Column
- ❖ Reinforced with Longitudinal bars and lateral ties

Column Dimension

- ❖ Office Col : 12”x12” , 10’ height
- ❖ STS Col : 16”x16”, 20’ height
- ❖ 3 Types of Detailing: C1, C2, C3

•**C1**: 100 mm | S: 200 mm | lo: 450 mm | L: 3000 mm
•**C2**:125 mm | S: 250 mm | lo: 925 mm | L: 6000 mm
•**C3**:125 mm | S: 250 mm | lo: 925 mm | L: 6000 mm

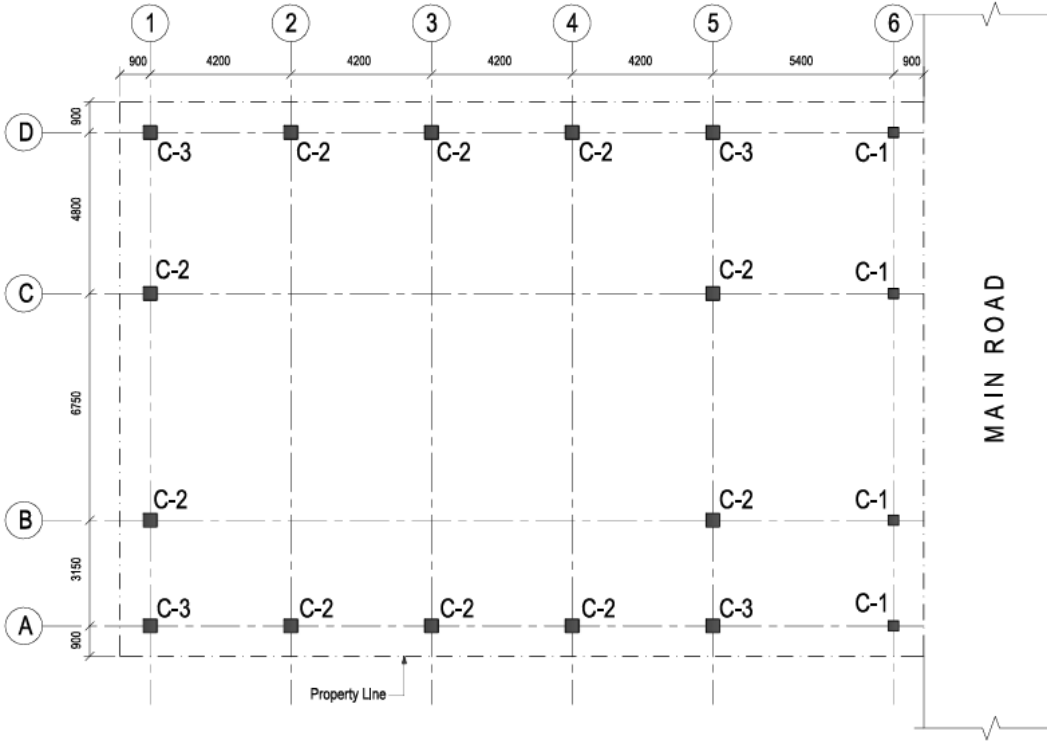


Fig: Column Layout

Details Drawing

Beam Design overview

❖ Rectangular Beam

Beam Layout:

Section Details:
Section X-X:
- 3-16 Ø Thru, 10 Ø @ 85 mm C/C.

Section Y-Y:
- 3-16 Ø Thru, 10 Ø @ 175 mm C/C.

Stirrups Legend:
A: 10 Ø @ 85 mm C/C
•**B**: 10 Ø @ 175 mm C/C
•**C**: 10 Ø @ 100 mm C/C

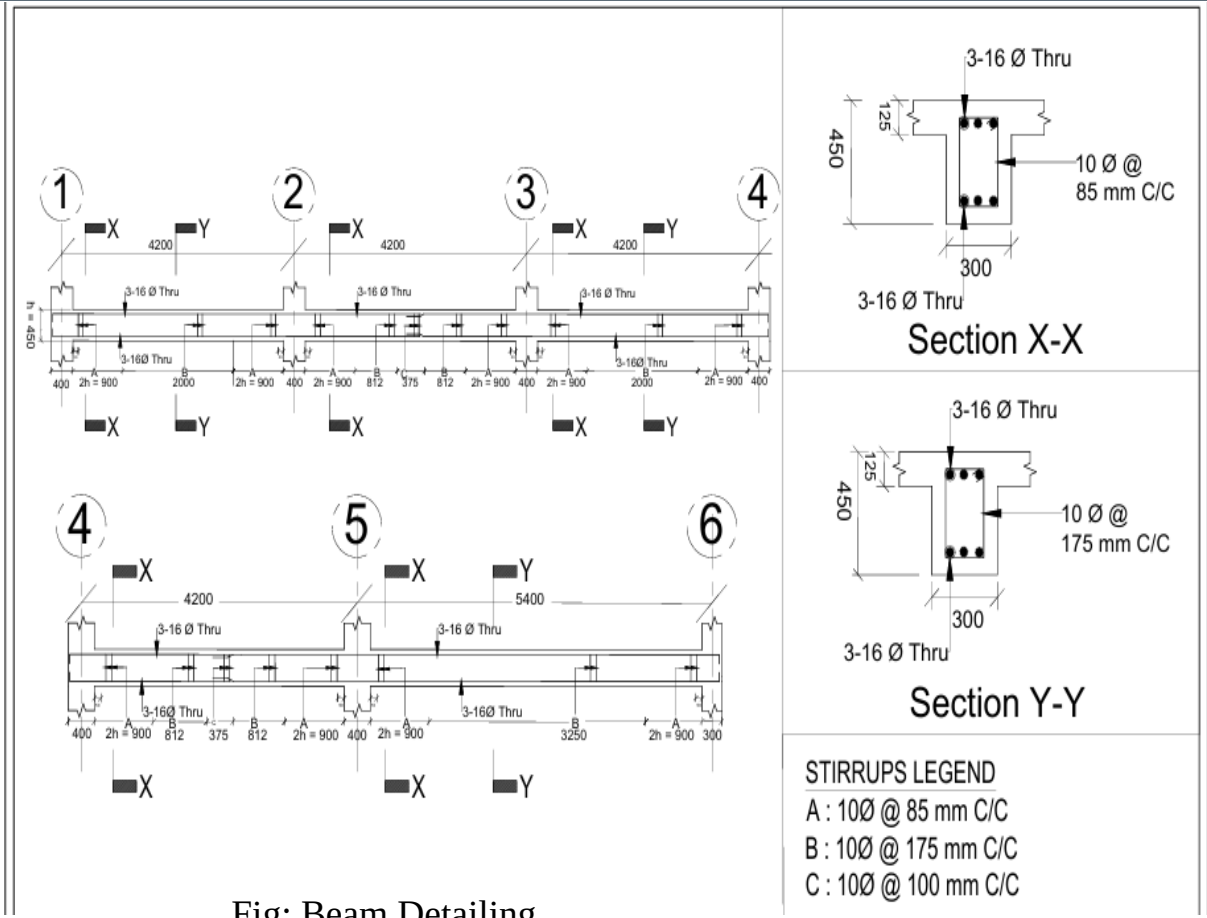


Fig: Beam Detailing

Details Drawing

Type of Slab

- Edge Supported Two way slab
- Discontinuous at four edges

Office room

(A): Ø10 mm bar @ 225 mm c/c (Straight Bottom)
(B): Ø10 mm bar @ 250 mm c/c (Straight Top)
(C): Ø10 mm corner bar @ 250 mm c/c
Diagonally at top, perpendicular at bottom

Staff room

(A): Ø10 mm bar @ 250 mm c/c (Straight Bottom)
(B): Ø10 mm bar @ 250 mm c/c (Straight Top)
(C): Ø10 mm corner bar @ 250 mm c/c
Diagonally at top, perpendicular at bottom

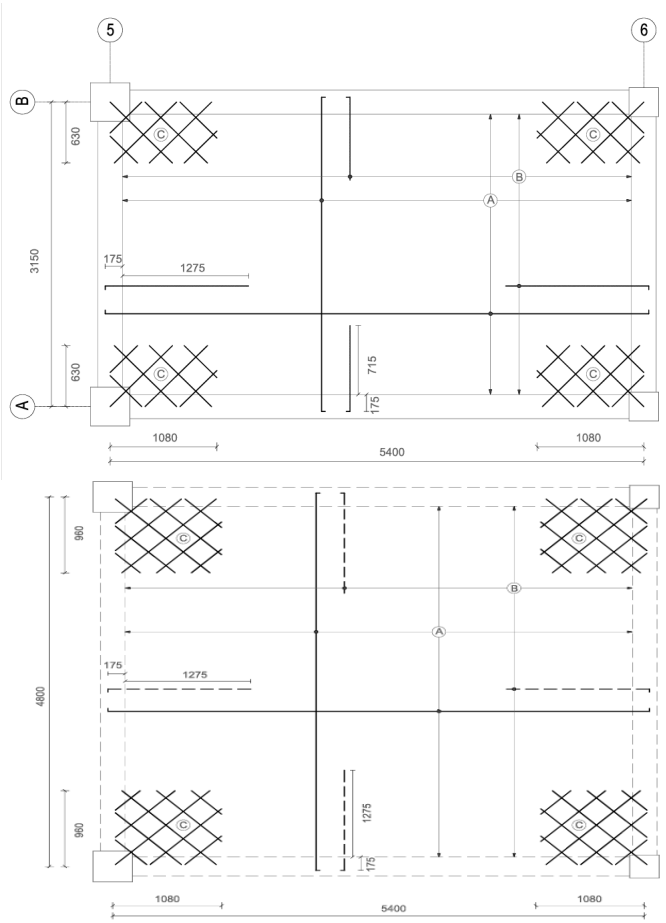


Fig: Slab layout

Details Drawing

Type of Footing

- ❖ Square footing
- ❖ Reinforced with Longitudinal bars and lateral ties

Footing Layout and Reinforcement Details

1.Footing Layout:

1. Footing Types: **F1, F2, F3**
2. Gridlines: **A-D** (Vertical) and **1-6** (Horizontal).
3. **Underground Water Reservoir** and **Pit** marked.

2.Reinforcement Schedule:

1. **F1**: 1200 x 1200 mm
   1. Ø12 mm @ 150 mm c/c (Bottom & Top Bars).
2. **F2**: 1350 x 1350 mm
   1. Ø16 mm @ 200 mm c/c (Bottom & Top Bars).
3. **F3**: 1500 x 1500 mm
   1. Ø16 mm @ 175 mm c/c (Bottom & Top Bars).

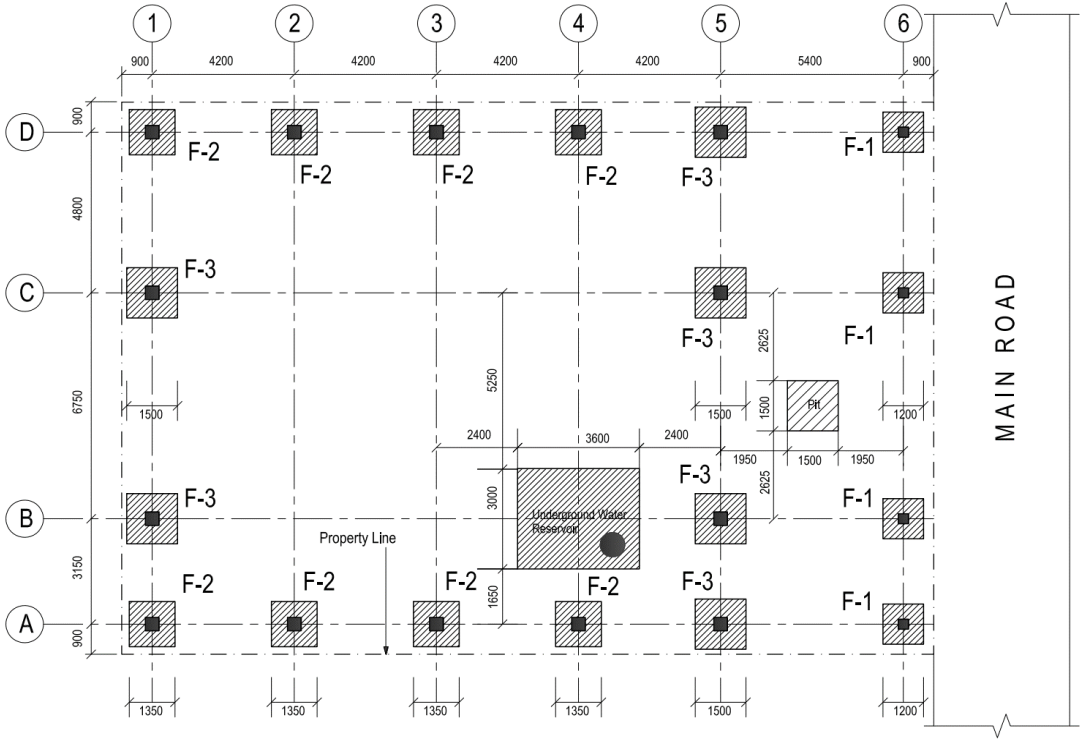


Fig: Footing layout

Details Drawing

Design consideration

- Cover slab – design for horizontal bending (slab action)
- Side walls – design for vertical bending (cantilever action) and horizontal bending (slab action)
- Base slab – design for horizontal bending (slab action)

Design conditions – 3 Types

- When tank is full with water and no soil Outside
- When tank is full with water and saturated soil Outside
- When tank is empty and saturated soil Outside

Critical Design condition:

- Considering last condition as Critical one for design underground water reservoir
- Cover and base slab- two way edge supported slab

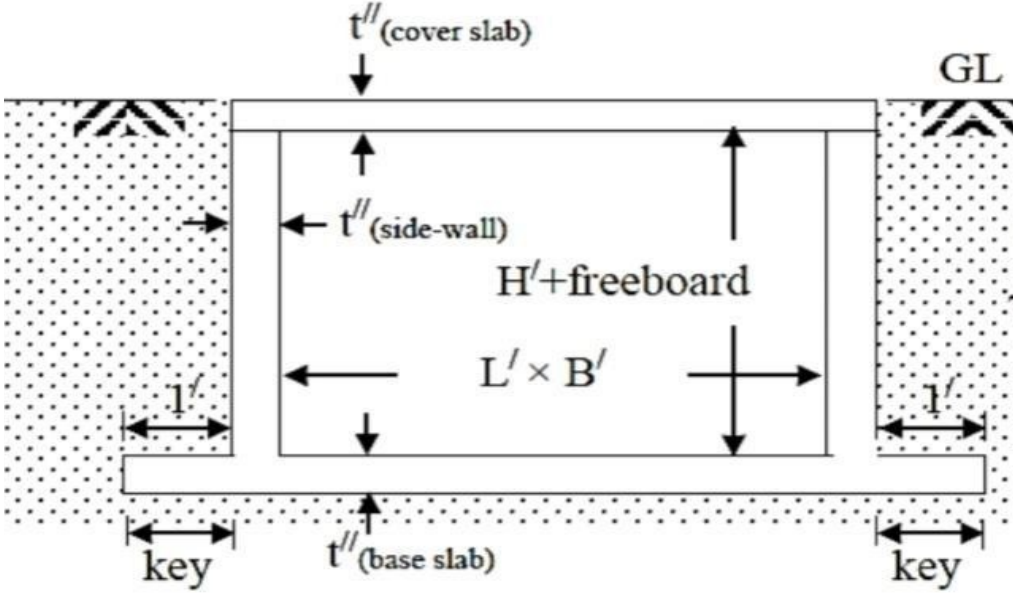


Fig: Underground water reservoir

Details Drawing

Design Results

- ❖ Reservoir dimensions – 3.6 X 3 X 1.8 m
- ❖ Reinforcement required at the both sides of side wall
- ❖ Extended base slab act as anti-uplift shear key
- ❖ No direct tension steels needed in base slab and Side wall

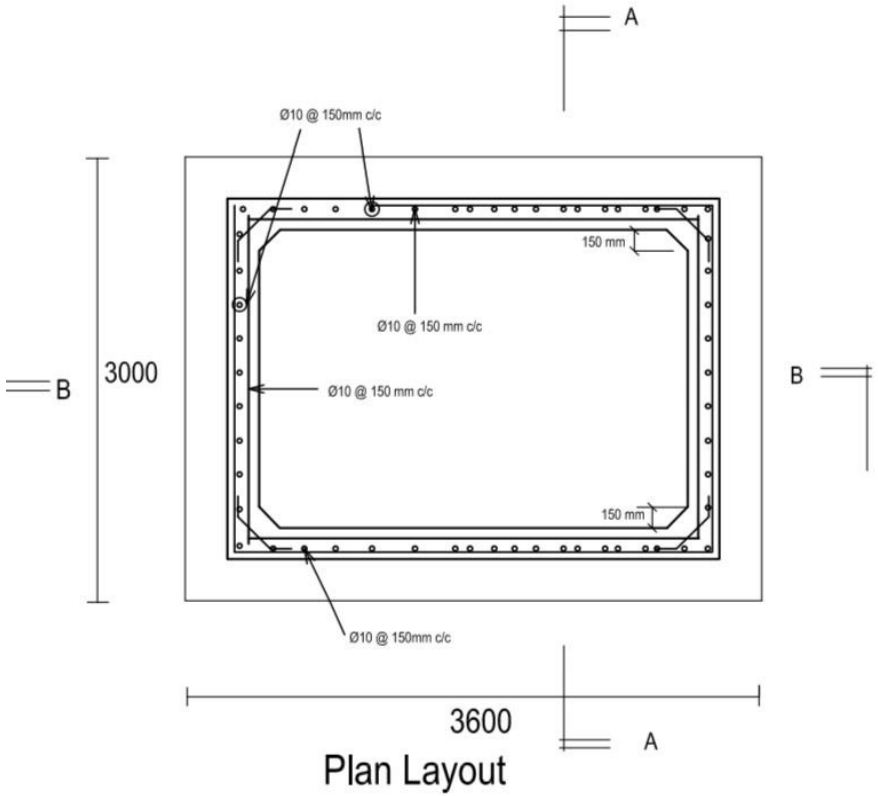


Fig: Underground water reservoir

Details Drawing

Roof Truss Joint

- Symmetrical 2D Pratt truss
- Joints are connected through bolts and gusset plate

Truss Dimensions:
Span: 14,940 mm
Height: 3,345 mm

Member Details:
Main Members: L 3x3x1/2
Purlins: C 6x13

Joint Spacing:
Horizontal: 2,490 mm (each segment)
Vertical: 1,115 mm

Key Sections:
Supports at **F** and central joint **A**
Diagonal bracing for structural stability

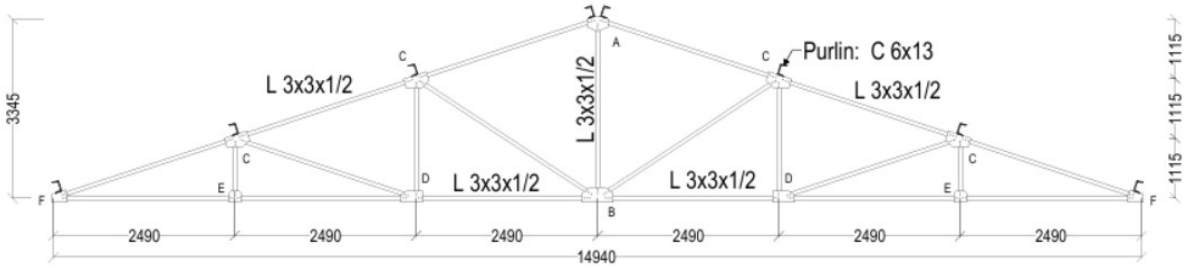


Fig: Roof truss joint

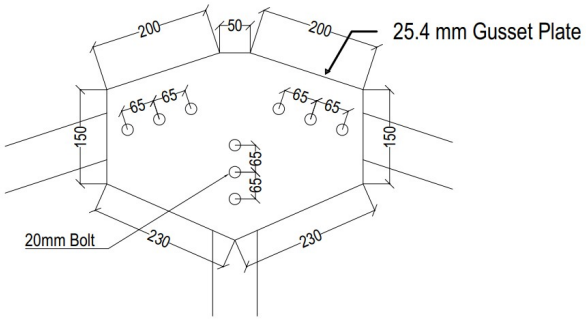


Fig: Truss joint Connections

Details Drawing

Plumbing Layout Plan

1.Key Features:

1. **Water Supply Stack**: Ø 37 mm CPVC Pipe
2. **Wastewater and Soil Stack**: Ø 100 mm UPVC Pipe
3. **Vent Pipe**: Ø 50 mm UPVC Pipe

2.Grid Alignment:

1. Vertical: **A-D**
2. Horizontal: **1-6**

3.Main Elements:

1. **Pit**: 1500 x 1500 mm
2. Connections to Municipal Sewage Line.

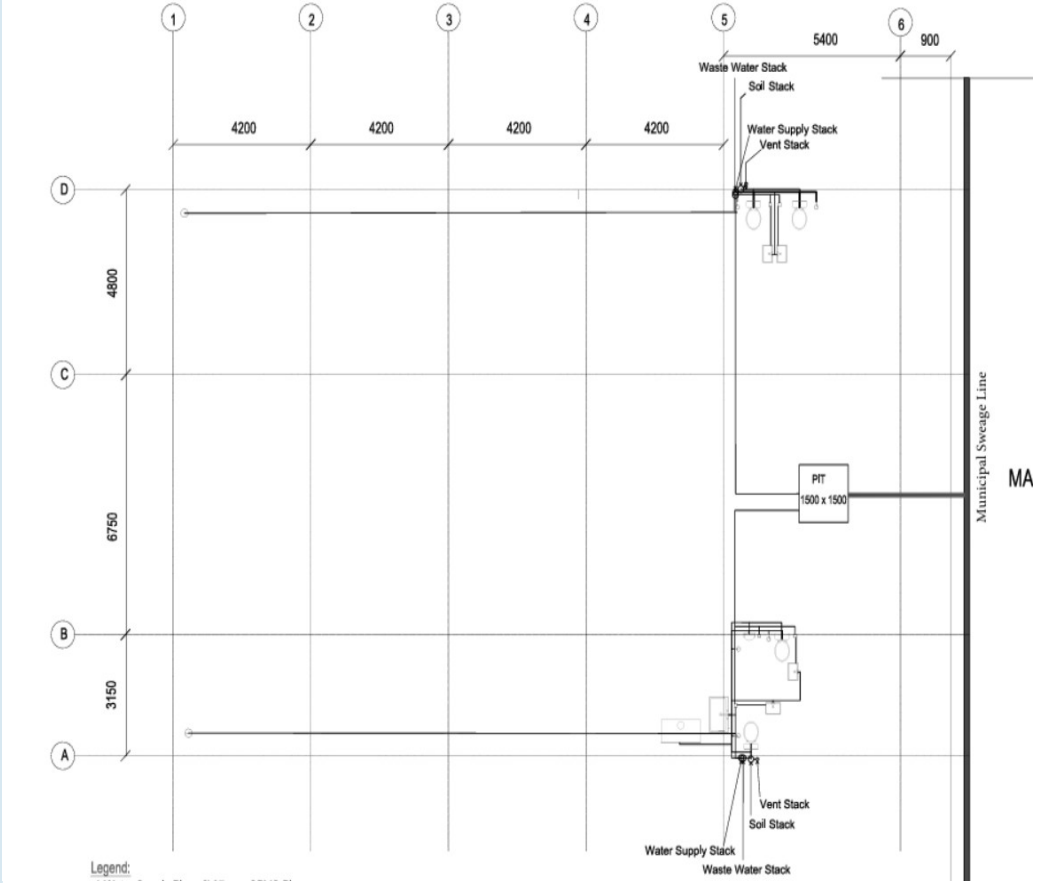
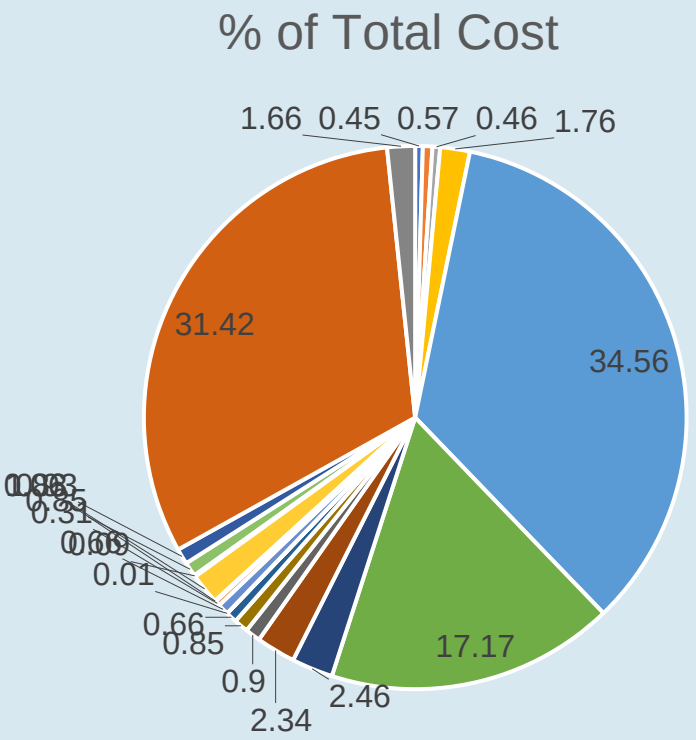


Fig: Plumbing Layout

Bill Of Quantity(BOQ)

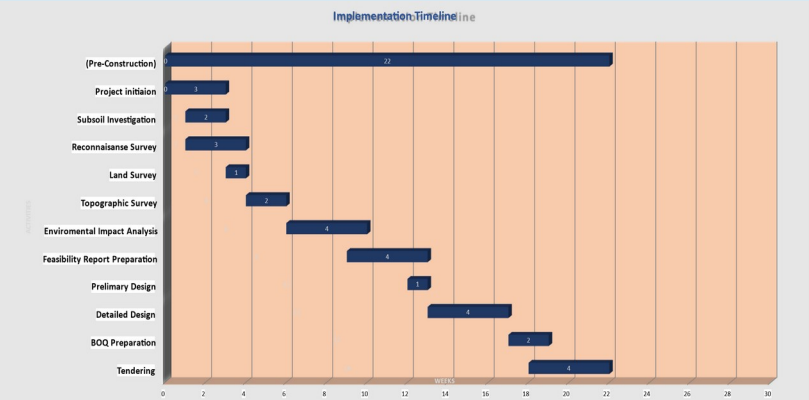
Materials and Component	Cost (in BDT)	% of Total Cost
Soil Investigation	184057	0.45
Earthwork Excavation	231424.4	0.57
Brick Flat Soling	186939.48	0.46
RCC Works	719911.23	1.76
Concrete Reinforcement	14148263.8	34.56
Structural Steel	7031503.26	17.17
Brick Work	1007141.85	2.46
Door Window Glasswork	956323	2.34
Plastering	367279.8	0.9
Painting	347151.12	0.85
Formwork(Steel)	272063.76	0.66
Roof Finish	2189.76	0.01
Sanitary and water supply works	271857	0.66
Tiles work	127380	0.31
False ceiling	24793	0.06
Fence	751216.8	1.83
Gate	38722	0.09
Safety Net and Scafolding	349587.6	0.85
Testing cost	380400	0.93
Additional cost	12866040	31.42
General, Site facility & Engineering Cost	679643.29	1.66
Grand total cost	**4,09,44,539**	
Cost per Sft	**12,711**	

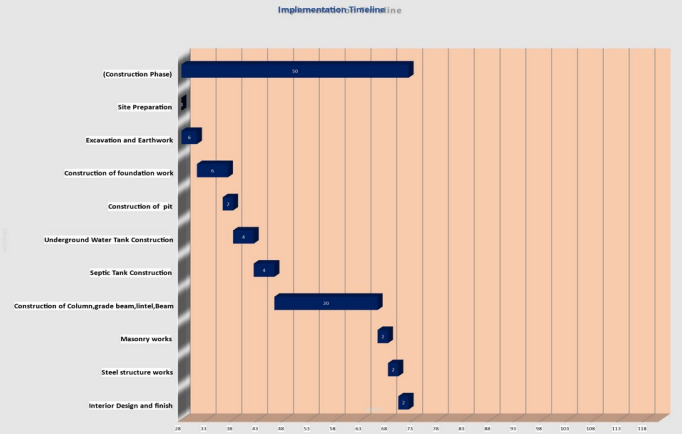


Grand Total Cost: **4,09,44,539 BDT**

Four Crore Nine Lac Forty Four Thousand Five Hundred Thirty Nine Taka

Implementation Timeline





Pre-Construction Phase (Weeks 0-22)

•Key Activities:

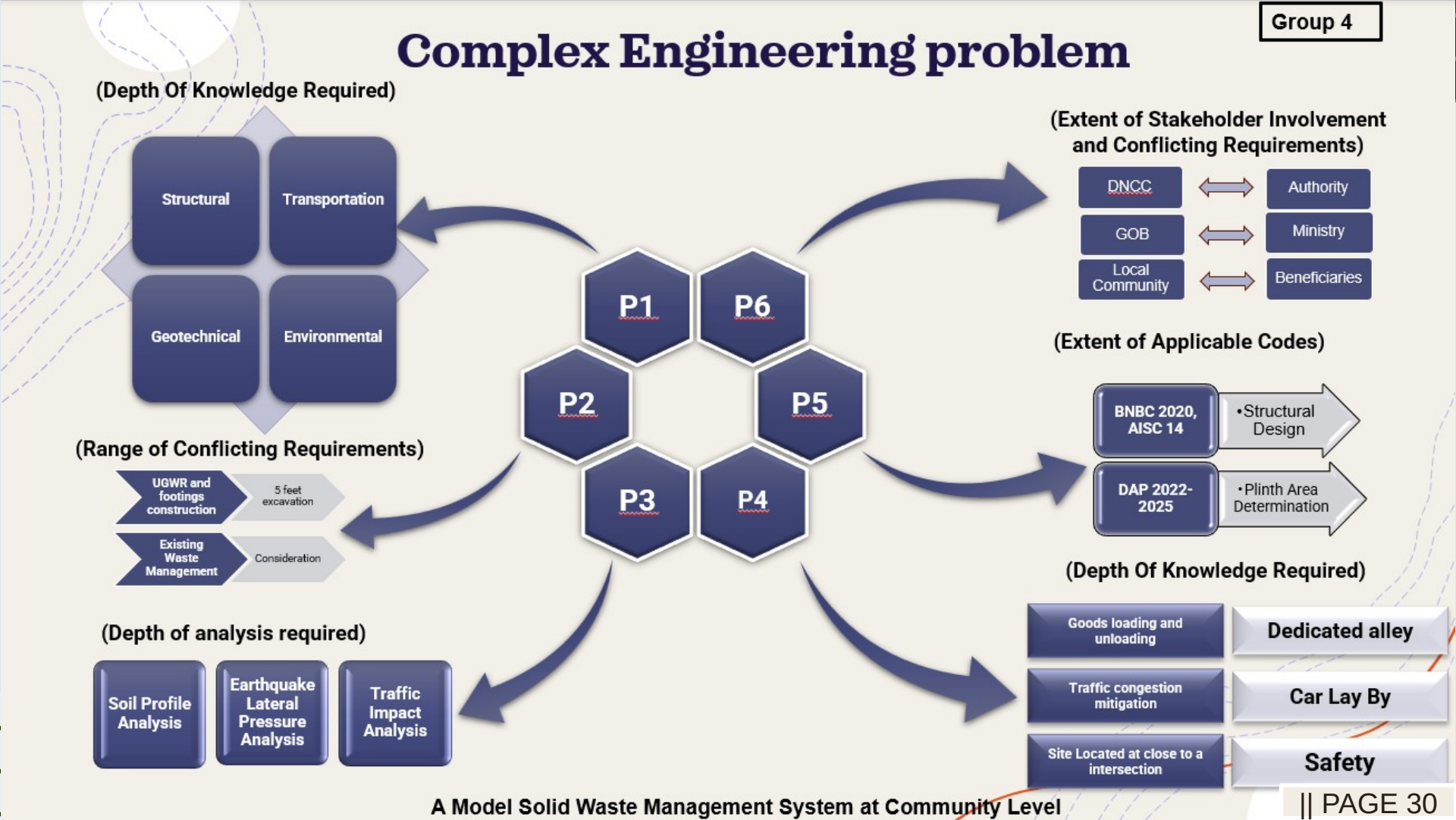
- Project Initiation: 3 weeks
- Subsoil Investigation: 2 weeks
- Reconnaissance Survey: 3 weeks
- Land & Topographic Surveys: 1-2 weeks
- Environmental Impact Analysis: 4 weeks
- Feasibility Report Preparation: 4 weeks
- Preliminary & Detailed Design: 4 weeks
- BOQ Preparation: 2 weeks
- Tendering: 4 weeks

Construction Phase (Weeks 28-50)

•Key Activities:

- Site Preparation: 3 weeks
- Excavation and Earthwork: 6 weeks
- Foundation Work: 6 weeks
- Pit Construction: 2 weeks
- Underground Water Tank: 4 weeks
- Septic Tank: 4 weeks
- Columns, Grade Beams, Lintel, Beams: 20 weeks
- Masonry Works: 2 weeks
- Steel Structure Works: 2 weeks
- Interior Design and Finish: 2 weeks

Complex Engineering problem



Conclusion

1.Modernization and Expansion:

a) Expansion of the existing STS with modern container trucks and advanced waste compaction techniques

2.Environmental and Social Benefits:

a) Adherence to Environmental Conservation Rules 2023 to minimize impact and improve residents' quality of life.

3.Economic Viability:

a) Despite initial financial challenges, the project demonstrates long-term benefits for the environment, public health, and society.

4.Innovative Solutions:

a) Use of advanced technologies, including compartmentalized tricycles and steel frame structures, setting benchmarks for urban waste management.

THANK YOU!
ANY QUESTIONS?