



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

(Est U/s(3) of UGC Act, 1956) Accredited with Grade "A" by NAAC (A Christian Minority Institution)

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHEMMENCHERY, CHENNAI – 600119. TAMILNADU.

PHONE: 2450 1443/9941912481 INTERNET: www.sathyabama.ac.in

E-mail: archhod@sathyabama.ac.in

**SCHOOL OF BUILDING AND ENVIRONMENT
DEPARTMENT OF ARCHITECTURE
M. Arch (Building management)**

**PROFESSIONAL TRAINING (S84 INT)
MAY- DEC 2020**

Name of the Student : MANJU R

Semester : III

Reg No. : 39840013

Batch : 2019-2021



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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

VIVA-VOCE EXAMINATION

This is to certify that the Professional Training (S84 INT) is the work of **MANJU R (39840013)** who had undergone training

EPMCR PVT LTD, Chennai and has been monitored by the continuous assessment during **May 2020 to August 2020 and Dec 2020.**

A handwritten signature in blue ink, appearing to read 'Devyani', is written over a light blue circular stamp.

Dr. Devyani Gangopadhyay
HOD AND DEAN

Submitted for Viva voce Examination held on 30.01.2021

Internal Examiner

External Examiner



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E-mail: archhod@sathyabama.ac.in



DECLARATION

I Manju R hereby declare that the Professional Training Report 110 Days (20th May to 21st August and from 7th December to 31st December 2021) done by me under the guidance of Mr.S.Kavinkumar is submitted in partial fulfillment of the requirements for the completion of practical training session.

DATE: 28-01-2021

PLACE: CHENNAI

S. Kavinkumar



R. Manju

SIGNATURE OF CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA INSTITUTE OF SCIENCE & TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay Dean, School of building and Environment** for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to Mr.S.Kavinkumar for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my Training.

I would also like to express my sincere thanks to Ar. Sukirtha Suresh (Internal Co-Ordinator) for her valuable guidance, during the entire Professional Training period.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Architecture who were helpful in many ways for the completion of the project.

Also thank Architect / Project Management firm- EPMCR Pvt. Ltd., No. 2B, First Floor, Balaji Nagar Main Road, New Perungalathur, Chennai - 600063

JANUARY 29, 2021

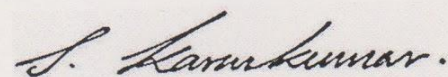
REF: EPMCRPL/20-21/INTERN/01-02

INTERNSHIP CERTIFICATE

Ms. Manju R, pursuing her Post Graduate Programmes in Architectural Building Management (Regd No: 39840013) at Sathyabama Institute of Technology, Chennai has undergone the Project Management Student training in our company, from May 20, 2020 to August 21, 2020 and from December 7, 2020 to December 31, 2020.

During her tenure as a trainee with us, we found him sincere, hardworking and result oriented during the Internship. She worked efficiently as part of a team during his tenure. We take this opportunity to train him and wish him all the best in all his future endeavors.

FOR ENGINEERING PROJECT MANAGEMENT CONSULTANCY & RESEARCH PVT LTD.,



S KAVINKUMAR
DIRECTOR



Engineering Project Management Consultancy and Research Private Limited

Regd. Office: #15, Rajamanickam Street, New Perungalathur, Chennai-600 063.
Tel : 044-4282 4759 | email : epmcr@epmcr.co.in | Web : www.epmcr.co.in



29th January 2021

To
The Head of the Department,
Sathyabama Institute of Science and Technology,
Rajiv Gandhi Salai, Jeppiar Nagar,
Chennai – 600 119.

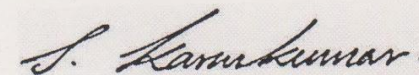
Sub: Confirmation Letter for Practical Training at our Office for Ms. Manju R, Regd No: 39840013

Respected Sir/ Madam,

With respect to the above subject we would like to induct Ms. Manju R, (Regd No: 39840013) M.Arch in Building Management, (Sathyabama Institute of Science and Technology) as a Project Management Trainee for a period of 110 days.

Thanking You

FOR ENGINEERING PROJECT MANAGEMENT CONSULTANCY & RESEARCH PVT LTD.,



S KAVINKUMAR
DIRECTOR



Engineering Project Management Consultancy and Research Private Limited

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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 13 working Days in the office to be submitted to HOD by the Trainee in Charge of the Organization)

1. Name of the office / organization : EPMCR PVT. LTD
2. Address & Contact Number : No. 2B, 1st floor, Balaji Nagar, Perungalathur, Chennai 044-22743332
3. Name of the student : Manju. R
4. Duration : From 19.05.2020 To 31.05.2020
5. Total No. of days : 13 days
6. Evaluation of Performance criteria shall be on

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted 40 marks by the department.

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillsets related to project management	✓				
Design Management	✓				
Understanding the Triple Constraints	✓				
Observation during Site Visits					✓
Understanding of construction details	✓				
Understanding of Construction sequences	✓				
Site Supervision / Discussion with clients					✓
Adherence to Time schedule	✓				
Quantitative aptitude	✓				
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*

A

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Very dedicated to the work and responded on time.

8. Signature of the
Head of the Office /
Organization (With Seal)

S. Karthikeyan



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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 30 working Days in the office to be submitted to HOD by the Trainee in Charge of the Organization)

1. Name of the office / organization : EPMCR PVT. LTD.
2. Address & Contact Number : No. 2B, 1st floor, Balaji Nagar, Perungalathur, Chennai 044-22743332
3. Name of the student : Manju. R
4. Duration : From 01.06.2020 To 30.06.2020
5. Total No. of days : 30 Days
6. Evaluation of Performance criteria shall be on

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted 40 marks by the department.

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillsets related to project management	✓				
Design Management	✓				
Understanding the Triple Constraints	✓				
Observation during Site Visits					✓
Understanding of construction details	✓				
Understanding of Construction sequences	✓				
Site Supervision / Discussion with clients					✓
Adherence to Time schedule	✓				
Quantitative aptitude	✓				
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*

A

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Very dedicated to work and responded on time.

8. Signature of the
Head of the Office /
Organization (With Seal)

S. Karthikeyan





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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 31 working Days in the office to be submitted to HOD by the Trainee in Charge of the Organization)

1. Name of the office / organization : EPMCR, PVT LTD .
2. Address & Contact Number : No. 2B, 1st floor, Balaji Nagar, Perungalathur, Chennai - 044-22743332
3. Name of the student : Manju R .
4. Duration : From 01.07.2020 To 31.07.2020
5. Total No. of days : 31 Days .
6. Evaluation of Performance criteria shall be on

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted 40 marks by the department.

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillssets related to project management	✓				
Design Management	✓				
Understanding the Triple Constraints	✓				
Observation during Site Visits	✗				✓
Understanding of construction details	✓				
Understanding of Construction sequences	✓				
Site Supervision / Discussion with clients					✓
Adherence to Time schedule	✓				
Quantitative aptitude	✓				
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*

A

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Very dedicated to work and responded on time

8. Signature of the Head of the Office / Organization (With Seal)

S. Karthikeyan



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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 21 working Days in the office to be submitted to HOD by the Trainee in Charge of the Organization)

1. Name of the office / organization : EPMCR PVT. LTD .
2. Address & Contact Number : No. 2B, 1st floor, Balaji Nagar, Perungalathur, Chennai - 044-22743332
3. Name of the student :
4. Duration : From 01.08.2020 To 21.08.2020
5. Total No. of days : 21 Days
6. Evaluation of Performance criteria shall be on

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted 40 marks by the department.

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillssets related to project management	✓				
Design Management	✓				
Understanding the Triple Constraints	✓				
Observation during Site Visits					✓
Understanding of construction details	✓				
Understanding of Construction sequences	✓				
Site Supervision / Discussion with clients					✓
Adherence to Time schedule	✓				
Quantitative aptitude	✓				
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*

A

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Very dedicated to work and responded on time

8. Signature of the Head of the Office / Organization (With Seal)

S. Karthikeyan





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DEPARTMENT OF ARCHITECTURE

M. Arch (Building management)

Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 18 working Days in the office to be submitted to HOD by the Trainee in Charge of the Organization)

1. Name of the office / organization : EPMCR PVT. LTD .
2. Address & Contact Number : NO. 2B, 1st floor, Balaji Nagar, Perungalathur, Chennai, 044-22743332
3. Name of the student : Manju. R.
4. Duration : From 07.12.2020 To 31.12.2020
5. Total No. of days : 18 Days
6. Evaluation of Performance criteria shall be on

* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted 40 marks by the department.

Description of works	Excellent	Good	Fair	Poor	NA
Understanding of office culture	✓				
Skillsets related to project management	✓				
Design Management	✓				
Understanding the Triple Constraints	✓				
Observation during Site Visits					✓
Understanding of construction details	✓				
Understanding of Construction sequences	✓				
Site Supervision / Discussion with clients					✓
Adherence to Time schedule	✓				
Quantitative aptitude	✓				
Documentation skills	✓				
Coordination with other consultants	✓				

Overall Grading*

A

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Very dedicated to work and responded on time.

8. Signature of the
Head of the Office /
Organization (With Seal)

S. Komkuma



WORK DIARY

(Annexure –VIII)

DATE	PROJECT NAME	WORK DONE	DATE	PROJECT NAME	WORK DONE
19-05-20	Lean Project Management	Understanding - Lean PM Vs Convention PM System	04-06-20	Conventional Project Management System	Design Thinking - Stake holder, their Constraints & Aspirations identification
20-05-20	Lean Project Management	Overview - Lean Project Management System	05-06-20	Conventional Project Management System	Presentation - Stake holder, their Constraints & Aspirations identification
21-05-20	Lean Project Management	Project Objective Identification	06-06-20	Ather Energy Cell Storage Building, Hosur	Design Thinking
22-05-20	Lean Project Management	Project Objective Definition	07-06-20	Ather Energy Cell Storage Building, Hosur	Project Study
23-05-20	Conventional Project Management System	Study	08-06-20	Ather Energy Cell Storage Building, Hosur	Project Understanding- Presentation
24-05-20	Conventional Project Management System	Presentation	09-06-20	Ather Energy Cell Storage Building, Hosur	Project Understanding- Presentation
25-05-20	Integrated Project Delivery System	Study & Presentation	10-06-20	Ather Energy Cell Storage Building, Hosur	Bylaws/ Code Documentation
26-05-20	IPD vs conventional project delivery	Study & Presentation	11-06-20	Ather Energy Cell Storage Building, Hosur	Bylaws/ Code Documentation
27-05-20	Workflow Chart - Project Life Cycle	Flow Chart	12-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
28-05-20	Workflow Chart - Project Life Cycle	Flow Chart	13-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
29-05-20	Lean Project Management Vs Convention PM System	Design Thinking & Presentation	14-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
30-05-20	Lean Project Management Vs Convention PM System	PRD / URD - Understanding & Documentation	15-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
31-05-20	Lean Project Management	PRD / URD - Understanding & Documentation	16-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
01-06-20	Lean Project Management	Project Objective Definition- Revision	17-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD
02-06-20	Meeting with Ar. Kruthika & Lean PM System	Understand EPMCR design delivery methodology & Their method of implementation lean	18-06-20	Ather Energy Cell Storage Building, Hosur	Questionnaire- Client & TVS Identification
03-06-20	Lean Project Management	Lean Tools Identification	19-06-20	Ather Energy Cell Storage Building, Hosur	Questionnaire- Client & TVS Identification

DATE	PROJECT NAME	WORK DONE	DATE	PROJECT NAME	WORK DONE
20-06-20	Ather Energy Cell Storage Building, Hosur	Questionnaire- Client	06-07-20	Ather Energy Cell Storage Building, Hosur	Material Study
21-06-20	Ather Energy Cell Storage Building, Hosur	Questionnaire- TVS Logistics	07-07-20	Ather Energy Factory Building, Hosur	Project Introduction, Client Meeting, False Ceiling Study
22-06-20	Ather Energy Cell Storage Building, Hosur	A3 Big Picture- Project Milestone Determination	08-07-20	Ather Energy Factory Building, Hosur	Interior Partition Design Thinking
23-06-20	Ather Energy Cell Storage Building, Hosur	WBS & Project Schedule	09-07-20	Ather Energy Factory Building, Hosur	Interior Partition Design Thinking
24-06-20	Ather Energy Cell Storage Building, Hosur	Client Meeting	10-07-20	Ather Energy Factory Building, Hosur	Internal Meet - False Ceiling & Interior Partition Design Thinking
25-06-20	Ather Energy Cell Storage Building, Hosur	M.o.M	11-07-20	Ather Energy Factory Building, Hosur	False Ceiling & Interior Partition Design Thinking - Overview
26-06-20	Ather Energy Cell Storage Building, Hosur	Questionnaire FORMAT Preparation & Questionnaire Revision- TVS & Client	12-07-20	Ather Energy Factory Building, Hosur	False Ceiling & Interior Partition Design Thinking Options- Presentation
27-06-20	Ather Energy Cell Storage Building, Hosur	Presentation of Questionnaires to TVS Logistics	13-07-20	Ather Energy Factory Building, Hosur	URD - Interior Partition
28-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD Revision	14-07-20	Ather Energy Factory Building, Hosur	URD - Interior Partition
29-06-20	Ather Energy Cell Storage Building, Hosur	Presentation Preparation - Explosion Vent & Fire Safety	15-07-20	Ather Energy Factory Building, Hosur	URD - Interior Partition
30-06-20	Ather Energy Cell Storage Building, Hosur	Internal Meeting - Presentation Discussion & Revision on Presentation Preparation - Explosion Vent & Fire Safety	16-07-20	Ather Energy Factory Building, Hosur	List of Activities- False ceiling & Interior Partition Identification
01-07-20	Ather Energy Cell Storage Building, Hosur	Architecture Team, Structure & Costing Team - Design Thinking	17-07-20	Ather Energy Factory Building, Hosur	Vendor Enquiry- False ceiling & Interior Partition with PUF Panel
02-07-20	Ather Energy Cell Storage Building, Hosur	Structural Layout Options & Scope Preparation	18-07-20	Ather Energy Factory Building, Hosur	Vendor Enquiry- False ceiling & Interior Partition with PUF Panel
03-07-20	Ather Energy Cell Storage Building, Hosur	Structural Layout Options & Scope Preparation	19-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition with PUF Panel
04-07-20	Ather Energy Cell Storage Building, Hosur	Meeting with Alan Mosses Sir regarding Lean	20-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition with PUF Panel
05-07-20	Ather Energy Cell Storage Building, Hosur	Cell Storage Building Design Delivery - Work flow Chart	21-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition with PUF Panel

DATE	PROJECT NAME	WORK DONE	DATE	PROJECT NAME	WORK DONE
22-07-20	Ather Energy Factory Building, Hosur	False ceiling & Interior Partition with Other option- Material Identification	07-08-20	Conventional Project Management Practices	Architecture: Input- Process- Output; Problems & Challenges
23-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition - Fibre cement & Calcium Silicate	08-08-20	Conventional Project Management Practices	Architecture - Overall Problem Statement; Aspiration
24-07-20	Ather Energy Factory Building, Hosur	3D Prototype- False ceiling & Interior Partition	09-08-20	Conventional Project Management Practices	Architecture - Solution & Idea
25-07-20	Ather Energy Factory Building, Hosur	3D Prototype- False ceiling & Interior Partition - Fibre cement & Calcium Silicate Board	10-08-20	Conventional Project Management Practices	Design Stage Deliverable by PMC, Architectural, Structural and Costing Team
26-07-20	Ather Energy Factory Building, Hosur	Fixing Detail- False ceiling & Interior Partition - Fibre cement & Calcium Silicate	11-08-20	Conventional Project Management Practices	Presentation - Revised Design Stage Deliverable
27-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition- Fibre cement & Calcium Silicate	12-08-20	Agri Food Supply Chain	Project Introduction
28-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition- Fibre cement & Calcium Silicate	13-08-20	Agri Food Supply Chain	Presentation - Agrifood Supply Chain
29-07-20	Ather Energy Factory Building, Hosur	Presentation - False ceiling & Interior Partition- Fibre cement & Calcium Silicate	14-08-20	Agri Food Supply Chain	Carbon Foot Print Calculation
30-07-20	Ather Energy Factory Building, Hosur	3D Prototype- False ceiling & Interior Partition - Fibre cement & Calcium Silicate Board	15-08-20	Agri Food Supply Chain	Carbon Foot Print Calculation
31-07-20	Ather Energy Factory Building, Hosur	URD Final Presentation - False ceiling, Interior Partition & Doors	16-08-20	IIT Chennai- Office Building	Fortnight Meeting - 2 / 6 Weeks Look Ahead Schedule
01-08-20	Ather Energy Factory Building, Hosur	Specification - Door	17-08-20	Conventional Project Management Practices	Design Stage Life cycle - Input, Process & Output
02-08-20	Ather Energy Factory Building, Hosur	Design Delivery Flow Chart- False ceiling, Interior Partition & Doors	18-08-20	Conventional Project Management Practices	Design Stage Life cycle - Work flow Pattern
03-08-20	Ather Energy Factory Building, Hosur	Swim lane Diagram - Design Delivery Flow Chart	19-08-20	Conventional Project Management Practices	Design Stage Life cycle - Script Writing
04-08-20	Ather Energy Factory Building, Hosur	Swim lane Diagram - Design Delivery Flow Chart	20-08-20	Conventional Project Management Practices	Design Stage Life cycle - Formats
05-08-20	Ather Energy Factory Building, Hosur	Revision of Swim lane Diagram - Design Delivery Flow Chart	21-08-20	Conventional Project Management Practices	Design Stage Life cycle - Formats
06-08-20	Conventional Project Management	PMC, Architectural, Structural and Costing & Estimation- Design Thinking	07-12-20	SS Logistics	SS Logistics Introduction

DATE	PROJECT NAME	WORK DONE
08-12-20	MRM Construction, Chennai	Introduction & Study of Drawings
09-12-20	MRM Construction, Chennai	Scope Preparation
10-12-20	MRM Construction, Chennai	WBS Preparation
11-12-20	MRM Construction, Chennai	Presentation - MRM Meet Preparation
14-12-20	MRM Construction, Chennai	Drawing Register - Ulundai
15-12-20	MRM Construction, Chennai	Drawing Register - Irungattukottai
16-12-20	MRM Construction, Chennai	Work flow Chart- Construction Project Management
17-12-20	SS Logistics, Iggalur	SS Logistics - Drawing & B.o.q Study
22-12-20	SS Logistics, Iggalur	Scope Preparation
23-12-20	SS Logistics, Iggalur	WBS Preparation
24-12-20	SS Logistics, Iggalur	Work flow Chart- Project Management
25-12-20	SS Logistics, Iggalur	2 Weeks Look Ahead Schedule
26-12-20	SS Logistics, Iggalur	Weekly Production Plan
28-12-20	Proposed School, Chitrakoota	Drawing Study
28-12-20	Proposed School, Chitrakoota	Scope Document Preparation
29-12-20	MRM Construction, Chennai	Weekly Tracking System at Site - Design Thinking
31-12-20	MRM Construction, Chennai	Weekly Tracking System at Site - A3 & A2 Format Preparation

Chief Architect Signature:

S. Kumar

Office seal:



TABLE OF CONTENTS

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1.	GENERAL	01
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ABOUT THE FIRM

Engineering Project Management Consultancy and Research Private limited (EPMCR (P) LTD) is a professional Engineering and Project Management Consultancy company incubated by IIT Madras and formed with a vision “to enable a quality Indian Infrastructure development within time and budget through our Engineering, Project Management, Research and Training Services.

OBJECTIVE OF TRAINING

Objective of the training is to understand the field works, opportunities to experience the essential practical tasks emphasised in the professional study and also to provide opportunities to apply acquired skills and knowledge in their work life

REASON FOR CHOOSING

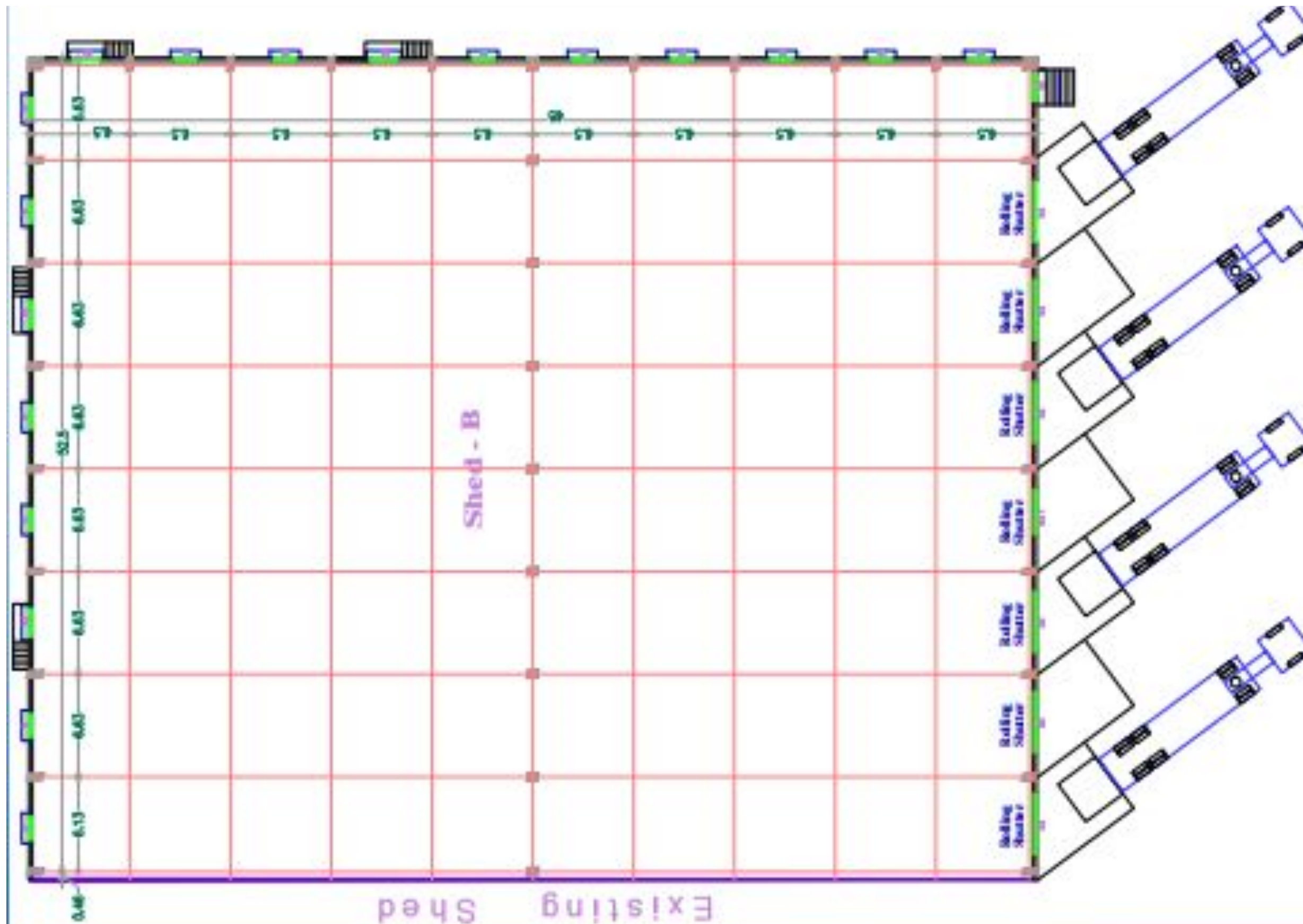
In this organization they practice innovation in construction technology and Management techniques through continuous research & cost effective solution to improve productivity through waste reduction and other new technologies.it was more interesting to learn new tools to solve the problem

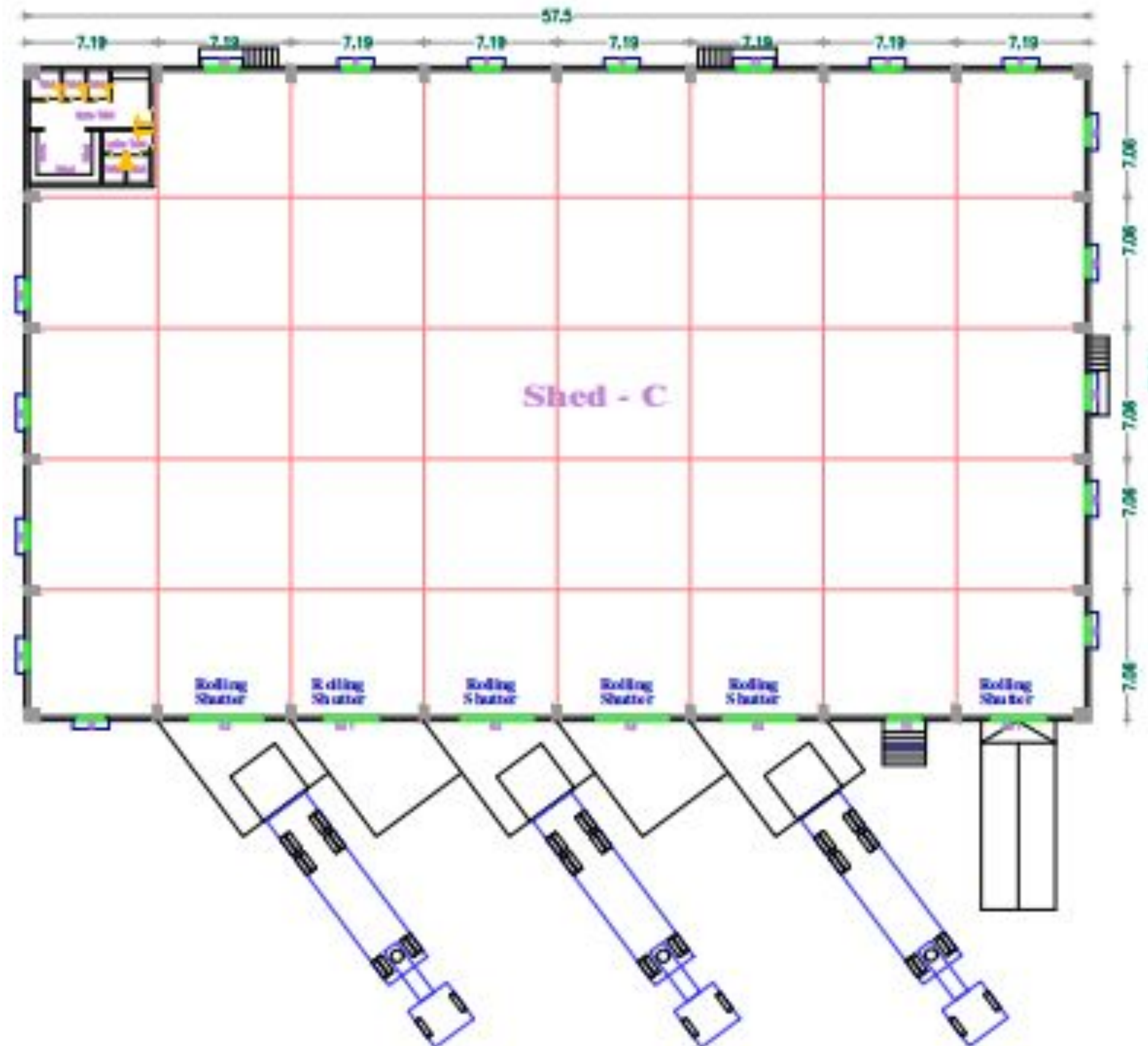
ROLES AND RESPONSIBILITIES

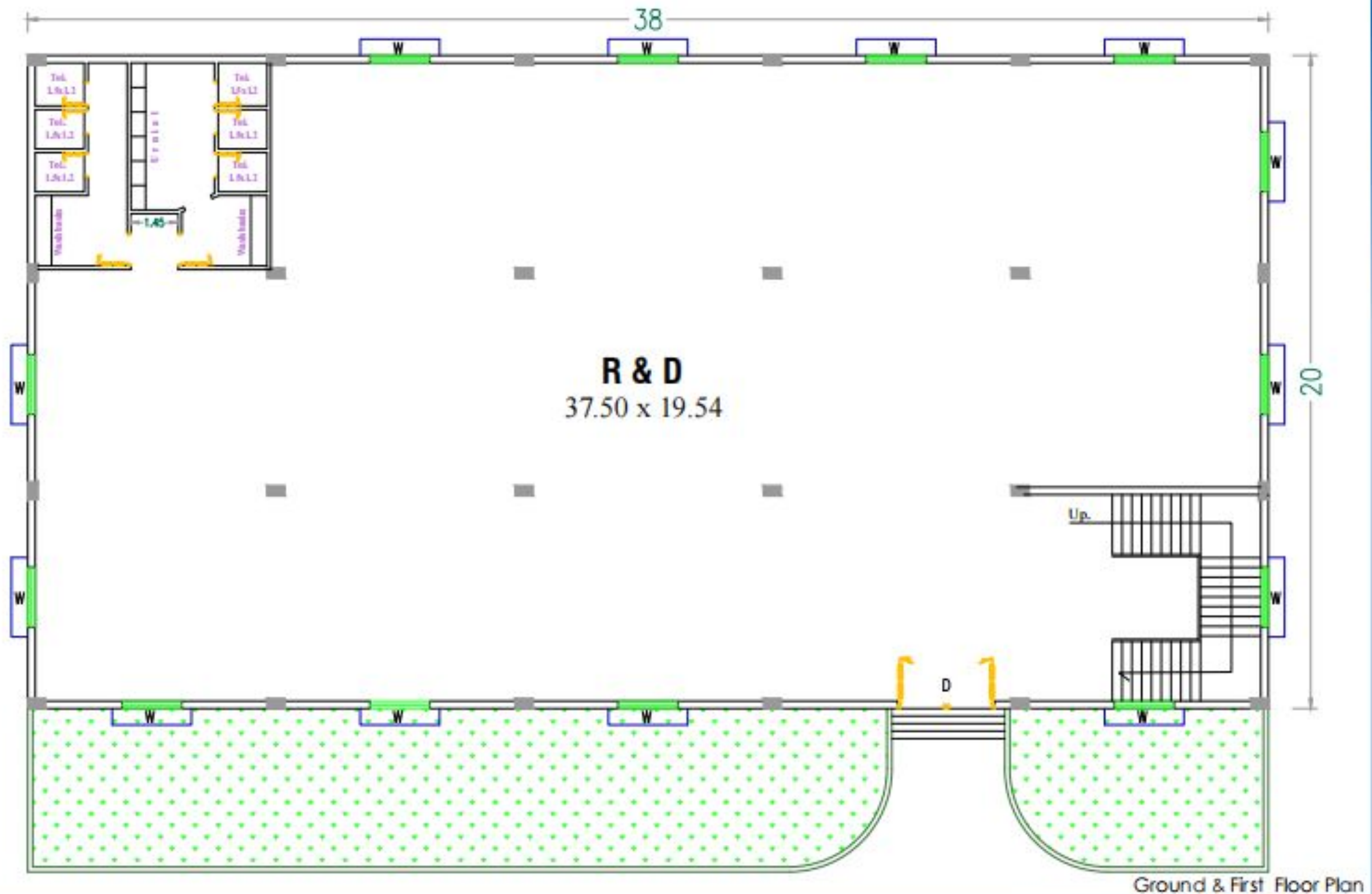
I was working in Architectural team, project Management team and also involved in research projects



MRM CONSTRUCTION, CHENNAI







PROJECT BACKGROUND:

Client has appointed EPMCR, Chennai as a Construction Management Consultant for the proposed Construction of PEB Building at Thodukadu & Irungattukottai, Chennai, Tamilnadu, Chennai.

Irungattukottai - Project Information

	BLOCK B	BLOCK C	BLOCK D
Total Site Area	4.135 ACRES / 16732 Sq.M		
Built up Area	38609 Sq.m	2490 Sq.m	760 Sq.m
Total Built up Area	7119 Sq.m		
Length of Building	65m	57.5	38
Width	53m	35.2	19.55
Clear Height	9m,	9m middle- 10.84m, Block work- 2.8m	-
Set Back - North	4.16m	1.59	
Set Back - South	11.68m	11.85	11.47
Set Back - East	2.01m	1.5	6.74
Set Back - West	-	2.01	1.5
Ancillary Buildings	Security Room, Driver Room, Conference,		
Utility Provisions	HT Panel, EB, STP, Transformer		

SCOPE OF THE PROJECT:

- Enable / Review Project Drawing List
- Enable / Review Project Documentation
- Enable / Review Project Plan & Activity Checklist
- Enable / Review Construction Budget
- Enable / Review Billing Cycle
- Enable / Review Material Availability Check
- Enable / Review Waste Management (Inflow & Outflow)
- Enable / Review Quality Assurance & Quality Control Plan
- Enable / Review Safety Management
- Enable / Review Project Monitoring & Reporting
- Enable / Review B.O.Q Vs. Actual Quantity
- Enable / Review Subcontractor Billing
- Enable / Review Budget Vs. Actual Cost
- Enable / Review Progress Report

	BLOCK B	BLOCK C	BLOCK D
Column Number	27	26	24
Bays	9- Horizontal, 8- Vertical (2 Brazing)	5- Horizontal, 8- Vertical (2 Brazing)	-
Entry	RS- 7nos (4m x 4m), (3m x 4m) ,EE- 5nos	RS- 6nos (4m x 4m), (3m x 4m), EE- 4nos	Double leaf door- 3m
Number of Dock Parking	4	3	-
Site Entry Dimension	20.97m		
Site Exit Dimension	20.97m		
Vehicular Path Dimension	-		
NGL	9.30m		
FFL	10.2 m	10.2m	9.75m

Thodukadu - Project Information

	BLOCK A	BLOCK B
Built up Area	5757 Sq.m	3188 Sq.m
Total Built up Area	8945 Sq.m	
Length of Building	101m (Building), Canopy -106m	71.86 m
Width	57m (Building), Canopy- 5m	80.61m
Clear Height	9 m (Block work-3.123m, Mezzanine-3.5m, Canopy-4.2m)	-
Set Back - North	8.9m	7m
Set Back - South	12.5m	12m
Set Back - East	9m	17.14m
Set Back - West	7.3m	6.82m
Ancillary Buildings	Security Room,	
Utility Provisions	HT Panel, EB, Pump, Raw water sump.	

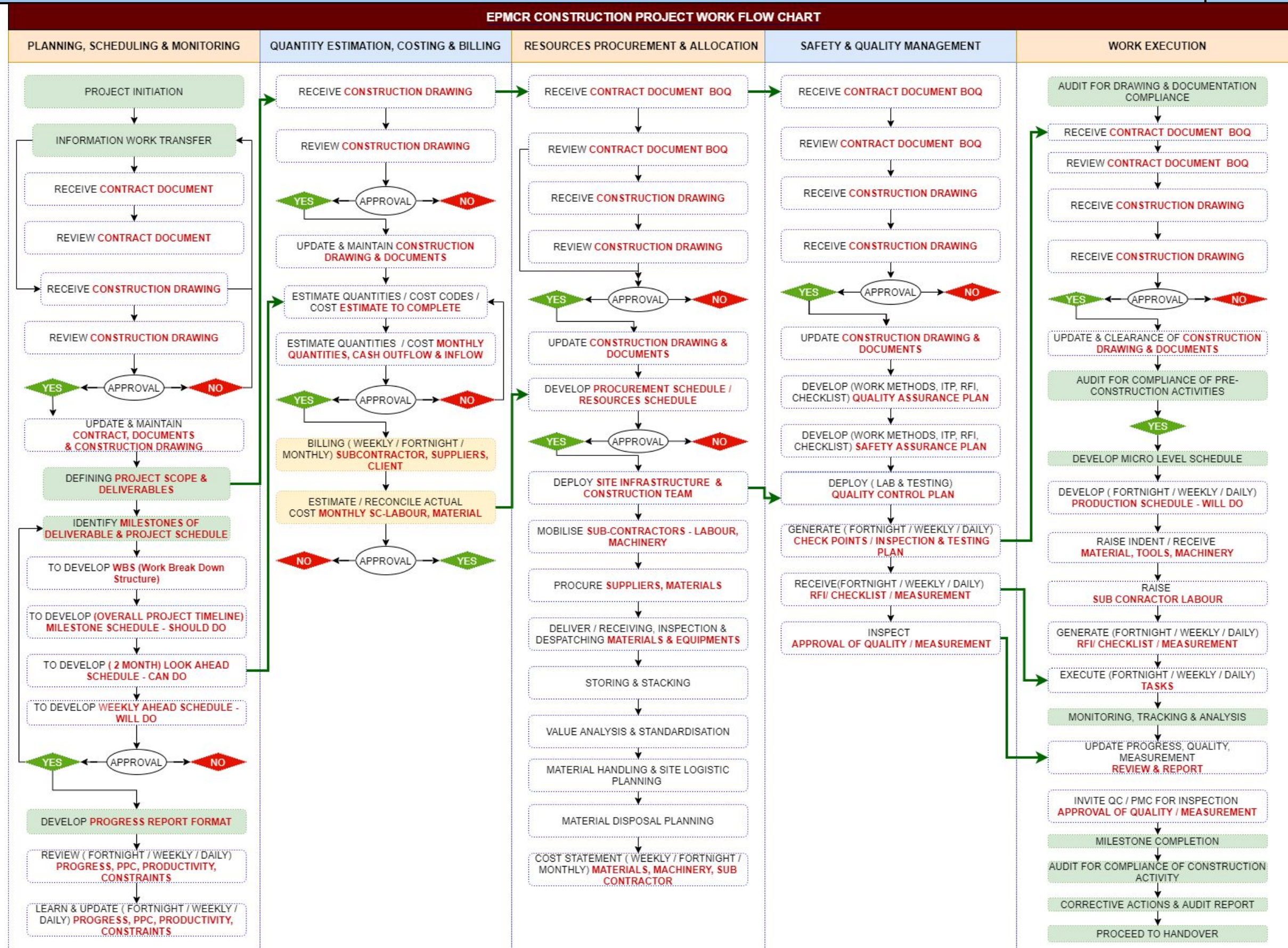
	BLOCK A	BLOCK B
Column Number	49	42
Bays	14- Horizontal (4 Brazing), 8- Vertical (1Brazing)	11- Horizontal , 12- Vertical
Entry	RS- 5nos,EE- 4nos (4m x 4m)	RS- 4nos,EE- 5nos (4m x 4m)
Number of Dock Parking	5	3
Site Entry Dimension	12m	
Site Exit Dimension	23m	
Vehicular Path Dimension	12m	

S.NO	MILESTONE
CONSTRUCTION PHASE	
1	Mobilization of Equipment ,Site Office and Labour shed
2	LAND DEVELOPMENT
2.1	Site Clearance work
2.2	Survey and Marking
2.3	Site grading
2.4	Filling of Soil Upto FGL
3	PRE ENGINEERED BUILDING WORK
3.1	PEB EXECUTION WORK
3.1.1	Material Procurement
3.1.1.1	Structural steel
3.1.1.2	Roofing and Cladding sheets
3.1.1.3	Louvers and roofing vent
3.1.1.4	Rolling shutters, Window Grills, Doors and Fire
3.1.1.5	Doors
3.1.1.6	Dock Levellers
3.1.1.7	UPVC Windows
4	Civil Work
	Sub Structure
4.1	Footing
4.1.1	Foundation Marking
4.1.2	Excavation
4.1.3	Dust Filling
4.1.4	Soil Dressing
4.1.5	PCC
4.1.6	Rebar work
4.1.7	Shuttering and Concreting
4.1.8	Deshuttering and Curing
5	Grade Beam
6	Pedestal
6.1	Pedestal Reinforcement
6.2	Pedestal column Shuttering

6.3	Anchor Bolt fixing
6.4	Pedestal Column Concreting
6.5	RR Masonry Upto FFL
6.6	Basement Earth Filling and Compaction
6.7	PCC Subgarde
	Super Structure
7	Blockwork Above FFL
8	Blockwork Internal Plastering above FFL
9	Blockwork External Plastering above FFL
10	Internal and External painting
11	PEB Erection and Fabrication
11.1	Erection of Primary members
11.2	Erection of secondary members
11.3	Erection of Roofing Sheets
11.4	Erection of Wall Cladding Sheets
11.5	Rolling shutters, Windows(Grills, Frames, shutters) , Doors(Grills,
11.6	Dock Levellers
11.7	Windows
12	CIVIL WORK- (FOR MAIN PLANT, UTILITY BLOCKS & INFRA WORK)
12.1	UG Sump
12.2	Raw Water Tank
12.3	Pump Room
12.4	STP
12.5	Collection tank
12.6	Security cabin
12.7	Driver Rest Area
12.8	Substation & EB yard
12.9	Plumbing and Sanitary works
12.1	Storm water drain
12.11	Concrete Road
13	Close out and Handover

HEADING: MRM CONSTRUCTION- PROJECT WORK FLOW CHART

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HEADING: MRM CONSTRUCTION-ULUNDAI- LIST OF DRAWINGS

Page No.: 10

 Engineering Project Management Consultancy & Research Pvt. Ltd. <i>- An IIT Madras Incubated Company</i> No. 2B, Balaji Nagar Main Road, Bharathi Avenue, New Perungalthur, Chennai - 600 063. T: 044 2274 3332. E: projects@epmcr.co.in						
Client:	MRM Construction				Job ID:	Page No: 1
Project:	Construction of warehouse at Ulundai				Date:	09-12-2020
Job:	Construction Audit				Doc. ID:	MRM-CM-001
Job Type:	Construction Management				Rev. No:	R1
					Checked By:	
					Reviewed By:	
					Approved By:	
A: List of Drawings Received						
S.No.	Drawing / Document Title	Title	No. of Copies	Rev.	Date	Remarks
1	G.A Drawings A Block	Cross Section @ GL 1,2,4,6,8,10,12			19.11.2020	PDF
2	G.A Drawings A Block	Cross Section @ GL 3,7,9,13			19.11.2020	PDF
3	G.A Drawings A Block	Cross Section @ GL- 5,11			19.11.2020	PDF
4	G.A Drawings A Block	Cross Section @ GL -14			19.11.2020	PDF
5	G.A Drawings A Block	Roof Framing Plan			19.11.2020	PDF
6	G.A Drawings A Block	Canopy Framing Plan			19.11.2020	PDF
7	G.A Drawings A Block	Side Wall Framing Elevation @ GL-A			19.11.2020	PDF
8	G.A Drawings A Block	Interior Framing Elevation @ GL-E			19.11.2020	PDF
9	G.A Drawings A Block	End Wall Framing Elevation @ GL-1			19.11.2020	PDF
10	G.A Drawings A Block	End Wall Framing Elevation @ GL-15			19.11.2020	PDF
11	G.A Drawings A Block	Mezzanine Layout Plan			19.11.2020	PDF
12	G.A Drawings A Block	Sectional View			19.11.2020	PDF
13	G.A Drawings A Block	Crane Beam Layout			19.11.2020	PDF

HEADING: MRM CONSTRUCTION-ULUNDAI- LIST OF DRAWINGS

Page No.: 11

14	G.A Drawings B Block	Cross Section @ GL- 1 to 8			28.11.2020	PDF
15	G.A Drawings B Block	Cross Section @ GL- G,H,J,K & L			28.11.2020	PDF
16	G.A Drawings B Block	Roof Framing Plan			28.11.2020	PDF
17	G.A Drawings B Block	Side Wall Framing Elevation			28.11.2020	PDF
18	G.A Drawings B Block	Side Wall Framing Elevation @ GL-9			28.11.2020	PDF
19	G.A Drawings B Block	Framing Elevation			28.11.2020	PDF
20	G.A Drawings B Block	End Wall Framing Elevation @ GL-13			28.11.2020	PDF
21	G.A Drawings B Block	End Wall Framing Elevation @ GL-M			28.11.2020	PDF
22	G.A Drawings B Block	Crane Beam Layout			28.11.2020	PDF
23	A Block Sie Plan	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	PDF
24	A Block Column Footing	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	PDF
25	B Block Sie Plan	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	PDF
26	B Block Column Footing	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	PDF
27	Master Layout	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	PDF
28	Block A Structure	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	CAD
29	Block B Structure	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	CAD
30	Master Layout	Proposed Factory Shed @ Thodukadu		R5	08.08.2020	CAD

HEADING: MRM CONSTRUCTION- IRUNGATTUKOTTAI- LIST OF DRAWINGS

Page No.: 12

 Engineering Project Management Consultancy & Research Pvt. Ltd. <i>- An IIT Madras Incubated Company</i> No. 2B, Balaji Nagar Main Road, Bharathi Avenue, New Perungalthur, Chennai - 600 063 . T: 044 2274 3332 . E: projects@epmcr.co.in						
Client:	MRM Construction			Job ID:		Page No: 1
Project:	Construction of warehouse at Irungattukottai			Date:	10-12-2020	
Job:	Construction Audit			Doc. ID:	MRM-CM-002	
Job Type:	Construction Management			Rev. No:	R1	
				Checked By:		
				Reviewed By:		
				Approved By:		
A	List of Drawings Received					
S.No.	Drawing / Document Title	Title	No. of Copies	Rev.	Date	Remarks
Drawings						
1	Erection Drawing- C Block	Part Marking Plan			20.10.2020	PDF
2	Erection Drawing- C Block	Cross Section			09.11.2020	PDF
3	Erection Drawing- C Block	Roof Framing Plan			09.11.2020	PDF
4	Erection Drawing- C Block	Side Wall Framing Elevation			09.11.2020	PDF
5	Erection Drawing- C Block	End wall Framing elevation @ GL-9			09.11.2020	PDF
6	Erection Drawing- C Block	End wall Framing elevation @ GL-1			09.11.2020	PDF
7	Erection Drawing- C Block	Roof Monitoring Plan			09.11.2020	PDF
8	Shed- B GA Drawing	Anchor Bolt Layout Plan			19.10.2020	PDF
9	Shed- B GA Drawing	Anchor Bolt Details			19.10.2020	PDF
10	Shed- B GA Drawing	Cross Section			19.10.2020	PDF
11	Shed- B GA Drawing	Roof Framing Plan			19.10.2020	PDF
12	Shed- B GA Drawing	Side Wall Framing Elevation			19.10.2020	PDF
13	Shed- B GA Drawing	End wall Framing elevation @ GL-9			19.10.2020	PDF
14	Shed- B GA Drawing	Framing elevation @ GL- F & L			19.10.2020	PDF
15	Shed- B GA Drawing	Roof Monitoring Plan			19.10.2020	PDF
16	Shed- C GA Drawing	Anchor Bolt Layout Plan			20.10.2020	PDF

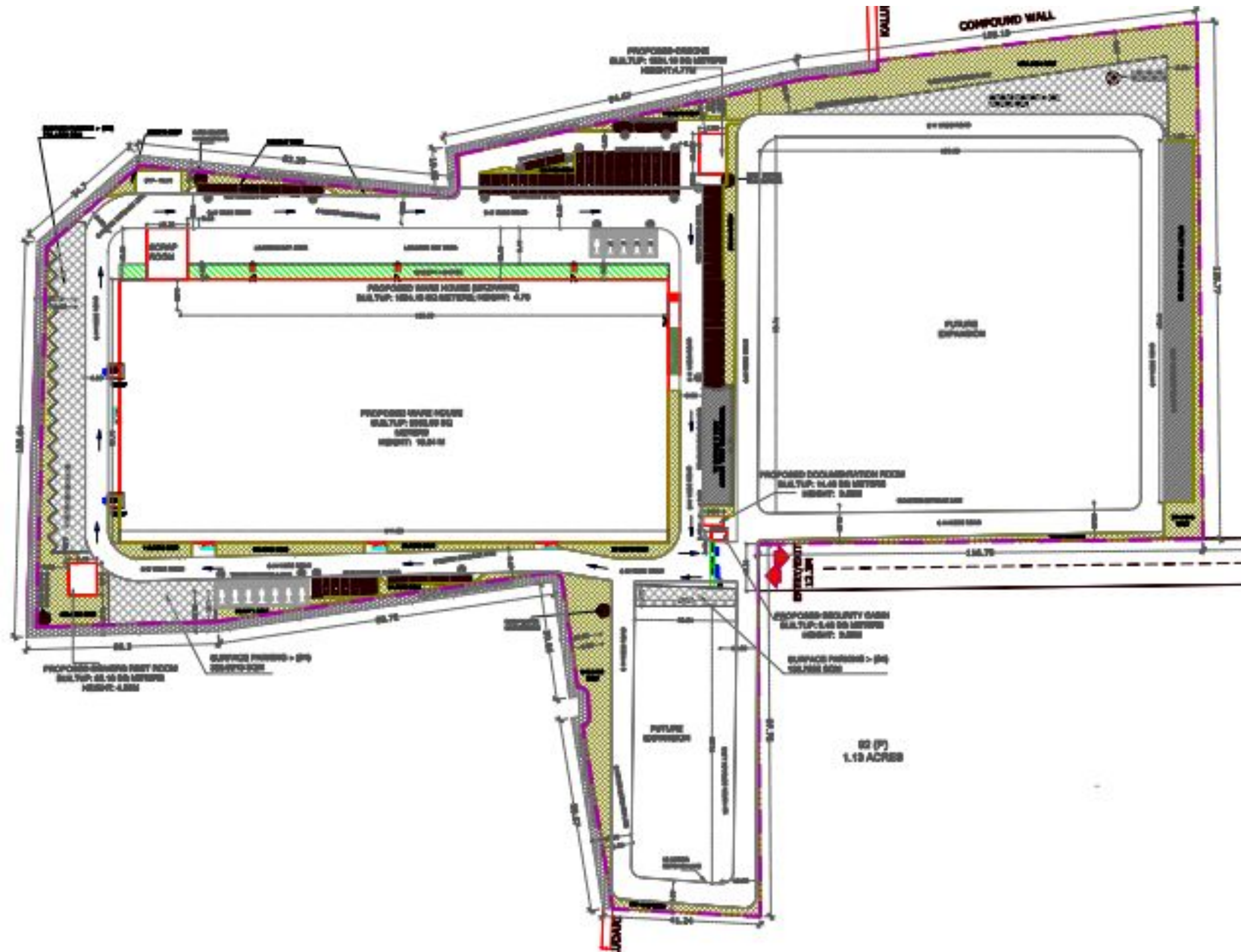
HEADING:MRM CONSTRUCTION-IRUNGATTUKOTTAI- LIST OF DRAWINGS

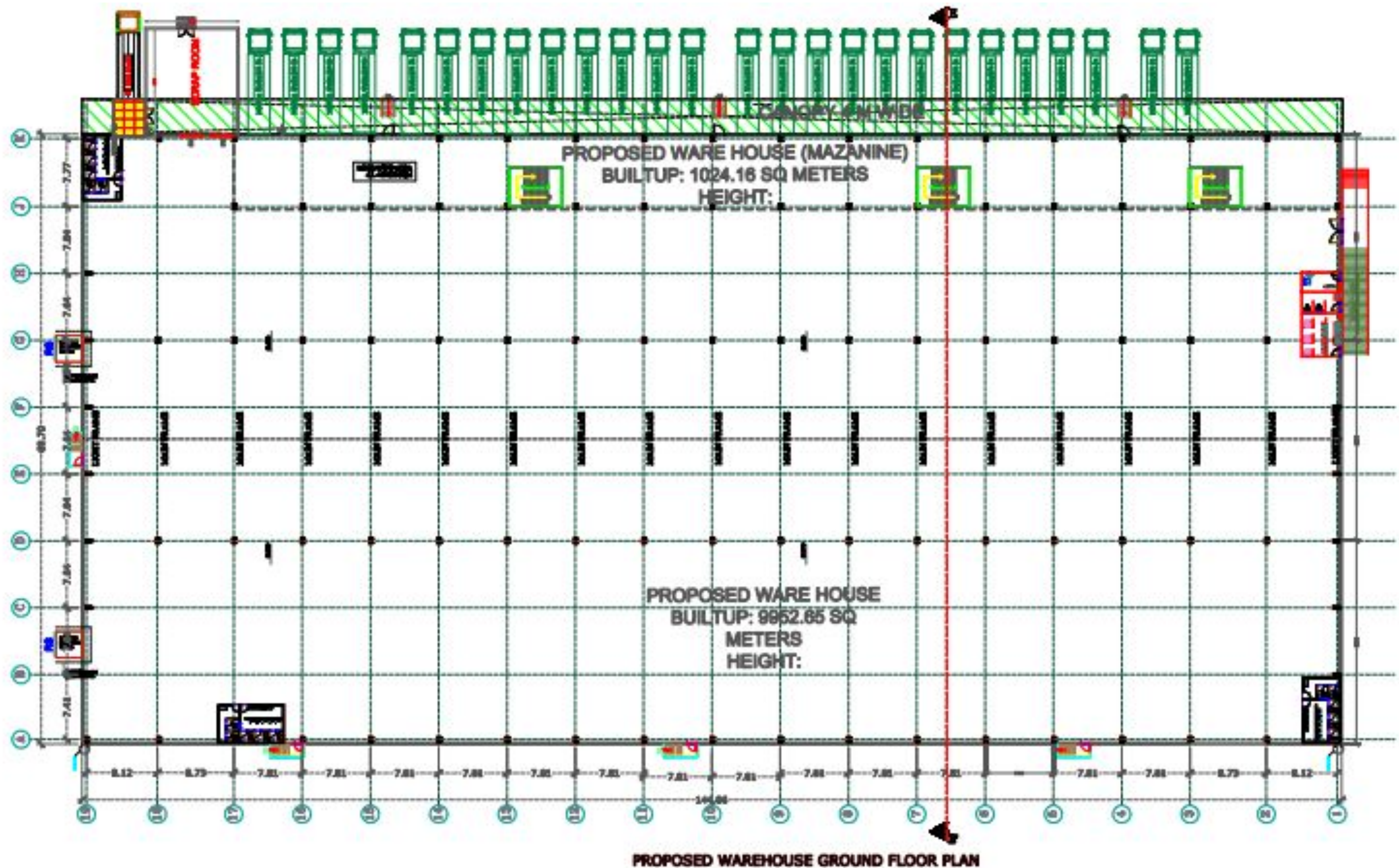
Page No.: 13

17	Shed- C GA Drawing	Cross Section			20.10.2020	PDF
18	Shed- C GA Drawing	Roof Framing Plan			20.10.2020	PDF
19	Shed- C GA Drawing	Side Wall Framing Elevation @ GL- A			20.10.2020	PDF
20	Shed- C GA Drawing	End wall Framing elevation @ GL-9			20.10.2020	PDF
21	Shed- C GA Drawing	End wall Framing elevation @ GL-1			20.10.2020	PDF
22	Shed- C GA Drawing	Roof Monitoring Plan			20.10.2020	PDF
23	Survey Drawings	Topographical Survey Map			21.07.2020	PDF
24	B & C Structural Details	Pile & Column Details			22.08.2020	PDF
25	B & C Block	Block Scheme			22.08.2020	PDF
26	B - C Centerline	B & C Centerline			22.08.2020	PDF
27	D Scheme	D- Block Scheme			22.08.2020	PDF
28	D Centerline	D Centerline Layout			03.11.2020	PDF
29	D Roof Details	Roof and Beam Layout			03.11.2020	PDF
30	D structural Detail	D- Block structural Detail			03.11.2020	PDF
31	D Terrace Drawing	Roof and Beam Layout			22.08.2020	PDF
32	Master Layout	Site Master Plan			21.07.2020	PDF
33	Survey Drawings	Topographical Survey Map			21.07.2020	CAD
34	Master Layout	Site Master Plan			21.07.2020	CAD
Documents						
35	Shed- B BOQ	Shed- B BOQ Main Factory Building			25.11.2020	EXCEL
36	Shed- C BOQ	Shed- C BOQ Main Factory Building			25.11.2020	EXCEL
37	Shed- D BOQ	Block - D RCC Building BOQ			25.11.2020	EXCEL



SS LOGISTICS, BANGALORE





HEADING: SS LOGISTICS- DRAWING DETAILS

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SS LOGISTICS- MAIN BUILDING FEATURES		
SL. NO.	DESCRIPTION	DIMENSION / NUMBER
1	Site Entry	12.3 m
2	Exterior Road Width	12.3 m
3	Site Exit	12.3 m
4	Warehouse	9952 Sq. m
5	Main building Setback	8 m
6	Main Building North Road Width	9 m
7	Main Building South Road Width	6 m
8	Main Building East Road Width	6 m
9	Main Building West Road Width	6 m
10	Fire Exit from building	7 m wide exit, 7 Nos.
11	Fire Control Room	3m x 8.5m
12	Canopy for the dock	128m x 4m
13	Building Entry	7 m; 6 Nos.
14	Mezzanine	1024 Sq.m; height= 5 & Clear ht below= 4.5m
15	Staircase connecting to Mezzanine	3 Nos; 1.5 m wide
16	Dumbwaiter	2 Nos.; 1.5m x1.5m
17	Ramp Slope	3m Wide; 12m; 1:10 Ratio
18	Scrap Room	15m x 10.75m
19	Driver's Rest Room	62.16 Sq.M
20	Sewage Collection Tank 1	4m x 6.25m
21	Sewage Collection Tank 2	4m x 6.25m
22	Sewage Collection Tank 3	3.2m x 4.55m
23	UG Sump	4m x 4m
24	STP 1	20KLD; 2.5m x 12m
25	STP 2	20KLD; 2.5m x 12m
26	Rainwater Harvesting Pit	4 Nos. at each Corner
27	Pedestrian Pathway	3m; 0.35Acres/ 1426 Sqm
28	Truck Parking	23 Nos; 3.5m x 10m

29	Mini Truck Parking	7 Nos; 3.5m x 7.5m
30	Car Parking	75 Nos; 2.5m x 5.5m
31	Bike Parking	257 Nos, 1m x 2m
32	Bus Parking	2.5m x 8.25m; 2 No
33	Ambulance Parking	2.5m x 8.25m; 1 No
34	Dock Leveler	14 Nos.; 2m x 3m
35	Proposed Creche	1024 Sq. m
36	Transformer Yard	6m x 6m
37	Substation	15m x 7m
38	DG Yard 1	10m x 3.5m
39	DG Yard 2	10m x 3.5m
40	Utility Area	31m x 8m
41	Document Room	6m x 2m
42	Security Cabin	4m x 2.4m
43	Porta Cabin	4m x 2.4m

SS LOGISTICS- BUILDING FEATURES - FUTURE EXPANSION 01

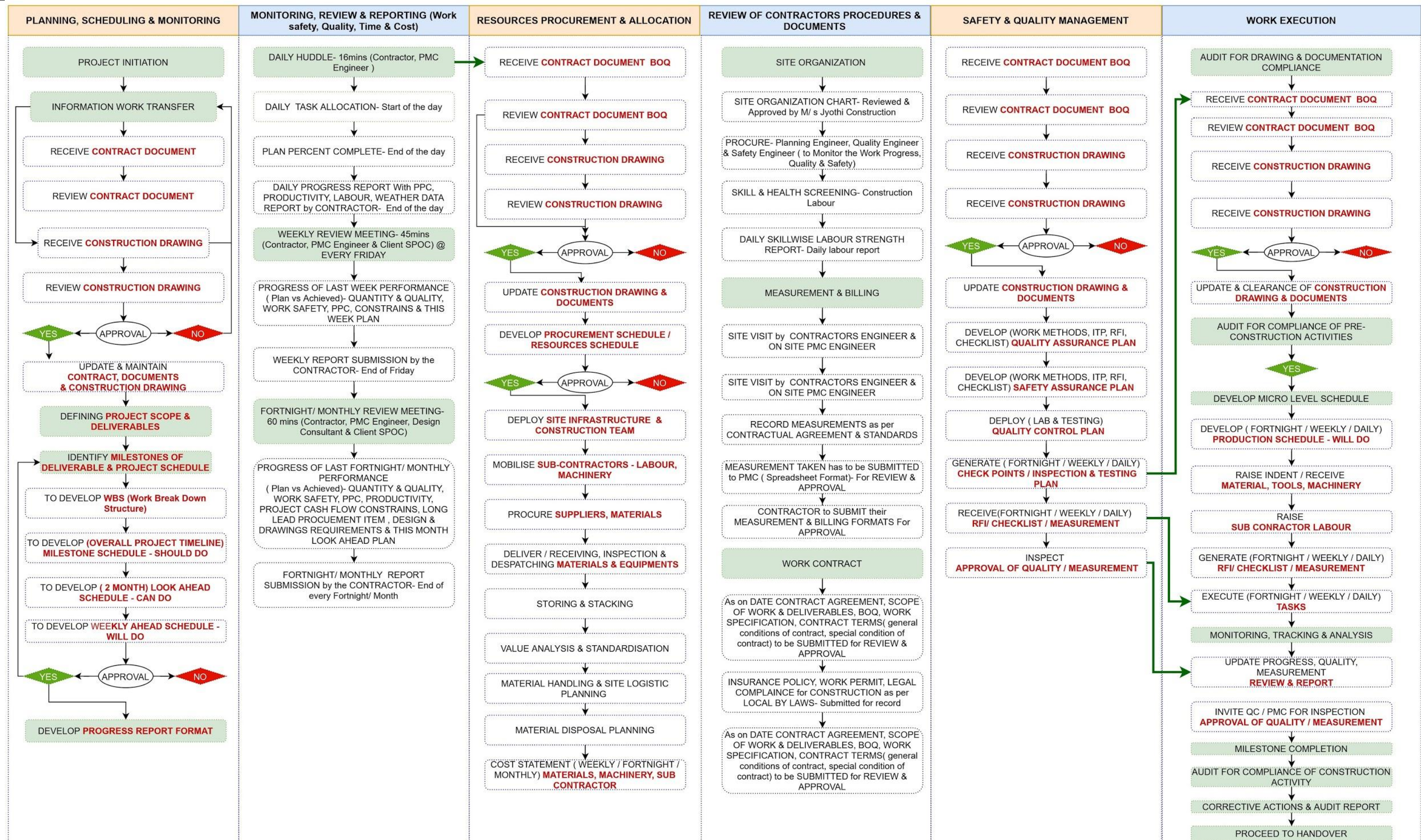
SL. NO.	DESCRIPTION	DIMENSION / NUMBER
1	Site - Future Expansion 01	100m x 99m
2	Site Setback	10 m
3	Site North Road Width	6 m
4	Site South Road Width	6 m
5	Site East Road Width	6 m
6	Site West Road Width	6 m

SS LOGISTICS- BUILDING FEATURES - FUTURE EXPANSION 02

SL. NO.	DESCRIPTION	DIMENSION / NUMBER
1	Site - Future Expansion 02	73m x 27m
2	Site Setback	8 m
3	Site North Road Width	6 m
4	Site South Road Width	6 m
5	Site East Road Width	6 m
6	Site West Road Width	6 m

HEADING: SS LOGISTICS- WORKFLOW PROCESS

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DESIGN THINKING - TO DEVELOP PLANNING & TRACKING SYSTEM FOR INDUSTRIAL PROJECT

TRENDS & TECHNOLOGY							
SITE	CIVIL	PEB	ELECTRICAL & LIGHTING	PLUMBING & SANITATION	FIRE	INTERIOR	HVAC
Site Clearance. Survey & Marking Site Grading Filling upto FGL. Site Office. Water Connection Electricity Road Labour Shed Site Infrastructure Compound Wall Fencing Gate	Survey & Marking Excavation Dust Filling Soil Dressing Pcc Dewatering Rebar Work Shuttering & Concreting. Deshuttering Curing. Grade Beam Plinth Beam. Pedestal. Anchor Bolt. Fixing RR Masonry Earth Filling & Compaction. Stiffener Column.	Purlin Rafter. Columns. Beams Eaves. Girt. Struts. Roof Sheet Wall Sheet Bracing Angles. Wall Cladding Plates Bolts Welding Louvers Roofing Vent E.O.T Cranes Rolling Shutter.	Substation DG Yard Diesel Storage Access Control System. Server Room Hv & Mv Panel. Electrical Room. Control Panel Room Maintenance Room Cabling DB Earthing Lighting Arrestor Interior & Exterior Lighting. Emergency Light Socket & Switch Ups / Inverter Telecommunication Networking	UG Sump Bore Well OHT STP Manhole & Inspection Chamber Pump Stormwater Drainage. Trench, Sump RainWater Collection Sump. RainWater Harvesting. ETP Water Treatment. Treated Water Sump. Plumbing & Sanitary Fixtures & Accessories. Ac Sump	CCTV PAS Fire Control Panel Fire Suppression. Fire Door. Fire Alarm & Detection System. Fire Rated Materials Fire Sump Fire Pump Yard Hydrant.	False Ceiling Tiles Windows(Grills, Frames, Shutters) Painting Doors Partition Wall Wall Cladding Furnitures Machineries HandRails Electronic Gadgets	Air Conditioning Mechanical Ventilation. Exhaust Pressurization. Axial Fans Ducts Dampers Dehumidifier Co2, O2, H2, CO,Etc. Detector Thermostat VRF Refrigerant.

HEADING:SS LOGISTICS- TO DEVELOP PLANNING & TRACKING SYSTEM FOR INDUSTRIAL PROJECT

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STAKEHOLDERS	FACTS	PLACES	PAIN POINTS	ASPIRATION
Client Contractor Architect Consultant PMC MEP Consultant • Fire • HVAC • Electrical • Plumbing • Lighting • Telecommunication • False Ceiling & Partition Structural Consultant Sub Contractor Supplier Vendor Tenant Costing & Estimation Approval Government	Substructure(below ground work). Superstructure(above ground work) Main Building Primary & secondary member. Erection Area. Fabrication Area Planning Tools Excel Primavera CPM Last Planner Ms office A3 system PPC Value Stream Mapping Progress Tracking & Reporting Look ahead schedule Weekly work plan Flow chart Planning Method Structural based Bay wise Place Based Stakeholder Based Client Priority- Time, cost Contractor Priority- Cost.	Loading & Unloading Area. Dock Area Road Scrap Yard Main Building(Warehouse) Mezzanine Stp Rainwater Pits Pedestrian Pathway Drivers Rest area Truck Parking Car Parking Transformer Yard Sub station HT Room Creche Pump Room Surface Car Parking Documentation Room Security Cabin Entry & Exit Canopy Area Future Expansion Assembly point for fire protection Site office Labour Shed Store Material Storage / Disposal Diesel / DG Yard UG Sump, Fire Sump Connecting Corridor	Accountability Billing Quantities Increase in cost Man Management Team Coordination Lack of Technical & Technology Awareness Improper Report Submission Lack of construction bylaws Cost of Management Material Management Understanding Site Requirements Problem solving capacity Branding Deflection from pre planned schedule Improper planning Site communication Delay of material supply Clarity of drawings Documentation Delay of work process Zero safety Site waste management Lack of collaboration Stagnant in productivity Lack of Quality Check Meeting the required demands Time Management Site infrastructure	Clear Work plan Achieving Targets Less wastage Reduce Cost Improve quality Proper Information Flow Workers safety Timely Approval In Accordance to work front availability Cost report Online material delivery On time subcontractor payment On time payment from client Learning from projects Branding Organized site infrastructure



FORMAT FOR 2 OR 6 WEEK LOOK AHEAD SCHEDULE DEVELOPED BY US BY UNDERSTANDING THE EXISTING 2 OR 6 WEEK LOOK AHEAD SCHEDULE

WORK PACKAGES	MONTH 01							
	WEEK 01		WEEK 02		WEEK 03		WEEK 04	
Package 01	Activity ID		Activity ID		Activity ID		Activity ID	
	Activity Name		Activity Name		Activity Name		Activity Name	
	Location Id		Location Id		Location Id		Location Id	
	Structure Id		Structure Id		Structure Id		Structure Id	
	Scope Quantity		Scope Quantity		Scope Quantity		Scope Quantity	
	Resources		Resources		Resources		Resources	
	Resp. Person		Resp. Person		Resp. Person		Resp. Person	
	Predecessor		Predecessor		Predecessor		Predecessor	
	Successor		Successor		Successor		Successor	
Package 02	Activity ID		Activity ID		Activity ID		Activity ID	
	Activity Name		Activity Name		Activity Name		Activity Name	
	Location Id		Location Id		Location Id		Location Id	
	Structure Id		Structure Id		Structure Id		Structure Id	
	Scope Quantity		Scope Quantity		Scope Quantity		Scope Quantity	
	Resources		Resources		Resources		Resources	
	Resp. Person		Resp. Person		Resp. Person		Resp. Person	
	Predecessor		Predecessor		Predecessor		Predecessor	
	Successor		Successor		Successor		Successor	
WORK PACKAGES	MONTH 02							
	WEEK 05		WEEK 06		WEEK 07		WEEK 08	
Package 01	Activity ID		Activity ID		Activity ID		Activity ID	
	Activity Name		Activity Name		Activity Name		Activity Name	
	Location Id		Location Id		Location Id		Location Id	
	Structure Id		Structure Id		Structure Id		Structure Id	
	Scope Quantity		Scope Quantity		Scope Quantity		Scope Quantity	
	Resources		Resources		Resources		Resources	
	Resp. Person		Resp. Person		Resp. Person		Resp. Person	
	Predecessor		Predecessor		Predecessor		Predecessor	
	Successor		Successor		Successor		Successor	
Package 02	Activity ID		Activity ID		Activity ID		Activity ID	
	Activity Name		Activity Name		Activity Name		Activity Name	
	Location Id		Location Id		Location Id		Location Id	
	Structure Id		Structure Id		Structure Id		Structure Id	
	Scope Quantity		Scope Quantity		Scope Quantity		Scope Quantity	
	Resources		Resources		Resources		Resources	
	Resp. Person		Resp. Person		Resp. Person		Resp. Person	
	Predecessor		Predecessor		Predecessor		Predecessor	
	Successor		Successor		Successor		Successor	



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WEEK 1

Release of GFC Drawing

ACTIVITY NAME: Master layout, Retaining Wall, Road Detail, Main building foundation layout & detail drawing	
LOCATION (S)	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

Utility Structure Detail Drawing

WEEK 5

ACTIVITY NAME: Stp, Sub station, DG Yard, Sewage Tank, IRN Room, Sewage Treated Tank, Drivers Room, Creche., Transformer yard & pump room.	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Work-Survey & Marking

WEEK 2

ACTIVITY NAME: Survey & Marking	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 2

Vendor Appointment

ACTIVITY NAME: STP	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 3

ACTIVITY NAME: Fire Protection System	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 5

ACTIVITY NAME: Electrical	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Work-Survey & Marking

WEEK 2

ACTIVITY NAME: Excavation & Soil Dressing	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 1

Main Building Works- PEB

ACTIVITY NAME: Structural Design Calculation	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 2

ACTIVITY NAME: Approval of Structural Drawing, Approval of GA Drawings	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 3

ACTIVITY NAME: Final GA Drawing, Supply of Anchor Bolts, Fabrication & supply of PEB Members	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 4

ACTIVITY NAME: Supply of Anchor Bolts, Fabrication & supply of PEB Members	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK- 5, 6, 7, 8, 9, 10, 11, 12

ACTIVITY NAME: Fabrication & supply of PEB Members	
LOCATION	SCOPE QTY
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 2

Civil Work-Footing

ACTIVITY NAME: Footing (PCC, Reinforcement, Shuttering &	
LOCATION:	SCOPE QTY: PCC- 43 Pits, Reinforcement to Concreting- 9 footings
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 3

ACTIVITY NAME: Footing (Reinforcement, Shuttering &	
LOCATION:	SCOPE QTY: Reinforcement to Concreting- 9 footings
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 4

ACTIVITY NAME: Footing (Reinforcement, Shuttering & concreting), Deshuttering & Curing	
LOCATION:	SCOPE QTY: Reinforcement to Concreting- 9 footings, Deshuttering & Curing- 43Nos
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Work-Grade Beam

WEEK 4, 5

ACTIVITY NAME: Grade Beam	
LOCATION:	SCOPE QTY: 46m
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Work- Pedestal

WEEK 5

ACTIVITY NAME: Pedestal Reinforcement, Pedestal Column Shuttering, Anchor Bolt Fixing.	
LOCATION:	SCOPE QTY: 17 Columns
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 6

ACTIVITY NAME: Anchor Bolt Fixing, Pedestal Column Concreting.	
LOCATION:	SCOPE QTY: 17 Columns. Column Concreting - 9
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Works- Stiffener Column

WEEK 6

ACTIVITY NAME: Stiffener Reinforcement, Shuttering, Concreting	
LOCATION:	SCOPE QTY: Reinforcement Tying-29, Shuttering-12 Nos Concreting-9Nos
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 7

ACTIVITY NAME: Shuttering, Concreting	
LOCATION:	SCOPE QTY: Shuttering-12 Nos, Concreting-9Nos
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 8

ACTIVITY NAME: Concreting	
LOCATION:	SCOPE QTY: Concreting-9Nos
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Works- Masonry Up to FFL

WEEK 5

ACTIVITY NAME: Masonry up to Finished FFL	
LOCATION:	SCOPE QTY: 70m/Day
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 6

ACTIVITY NAME: Masonry up to Finished FFL	
LOCATION:	SCOPE QTY: 70m/Day
RESOURCES:	
PREDECESSOR ACTIVITY	

Civil Works- Basement Earth Filling & Compacting

WEEK 5

ACTIVITY NAME: Earth Filling & Compaction	
LOCATION:	SCOPE QTY: 1300 Sq.m/ day
RESOURCES:	
PREDECESSOR ACTIVITY	

WEEK 6

ACTIVITY NAME: Earth Filling & Compaction	
LOCATION:	SCOPE QTY: 1300 Sq.m/ day
RESOURCES:	
PREDECESSOR ACTIVITY	



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Look Ahead Schedule (Production Plan) - WEEK 1 (07.12.20- 13.12.20)								
Location	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Activity
					Master Layout			Good For Construction Drawing
					Retaining Wall Dwg			
					Road Detail Dwg			
					Main Building Foundation Layout & Detail Dwg			
					UG Sump			Utility Structural Detail Dwg
					Structural Design Calculation			Main Building- PEB Works
Look Ahead Schedule (Production Plan) - WEEK 2 (14.12.20- 20.12.20)								
Location	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Activity
		STP						Vendor Appointment Main Building- PEB Works
	Approval of Structural Design	Approval of GA Drawing	Approval of GA Drawing	Approval of GA Drawing	Approval of GA Drawing			
	Survey & Marking							Civil Work- Survey & Marking
North West - South East		Excavation, Soil Dressing	Excavation, Soil Dressing	Excavation, Soil Dressing	Excavation, Soil Dressing	Excavation, Soil Dressing		Civil Work- Excavation
		SCOPE QTY: 17 Pits (Column. Nos: 74, 76,85,84, 83, 82, 81, 80, 79,78,77, 75, 71,70, 72, 73, 69)	SCOPE QTY: 17 Pits (Column.Nos: 67, 68, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57,56,55, 54, 53, 52)	SCOPE QTY: 17 Pits (Column. Nos: 51,50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35)	SCOPE QTY: 17 Pits (Column.Nos: 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18)	SCOPE QTY: 17 Pits (Column.Nos: 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)		
			PCC	PCC				Civil Work- Footing
			SCOPE QTY: 43 Pits (Column.Nos: 74, 76,85,84, 83, 82, 81, 80, 79,78,77, 75, 71,70, 72, 73, 69, 67, 68, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57,56,55, 54, 53, 52, 51,50, 49, 48, 47, 46, 45, 44, 43)	SCOPE QTY: 43 Pits (Column. Nos: 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)				
					Reinforcement	Reinforcement	Reinforcement	
					SCOPE QTY: 9 No.of Footing / Day(Column. Nos- 70, 71, 75, 77, 78, 79, 80, 81, 82)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 83, 84, 85, 76, 74, 73, 72, 69, 68)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 67, 66, 65, 64, 63, 62, 61, 60, 59)	
						Shuttering & Concreting	Shuttering & Concreting	
						SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 70, 71, 75, 77, 78, 79, 80, 81, 82)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 83, 84, 85, 76, 74, 73, 72, 69, 68)	
Look Ahead Schedule (Production Plan) - WEEK 3 (21.12.20- 27.12.20)								
Location	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21	Activity
			Fire Protection System					Vendor Appointment



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	Final GA Dwg	Final GA Dwg	Final GA Dwg	Final GA Dwg	Supply of Anchor Bolts	Supply of Anchor Bolts		Main Building- PEB Works
					Fabrication & Supply of PEB Members			
	Reinforcement	Reinforcement	Reinforcement	Reinforcement	Reinforcement	Reinforcement	Reinforcement	Civil Work- Footing
	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 58, 57, 56, 55, 54, 53, 52, 51, 50)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 49, 48, 47, 46, 45,44, 43, 42, 41)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 40, 39, 38, 37, 36, 35, 34, 33, 32)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 31, 30, 29, 28, 27, 26, 25, 24, 23)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 22, 21, 20, 19, 18, 17, 16 , 15, 14)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 13, 12, 11, 10, 09, 08, 07, 06, 05)	SCOPE QTY: 4 No.of Footing / Day (Column. Nos- 04, 03, 02, 01)	
	Shuttering & Concreting	Shuttering & Concreting	Shuttering & Concreting	Shuttering & Concreting	Shuttering & Concreting	Shuttering & Concreting	Shuttering & Concreting	
	SCOPE QTY: 9 No.of Footing / Day (Column.Nos- 67, 66, 65, 64, 63, 62, 61, 60, 59)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 58, 57, 56, 55, 54, 53, 52, 51, 50)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 49, 48, 47, 46, 45,44, 43, 42, 41)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 40, 39, 38, 37, 36, 35, 34, 33, 32)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 31, 30, 29, 28, 27, 26, 25, 24, 23)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 22, 21, 20, 19, 18, 17, 16 , 15, 14)	SCOPE QTY: 9 No.of Footing / Day (Column. Nos- 13, 12, 11, 10, 09, 08, 07, 06, 05)	
Look Ahead Schedule (Production Plan) - WEEK 4 (28.12.20- 03.01.21)								
Location	Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28	Activity
	Supply of Anchor Bolts	Supply of Anchor Bolts						Main Building- PEB Works
					Fabrication & Supply of PEB Members			
	Shuttering & Concreting							Civil Work- Footing
	SCOPE QTY: 4 No.of Footing / Day (Column. Nos- 04, 03, 02, 01)							
		Deshuttering & Curing	Deshuttering & Curing					
		SCOPE QTY: 43 Pits (Column. Nos: 74, 76,85,84, 83, 82, 81, 80, 79,78,77, 75, 71,70, 72, 73, 69, 67, 68, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57,56,55, 54, 53, 52, 51,50, 49, 48, 47, 46, 45, 44, 43)	SCOPE QTY: 43 Pits (Column.Nos: 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)					Civil Work- Grading
			Grade Beam	Grade Beam		Grade Beam	Grade Beam	
			SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day		SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	
Look Ahead Schedule (Production Plan) - WEEK 5 (04.01.21- 10.01.21)								
Location	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35	Activity
	Stp, Sub station, DG Yard, Sewage Tank, IRN Room, Sweage Treated Tank, Drivers Room, Creche, Transformer yard & pump room							Utility Structural Detail Dwg
	Electrical							Vendor Appointment
					Fabrication & Supply of PEB Members			Main Building- PEB Works
	Grade Beam	Grade Beam	Grade Beam	Grade Beam	Grade Beam	Grade Beam		Civil Work- Grade Beam
	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day		
				Pedestal Reinforcement	Pedestal Reinforcement	Pedestal Reinforcement	Pedestal Reinforcement	



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				SCOPE QTY: 17 Columns / Day (Column.Nos: 70, 71, 75, 77, 78, 79, 80, 81, 82, 83, 84, 85, 76, 74, 73, 72, 69)	SCOPE QTY: 17 Columns / Day (Column.Nos: 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52)	SCOPE QTY: 17 Columns / Day (Column.Nos: 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35)	SCOPE QTY: 17 Columns / Day (Column.Nos: 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18)	Civil Work- Pedestal
					Pedestal Column Shuttering	Pedestal Column Shuttering	Pedestal Column Shuttering	
					SCOPE QTY: 17 Columns / Day (Column.Nos: 70, 71, 75, 77, 78, 79, 80, 81, 82, 83, 84, 85, 76, 74, 73, 72, 69)	SCOPE QTY: 17 Columns / Day (Column.Nos: 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52)	SCOPE QTY: 17 Columns / Day (Column.Nos: 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35)	
						Anchor Bolt Fixing	Anchor Bolt Fixing	
						SCOPE QTY: 17 Columns / Day (Column.Nos: 70, 71, 75, 77, 78, 79, 80, 81, 82, 83, 84, 85, 76, 74, 73, 72, 69)	SCOPE QTY: 17 Columns / Day (Column.Nos: 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52)	
				Masonry upto FFL	Masonry upto FFL	Masonry upto FFL	Masonry upto FFL	Civil Works- Masonry Up to FFL
				SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day	
					Basement Earth Filling & Compacting	Basement Earth Filling & Compacting	Basement Earth Filling & Compacting	Civil Works- Basement Earth Filling & Compacting.
					SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day	
Look Ahead Schedule (Production Plan) - WEEK 6 (11.01.21- 17.01.21)								
Location	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42	Activity
					Fabrication & Supply of PEB Members			Main Building- PEB Works
	Pedestal Reinforcement							Civil Work- Pedestal
	SCOPE QTY: 17 Columns / Day (Column.Nos: 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)							
	Pedestal Column Shuttering	Pedestal Column Shuttering						
	SCOPE QTY: 17 Columns / Day (Column.Nos: 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18)	SCOPE QTY: 17 Columns / Day (Column.Nos: 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)						
	Anchor Bolt Fixing	Anchor Bolt Fixing	Anchor Bolt Fixing					
	SCOPE QTY: 17 Columns / Day (Column.Nos: 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35)	SCOPE QTY: 17 Columns / Day (Column.Nos: 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18)	SCOPE QTY: 17 Columns / Day (Column.Nos: 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01)					
	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.					
	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 70, 71, 75, 77, 78, 79, 80, 81, 82)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 83, 84, 85, 76, 74, 73, 72, 69, 68)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 67, 66, 65, 64, 63, 62, 61, 60, 59)					
		Stiffener Reinforcement	Stiffener Reinforcement					

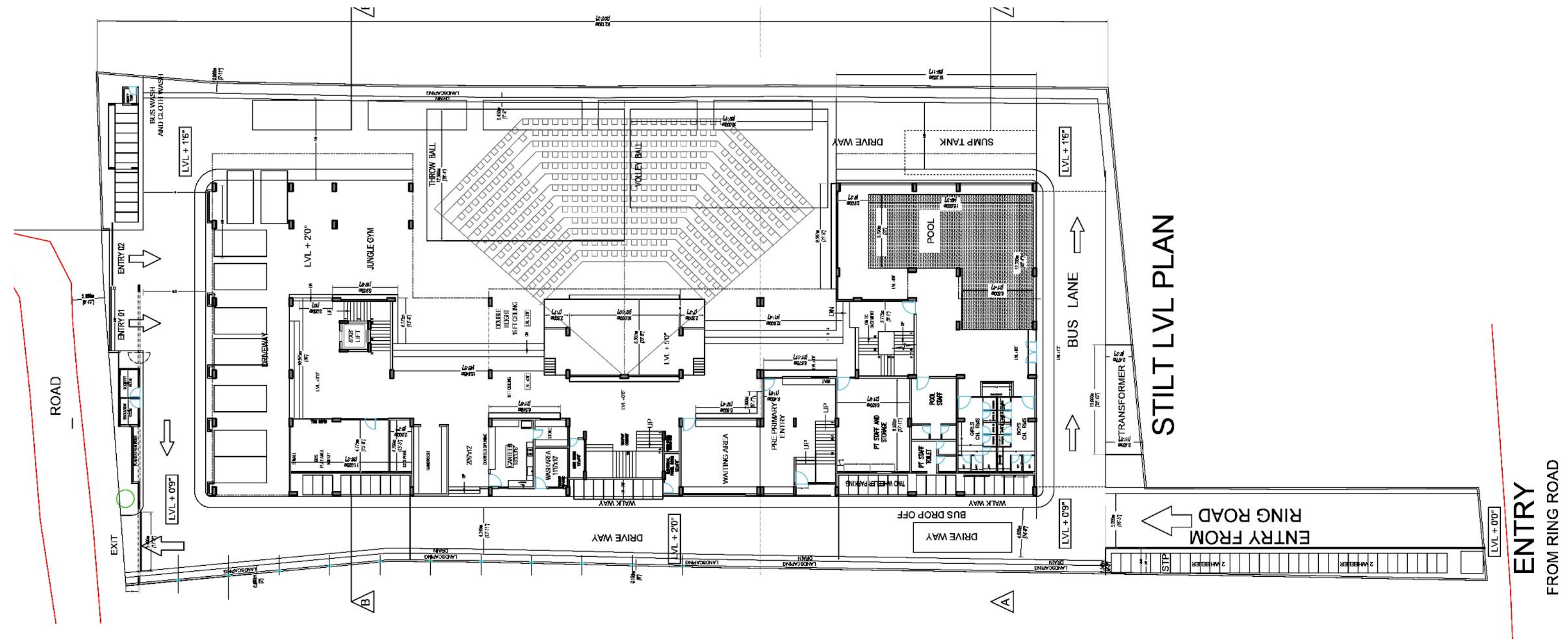
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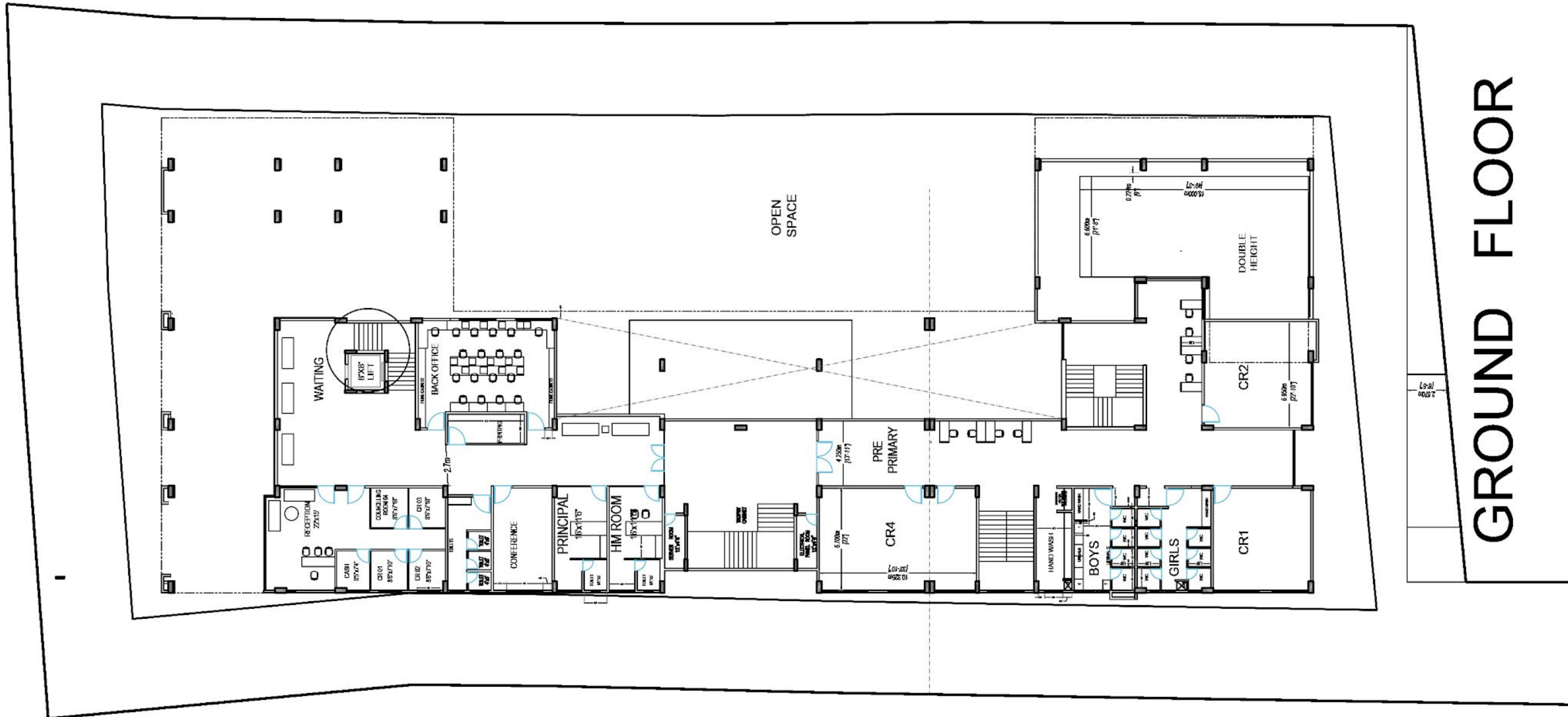
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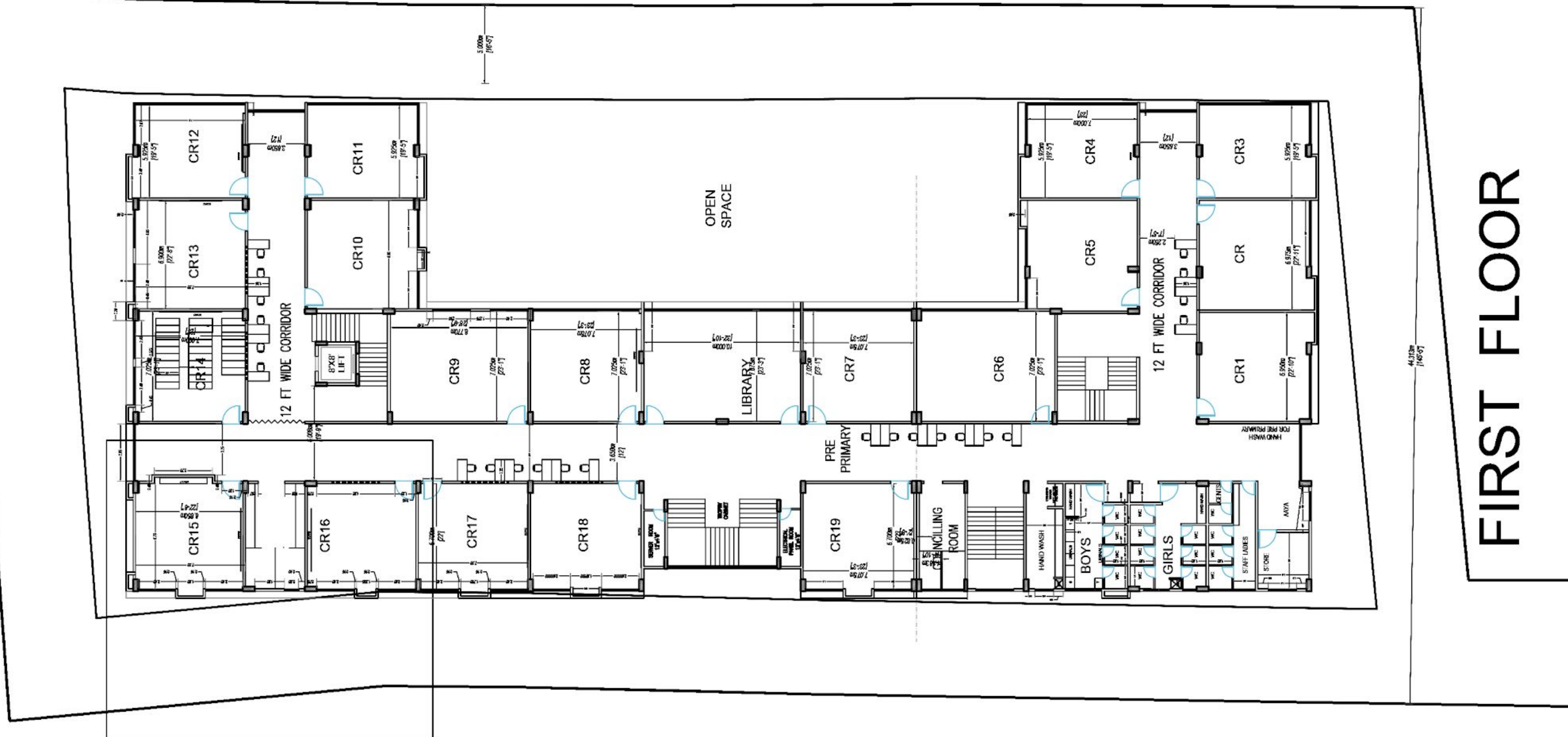
		SCOPE QTY: 29 Nos of Column / Day	SCOPE QTY: 29 Nos of Column / Day					
			Shuttering					
			SCOPE QTY: 12 Nos of Column / Day					
			Concreting					
			SCOPE QTY: 09 Nos of Column / Day					
	Masonry upto FFL	Masonry upto FFL	Masonry upto FFL	Masonry upto FFL				
	SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day	SCOPE QTY: 70m/Day				
	Basement Earth Filling & Compacting	Basement Earth Filling & Compacting	Basement Earth Filling & Compacting	Basement Earth Filling & Compacting	Basement Earth Filling & Compacting			
	SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day	SCOPE QTY: 1299 Sq.m / Day			
Look Ahead Schedule (Production Plan) - WEEK 7 (18.01.21- 24.01.21)								
Location	Day 43	Day 44	Day 45	Day 46	Day 47	Day 48	Day 49	Activity
					Fabrication & Supply of PEB Members			Main Building- PEB Works
	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Civil Work- Pedestal
	SCOPE QTY: 9 No.of Column / Day (Column. Nos- 58, 57, 56, 55, 54, 53, 52, 51, 50)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 49, 48, 47, 46, 45,44, 43, 42, 41)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 40, 39, 38, 37, 36, 35, 34, 33, 32)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 31, 30, 29, 28, 27, 26, 25, 24, 23)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 22, 21, 20, 19, 18, 17, 16 , 15, 14)	SCOPE QTY: 9 No.of Columns / Day (Column. Nos- 13, 12, 11, 10, 09, 08, 07, 06, 05)	SCOPE QTY: 4 No.of Columns / Day (Column. Nos- 04, 03, 02, 01)	
	Stiffener Reinforcement	Stiffener Reinforcement						Civil Works- Stiffener Column
	SCOPE QTY: 29 Nos of Column / Day	SCOPE QTY: 29 Nos of Column / Day						
	Shuttering	Shuttering	Shuttering	Shuttering	Shuttering	Shuttering	Shuttering	
	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day	
	Concreting	Concreting	Concreting	Concreting	Concreting	Concreting	Concreting	
	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	
Look Ahead Schedule (Production Plan) - WEEK 8 (25.01.21- 31.01.21)								
Location	Day 50	Day 51	Day 52	Day 53	Day 54	Day 55	Day 56	Activity
					Fabrication & Supply of PEB Members			Main Building- PEB Works
	Shuttering	Shuttering						
	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day						
	Concreting	Concreting	Concreting	Concreting	Concreting	Concreting		Civil Works- Stiffener Column
	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day	SCOPE QTY: 09 Nos of Column / Day		



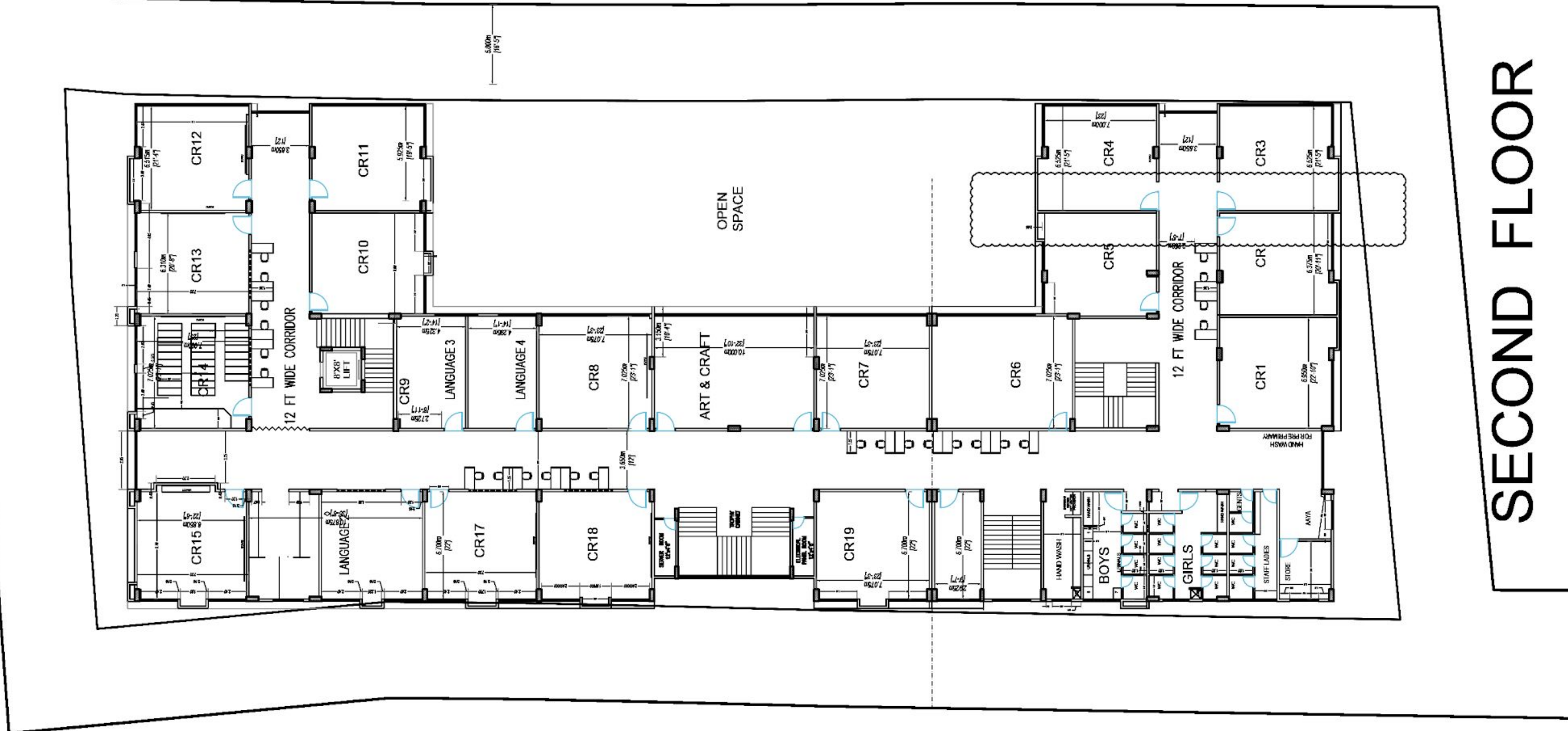
PROPOSED SCHOOL BUILDING, CHITRAKOOTA, BANGALORE



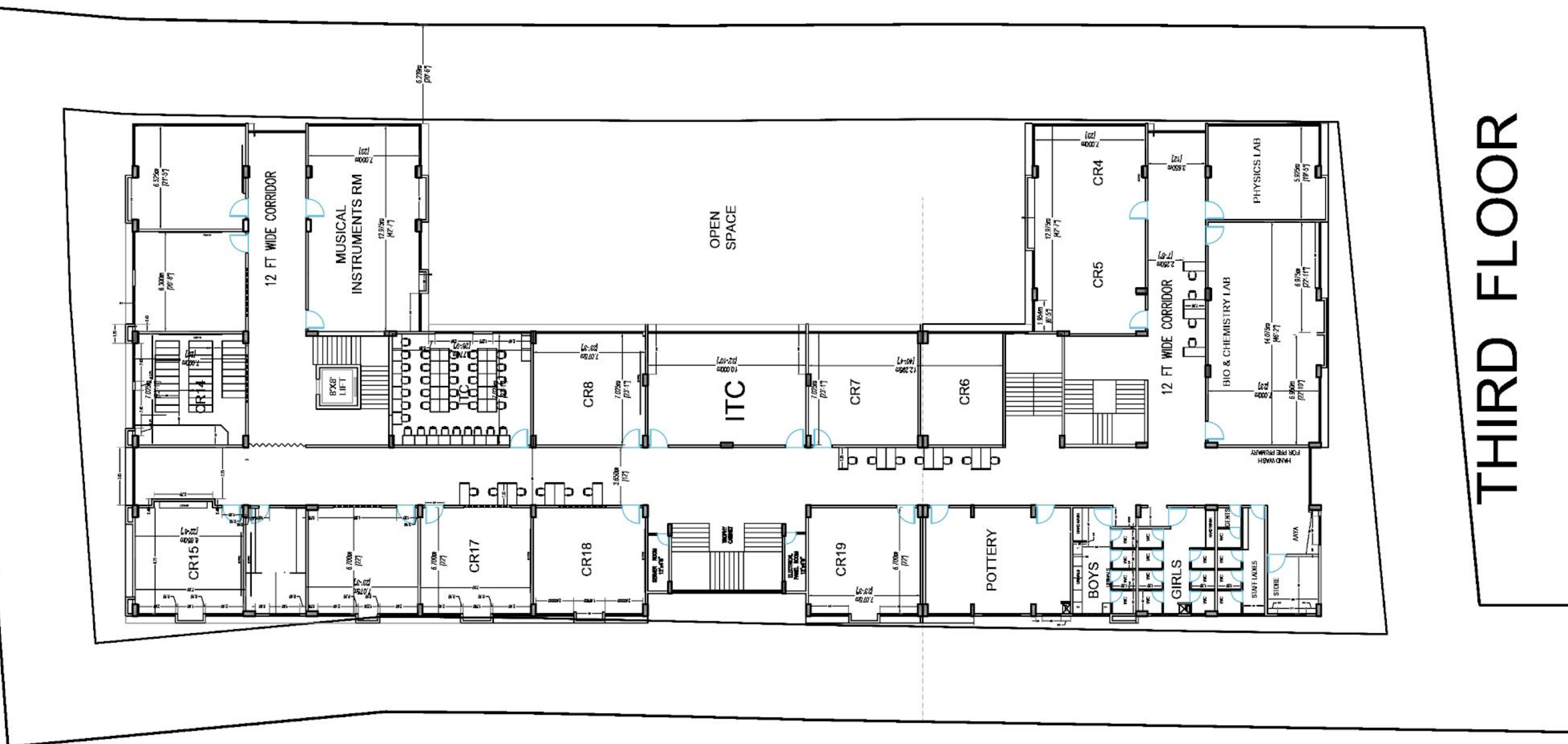




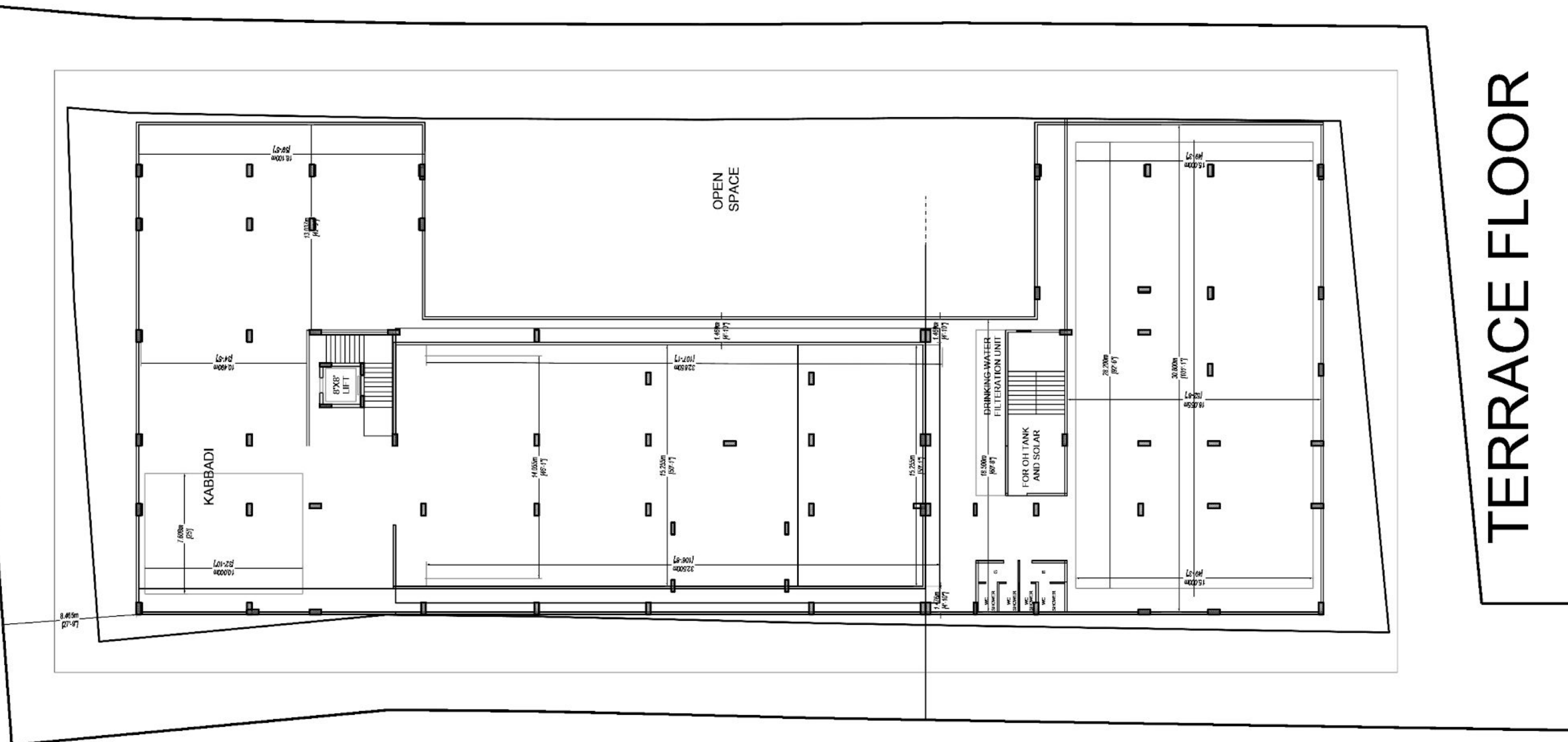
FIRST FLOOR



SECOND FLOOR



THIRD FLOOR



PROPOSED SCHOOL BUILDING - CHITRAKOOTA, BANGALORE

Overall Scope of Work - 24.12.2020

INDOOR	
DESCRIPTION	REQUIREMENT
ELECTRICAL	1. Location of fan & light point and their control points within the classroom & at the corridor/common space at electrical room 2. UPS load Calculation 3. UPS Room Dimension & Location Demarcation 4. Electrical Room Size check 5. Emergency Power supply requirement 6. Sockets for student's laptop/Tab & Faculty Laptop 7. TV Socket Location 8. Load calculation & Power Socket location for Lab equipments based on their capacity 9. General Electrical load calculation 10. Emergency electrical Load Calculation 11. Provision of List of Makes & Technical Specification & BoQ 12. LT Panel Room 13. DG Provision 14. DG Pump
LIGHTING	1. Normal Lighting - Number of lightings & capacity, fixing detail & location 2. Emergency lighting - Number of lightings & capacity, fixing detail & location 3. Stage Lighting 4. Elevation Lighting 5. Terrace Lighting 6. Swimming Pool 7. Gym-Focus 8. Assembly Area- Focus lights 9. Provision of List of Makes & Technical Specification & BOQ 10. Stilt Parking 11. Stilt Jungle Gym

VENTILATION	1. Canteen Ventilation 2. Kitchen Ventilation 3. Classroom Ventilation load calculation 4. Fan Numbers & locations 5. Staircase Ventilation & Pressurization 6. Lift room Ventilation & Pressurization 7. Corridor & common spaces ventilation 8. Fire Ventilation 9. Other Room Ventilation 10. Provision of List of Makes & Technical Specification & BOQ
PLUMBING & SANITATION	1. STP 2. UG Sump 3. Rain water drainage layout & Slope 4. demarcation 5. Rainwater drainage - Stilt floor 6. Rainwater down pipe sizing calculation & location 7. Plumbing & sanitation calculation based on occupancy as per NBC - Fixtures, UG sump Capacity, OHT Capacity, Fire Tank Capacity, Plumbing Fixture (numbers, location, spacing, Pipe slope & dimension, Rainwater collection tank capacity, STP Capacity, Rainwater runoff & drainage 8. Water balance check 9. Plumbing & sanitary fixtures & location Rainwater Collection Tank 10. Fire Water Sump 11. Over Head Tank 12. Pump room-Water Supply, Fire Pump, Rainwater, Water treatment 13. AC Makeup water 14. Swimming Pool- Water calculation, Sump requirement, Pump, Water treatment requirement 15. Ring Main 16. Renewable & Nonrenewable resources disposal 17. Provision of List of Makes & Technical Specification & BOQ.
FIRE PROTECTION	1. Fire Suppression System, 2. Fire Alarm & Detection System 3. Fire Water Sump 4. Fire Pump 5. Staircase location & size, Egress Points 6. Signages 7. Corridor Lighting, Emergency Lighting & Power supply system, Access Control System 8. Staircase & lift well pressurization 9. Fire rated doors & materials

HEADING: PROPOSED SCHOOL BUILDING- WORK SCOPE

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	10. Dampers 11. Assembly Point Capacity & Location 12. PAS 13. Fire Control Panel 14. CCTV 15. Fire lift 16. Provision of List of Makes & Technical Specification & BOQ
VERTICAL TRANSPORTATION	1. Lift Capacity Calculation & dimension, Staircase location & capacity Calculation 2. Provision of List of Makes & Technical Specification & BOQ
IBMS	1. Fire Control Panel 2. Lift 3. PAS & CCTV System 4. Telecommunication 5. Server Room 6. Television System 7. IT & Networking System 8. Plumbing & Sanitation - Monitoring & Controlling 9. HVAC Control & Monitoring 10. Access Control System 11. Provision of List of Makes & Technical Specification & BOQ
EARTHING & LIGHTNING	1. Lightning Arrester Number calculation & location. 2. Internal Earthing design & Calculation. 3. Provision of List of Makes & Technical Specification & BOQ
MATERIAL	1. Block work (Interior & Exterior) 2. Other Blocks: a. OHT b. Treated water Tank c. Rainwater Tank d. Swimming Pool Treated water & supply water tank e. Fire sump 3. Acoustic Insulation - Classroom, Gym, other required area if any. 4. Fire rating 5. Painting 6. Weathering Course 7. Water Proofing 8. Heat insulation 9. False ceiling & Partition - Class room & other room if required 10. False ceiling - Corridor & Common spaces

	11. Exterior Wall Cladding 12. Swimming pool - Special requirements 13. Interior treatment - Class room, Labs, Staff room, Toilet, Corridor & Common spaces, Admin, Gym, Swimming pool, Canteen, Kids Play Area 14. Musical Room - Acoustic Panel
--	--

OUTDOOR	
DESCRIPTION	REQUIREMENT
ELECTRICAL	1. Substation- Transformer Yard, RMU Unit, 2. HT Panel 3. Diesel Generator 4. Electrical Power supply for outdoor lighting (General & Emergency) 5. Electrical Power supply, Sockets & Switches: a. Security Room b. Discussion Room c. Bus Wash d. Cloth Wash e. Security Toilet f. Volleyball & Throwball court g. Electrical room / Substation 6. Provision of List of Makes & Technical Specification & BOQ
LIGHTING	1. Outdoor Lighting : a. Parking b. Driveway c. Atrium d. Landscape e. Entry & Exit f. Facade Lighting g. Substation h. Volleyball & Throwball court 2. Indoor Lighting: a. Security Room b. Discussion Room c. Bus Wash d. Cloth Wash e. Security Toilet 3. Provision of List of Makes & Technical Specification & BOQ

HEADING: PROPOSED SCHOOL BUILDING- WORK SCOPE

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VENTILATION	- Outdoor Ventilation Calculation & Design: - STP - Water sump - Substation - DG Room (if any) - Indoor Ventilation Calculation & Design: - Security Room - Discussion Room - Bus Wash - Cloth Wash - Security Toilet - Provision of List of Makes & Technical Specification & BOQ		- Plumbing & Sanitation - Monitoring & Controlling - Access Control System - Network System - PAS - FCC - CCTV Fire Alarm & Detection System for: - Security Room - Discussion Room - Bus Wash - Cloth Wash - Provision of List of Makes & Technical Specification & BOQ
PLUMBING & SANITATION	- STP - Underground Water Sump - Storm Water Drainage location, slope, capacity & layout, - Rainwater trench location & Capacity - Rainwater collection sump location & Capacity, - Rainwater recharge pit - Capacity, number & location - Manhole & Inspection Chamber - Plumbing and Sanitation Fixture location & Dimension: - Bus Wash - Cloth Wash - Security Toilet - Landscape - Provision of List of Makes & Technical Specification & BOQ	EARTHING & LIGHTNING	- Earthing type, pit size, Numbers & Location - Indoor Earthing for: - Security Room - Discussion Room - Bus Wash - Cloth Wash - Security Toilet - Provision of List of Makes & Technical Specification & BOQ
FIRE PROTECTION	- Fire Hydrants- Location & Numbers - Fire water Sump - Fire hydrant Pump - Fire Assembly Points location & Capacity - PAS - Fire engine accessibility - Provision of List of Makes & Technical Specification & BOQ	MATERIAL	- Pavement - Driveway Road - Compound Wall - Volleyball & Throwball court - Parking - Painting - Block Work - Security Room - Discussion Room - Bus Wash - Cloth Wash - Security Toilet - Substation - UG Tank - STP - Fire Sump - Rainwater Sump - Rainwater Pit - DG Tank - Atrium - Landscape Area - Tensile roof structure for open area - Provision of List of Makes & Technical Specification & BOQ
IBMS	- Outdoor Lighting Control - Security - TeleCommunication System		



PROJECT TRACKING FORMAT



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WEEKLY TRACKER AT SITE - WORK PROGRESS

COMPANY NAME	EPMCR, CHENNAI		PROJECT TITLE		PARTICIPANTS	
DAY 01	DAY 02	DAY 03	DAY 04	DAY 05	DAY 06	DAY 07

A2 BOARD FORMAT - 1 WEEK

A2 BOARD SIZE:

23.4" x 16.5" (OR) 594 x 420 MM - LANDSCAPE FORMAT - 84.8

STANDARD STICKY NOTES SIZE:

OPTION 01- 3" x 3" (OR) 76.2 x 76.2 MM - Font Size: 11

OPTION 02- 3.3" x 3.3" (OR) 84.8 X 84.8 MM - Font Size: 12 or 13

A3 BOARD FORMAT - 1 WEEK

A3 BOARD SIZE:

16.5" x 11.7" (OR) 420 x 297 MM - LANDSCAPE FORMAT

STANDARD STICKY NOTES SIZE:

OPTION 01 - 2" x 2" (OR) 50.8 x 50.8 MM - Font Size: 07

OPTION 02 - 2.36" x 2.36" (OR) 60 x 60 MM- Font Size: 08

A2/ A3 BOARD FORMAT - 1 WEEK

HEADING:

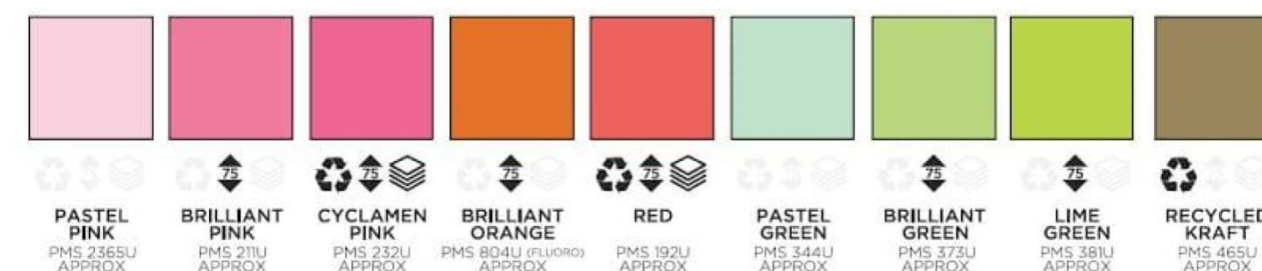
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STICKY NOTE FORMAT

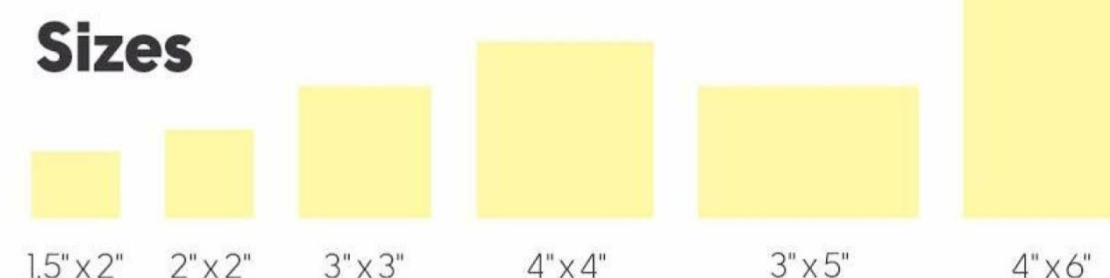
Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

OTHER AVAILABLE COLORS FOR A WEEK FOR STICKY NOTES



OTHER AVAILABLE SIZES FOR A WEEK FOR STICKY NOTES



PROPOSED COLOR FOR A WEEK FOR STICKY NOTES

Week 01

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Green

Week 02

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Florent Green

Week 03

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Dark Pink

Week 04

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Pink

Week 05

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Orange

Week 06

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

Blue

Week 07

Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

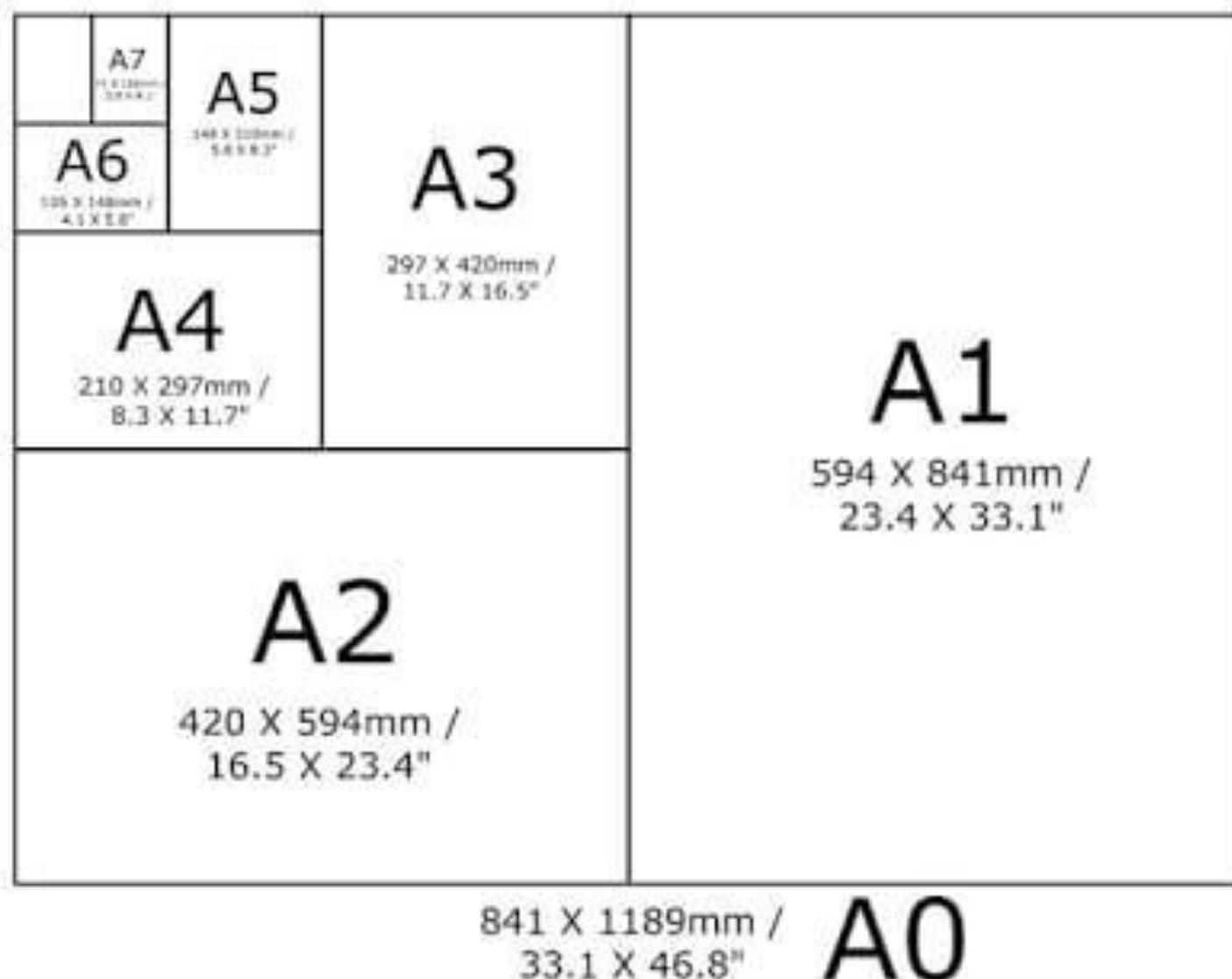
Florent Blue



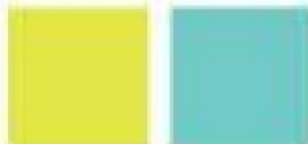
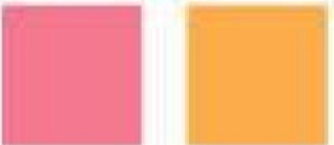
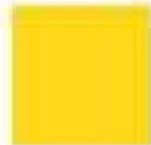
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COMPANY NAME		EPMCR, CHENNAI		PROJECT TITLE				PARTICIPANTS					
DAY 01		DAY 02		DAY 03		DAY 04		DAY 05		DAY 06		DAY 07	
Activity ID		Activity ID		Activity ID		Activity ID		Activity ID		Activity ID		Activity ID	
Activity Name		Activity Name		Activity Name		Activity Name		Activity Name		Activity Name		Activity Name	
Location Id		Location Id		Location Id		Location Id		Location Id		Location Id		Location Id	
Structure Id		Structure Id		Structure Id		Structure Id		Structure Id		Structure Id		Structure Id	
Quantity to complete & Remaining		Quantity to complete & Remaining		Quantity to complete & Remaining		Quantity to complete & Remaining		Quantity to complete & Remaining		Quantity to complete & Remaining		Quantity to complete & Remaining	
Resources		Resources		Resources		Resources		Resources		Resources		Resources	
Resp. Person		Resp. Person		Resp. Person		Resp. Person		Resp. Person		Resp. Person		Resp. Person	
Predecessor		Predecessor		Predecessor		Predecessor		Predecessor		Predecessor		Predecessor	
Successor		Successor		Successor		Successor		Successor		Successor		Successor	



FOR TRACING WITHIN A DAY AT FORENOON & AFTERNOON / ACTIVITY PROGRESS THROUGH DIFFERENT STAGES

	To-do	In-Process	Done
Stage 1			
Stage 2			
Stage 3			

A2 BOARD FORMAT - SCHEDULE COMPOSITION

- A2 X 1 = 1 WEEK SCHEDULE
- A2 X 2 = 2 WEEKS/ FORTNIGHT SCHEDULE = 1 A1 SHEET
- A2 X 4 = 4 WEEKS / 1 MONTH SCHEDULE = 1 A0 SHEET
- A2 X 6 = 6 WEEK SCHEDULE = 1 A0 PLUS

A3 BOARD FORMAT - SCHEDULE COMPOSITION

- A3 X 1 = 1 WEEK SCHEDULE
- A3 X 2 = 2 WEEKS/ FORTNIGHT SCHEDULE = 1 A2 SHEET
- A3 X 4 = 4 WEEKS / 1 MONTH SCHEDULE = 1 A1 SHEET
- A3 X 6 = 6 WEEK SCHEDULE = 1 A1 PLUS

SHEET SIZE:

A3 (Daily Progress) / A2 (Activity Progress)

STICKY NOTE SIZE:

2"x 2" (A3 SHEET) ; 3" x 3" (A2 SHEET)



LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY

LIST OF STAKEHOLDERS:

1.INTERNAL STAKEHOLDERS:

- Ather Energies.
- Client's Manager.
- The working staff in the warehouse.
- Ather energies customers
- Architect: Kruthika
- Project Manager. (Mr.Kavin Kumar)
- Structural Engineer.
- Cost Consultant.
- Team members.
- Quality management.
- Accountant.
- Financier
- Contractors
- Sub Contractors
- Material / Equipment Suppliers
- Labors
- Manufacturers
- Vendors
- Security
- Transport
- Site Office Manager

2. EXTERNAL STAKEHOLDERS:

- Government Authorities (National & local)
- Political Parties / Organisation
- Court / Legislators
- Police
- Arbitrators
- Legal systems & Regulation Body.
- Licencing & Inspection organization
- Public Utilities
- Technical Institutes
- Special Interest Groups
- Environmental Authority
- Town Planning Board
- General Public
- Other Competitors
- Local Residents / Community
- Local Landowners
- Marketing

Classification of Stakeholders:

Class 1: Bodies that are internal stakeholders but not directly involved in the construction.

Class 2: Internal stakeholders and directly involved in construction, design, planning.

Class 3: Supporting bodies for class 2.

Class 4: Governing bodies, lawmakers.

Class 5: Others.

PLACE:

- Office
- Creche
- Site office
- Fabrication Area
- Material storage Area
- Factory Building
- Cell Storage building
- Connecting Bridge
- Proto Lab
- Scrap yard
- Substation, Transformer Yard
- Electrical Room
- Staff Area
- Site
- Labour's Accommodation
- Training Room
- Utility Area
- Dock
- Security Room
- Testing Lab, Battery Room, Processing Unit
- Loading / Unloading Space & Bay
- Treatment Area
- Conference / Meeting Room
- Record Room, Server room
- Material / Sample Lab
- Accessibility & Circulation
- Location for Equipment
- Canteen, Change A rea, Restroom

FACTS:

1. A lithium-ion battery or Li-ion battery (abbreviated as LIB) is a type of rechargeable battery.
2. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications.
3. Warehouses are prone to fire hazards due to failures in battery.
4. The battery consists of high energy densities coupled with the flammable organic electrolyte, which on vent reaction causes fire.
5. On vent reaction it releases flammable products such as hydrogen, Carbon Monoxide, Hydrocarbons, carbon dioxide, etc.
6. Storage Warehouse should be with 4hrs - 0 to 10ft; 2hrs- 10 to 30 ft. of Fire Rating.
7. Battery fails in case of contact with water, seawater, crash / Mechanical abuse.
8. Batteries should be disposed of only through E.Media bin / Completing online chemical waste collection requests.
9. Batteries have to be stored in a protective Packaging(ie,hard plastic/ Equal/ Metal container) with fire resistance.
10. The temperature for the warehouse should be from 5 degree celsius to 20 degree celsius.
11. They should not be exposed to sunlight, High temperature & conductive materials.
12. Temperature, Humidity, Pressure should be continuously monitored for safe functioning.
13. Continuous Ventilation (12 air changes/ hours) should be enhanced by passive / Mechanical means.
14. Light pressure should be maintained through Explosion vents

OTHER FACTS

1. Minimum distance should be maintained between warehouse and the surrounding factory / structures.
2. Currently automation systems are used for racking, protective storing & handling.
3. Many problems in warehouses are arising today on improper circulation patterns & traffic between handling equipment & workers.
4. Proper drainage of water from various sources (eg: sprinkler) has to be mixed ground water, to be collected and discharged separately, not they are since they are toxic.
5. Proper fire egress and entry points should be provided along with floor drain at all door locations
6. Proper emergency lighting (equally spaced, 30% of total lighting) should be provided.
7. Lux level of 300 should be maintained.
8. And use of LED would be recommended.
9. Hazardous goods cabinet / Safe storage Cabinets With inbuilt Automation system are available in today's market for racks.
10. Flooring Options
 - a. Bare concrete
 - b. Flooring to be fire retardant
 - c. Fibreglass Floor Grating
 - d. T-Bar Fiberglass Grating
 - e. Steel Grating Gravity Roller Flooring

11. There should be proper clearance between the top most pallet and the ceiling to enhance appropriate ventilation, exit of smoke during fire and hazardous gases.

12. IBMS plays an important role here.

TRENDS & TECHNOLOGIES:

- Conventional battery analyzers
- Cadex Battery Analyzers
- Fleet Battery Management
- FORKLIFT - Pallet storage & Handling
- Truck - Transportation / Delivery
- CCTV
- Sprinkler system
- Smoke detectors
- Signs
- Emergency Eyewash /deluge shower station
- Aisle Mats
- Concealed conduit system (Electrical, Data, Signal cables)
- Passive & Mechanical Ventilation [Exhaust fans (Jet fans)]
- Dampers
- Alarm system
- Fire rating Walls & doors (4hrs - 0 to 10ft; 2hrs- 10 to 30 ft)
- E-Media bin
- Online waste collection
- Human safety Equipments / Materials
- Spill containment & Neutralization

- Fire resistance & flame arrestor storage - individual cell
- Anti corrosive Racks
- Automation system
- Hazardous goods cabinet / Safe storage Cabinets With inbuilt Automation system
- Explosion Proof Exhaust fan - ventilation & fume removal
- Axial fans
- Ducting
- Automatic Smoke/ fire Vent - roof / wall
- Fusible link
- Fireman's override control
- Plenum ventilation
- Balanced ventilation
- Explosion vent with Flameless venting device
- Explosion proof Air conditioner with / without inbuilt thermometer
- Wall/ ceiling mounted Explosion proof axial fan
- Smoke detector integration with Air Conditioner,Vent and Exhaust system.
- Non- Sparking & Explosion proof motor
- ABC dry chemical fire Extinguisher
- In-Rack Sprinkler / Pallet
- Seismic protection bracing - batteries

Racks Typologies:

- Static pallet storage
- High-bay racking saves space:
- Pallet racking systems for FIFO and LIFO
- Dynamic pallet storage:
- Push-back racking: Optimum use of space
- Hazardous goods cabinet / Safe storage Cabinets With inbuilt Automation system

Partition wall:

- Open mesh partition wall
- UL classified fire- resistive gypsum wallboard partition wall (bi- directional - 4hrs rating)

Flat Roofing Material (Class A fire rated):

- Concrete/ clay
- Fiberglass asphalt composition shingles
- Metal roofs

Ceiling treatment:

- Same as wall
- Light color
- Acid resistant enamel paint

Wall Material (Class A fire rated):

- Concrete Masonry
- Insulated concrete form wall
- Cast-in-place concrete
- Fully Grouted concrete masonry unit
- Reinforced glass with steel wire

OTHER TRENDS & TECHNOLOGIES:

1. Flooring options:

- Concrete flooring(Ground floor)
- Reinforced concrete floor (above ground level)
- Fiberglass Floor Grating flooring
- T-Bar Fiberglass grating flooring
- Steel grating flooring
- Gravity roller flooring

2. Floor finish:

- Slip resistant & acid / alkali resistant
- Non skid & acid resistant ceramic tiles
- Acid resistant epoxy coating.

3. Door (UL Listed 4 hrs fire rated):

- Swing door (single / double leaf) with push bar
- UL listed self door closes, steel latch guards, positive pressure thresholds
- UL listed keyed locks
- Roll Up Doors (in front of the storage building)
- Sliding Doors

4. Lighting:

- Parallel wall mounted / pendant lights / Ceiling mounted
- 300 lux level
- Explosion proof luminaire
- Lamp protection fixture by shatterproof lenses / wire guard
- Corrosive resistance(To acid vapour)
- Receptacles & lighting switches
- Minimal heat output lamps & luminaire
- LED lighting
- Allowable Glare index (10-16 or 16-22)
- C.I.E Color rendering index - 90 to 80 or above 90
- Color Temperature- 4600K to 6500K.

BMS:

1. Alarms & Instrumentation to measure:

- Battery voltage
- Battery current
- Ground detection for ungrounded system
- Carbon monoxide sensor
- Hydrogen gas sensor
- Occupancy sensor
- Thermostat & Climate control system
- Temperature, Humidity & Pressure monitoring system
- Access control system
- PA System
- Fire control panel (FAS System)
- CCTV Control Panel
- Damper control
- Ventilation fan failure / run status
- HVAC monitoring & controlling
- Electrical, Plumbing & lighting system monitoring
- Short circuit sensor

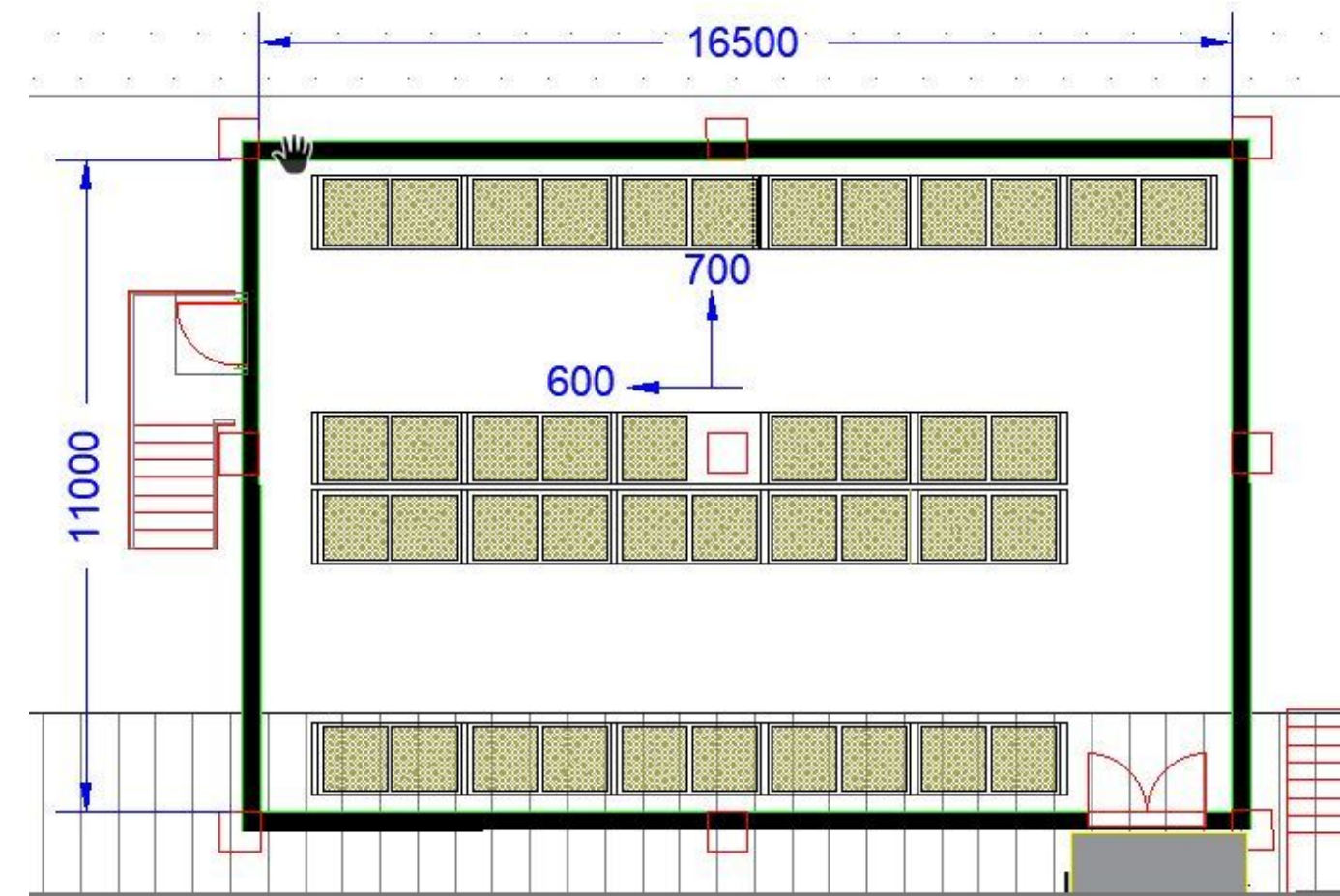
2. Central control panel & room

3. Interconnected alarm system

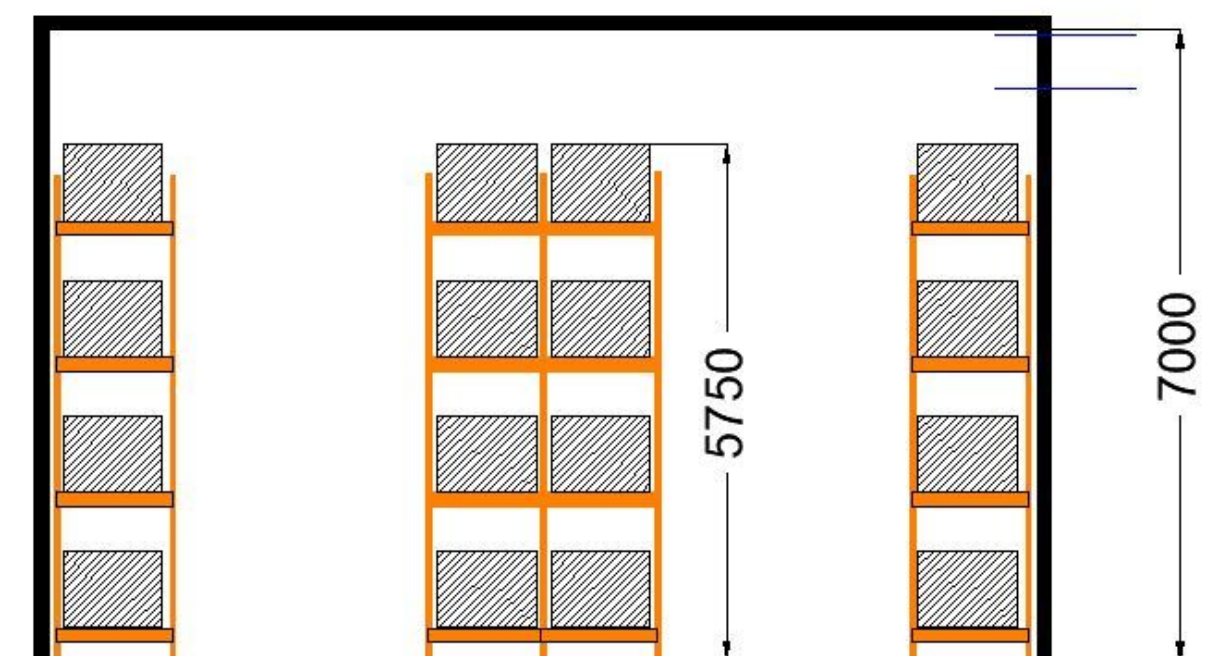
4. Wireless BMS / Automotive Battery Management Sensor:

- Wireless Batter area network
- Managing module
- Sensing module (on battery).

5. Bar Codes & ID management - Battery for storage



CELL STORAGE BUILDING- PLAN



ELEVATION VIEW

LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY

PROJECT DEFINITION

To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.

OBJECTIVES

- To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.
- To provide structural stability to the building against various types of loading (live loads, dead loads, collateral loads), operational hazards (fall, leakages, electric short circuits, fire, explosion) and natural calamities (cyclones, flood, and earthquake)
- To provide ease of access for men, machinery, and material during operations.
- To facilitate safe and comfortable material handling, storage, and retrieval.
- To provide quality storage and healthy workspace with adequate circulation space, lighting, indoor temperature, humidity, and ventilation.
- To minimize energy and water consumption.
- To reduce waste generation and effectively recycle and reuse industrial and biowaste.
- To protect against pests, Micro and Macro organisms.

STAKEHOLDERS - LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY

ATHER ENERGIES	ARCHITECT	FINANCIER	GOVERNMENT AUTHORITIES	GENERAL PUBLIC
Client's Manager.	PROJECT MANAGER	MATERIAL/ EQUIPMENTS SUPPLIERS	COURT/ LEGISLATORS	OTHER COMPETITORS
The working staff in the warehouse.	STRUCTURAL ENGINEER	MANUFACTURERS	LEGAL SYSTEMS AND REGULATING BODIES	LOCAL RESIDENTS/ COMMUNITY
Ather energies customers	COST CONSULTANTS	VENDORS	LICENSING AND INSPECTION ORGANISATIONS	
	CONTRACTORS	SECURITY	ENVIRONMENT AUTHORITY	
	SUBCONTRACTOR S	TRANSPORT	TOWN PLANNING BOARD	
	LABOURERS	PUBLIC UTILITIES		
	SITE OFFICE MANAGERS	TECHNICAL INSTITUTIONS		
	QUALITY MANAGER			

BUILDING SHAPE & PROPORTION

REQUIREMENT

- Travel Distance:**
 - Minimum distance between high activity operations area.
 - Avoid aspect ratios for perimeter exceeding 3.00 for conventional warehousing operations. Recommended to have Aspect ratio of 1.25 (square).
- Irregular Shapes:**
 - Avoid irregular shapes.
- Height:**
 - High-rise storage is preferred over low height buildings.
 - Minimum of 6' clearance from top of highest pallette
 - Enough volume for gases to find their way to venting or exhaust system and for installation of sprinklers.
- Area:** 30.0 Sq. M / Person
- Building Spacing:**
 - The width of Access way & fire engine access clear from obstruction - 7 to 9 m (min - 6 m) & The height of fire Engine clearance - 3.85 m
 - Inner turning radius - 4m; Outer turning radius - 10 m
- Hazardous Materials Facilities**
 - Buffer zone between the facility or portion of facility containing Hazardous Materials & Nearby facilities
- Docking Facilities:**
 - loading and unloading operations at warehouse rail and truck docks.
 - Protect building corners and dock areas from vehicle impact by using concrete-filled steel pipes

STORAGE

REQUIREMENT

- Charge or discharge the battery to approximately 50% of capacity before storage.
- Charge the battery to approximately 50% of capacity at least once every six months. Remove the battery and store it separately from the product.
- Store the battery at temperatures between 5°C and 20°C (41°F and 68°F).

NOTE:

- The battery self-discharges during storage. Higher temperatures (above 20°C or 68°F) reduce the battery storage life.
- For larger quantities in storage (over 60m² of space occupied and/or stacks over 3 meters tall), it is also advisable to store the Li-ion batteries in suitable non flammable containers, separate fire-proof rooms or fire compartments.

HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY

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HANDLING

REQUIREMENT

- Do not disassemble, crush, or puncture a battery.
- Do not dispose of a battery in fire or water.
- Do not expose a battery to temperatures above 60 °C(140°F).
- Avoid exposing the battery to excessive shock or vibration.
- If the voltage of a lithium-ion cell drops below a certain level, it's ruined. Lithium ion batteries age. They only last two to three years, even if they are sitting on a shelf unused.

PRINCIPLES OF AN EFFICIENT WAREHOUSE LAYOUT

REQUIREMENT

a. Flow:

- Warehouse flow can be summarized as the uninterrupted movement of materials, people, and traffic within the building.
- First goal should be to cut down on any areas of high traffic or potential for cross flow crashes.
- So, each activity that an employee performs must be located as close as possible to the activity that precedes it and proceeds from it.
- That also means materials used to perform those activities should be situated as close as possible to each workstation.

REQUIREMENT

b. Accessibility:

- Every product and all products on pallets should be accessible by everyone, usually without the need to move one product to get to another.
- That means structuring your pallet racks in rows that are wide enough to accommodate pallet jacks and trucks, and stacking and stocking items strategically for minimal interference with one another.

REQUIREMENT

c. Space:

- Consider, to maximize the space, taking into consideration storage, stock, offices, working areas, empty pallet storage, battery charging, etc.
- A wide variety of vertical racks and freestanding equipment.

LOADING & UNLOADING AREA

REQUIREMENT

LOADING & UNLOADING AREAS:

- Loading and unloading areas, which are normally located outside the warehouse or incorporated into it, are those that trucks and vehicles transporting and distributing goods have direct access to.
- In a well-organized warehouse, it is useful to separate these activities from the rest of the installation, allowing sufficient space for loading and unloading. This area can be integrated into the warehouse or be independent.

OPTIONS

- Integrated Facility
- Independent Facility

RECEPTION AREA

REQUIREMENT

- The reception area must be located as independently as possible from the rest of the warehouse, so that it can be used not just for receiving goods, but also for quality-control and sorting.
- Once it has been ensured that the characteristics and quality of the delivery received matches those of the products ordered, the next stage is to determine where to position the load within the warehouse.
- Depending on the type of warehouse, it may or may not be necessary to transform the units received. If this is necessary, a suitable area must be established for this function.
- For example, it may be necessary to split the pallets that have arrived into smaller units, remove parts that are strapped together, etc.
- Almost all products handled in a warehouse come with barcodes that can be read using a scanner. Therefore, once the warehouse's central computer has identified the units, it can in turn immediately generate the position label.
- This label can subsequently be read by a forklift operator or by the scanners of the warehouse's automated system so that, in both of these cases, they can be positioned in the correct location.

WALLS

REQUIREMENT

- Building (Walls & doors) should be with 4hrs - 0 to 10ft; 2hrs- 10 to 30 ft. of Fire Rating.
- Here, We shall require 4 Hrs fire rated - Class A material.
- Walls shall be continuous from floor to ceiling and be securely anchored.
- The battery rooms shall be protected against electrolyte splashes, by applying an approved light colored, Corrosion resistant acid resistant enamel paint.
- Windows shall not be provided in battery rooms.
- Bracing of racks & batteries.

OPTIONS

- Insulated metal
- Siding
- Brick
- Concrete masonry
- Tilt up precast
- Cast-in-place concrete panels.

WALLS

REQUIREMENT	OPTIONS
Exterior walls: - When metal walls are used, the first 4 feet (1220 mm) of wall above the floor must be of reinforced masonry construction - To protect the structure from fork truck impact and provide additional security. Interior Walls: - Interior wall construction will vary depending upon use, finish, and required fire and corrosion resistance.	- Insulated metal - Siding - Brick - Concrete masonry - Tilt up precast - Cast-in-place concrete panels.

FLOORING

REQUIREMENT	OPTIONS
- Floor design and construction is essential to proper operation of narrow aisle high-rise storage systems. - Building (Walls & doors) should be with 4hrs - 0 to 10ft; 2hrs- 10 to 30 ft. of Fire Rating. Here, We shall require 4 Hrs fire rated - Class A material. - Provide a Class 5 floor Higher class floor, a special metallic or mineral aggregate monolithic surface treatment or a high standard concrete is used. - Wear resistant (based on concrete mixture proportion, type of aggregates & construction technique) - No Expansion joints - Ramp ratio - 1:10 - When the battery room is located at ground level, the floor shall comprise of concrete bed laid on compacted earth - When the battery room is above ground level, the floor shall comprise a reinforced concrete slab - The floor should be absolutely stable and even Finishes: - Floor hardeners, dressings, or toppings are required for durability - Slip resistant & acid / alkali resistant	Finishes: - Non skid & acid resistant ceramic tiles - Acid resistant epoxy coating. Materials: - Concrete flooring(Ground floor) - Reinforced concrete floor (above ground level) - Fiberglass Floor Grating flooring - T-Bar Fiberglass grating flooring - Steel grating flooring

PARTITION WALLS

REQUIREMENT	OPTIONS
4Hrs. Fire rated Partition Wall. Open Mesh Partition Wall: - Strong galvanized wire mesh allows air movement between compartments - It allow exhausting of fumes and temperature control in a cost-effective method. Fire Rated Partition Wall: - Safely store and maintain hazardous materials in your storage buildings. - Fabricated from superior UL Classified fire-resistive gypsum wallboard,with bi-directional partition walls. - Fire-rated walls feature a sump separator and are fire and smoke resistant.	- Open mesh partition wall - UL classified fire-resistive gypsum wallboard partition wall (bi- directional - 4hrs rating)

DOCK DOORS / FORKLIFT PORTAL

REQUIREMENT	OPTIONS
- The battery room door shall have the applicable fire and security rating (4hrs) - Class A fire rated Material - Forklift ramp door Size - 15' or 4,572 mm (W) x 15' or 4,572mm (H) - Exterior doors must have overhead rain drips & door drips. Door Width: - Truck dock door must be at least 9ft (2745 mm) high Door Height: - Truck dock door must be at least 9ft (2745 mm) high - Door accessories/ hardware shall be UL listed - Metal overhead doors must be chain hoist operated, except when frequently use demands motorized operation	Roll Up Doors (Manual / Motorized)

CEILING

REQUIREMENT

- The ceilings should be flat to ensure that the release of hydrogen gas cannot be trapped in pockets.(Highly recommended)
- Building (Walls & doors) should be with 4hrs - 0 to 10ft; 2hrs- 10 to 30 ft. of Fire Rating. 4Hrs. Fire rating Material to be used.
- Low slope less than 1 inch per foot (83mm per meter) is permissible if unavoidable.
- Skylights and false ceilings shall not be used.
- Ceilings shall be given the same paint treatment as walls (light colored, acid resistant enamel paint).
- Gutter & downpipes must be used.

OPTIONS

- Steel Decking
- Reinforced Concrete
- Precast Concrete Panel

DOOR HARDWARE

REQUIREMENT

- Door accessories/ hardware shall be UL listed
- Mortise lockset , latches & mortise butt hinges shall be used
 - Metal overhead doors must be chain hoist operated, except when frequently use demands motorized operation
 - Frames must match door level
 - Exterior door frame must be welded type

OPTIONS

- UL listed self door closers,steel latch guards, positive pressure thresholds
- UL listed keyed locks shall be used
- Mortise lockset , latches & mortise butt hinges

DOORS

REQUIREMENT

- The battery room door shall have the applicable fire and security rating (4hrs) - Class A fire rated Material
- It shall be not less than 900mm wide and 2000mm high
- All doors should be provided with vision panel of size 200mm(W) x 300 mm(H)
- Exterior doors must have overhead rain drips & door drips.
- Door Width:**
 - Must have clearance 12 inches (300mm) clearance on each side of passing materials handling equipment (Fork lift).
- Door Height:**
 - Must have clearance 6 inches (150mm) clearance for highest loads or passing materials handling equipment (Fork lift).
- Entry doors:**
 - It opens inside with access control system
 - Position: As possible as to the corner of the building
 - The inside surfaces of the door shall be protected by an approved light colored, acid resistant paint.
- Fire exit :**
 - The door shall have one leaf that opens outwards with push bar inside the room.
 - Min Width 900 mm.
 - Position: Center Of the gangway / egress

OPTIONS

- Metal covered / industrial type metal fire door (High Hazard)
- Standard Steel doors & frames
- Swing door (single / double leaf) with push bar
- Roll Up Doors (in front of the storage building)
- Sliding Doors

OTHER REQUIREMENT

REQUIREMENT

- There shouldn't be any column projections inside the Room or clear interior area.
- In Case there is a requirement of column at center of the building based on structural design, consider the offset as 600mm to left side and 700mm in width side
- Drainage water after Sprinkler action to be stored separately preferably the area between factory wall and the Cell Storage Building. (The Water shouldn't be passed on to the ground as it is toxic to environment)

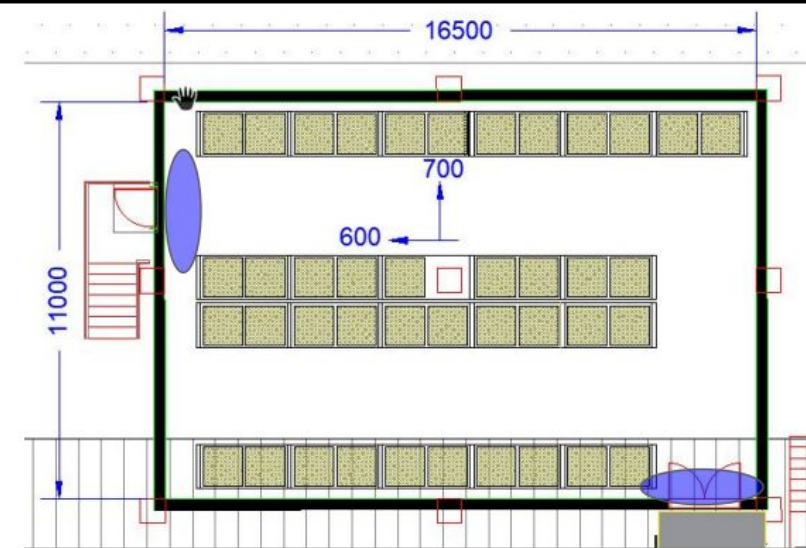


FIG- PLAN - CIRCULATION

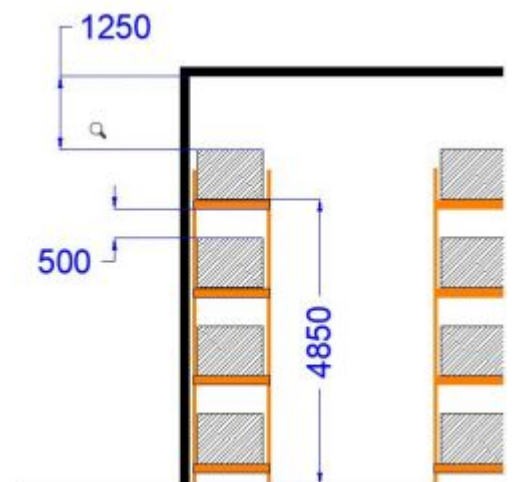


FIG- SECTION WITH RACK

HVAC

REQUIREMENT	OPTIONS
- Temperature to be Maintained: 5 to 20 deg. C - Humidity : Less than 40 % RH <u>Infiltration Rate:</u> 2 air changes / hour in warehouse area - There shouldn't be any water spillage inside the room from the HVAC system - The entire HVAC system should get shut off when smoke detector is activated. - Explosion proof Air conditioner with / without inbuilt thermostat - Temperature, Humidity & Pressure has to be monitored - They must be insulated - They must be coated with corrosion protection (both indoor & outdoor unit, including coils & except louvers <u>Noise and Vibration Control:</u> - Design mechanical systems and equipment to limit noise and vibration. - Sound isolation and sound absorption measures for individual spaces as appropriate.	- Explosion proof Air conditioner with / without inbuilt thermostat - Plenum ventilation - Dampers to be installed - Occupancy sensor - Space Thermometer - Automatic Thermostat & Climate control system - Temperature, Humidity & Pressure monitoring system - Small Area unit / Central system Air conditioning - Jet Vent fans

VENTILATION DESIGN CRITERIA

- Battery room shall be ventilated at the rate of 12 air changes/ hour & at high points for removal of accumulated hydrogen.
- Ideally the battery room exhaust ventilation shall have both high level exhaust for hydrogen and low-level exhaust for electrolyte spills (acid fumes and odors).
- Distribute one-third of the total exhaust flow rate to the high-level exhaust to ventilate all roof pockets.
- Locate low-level exhaust at a maximum of 1-ft above the floor.
- Hydrogen gas from battery rooms shall be extracted to a safe area, i.e. outdoors, or to an area where the gas will always dissipate into the atmosphere without possible danger of the gas accumulating in any part of that area.
- The ventilation system for the battery room shall be separate from ventilation systems for other spaces.
- Air recirculation in the battery room is prohibited.

- Exhaust air through a dedicated exhaust duct system if the battery room is not located on an outside wall.
- Ductwork shall be fabricated from fiberglass reinforced plastic (FRP) or polyvinyl chloride (PVC).
- Design ventilation systems to maintain concentrations of hydrogen gas in the battery room below 1 percent concentration.
- Design the makeup (replacement) air volumetric flow rate equal to approximately 95 percent of the exhaust flow rate to maintain the battery room under negative pressure and prevent the migration of fumes and gases into adjacent areas.
- Makeup air can be transferred directly, it shall be filtered.
- The air inlets shall be no higher than the tops of the battery cells of the lower tier if more than one tier is present.
- Provide means for balancing air flow to ensure a negative pressure relationship. Exhaust all air directly to the outdoors.

EXHAUST SYSTEM

REQUIREMENT	OPTIONS
- Battery room requires continuous ventilation - Suction Heads to be spreaded evenly inside the room - Forced Exhaust System 12 Air Changes / Hr. (12000 cu.m/ hr) is the requirement at the time of fire event - Operation of the Exhaust should be integrated with smoke detectors inside the room. Exhaust operation to be started when smoke detector is activated. - Vents can either automated smoke/ fire vent with fusible links installed at the ceiling or wall mounted Centralized Axial Exhaust fans with ducting system. - The wall mounted fan should be mounted above the level of lighting fixture - Motors should be Non- Sparking & Explosion proof. - Motors should be of n + 1 configuration. - Wall/ ceiling mounted Explosion proof axial fan	- Explosion Proof Exhaust fan - ventilation & fume removal - Axial fans - Ducting - Automatic Smoke/ fire Vent - roof / wall - Fusible link - Motors should be Non-Sparking & Explosion proof. - Wall/ ceiling mounted Explosion proof axial fan

EXPLOSION VENT

REQUIREMENT	OPTIONS
- Explosion Vent to be provided on the topside of the walls. - Explosion vents should be opened for minimal pressure increase as possible inside the storage building	Explosion vent with Flameless venting device

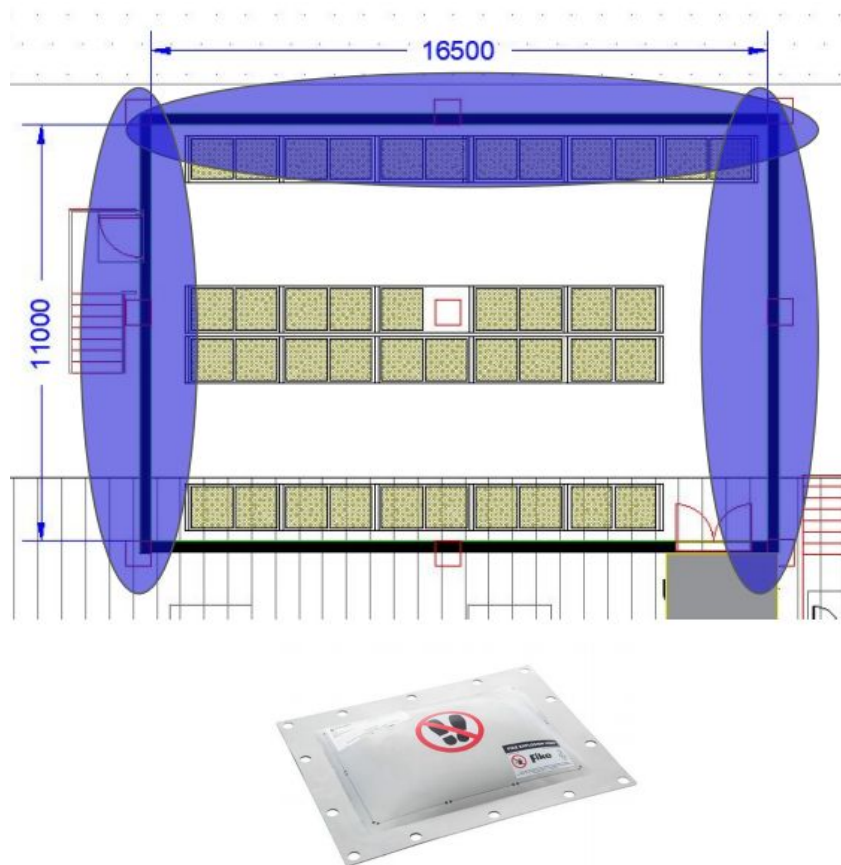


FIG - EXPLOSIVE VENT LOCATION AT PLAN

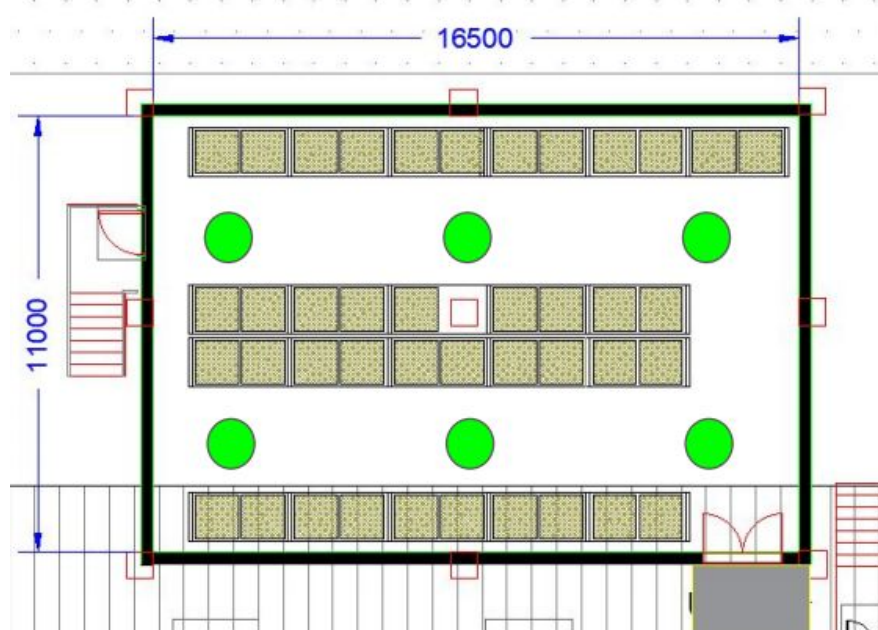


FIG - EXHAUST LOCATION AT PLAN

 Tentative Exhaust Suction Head locations

FIRE SUPPRESSION

REQUIREMENT	OPTIONS
In- Rack Sprinkler - Vertical Distance between Top pallet to the roof to be minimum 6 ft and above. - In Rack sprinkler system to be used - One sprinkler head per pallet should be used. - Water flow rate required/ Sprinkler Head = 9.67 Cu.m/ Hr. (160 L/min) ABC dry chemical fire Extinguisher: - AS it leads to Class A, B, C fire, indeed it is considered as Class B fire Fire Alarm System Smoke detectors Carbon monoxide Sensor & Hydrogen gas sensor CCTV	In-Rack Sprinkler ABC dry chemical fire Extinguisher Fire Alarm System: - Hooters, Manual Call Point, 2 Way wall mounted speakers / PA System Smoke detectors CCTV: - Dome Camera, 360 Degree Camera Carbon monoxide Sensor & Hydrogen gas sensor

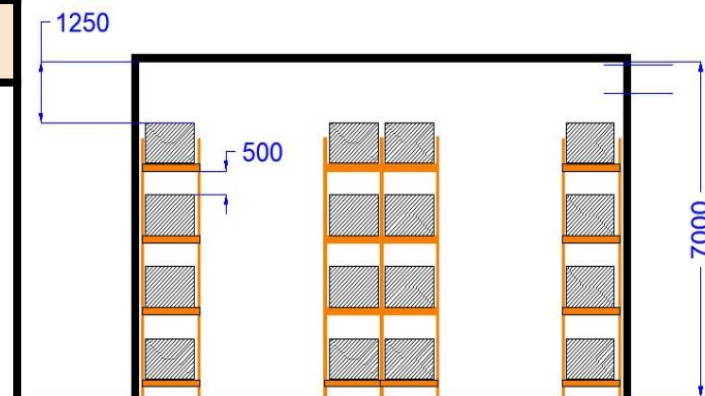


FIG - SECTION - CLEARANCE FOR SPRINKLER UNIT

Note: One Sprinkler Head per Pallet. Total no. of pallets 41 x 4 layers = 164 nos.

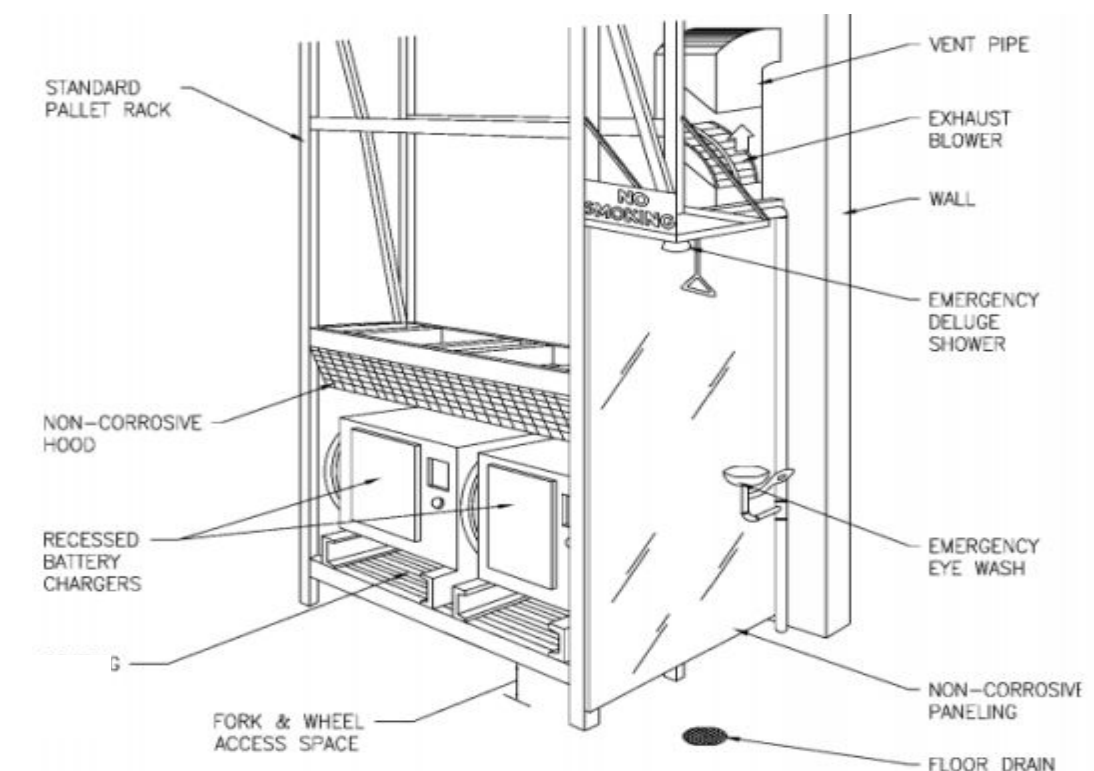
PLUMBING

REQUIREMENT
- Every battery room should have a combination eyewash/deluge shower station to provide a means of decontaminating personnel exposed to and contaminated by battery acid. - Standard requires eyewash/shower within 25 feet of battery work. - Plumbed shower stations: 30 gpm - Wall-mount stations: 0.4 gpm for 15 min. - Eyewash bottles (1 qt.) - Where there is not enough space for civil extensions to accommodate an industrial emergency shower, it shall be located outside the battery room next to the door. The shower drain shall be connected to the battery room drain system.

NOTE:
APPLY ACID RESISTANT COATING TO THE FLOOR.

ALL METAL CHARGER SUPPORTS TO BE GROUNDED.

Image : Typical Battery Charger Installation
(With Eye Wash/Shower using Standard Pallet Rack)



	Engineering Project Management Consultancy and Research Private Ltd <i>- An IIT Madras incubated company</i>
Client & Project Detail	M/s ATHER ENERGY- Lithium Ion Battery storage facility
Job Description	Structural Design, Coordination, Tendering & Monitoring of works through weekly audits and bill certification
Document No.	
Kick off Meeting- Minutes of Meeting (Thru Google Meet 2.30 pm to 4pm)	
Date of Submission	24-06-2020
Project Location	Hosur, India
Participants	M/s Ather Energy, M/s EPMCR
Objective	To understand Ather Energy's requirements and expectations of Cell storage building
	To identify challenges, constraints and input data for design of structure

- 4 hrs fire rating door at cell storage area
- Door width 2m
- Entry door opens towards the inside.
- Check for the direction of opening of doors in terms of fire based accidents.
- Emergency exit, opposite to the entry, Where door opens outwards.
- Door will be opened only during the inlet & outlet of the pallet.
- Check for fire exit door
- Door drains at entry & exit of the door
- No ETP provision
- Lithium ion battery reactivity to water as fire suppression agent to be checked
- Spill containment provision yet to be finalised
- Sprinkler water collection tank to be provided at outdoor & at indoor floor trap & nominal slope to be provided.
- Floor will be cleaned only by mopping machine
- Avoid stagnant, splashing of water to avoid cell corrosion / damage.
- Fire staircase required

- Distance between wall and racks to be checked.
- Types of Racks used, storage height, Arrangement of Racks : 2 floors - One Aisle with 2 floor storage system of height 2.5 m each floor
- The design of the pallet is required.
- Point loads from racks are required.
- B.O.T (Battery Operated Pallet Truck) equipment of 2.3 - 3.5 ton model
- Setback (Gap) between wall & Rack to be checked.
- Lateral load on the wall from Rack should be taken care of. Any warehouse, The gap between wall & rack should be provided in such that 1 person (inspection person) can go around & no lateral load from the rack acts on the wall, If not to, check for an alternative.
- Change of previous layout to
- Pallet composition & cell arrangement pattern
- Pallet dimension (1.1m x 1.1m x 0.8m)
- Number of cells per pallet - 56 Boxes, overall - 168
- Each box has 130 cells, overall 7280 cells in one pallet
- pallet weight
- Finalization of storage & Handling equipment (Battery Operated Pallet Truck & Scissor lift)
- Temperature= 20 - 25 degree Celsius
- Humidity-60 RH
- Location of loading and unloading area and provision of three material docks & its parking facility
- No forklift
- Provision of scissor lift for second floor accessibility & placing of pallets
- Scissor lift model yet to decide.
- Regular earthing provision
- Lightning arrester yet to be decided
- Cells are stored as palette conditions for max 6 months(in current scenario) & Weekly Consignment on regular basis.

- Cells are imported
- No charging points required & No unpacking of pallets.
- Separate area for sampling (IQC Area) & assembling area.
- Purpose of this proposed warehouse: storing & Retrieving process
- Only five cells at a time taken for testing to IQC Area
- Automation system used:
 - Exhaust system actuated by smoke detector
 - Smoke detectors
 - Dampers
 - Dehumidifiers
 - Temperature & humidity sensors (at 5 locations)
 - Monitoring unit at outside the cell storage building
- Cell Manufacturer- LG
- No manufacturing defects
- No self ignition (No Internal factors)
- Fire accidents probability to occur mainly due to (External Factors):
 - Mechanical damage:
 - Puncture
 - Improper Handling (Improper lifting of pallet by forklift)
 - Pallets dropping down
 - Electrical points that sparks
- No cell compression In packaging
- No liquid emission
- No ventilation required
- Height of the building provided based on accessibility & not based on room ventilation & other hazardous factors caused due to fire accidents (Gas emission, Pressurization)
- Maximum labour inside the storage space - 2 person inside the room :
 - During retrieving the battery - 1 person;
 - When incoming loads comes in , for stacking- 2 persons (1- B.O.T Operator & Scissor lift Operator

- Clients shall be required to check the height of the building based on chemical aspects / hazardous factors (Gas emission) for safety aspects.
- Need to continuously maintain temperature & humidity even while storage is not occupied by labour (long / short duration, Eg.: Holidays, COVID 19, Uncertain situations)
- Thermal runaway in between cells due to positive negative charges.
- By testing 1 pallet with 7280 numbers of cell for ventilation Calculation, it is found that:
 - Main Gas Emission:
 - CO₂ - 41.20%
 - H₂- 30.80% - Flammable Gas
 - CO- 13% - Flammable Gas
 - C₂H₄ - 8.20%
 - CH₄ - 6.80%
 - 12 air changes per hour requirement
 - No liquid emission
- Air conditioner:
 - Outdoor AHU Unit - 25TR 5100 CFM AHU with Dehumidifier
 - Model: Bry- Air Model FLi- 6200
 - Outdoor AHU Placement:
 - Option 1:At the of roofing
 - Option 2: At the truck parking
- Location of column and foundation should be finalized.
- To check whether the foundations are overlapping with existing factory building
- To ensure enough setback for the foundation to be built.
- Depth of foundation in factory building is 1.5m from ground level and soil bearing capacity 25 tons.
- Intensity of explosion to be identified to decide on wall & other material thickness
-

- Cost for execution should be finalized
- Structure (Column, Roof & wall) should be finalized - RCC or STEEL
- Choice of material to be made, in such a way that it should be able to be dismantled & relocated, if the warehouse has to be shifted to another place.
- If metal roofing is provided, fire insulation material to be provided below the roofing.
- Not to increase footing size & reduce structural load of the building by employing
- Not to have columns in the centre of the layout for easy accessibility & storage of pallets.
- Decision of fire rating door whether it is 4 hrs or 2hrs.
- Check on the precast wall as a material.
- Need for canopy with slope & rainwater gutter (drainage facility) provision for bridge connecting factory & storage facility.
- Client's need for completion of project by November, 2020.
- Need for crashing of project duration by 1 week, to complete the project by December, 2020.
- To discuss partition at the next meeting.

		Engineering Project Management Consultancy and Research Private Ltd <i>- An IIT Madras incubated company</i>	
Client & Project Detail		M/s ATHER ENERGY- Lithium Ion Battery storage facility	
Job Description		Structural Design, Coordination, Tendering & Monitoring of works through weekly audits and bill certification	
Document No.			
Technical Queries for Clarification			
Date of Submission		Date of Response	
Project Location		Hosur, India	
Project Deliverables		To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.	
S.No.	Queries	Clarifications received from Ather Energy	Remarks/Attachment
1			
2			
3			
4			
5			
Name of the Responder			
Signature of The Responder			



	Engineering Project Management Consultancy and Research Private Limited <i>An IIT Madras Incubated Construction Technology Company</i>		
Title	Technical Queries for Clarification		
Document No. :			
Client Name	M/s Ather Energy		
Expected Date of Response	26-06-2020		
Technical Queries for Clarification		Date	22-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on or before 26 JUNE	
SITE			
1. Is there any existing trees/vegetation within and around the site?			
2. Topography and Contour map of the site showing the site existing features and <u>reduced levels</u>			
3. Plan, Elevation, sectional drawings, and detailed foundation drawings of the factory building and adjacent buildings to Cell storage buildings.			
SITE - NUMERICAL BASED			
1. Site dimension & setback required?			
2. Size of the facility to be designed (Built Up area)?			
3. Road width required around the site for vehicular & Pedestrian access ?			
4. Width of main road abutting in front of the site?			
5. Existing Water table level			
6. NGL (Natural Ground Level), of the existing ground, FFL (Finished Floor Level) Of the cell storage building, FFL of the adjacent factory building, FRL (Finished Road Level) of the access road, and Maximum Flood Level (MFL) within the site			
APPROVAL			
1. What is the land use zoning of the site?			
2. Approved Master plan of the factory premises?			
3. What are the approvals that are required at different stages of the construction process lifecycle?			
4. Location of the proposed Cell storage facility incorporated in the master plan with <u>clearly marked access roads and setback spaces as per TNCBR</u>			
5. Approved Geotechnical report at the proposed cell storage building location			
6. What are the standards & codes followed for lithium-ion battery warehouse design?			
7. For total quality management, what are the factors to be considered when it comes to battery warehouse design?			

APPROVAL - NUMERICAL BASED	
1. What are the heights of nearby buildings?	
MEP- PROJECT MANAGEMENT	
1. How do you schedule your work during the warehouse construction process?	
2. What is the overall duration to complete a warehouse construction project?	
3. What are the problems faced during construction? How do you address them?	
4. What are the labour safety precautions that have been established during construction & normal times and in current covid-19 conditions such as social distancing & government norms?	
MEP - STRUCTURAL REQUIREMENT	
1. What is the water table level?	
2. Typology of soil ? Soil Investigation report?	
3. Is the site prone to Earthquakes?	
4. Do you recommend a slope or flat roof?	
5. What are the materials that can be suggested for wall, roof, flooring?	
6. Flooring finishes used?	
7. Wall thickness and finishes used?	
8. Is wall partition used, if yes what are the different types of wall partition used?	
9. What is the usual recommended height of the building?	
10. What type of foundation is usually employed?	
11. Type of waterproofing	
12. Foundation type (shallow and deep)	
13. Metal sheet roofing thickness	
14. Earthquake Resistant structural design features to be taken into consideration?	
15. What are the loads to be taken into consideration for the structural load calculation?	
16. What are the commonly used racks?	
17. Is there any standard specification for racks?	
18. Methods (Typology) of placement of racks?	



19. What type of materials will be used for racks?	
20. What type of materials to be used in walls, floors, roofs?	
21. What are the automation technologies used in construction of warehouses and in safe functioning of warehouses?	
STRUCTURAL REQUIREMENT - NUMBER BASED	
1. Water cement ratio	
2. Cement grade and Concrete grade	
3. Aggregate size	
4. Steel rod size	
5. Mortar for concrete masonry	
6. Number of Racks used?	
7. Dimension (Length x Width x Height) & width of the racks used?	
8. With the Batteries what is the load per rack?	
9. Storage height of rack?	
10. Hardrock level?	
11. Dimension & Weight of the battery that is required to be stored?	
12. How many batteries can be stored per rack?	
13. Total Number of Batteries to be stored in the warehouse?	
MEP - HVAC	
1. What is the ideal temperature to be maintained for the lithium ion battery warehouse?	
2. What is an explosion vent & What are the provisions required & made for the same?	
3. Types of ventilation systems that are provided for a battery based warehouse?	
4. How is Cooling, Ventilation, Pressurisation process Parallely achieved?	
5. What are the usual ventilation & Pressurisation design requirements for a battery Warehouse?	
6. Since nearby facilities are closer to the site how do you design for explosion vent & ventilation in such a way flammable gasses (hydrogen) does not affect surrounding facility ventilation?	
7. Is it allowable to provide Window on the top of the wall?	
8. Is it continuously required to maintain minimum pressure inside the warehouse & how is it achieved?	
9. Is ventilation required continuously or only during smoke detection / fire scenarios ?	
10. For ventilation do you use Jet Vent fan & High volume low-speed fan?	
11. Do you require the filtration process of incoming air? If yes, what filtration process will be employed?	
12. What are the non explosive air conditioner types?	
13. How is the acoustic protection done?	
14. Is the heat recovery wheel / Treated fresh air system employed here?	
15. What are the commonly used air conditioners and their capacity?	
16. What are the Commonly used refrigerants?	
17. What are the Anti corrosive protection used for HVAC systems?	

MEP - HVAC - NUMBER BASED	
1. Number of air conditioning units required?	
2. For a Lithium-ion battery warehouse, What are the how do you calculate heat & electric load ? What are mechanical devices that are to be taken into considerations for respective calculations?	
3. What is the infiltration rate commonly used for HVAC systems?	
MEP- PLUMBING & SANITATION	
1. What are the spill containment measures taken to discharge chemicals from the site/facilities without contaminating the groundwater? Finally, where is it disposed of?	
2. Since the nearby facilities are closed, How is the drainage & spill containment design can be done in such a way it does not affect the surrounding facility?	
3. Spill containment sump locations?	
4. Where do you dispose of the damaged cells within the site & outside the site? Disposing methodology?	
5. Do you need shower & eye wash or any outlet facility within the storage / warehouse? If yes, where is it required to be positioned?	
6. How is plumbing , Spill containment drainage & grey water sanitation is done & at what levels? Where are the plumbing & drainage lines provision made?	
MEP- PLUMBING & SANITATION - NUMBER BASED	
1. Number of plumbing outlets required?	
2. Number of Eyewash & Shower areas required?	
3. Spill containment & spill containment sump numbers?	
MEP - ELECTRICAL	
1. What are the commonly used Cable & cable entry facility / provisions ? Types & conduit / cable supporting methods employed here ?	
2. What type of earthing is used in warehouses?	
MEP- LIGHTING	
1. What is the common lighting fixture & lamp type used? Any special features to be taken into consideration?	
2. Mounting height of lighting fixtures?	
MEP- LIGHTNING ARRESTER	
1. What are the types of lightning arresters that are commonly used in warehouses for lithium-ion batteries (Hazardous)? How is surge protection achieved?	
MEP - INFRASTRUCTURE	

**HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Technical Queries for Clarification TVS LOGISTICS & CLIENT**

Page No.: 54

1. Open and Underground utilities, cable crossings (below and above ground), stormwater drains at the proposed cell storage site	
2. Nearest tapping point for power, raw water, firewater, and drainage outlet points for rainwater and wastewater.	
MEP - FIRE SUPPRESSION	
1. What are the hazards of lithium-ion battery handling and storage? What are the safety measures that have to be included?	
2. What are the issues / pain points you come across?	
3. Properties of lithium-ion batteries?	
4. What are the fire suppression methods used?	
5. Is there a provision of a fire hose cabinet within the building or facility?	
6. Is there a need for fire hydrant provision within the site?	
7. Requirement & Standards for Aisles?	
MEP - FIRE SUPPRESSION - NUMBER BASED	
1. Number of fire hose cabinets within the building or facility?	
2. Number of fire hydrant provision required within the site?	
3. Space between batteries / Palette	
4. Space between adjacent Racks	
5. Space for an aisle?	
6. Space for each bay?	
7. Entry & Exit Door dimension?	
8. Number of fire exits required for the warehouse?	
9. Number of entries required for the warehouse?	
MEP - IBMS	
1. Security issues that are required to be taken care?	
2. Different IBMS used here?	
3. What are the automation systems you would like to undertake(Cell Handling, Storage , Security, Monitoring)?	
SITE SAFETY	
1. How do you handle covid-19 scenarios and what are the safety measures that have been established in the working facility to achieve social distancing and government norms related to covid-19?	
2. Is it required to provide different circulation paths for vehicles & Labours? How do you avoid congestion / Traffic or Related Accidents within the warehouse and the site?	
3. What are the common hazards & safety measures that are required to be taken into consideration for a lithium- Ion Battery Warehouse?	
Name of the Responder :	
Date of response:	
Signature of the Responder:	

**Engineering Project Management Consultancy and Research Private Ltd**

- An IIT Madras incubated company

Title	Technical Queries for Clarification - Client		
Document No.	1		
Client Name	M/s Ather Energy		
Expected Date of Response	24-06-2020		
Technical Queries for Clarification			Date
			24-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations.To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on or before	
Cell Storage Building overview Purpose - Process - Places - People			
Questionnaire		Response	
FUNCTIONAL REQUIREMENTS			
1. Who are all the end-users?			
2. What are the Functional requirements?			
3. What are the Spaces that are required (Reception, loading &			
4. Is there a need for dock based facilities (such as dock door,			
5. Is there a need for Loading & unloading area?			
6. Is there a need for parking spaces?			
7. Different Activities involved in the workshop? & Labours			
FUNCTIONAL REQUIREMENT - NUMERICAL BASED			
1. Number of people & vehicles (Forklift) involved in the			
2. How frequent vehicles are used & numbers?			
3. Number of loading & unloading areas required?			
4. Number of Parking spaces required?			
5. What are the vehicles that are required to be parked? Their			
6. Vehicles used inside the warehouse for material handling?			
7. Size of the individual spaces / facility?			
Nature of Storage : Material & Behaviour in internal and external environment. Physical & Chemical properties - Dimensions, weight, temperature, chemistry and its reactions			
1. Physical & Chemical properties of the battery?			
2. Ideal temperature for the battery			
3. Dimension & Weight of the battery that is required to be			



HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Technical Queries for Clarification- CLIENT

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	Engineering Project Management Consultansy and Research Private Ltd - <i>An IIT Madras incubated company</i>		
Title	Technical Queries for Clarification - Client		
Document No.	2		
Client Name	M/s Ather Energy		
Expected Date of Response	24-06-2020		
Technical Queries for Clarification		Date	24-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations.To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on or before	
Storage & Handling Requirements Volume of Storage, Internal storage Layout (area & height), Loading & unloading, Storage system, Handling equipment, Access & Fire escape, Circulation space"			
STORAGE			
1. Types of racks used?			
2. Automation for the rack			
3. Properties of rack?			
STORAGE - NUMERICAL BASED			
1. Number of Racks used?			
2. Dimension (Length x Width x Height) & width of the racks			
3. With the Batteries what is the load per rack?			
4. Storage height of rack?			
5. Total Number of Batteries to be stored in the warehouse?			
6. How many batteries can be stored per rack?			
MEP - FIRE SUPPRESSION			
1. What are the hazards you have faced when it comes to			
2. What are the issues / pain points you come across?			
3. What are the fire suppression methods used?			
4. Is there a provision of a fire hose cabinet within the			
5. Is there a need for fire hydrant provision within the site?			
6. Requirement & Standards for Aisles?			
MEP - FIRE SUPPRESSION - NUMBER BASED			
1. Number of fire hose cabinets within the building or facility?			
2. Number of fire hydrant provision required within the site?			
3. Space between batteries / Palette			
4. Space between adjacent Racks			
5. Space for an aisle?			
6. Space for each bay?			
7. Entry & Exit Door dimension?			

	Engineering Project Management Consultansy and Research Private Ltd - <i>An IIT Madras incubated company</i>		
Title	Technical Queries for Clarification - Client		
Document No.	3		
Client Name	M/s Ather Energy		
Expected Date of Response	24-06-2020		
Technical Queries for Clarification		Date	24-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations.To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on or before	
Amenities & Utilities Battery Mgmt System(Monitoring) & Testing room, Wash area, Fire Protection, HVAC, Automation, Water supply, Effluent & waste water disposal, Lighting, Doors, windows & explosion vents			
MEP - HVAC			
1. What is the ideal temperature to be maintained for the			
2. What is an explosion vent & What are the provisions			
3. Types of ventilation systems that are provided for a battery			
4. How is Cooling, Ventilation, Pressurisation process Parallely			
5. What are the usual ventilation & Pressurisation design			
6. Since nearby facilities are closer to the site how do you			
7. Is it allowable to provide Window on the top of the wall?			
8. Is it continuously required to maintain minimum pressure			
9. Is ventilation required continuously or only during smoke			
10. For ventilation do you use Jet Vent fan & High volume low-			
11. Do you require the filtration process of incoming air? If			
12. What are the non explosive air conditioner types?			
13. How is the acoustic protection done?			
14. Is the heat recovery wheel / Treated fresh air system			
15. What are the commonly used air conditioners and their			
16. What are the Commonly used refrigerants?			
17. What are the Anti corrosive protection used for HVAC			
MEP - HVAC - NUMBER BASED			
1. Number of air conditioning units required?			
2. For a Lithium-ion battery warehouse, What are the how do			
3. What is the infiltration rate commonly used for HVAC systems?			
MEP- PLUMBING & SANITATION			
1. Spill containment sump locations?			
2. Where do you dispose of the damaged cells within the site			
3. How is plumbing , Spill containment drainage & grey water			



MEP- PLUMBING & SANITATION - NUMBER BASED

1. Number of plumbing outlets required?	
2. Number of Eyewash & Shower areas required?	
3. Spill containment & spill containment sump numbers?	

MEP - ELECTRICAL

1. What are the mechanical equipment used in the building?	
2. What are the telecommunication systems used in warehouse?	
3. What is the source (Eg: Solar Panels) of charging to be used?	
4. Is there a need for charging points & sockets. And where do they go?	
5. What are the commonly used Cable & cable entry facility / type?	
6. What type of earthing is used in warehouses?	

MEP- LIGHTING

1. What is the common lighting fixture & lamp type used? Any?	
2. Mounting height of lighting fixtures?	

MEP- LIGHTNING ARRESTER

1. What are the types of lightning arresters that are used?	
2. How is surge protection achieved?	

MEP - ELECTRICAL - NUMBER BASED

1. Number of provisions of charging points & sockets?	
2. Number of mechanical equipment used in the building & its location?	

INFRASTRUCTURE

1. Open and Underground utilities, cable crossings (below ground) & their locations?	
2. Nearest tapping point for power, raw water, firewater, and gas?	

IBMS

1. Security issues that are required to be taken care of?	
2. What are the automation systems you would like to have?	

Engineering Project Management Consultancy and Research Private Ltd
An IIT Madras incubated company

Title	Technical Queries for Clarification - Client
Document No.	4
Client Name	M/s Ather Energy
Expected Date of Response	24-06-2020

Technical Queries for Clarification

Date

24-Jun-20

Project Delivery

To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.

Queries

Clarifications to be received from Ather Energy on or before

Operation Challenges, Hazards & Risks

Mechanical damages, electrical surges, Thermal runaway, battery short circuit, fire, explosion, occupant health, environment, risks to neighbouring building and assets

SITE SAFETY

1. How do you handle covid-19 scenarios and what are the measures taken?	
2. What are the common hazards & safety measures that are in place?	
Since the nearby facilities are closed, How is the drainage & disposal of waste handled?	
1. What are the spill containment measures taken to prevent environmental contamination?	
3. Where do you dispose of the damaged cells within the site?	
2. Is it required to provide different circulation paths for different types of personnel?	



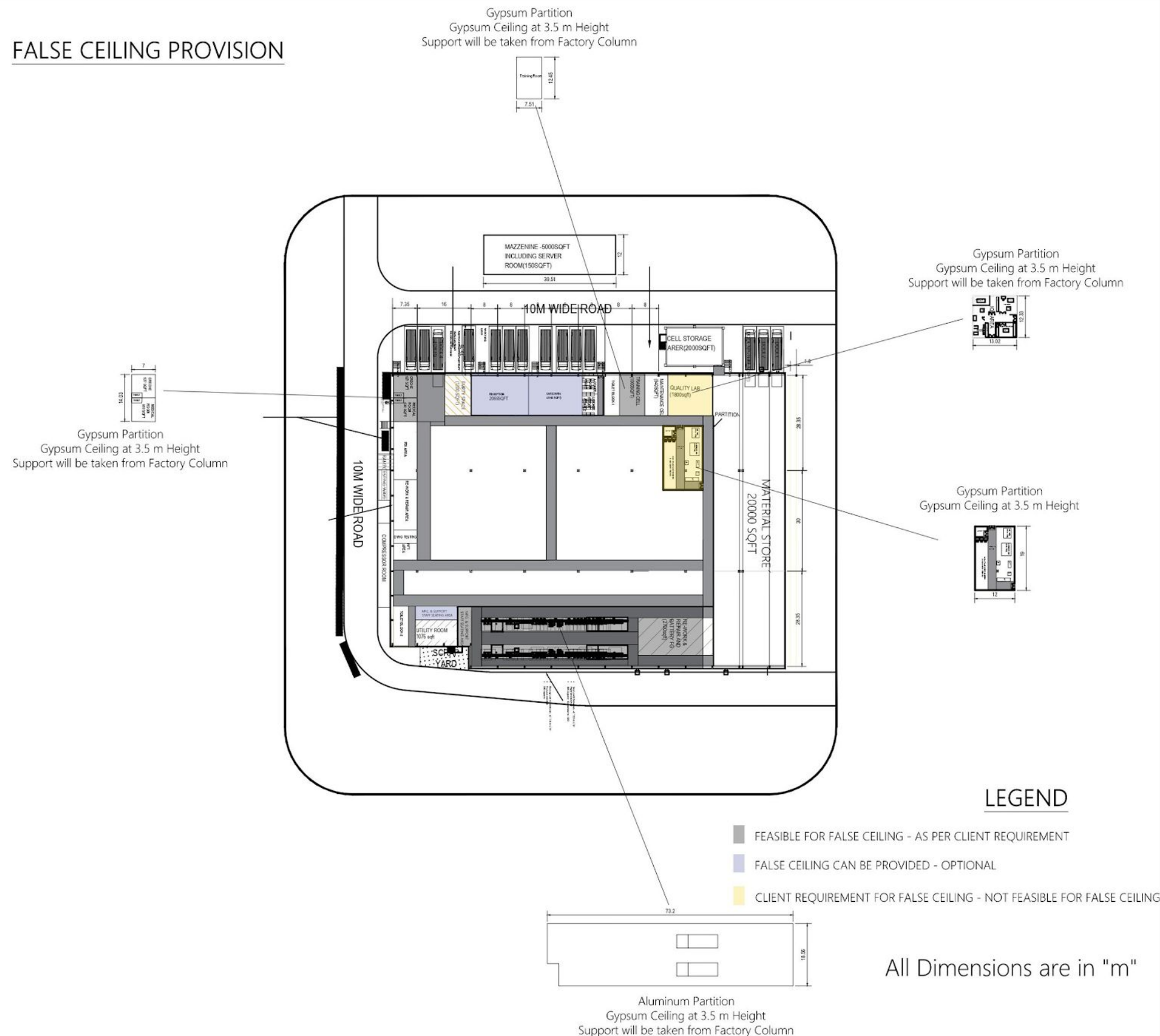
HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Technical Queries for Clarification- CLIENT

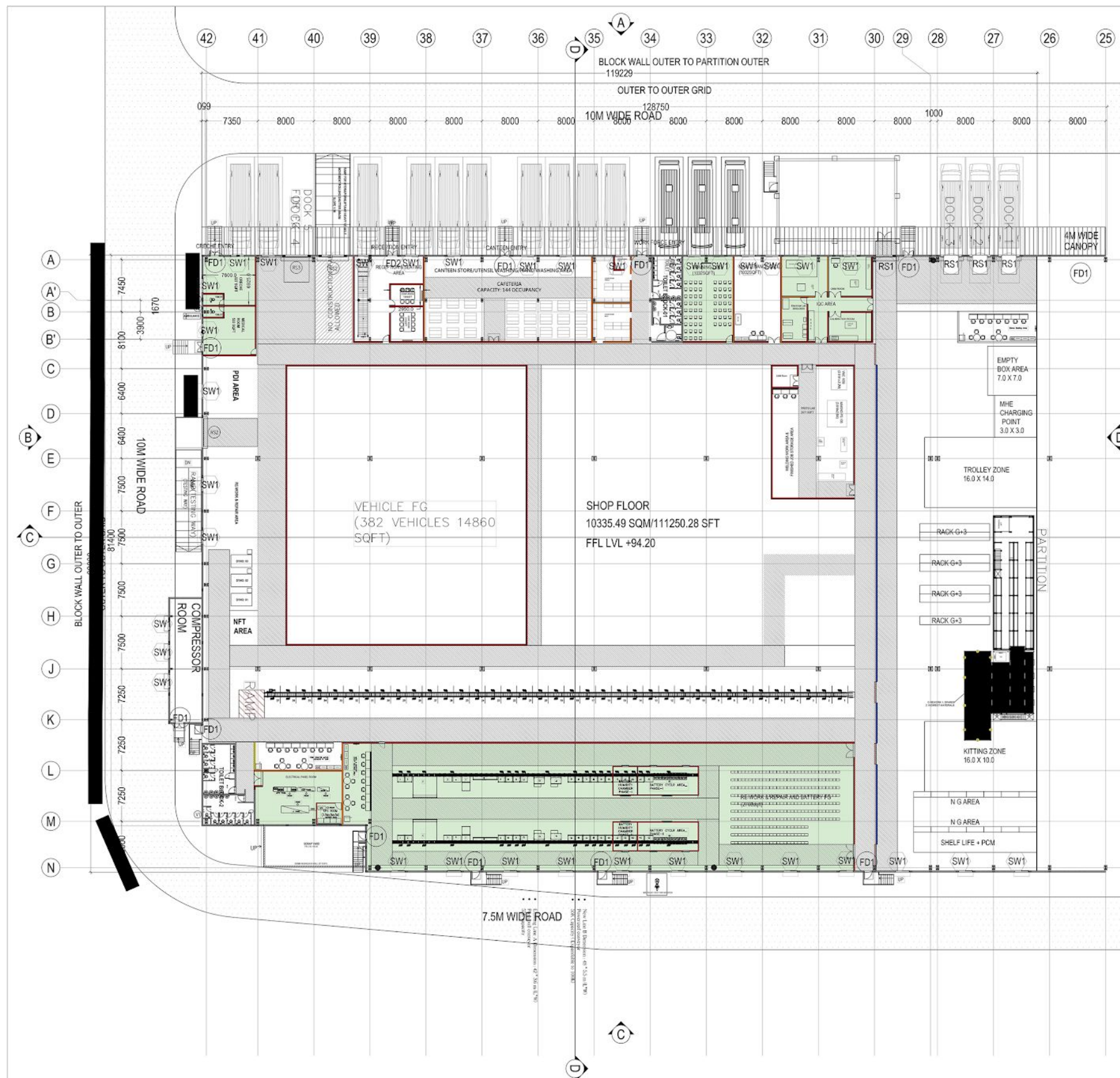
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	Engineering Project Management Consultancy and Research Private Ltd <i>An IIT Madras incubated company</i>		
Title	Technical Queries for Clarification - Client		
Document No.	5		
Client Name	M/s Ather Energy		
Expected Date of Response	24-06-2020		
Technical Queries for Clarification		Date	24-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on or before	
Location, Building Compliances & Approvals Building location, Building plan & elevation, Access roads, adjacent buildings & setbacks, Reduced Levels - NGL, FRL, MFL, FFL and compliance to buildings & industrial safety byelaws			
SITE			
1. Is there any existing trees/vegetation within and around			
2. Site Photos			
3. Plan, Elevation, sectional drawings, and detailed foundation			
SITE - NUMERICAL			
1. Site dimension & setback required?			
2. Size of the facility to be designed (Built Up area)?			
3. Road width required around the site for vehicular &			
4. Width of main road abutting in front of the site?			
5. Existing Water table level			
6. NGL (Natural Ground Level), of the existing ground, FFL			
7. What are the heights of nearby buildings?			
APPROVAL			
1. What is the land use zoning of the site?			
2. What are the approvals that are required at different stages			
3. Location of the proposed Cell storage facility incorporated			
4. What are the standards & codes followed for lithium-ion			
5. For total quality management, what are the factors to be			
APPROVAL - NUMERICAL BASED			
1. What is the cost and quality of the project expected?			

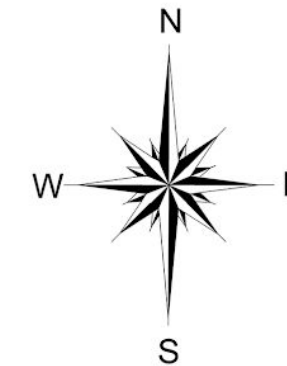
	Engineering Project Management Consultancy and Research Private Ltd <i>An IIT Madras incubated company</i>		
Title	Technical Queries for Clarification - Client		
Document No.	6		
Client Name	M/s Ather Energy		
Expected Date of Response	24-06-2020		
Technical Queries for Clarification		Date	24-Jun-20
Project Delivery	To deliver a design for a warehouse to store Li-ion batteries for Ather Energies at their Hosur facility. The design should facilitate easier and efficient storage and retrieval of batteries, maintain quality of batteries, and safety of the building considering its structural stability and the potential hazards during storage and operations. To provide adequate storing space as per the client's requirement and deliver a design for a warehouse following standard codes.		
Queries		Clarifications to be received from Ather Energy on 24 JUNE	
Building Structural System Soil bearing capacity, operational & Live Loads, Collateral loads, External forces (wind, seismic), explosion intensity, fire rating, chemical reactions, and various structural options for building			
1. Is the site prone to Earthquakes?			
2. Is there any standard specification for racks?			
3. Methods (Typology) of placement of racks?			
4. What type of materials will be used for racks?			
5. Do you recommend a slope or flat roof?			
6. What are the materials that can be suggested for wall,			
7. Flooring finishes used?			
8. Wall thickness and finishes used?			
9. Is wall partition used, if yes what are the different types of			
10. What is the usual recommended height of the building?			
11. What type of foundation is usually employed?			
12. Type of waterproofing			
13. Foundation type (shallow and deep)			
14. Metal sheet roofing thickness			
15. Earthquake Resistant structural design features to be			
16. What are the loads to be taken into consideration for the s			
17. What are the commonly used racks?			
18. Is there any standard specification for racks?			
19. Methods (Typology) of placement of racks?			
20. What type of materials will be used for racks?			
21. What type of materials to be used in walls, floors, roofs?			
22. What are the automation technologies used in			
STRUCTURAL REQUIREMENT - NUMBER BASED			
1. Water cement ratio			
2. Cement grade and Concrete grade			
3. Aggregate size			
4. Steel rod size			
5. Mortar for concrete masonry			

FALSE CEILING PROVISION





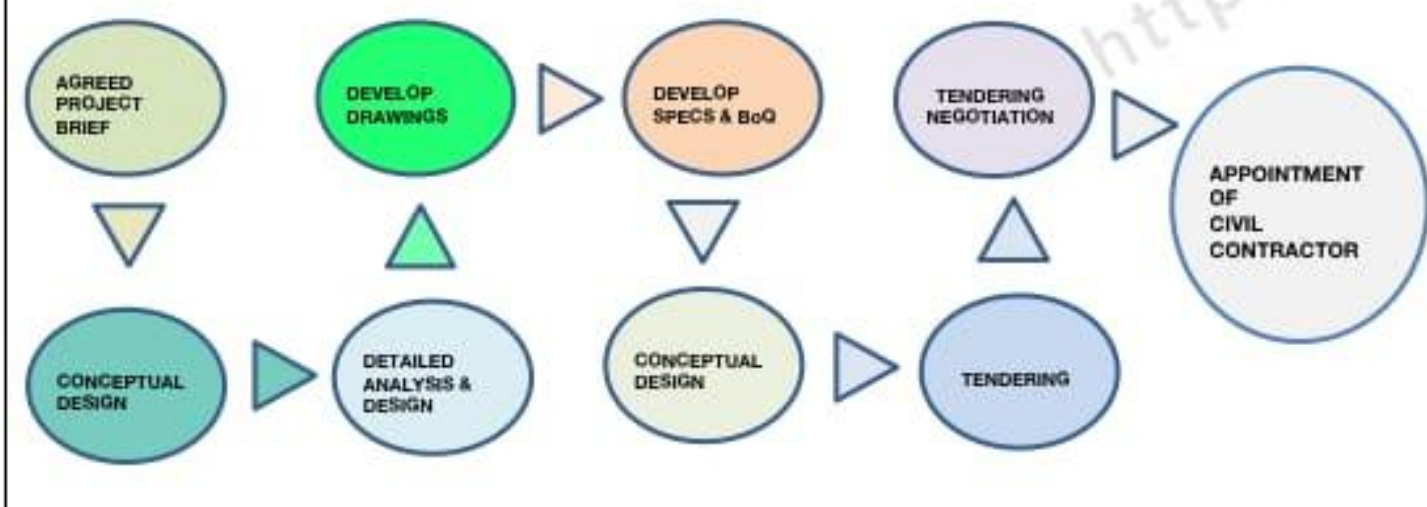
ORIENTATION



LEGEND

- Partly glazed and partly opaque partition
- Mesh partition
- Handrail of 3 feet height
- Full opaque partition (3.5m height)
- False ceiling area

All dimensions are in mm.

 Engineering Project Management Consultancy and Research (EPMCR) Private Limited <i>An IIT Madras incubated company</i>		Project Delivery Model		26th June 2020
Client & Project Detail		M/s ATHER ENERGY- Lithium Ion Battery storage facility		
Job Description		Structural Design, Coordination, Tendering & Monitoring of works through weekly audits and bill certification		
BACKGROUND: M/s Ather Energy intends to construct a Lithium Ion Battery storage facility at its Hosur facility. Ather Energy has appointed EPMCR as its consultant to design the structure(civil), deliver the necessary drawings, Bill of quantities, specifications, tender documents, tendering and appointment of Civil contractor.				
THE BIG PICTURE AT THE END OF DELIVERY: of Work Contract and appointment of Civil Contractor.				
PLACE: Ather Energy office, Bengaluru.				
STAKEHOLDERS AT THE SCENE: Ather Energy – Director Civil Contractor – Director EPMCR – Director				
DELIVERY ANALYSIS (Logical steps (Trailer) leading to the Big Picture)				
				
EPMCR/PD/001/01	Project Delivery Model		26th June 2020	
AUTHOR & TEAM	Mr. Kavinkumar & Kruthika, Vinoth, Sruthi, Nithya and Interns			
MILESTONES	OBJECTIVES	STAKEHOLDERS	LOCATION	
AGREED PROJECT BRIEF 30 June 2020	Understand Client Requirements, Define Project Objectives and Deliverables	Ather Energy, TVS Logistics, EPMCR	EPMCR office	
DESIGN, ANALYSIS & DEVELOPMENT OF DRAWINGS 06 July 2020 – 27 July 2020	Identifying of spaces, shape & size based on design parameters, function, safety, comfort & aesthetics. Development of Layout & Structural design through design parameter analysis for various scenarios.	Ather Energy, TVS Logistics, TCE, Approval Consultant, MEP Consultant, EPMCR	EPMCR office	
	Identify drawing delivery schedule.	EPMCR	EPMCR office	
DEVELOP SPECS & BOQ 30 July 2020	Identify Work Break Down, Specification standards and costing method	EPMCR	EPMCR office	
DEVELOP TENDER DOCUMENTS 30 July 2020	Identify tender type, bid quaification and contract model.	EPMCR Ather Energy	EPMCR office	
TENDERING 10 August 2020	Identify potential contractors, tendering time and location for Prebid meeting, Bid opening.	EPMCR Ather Energy	EPMCR office Ather Energy Office	
TENDER ANALYSIS & NEGOTIATION 16 August 2020	Estimated cost VS offered price, contractor's work quality and delivery.	EPMCR Ather Energy	Ather Energy Office	
APPOINTMENT OF CONTRACTOR 23 August 2020	Release of P.O from Ather Energy	EPMCR Ather Energy	Ather Energy Office	

BRICK WALL - FLY ASH & CLAY

Properties	Density	Compressive strength	Absorption	Dimensional stability	Wastage during transit	Plastering
Red Bricks/ Clay Bricks	1600-1750 kg/m ³	30-35 kg/cm ²	15-25%	Very low tolerance	Up to 10%	Thickness vary on the both sides of wall
Fly Ash Bricks	1700-1850 kg/m ³	90-100 kg/cm ²	10-14%	High tolerance	Less than 2%	Even on both sides
Remarks	Higher load bearing	Higher load bearing	Less dampness	Saving in mortar up to 25%	Saving in cost up to 8%	Saving in plaster up to 15%.

AUTOCLAVED AERATED CONCRETE BLOCKS

Available - Special block

- Thickness- 50,70,90,120,140,190,225,250 and 275 mm
- Length- 300,400,450,500,600 and 625 mm
- Height- 200,300 and 400 mm

Types of Finished to Block Surface

- Calibrated finish
- Plain finish

Physical properties of Flyocrete Autoclaved Aerated Concrete Blocks (Manufactured as per BIS-2185-Part-3-Grade-2)					
Sr. No	Description	Units	Thickness	Height	Length
1	Sizes of the Flyocrete Blocks	MM	75/100/125/150/200/230/300	240	650
			75/100/125/150/200/230/300	200	600
			75/100/125/150/200/230/300	240	625
2	Density (Oven Dry)	Kg/Cum	551-650		
3	Compressive Strength	Kg/Sqm	More than 30 Kg/Sqm		
4	Thermal Conductivity	W/m.k	Not Greater Than 0.24		
5	Sound Absorption				
a	Sound absorbency of air borne sound For 75 & 100mm thick wall	db	38 to 40		
b	For 200mm thick wall	db	45		
6	Drying Shrinkage	%	Less than 0.1		
7	Moisture content while Testing compressive strength	%	Between 8 to 12%		

AUTOCLAVED AERATED CONCRETE BLOCKS

Earthquake Resistance

Enviro Friendly

- Made out of pollutant fly ash

High Dimension Accuracy & Uniform surface

- Easy installation
- Less cement motor for joinings
- Uniform surface require min thickness of finishing materials

Water Penetration

- They have closed cells hence there is less capillary action and high surface activity allows through fast evaporation of moisture.
- Better than brick

High Workability

Available - Normal block

- Thickness- 75,100,125,150,200,230 and 300 mm
- Length- 650mm
- Height- 240mm

POLYURETHANE FOAM(PUF) PANEL

USAGE : Wall Panel ,Roof Panel

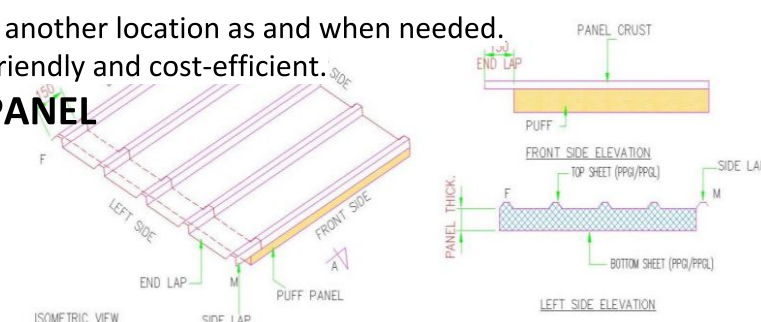
ADVANTAGES

- Durable and lasts long.
- Manufactures in factory conditioned and engineered using state-of-the-art technology.
- Manufacturing is done under the supervision of technicians in controlled environment for precision and accuracy.
- Panels offer high thermal efficiency resulting in low energy consumption and high energy efficiency.
- Customized to meet client requirements in terms of design and dimensions.
- It is easy to expand a building constructed with PUF panels.
- Durable but lightweight
- Easily dismantled, moved and re-constructed at another location as and when needed.
- Panels also low on maintenance, environment friendly and cost-efficient.

APPLICATION OF PUF PANEL

- Portable Site offices
- Prefabricated buildings
- Industrial and commercial buildings
- Cold Storage rooms & Clean room panel

WALL PANEL

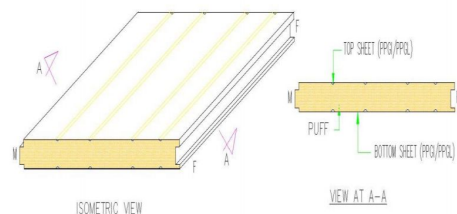


POLYURETHANE FOAM(PUF) PANEL

SIZES

- **Thickness-** 25 - 150 mm
- **Width-** 1000mm
- **Length-** as per requirement of the customer

ROOF PANEL



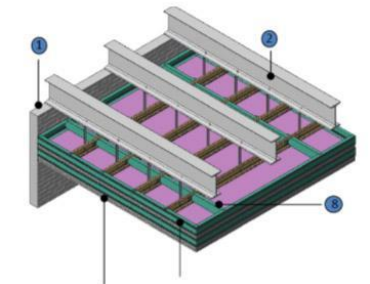
S. No.	Parameters	Test Method	Requirements	Results
1.	Density	ASTM D 1622	40±2 kg/m ³	40.2 kg/m ³
2.	Compressive strength at 10%	IS 11239 (Part 11):1985	≥ 210 KPa	235.6 Kpa
3.	Dimensional stability	IS 11239 (Part 3):2009	2% max.	< 0.5%
4.	Closed cell content	IS 11239 (Part 5):2009	85% min.	92.5%
5.	Thermal conductivity	ASTM D 564	0.023 W/m.K @10°C max.	0.021 W/m.K
6.	Water absorption @100% RH	IS 11239 (Part 9):1988	2% max.	< 0.2%
7.	Water vapour permeability	IS 11239 (Part 4):2014	5.5 ng/pasm max.	3.9 ng/pasm max.
8.	Tensile strength	ASTM D 1623	2.5 kg/cm ² min.	3.1 kg/cm ²
9.	Flexural strength	IS 11239 (Part 10):1985	3.0 kg/cm ²	3.7 kg/cm ²
10.	Salt spray test 300h	IS 14246:2013	There shall be no defect	Test in progress
11.	Horizontal burning	IS 11239 (Part 12):1988	< 125mm	48mm

FALSE CEILING

- Passive fire protection (PFP) is generally built into the structure so that the building can withstand fire for a specified period. PFP protects the structure and the lives of people inside the building in a fire by reducing or preventing the fire from spreading internally and externally, thereby maintaining the stability of the building and the safety and escape routes for the occupants.
- PFP Systems are always 'switched on' and do not require activating in order to fulfill their role.

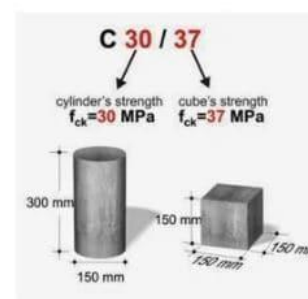
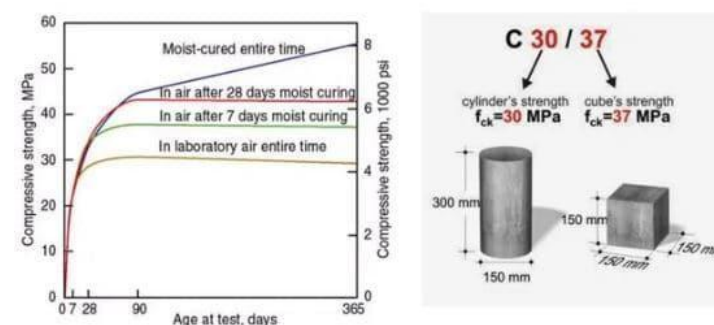
MATERIAL

- A hydrated sulphate of calcium, **gypsum** - it is lightweight, **fire-resistant**.



REINFORCED CONCRETE WALL

- Reinforced concrete is a combination of traditional cement concrete with reinforcements (steel bar). This combination is made to use the compressive strength of concrete and tensile strength of steel at the same time, hence, work together to resist many types of loading.
- This building material must be carefully engineered. If it is not reinforced enough, the concrete can be weak and subject to failure.



PRE-ENGINEERED BUILDING

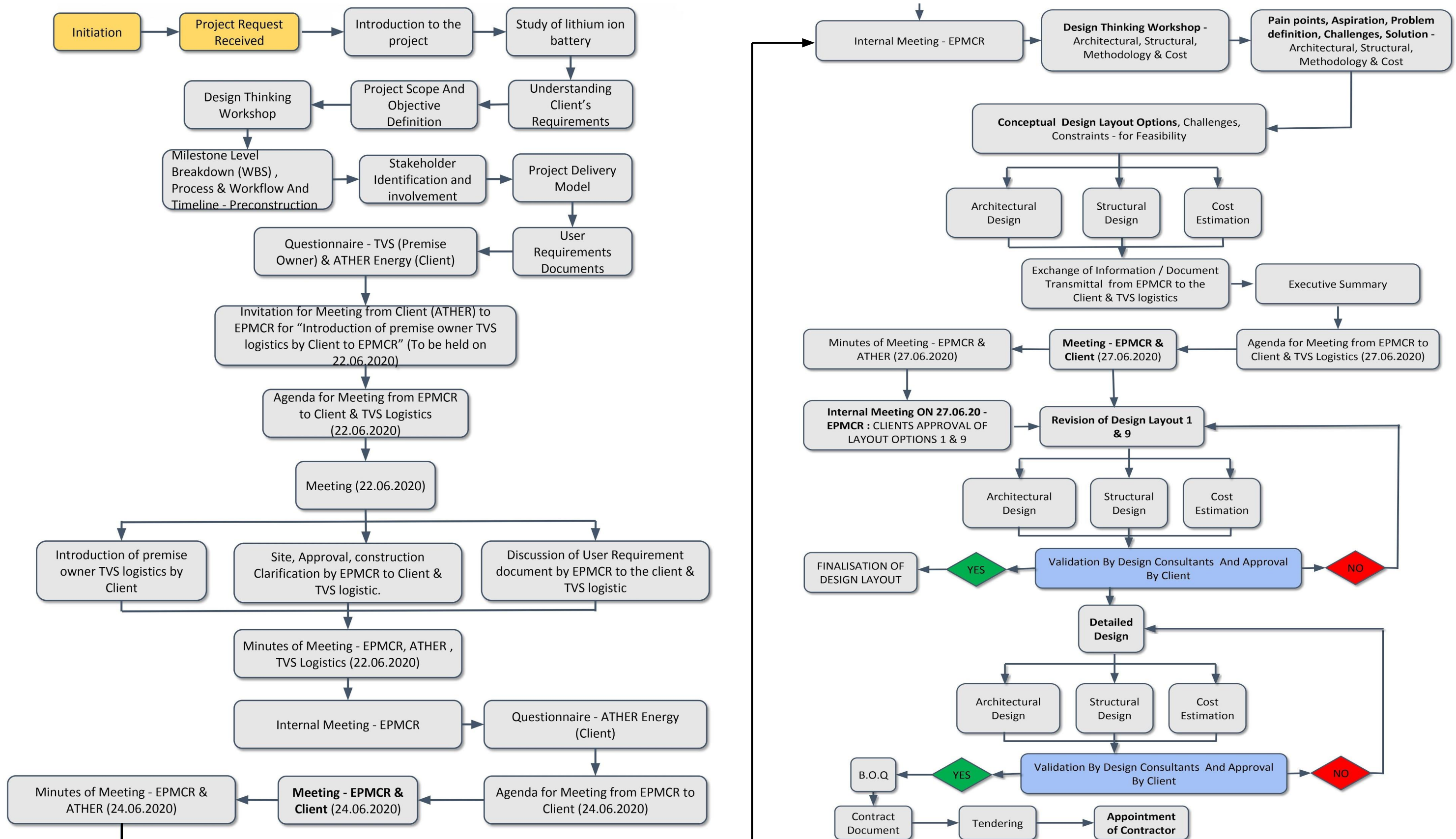
- Pre-Engineered Building concept involves the steel building systems which are predesigned and prefabricated.
- Steel quantity depends on primary members and purlins.
- Low weight flexible frames of PEB offer higher resistance to wind loads.
- Material wastage plays a significant role in reducing steel quantity and cutting the cost of structure as all fabrication work for conventional steel frames are performed at site results in lots of wastage in material.
- The basis of the PEB concept lies in providing the section at a location only according to the requirement at that spot.
- Standard hot-rolled sections, cold-formed sections, profiled roofing sheets, etc. is also used.
- The use of optimal least section leads to effective saving of steel and cost reduction.

CIVIL WORK:

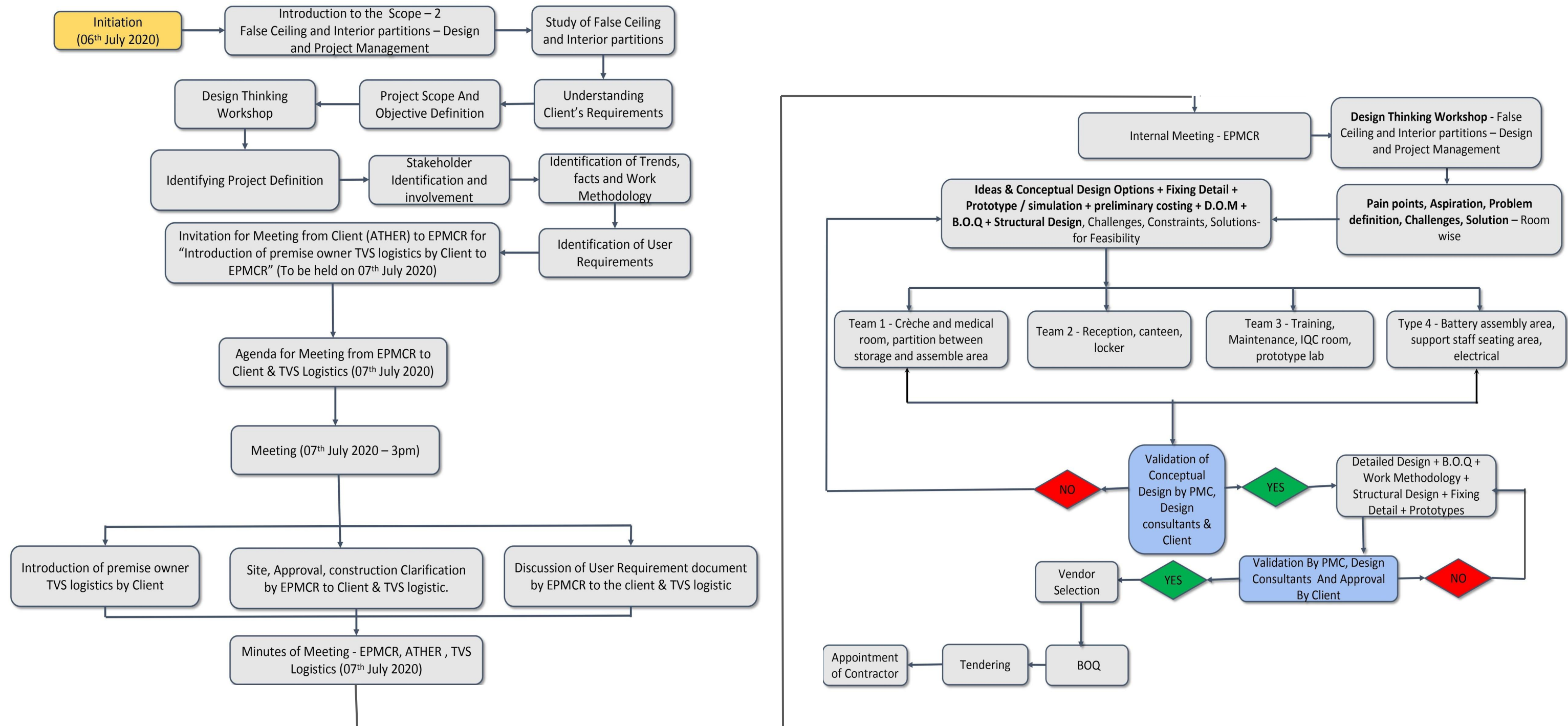
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| <ol style="list-style-type: none"> 1. Site Clearance 2. Marking 3. Excavation 4. Foundation: <ol style="list-style-type: none"> 4.1. Foundation Marking 4.2. Excavation 4.3. Footing and Column Marking 4.4. Rebar work 4.5. PCC Work 4.6. RCC Concrete work 4.7. Refilling 4.8. Consolidation 5. Plinth work <ol style="list-style-type: none"> 5.1. Column 5.2. Ground Beam 5.3. Wall 5.4. Plinth Beam 5.5. Backfilling 5.6. Pcc Work 6. RCC Frame Work <ol style="list-style-type: none"> 6.1. Ground floor framework <ol style="list-style-type: none"> 6.1.1. Column- Rebar 6.1.2. Column Shuttering 6.1.3. Column concreting 6.1.4. Column Deshuttering 6.1.5. Beam & Slab - Shuttering 6.1.6. Beam & Slab - Rebar 6.1.7. Beam & Slab - Concrete 6.1.8. Beam & Slab - Deshuttering 6.1.9. Staircase Foundation - Shuttering 6.1.10. Staircase Foundation - Rebar 6.1.11. Staircase Foundation - Concreting 6.1.12. Staircase Foundation - Deshuttering 6.1.13. Pathway - Shuttering 6.1.14. Pathway - Rebar 6.1.15. Pathway - Concrete 6.1.16. Pathway - Deshuttering 7. Block Work <ol style="list-style-type: none"> 7.1. Ground Floor <ol style="list-style-type: none"> 7.1.1. Brickwork till lintel 7.1.2. Lintel Beam - Shuttering | <ol style="list-style-type: none"> 7.1.3. Lintel Beam - Rebar 7.1.4. Lintel Beam - Concrete 7.1.5. Lintel Beam - Deshuttering 7.1.6. Brickwork till slab 8. Roofing Slab <ol style="list-style-type: none"> 8.1. Roof Slab - Shuttering 8.2. Roof Slab -Rebar 8.3. Roof Slab -Concreting 8.4. Roof Slab -Deshuttering 9. Parapet Brickwork 10. Metal Staircase 11. Roof Cover -Bridge 12. Finishes <ol style="list-style-type: none"> 12.1. Plastering 12.2. Painting 12.3. False Ceiling 12.4. Flooring & Wall tile 13. MEP <ol style="list-style-type: none"> 13.1. Plumbing work <ol style="list-style-type: none"> 13.1.1. Water Sprinkler pipeline 13.1.2. Spill containment 13.1.3. Sprinkler water drainage pipeline 13.1.4. Floor Trap Installation 13.1.5. Rainwater drainage pipeline 13.1.6. Door Drain traps 13.1.7. Laying of Underground pipes 13.1.8. Spill Containment Sump 13.1.9. Manhole / Chamber 13.2. Electrical <ol style="list-style-type: none"> 13.2.1. PVC Conduiting-recessed 13.2.2. LV Cabling - Lighting, Fire fighting System & small powers 13.2.3. Distribution Board 13.2.4. Lightning Protection System 13.2.5. Earthing system 13.2.6. Light Fixtures 13.2.7. Fixing Switches & Accessories 13.3. Fire Fighting Work <ol style="list-style-type: none"> 13.3.1. Fixing hangers & supports 13.3.2. Fixing pipes 13.3.3. Detection & Alarm systems 13.3.4. Sprinkler fixing 13.3.5. Fire Extinguisher 13.3.6. Laying of hydrant pipes | <ol style="list-style-type: none"> 13.3.7. Installation of fire pumps 13.4. HVAC <ol style="list-style-type: none"> 13.4.1. Duct hangers & Supports 13.4.2. Chilled water Pipe hanger & Support 13.4.3. Ducting work for supply, Return, Fresh & Exhaust Air 13.4.4. Fire & Smoke Damper Fixing 13.4.5. Duct insulation 13.4.6. Chilled water piping 13.4.7. AHU Installation 13.4.8. Air-cooled chiller Installation 13.4.9. Duct Connection to AHU 13.4.10. Pipe Connection to AHU 13.4.11. Dehumidifier fixation 13.4.12. Temperature & Humidity sensor fixing 13.4.13. Temperature & Humidity Monitoring & Control panel fixation 13.4.14. Exhaust system fixation 13.4.15. Duct connection for Exhaust System 13.5. Explosion Vent 14. IBMS <ol style="list-style-type: none"> 14.1. CCTV 14.2. PA System 14.3. Monitoring & Control Panel |
|--|---|--|

HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- PRE-CONSTRUCTION PHASE - FLOW CHART

Page No.: 64



ATHER ENERGY FACTORY - FALSE CEILING & INTERIOR PARTITION FLOW CHART



ATHER ENERGY - INTERIOR PARTITION

DEFINITION, LOCATION, DIMENSION, STAKEHOLDERS, TRENDS & TECHNOLOGIES

PROJECT DEFINITION:

To design a cost-effective, structurally stable & re-assemble interior wall partition assembly system that can provide a covered work-space with respect to functionality, accessibility, safety, comfort, aesthetics & support.

PROBLEMS IDENTIFIED:

1. Internal partitions are required to separate the work zones based on functionalities.
2. Identifying the right dimension of the internal partition to be considered based on the activities inside the room or area.
3. Identifying the right material for interior partition walls which can provide structural, chemical and fire safety, access control, monitoring of works, comfort(Lighting, Temperature, ventilation and acoustics) and aesthetics.
4. Identifying the interior partition walls which can give access and monitor the outside activity within the room.
5. Identifying the interior partition walls which can give access and private space for activities inside the building.
6. Providing structural support for the internal partition wall considering the self-weight , live loads, impact loads, etc.
7. The loads due to false ceilings and internal partitions are considered in PEB buildings and civil structural design.

LIST OF STAKEHOLDERS:

1.INTERNAL STAKEHOLDERS:

- Ather Energy (Top Management)
- Ather Energy Operation Manager
- Ather Energy staffs
- TVS Logistics
- Interior Designer
- EPMCR Pvt Ltd (Architecture, Structural Consultant)
- PMC & Quality
- Interior Partition Consultant
- HVAC Consultant
- MEP Consultant
- Fire Consultant
- Lighting Consultant
- Estimation Consultant
- Contractors - Civil/Interior
- Sub Contractors
- Vendors - Material / Equipment Suppliers
 - Gypsum
 - Calcium Silicate
 - Brickwork, glass
 - Fly Ash brick
 - AAC wall
- Manufacturers
- Logistics
- Maintenance workers
- Security

2. EXTERNAL STAKEHOLDERS:

- TVS Logistics
- Arbitrators
- Special Interest Groups
- Environmental Authority - To check the disposal and storage of scrap
- Town Planning Board - To confirm with the minimum standards required for interiors
- Local public & Neighbours
- Other Competitors
- Marketing
- Customers of Ather Energy
- Visitors of Ather Energy

Classification of Stakeholders:

Class 1: Bodies that are internal stakeholders but not directly involved in the construction.

Class 2: Internal stakeholders and directly involved in construction, design, planning.

Class 3: Supporting bodies for class 2.

Class 4: Governing bodies, lawmakers.

Class 5: Others.

PLACE:

- Access to site
- Access to factory - Factory Entrance - Access to materials inside the factory
- Creche - Acoustics, Safety (fire/electrical short-circuits), Lighting & Ventilation, Signages
- Medical Room - Acoustics, Safety, Lighting & Ventilation
- Reception & Seating Area
- Conference Room - 1
- Conference Room - 2
- Canteen / Washing area
- Cafeteria
- Locker Room (Female)
- Locker Room (Male)
- Toilet Block - 1
- Training Cell
- Maintenance Cell
- IQC Area
 - Salt Spraying
 - Electrical Lab
 - CMM Room
 - Calibration Room
- Re-work & Battery Repair FG
- Battery Cycle Area Phase - 1
- Battery Humidity Chamber -1
- Battery Cycle Area Phase - 2
- South-side partition wall
- East-side partition wall
- Electrical panel room

- Mfg. & Support staff seating area - 1
- Mfg. & Support staff seating area - 2
- Toilet Block - 2
- Compressor Room
- Vehicle FG area
- Proto labs
 - **CMM Room**
 - **VMC**
 - **Makino**
 - **Esteam**
 - **Bench grinder**
 - **Milling M/C**
 - **Band saw**
 - **Welding work area & Finished Job area**

FACTS:

1. Limiting the access of oxygen as a fire fighting strategy carries major risks, as toxic gases or combustible gas mixes may develop. For this reason, limiting the propagation of fire through a building is done by dividing the building into fire compartments.
2. Integrity - ability to stop flames and hot gases from penetrating
3. Insulation - ability to restrict the temperature rising on the cold side. In most cases, the temperature at the cold surface may not increase more than 140 degree C on average, or 180 degree C locally, compared to initial temperature.
4. Load-bearing function - ability of a structure to carry loads or actions without collapsing.
5. Applicable to partitions if the fire compartmentalization boundary also has load-bearing functions.

TRENDS & TECHNOLOGIES:

- AAC interior partition panels:
 - High thermal insulation: protects against the cold and heat
 - Sound Insulator
 - Saves air conditioning costs and energy consumption
 - Up to 4 hours of fire endurance (direct exposure)
 - Flexual strength
 - Superior sound absorption and earthquake resistance properties
- Gypsum (Drywall) interior partition board:
 - Quick Installation
 - Dry Construction
 - Light-Weight and Flexible
 - Sound Insulators
 - Fire Resistant (4hrs.)
 - Thermal security
 - Durability
 - Cost Effective
 - All types of finishes
- Open-Mesh partition wall:
 - Strong galvanized wire mesh allows air movement between compartments.
 - It allows the exhausting of fumes and temperature control in a cost-effective method.
- Aluminium-framed glass partition wall:
- Fire-resistant
- Sound-proof
- Thermal insulator, Easy to maintain
- Water-proof, Cost-efficient

OVERALL FALSE CEILING & INTERIOR PARTITION TEAM DESIGN THINKING

Materials:

- **Bricks & Blocks**
 - Brick
 - Clay
 - Exposed brickwork
 - Porotherm bricks
 - Wire cut brick work
 - Fly ash bricks
 - Concrete blocks
- **Cement Based panel:**
 - Brila aerocon fibre board
 - AAC panels
 - Hollow core precast
 - Pre stressed concrete wall panels
 - Ferro cement wall panels
 - EPS panels
- **Gypsum and fibre based composite panels**
 - POP
 - GYPSUM
 - CALCIUM SILICATE panels
 - Fibre board
 - GFRG panels- Glass fibre Reinforced Gypsum panels
 - Glass fibre Reinforced panels
- **Glass, wood, plastic, metal composite panels**
 - PVC
 - PUF
 - METAL
 - WOODEN
 - GLASS
 - Aluminum composite
 - WPC ;
 - PLYWOOD
 - FRP Partition

- Bamboo Composite partitions
- Aluminium frame glass partition
- Composite wall - AAC till 3 ft , Glass & Gypsum
- Fire rated glass partitions
- Perforated Aluminium partition
- Aluminium frame partition
- Perforated glass
- **Finishes:**
 - Leather Finish
 - Customised - logo
 - Wall paper finish
 - Wall cladding
 - Pvc cladding
 - Painted finish
 - Epoxy paint
 - Emulsion Paint
 - PU Paint
 - Metal cladding
 - Stone cladding
 - 1mm clay tile
 - 1mm stone tiles
 - Ceramic tile Cladding
 - Glass cladding
 - Stained glass
 - Stainless Steel Cladding
 - RMD Panels
 - Plywood laminates / panels
- **Barricade:**
 - Mesh Barricades
 - Open Mesh Wire
 - Laser cut Aluminium Barricades
 - Stainless steel barricade
 - Steel wire barricades
 - Brick Jali
 - Concrete jali
 - Composite jali
 - Chain links
 - FRP composites

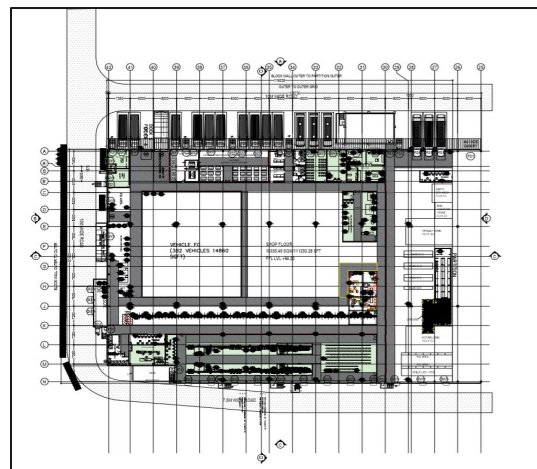
- **Handrail:**
 - Stainless Steel handrail
 - Glass handrail
 - Composite handrail
- **Door & Access:**
 - Fire rated metal door
 - Sliding door - Side
 - Wooden doors
 - Sliding door - Upward
 - Flush doors with vision panel
 - Fire rated glass doors
 - FRP Door
 - Epoxy finish door
 - Aluminium framed door with wooden slots
 - WPC door
 - Rolling Shutter
 - Access Control System
 - Laminated finish - door
- **Vendors**
 - GYPROC
 - ARMSTRONG
 - USG BORAL
 - Everest
 - Saint Gobain
 - Aerocon
 - Aditya Birla
 - Interior Contractors
 - R&M electricals
 - Disha interiors
 - Touch stone
 - Steel Contractors
 - Dorma
- **Connections**
 - Anchor fasteners
 - Vendor based - framing connection
- Screw connection
- Interlocking connection
- Vertical struts
- Connection brackets
- Gusset plate
- Cleat supports
- Soffits
- Wall Angle
- Clips
- Welded connections
- Riveted Connection
- **Structural Member/materials**
 - GI Track & Channel
 - Aluminium Track & Channel
 - Metal Panels - Aluminium
 - Aluminium framing system
 - GI framing system
 - MS framing system
 - AAC - Self-supportive
 - Channel supports
 - EPS Panels - material
 - Steel Column
 - Support for conduit & sockets - electrical
- **Structural stability and support:**
 - support from Factory building walls
 - support from Factory building floor
 - support from Factory building column
 - Intermediate column supports - wooden
 - Intermediate column supports - Steel(pipe supports, box supports)
 - AAC panels - self supporting system
- **Structural Properties:**
 - No deflect
 - Light weight
 - Easy to dismantle
 - Easy to erect
 - Chemical resistant
- Durability
- Corrosion Resistant
- Malleable
- Ductile material
- With stand Suspension load
- Saline Resistant
- Impact Resistant
- Lateral load resistant
- Pull load resistant
- Utility loads
- Axial load resistance
- Compressive load
- **Access & Safety**
 - Access door
 - Access control
 - Doors with vision panels
 - Crash barriers
 - Vibration Isolation
 - Provision for recessed conduit & sockets electrical
- **Comfort**
 - **Thermal & Acoustics**
 - Glass Wool Thermal Insulation
 - Calcium Silicate Board
 - Acoustic Panel - Training room
 - Fibre board
 - Sealants for joints & gaps
 - **Lighting**
 - light-colored material
 - Grid lights
 - Eco friendly & Healthy Material
 - Ventilation & Air Conditioning System
 - Ceiling Mounted Air Conditioners
 - Forced Exhaust system
- **Aesthetics:**
 - **finishes**
 - Textured Board
- Colour
- Decorative
- Metal finish
- Curved false ceiling
- Shapes
- Cove lighting
- Strip lighting
- **Types**
 - Suspended False ceiling
 - False ceiling drops at different levels
 - Baffle false ceiling
 - Engraved false ceiling
 - Wooden box
 - Theme based false ceiling
 - Stretch false ceiling
 - Grid lighting

MATERIALS VENDORS

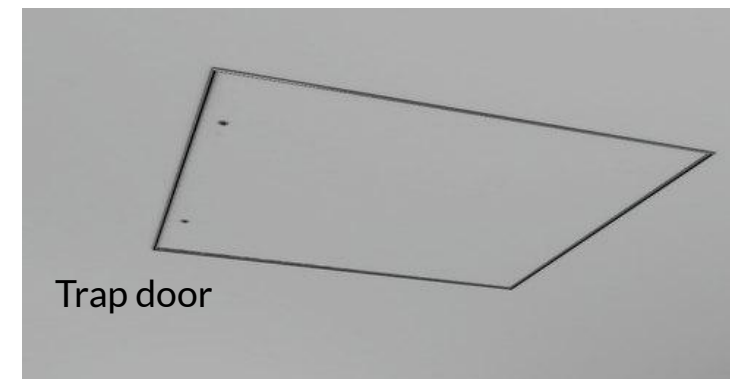
MATERIAL	PRODUCT	BRAND
Fibre cement board	Rapicon Wall Panel	
Calcium silicate board	Hilux	

Material	Fibre cement board
Structural Support	Steel box section-column
Structural Member	Rafter and Girder
Connection	Vertical Struts; Plate, Nut - Steel Column to floor, screw & interlocking
Access & Safety	Trap door & Fire resistance
Comfort	Acoustics , good illumination & Ceiling Mounted Air Conditioner
Aesthetics	Textured

TRAINING ROOM 7.1m x 12.1m x 3.5m



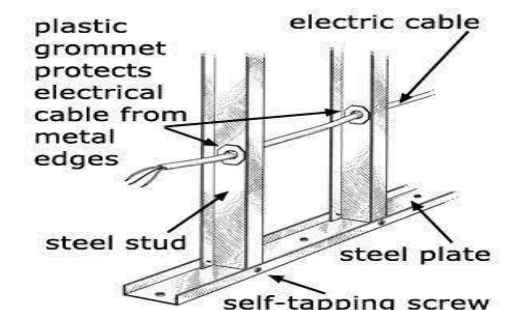
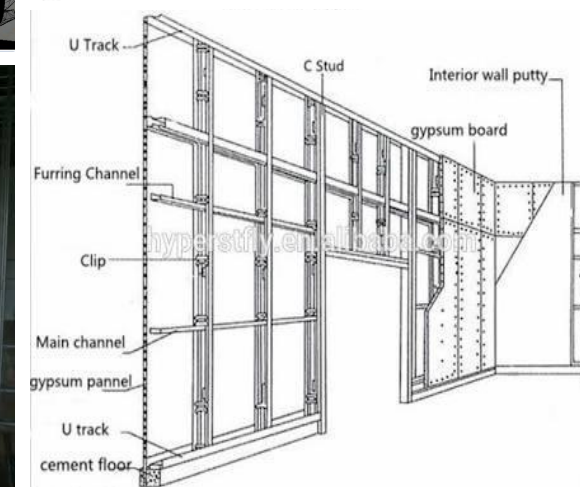
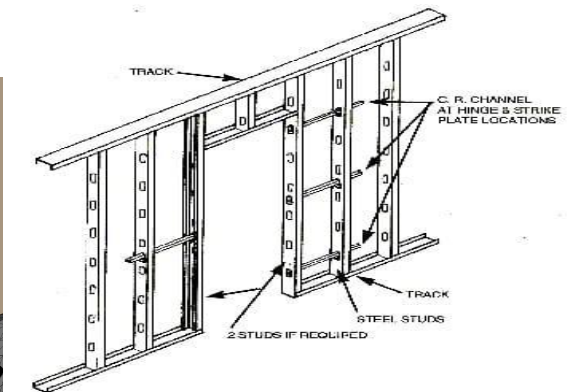
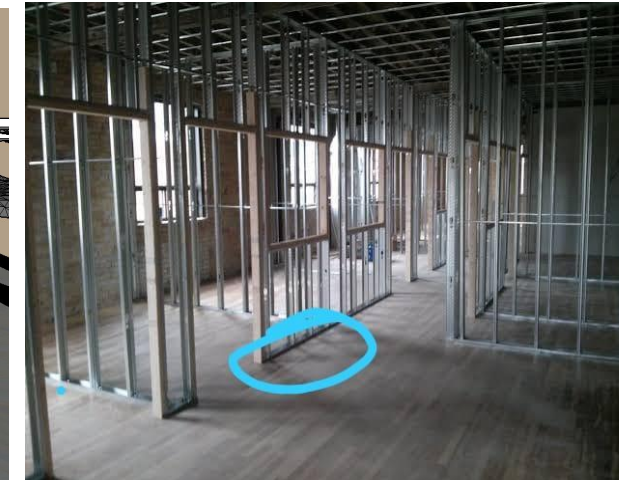
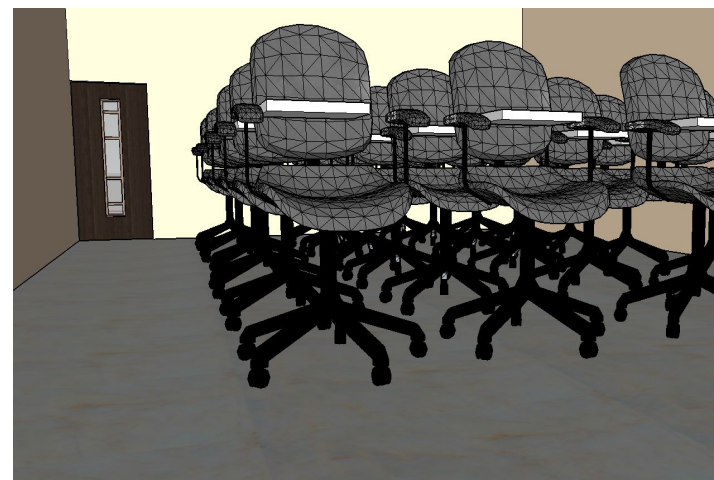
Purpose	Problem
- Lectures - Meetings - Presentation	- Acoustic - Thermal Insulation - Good Ambience - Illumination - Ventilation



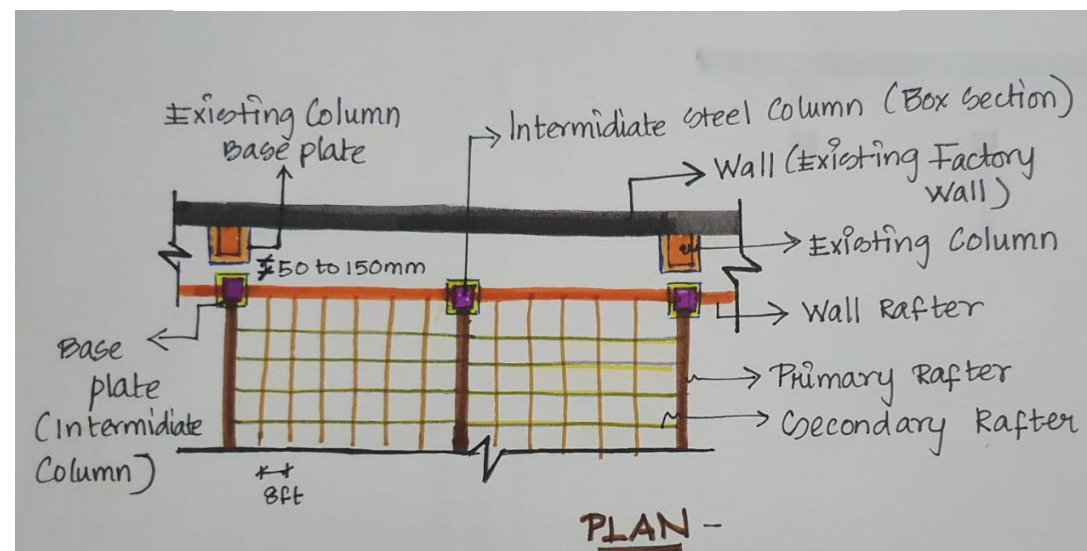
Technical Comparison of Calcium Silicate and other false ceiling :

Characteristics	Calcium Silicate Ceilings	Mineral Fibre Ceilings	Gypsum Ceilings
Humidity Resistance	100%	70%-90%	90%
Water Resistance	In case of contact with water, it does not lose its physical integrity.	In case of contact with water, the ceiling starts disintegrating immediately.	In case of contact with water, the ceilings start disintegrating.
Non combustible/ Fire Resistance	Non combustible as per BS 476 Part 4	Combustible	Combustible
Light Reflectance	>85%	>85%	>75%
Sound Absorption (NRC)	0.10 to 0.75 depending on surface finish	0.10 to 0.75 depending on surface finish	0.10 to 0.70 depending on surface finish
Sound Attenuation	32dB	34dB	28dB
Coefficient of Thermal Conductivity	0.048 – 0.050W/mK	0.057/ W/ M° K	0.016/ W/ M° K
Termite Resistance	Inorganic material. Hence no termite attacks	Organic binders used, hence prone to termite attacks	Organic binders used, hence prone to termite attacks
Weight	5 - 5.5 kgm ²	3.8 kgm ²	12.5 kgm ²

3D VIEWS-TRAINING ROOM



False ceiling framework - plan

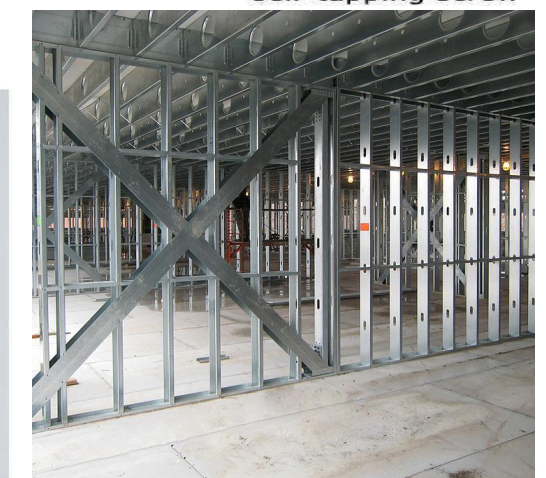


Training room-Partition wall

Material	Fibre cement board
Structural Support	Floor
Structural Member	Aluminium Tracks & Channels
Connection	Screw & interlocking connection
Access & Safety	Fire resistance
Comfort	Acoustics , good illumination
Door	Sliding door - Side Access Control System
Aesthetics	Textured

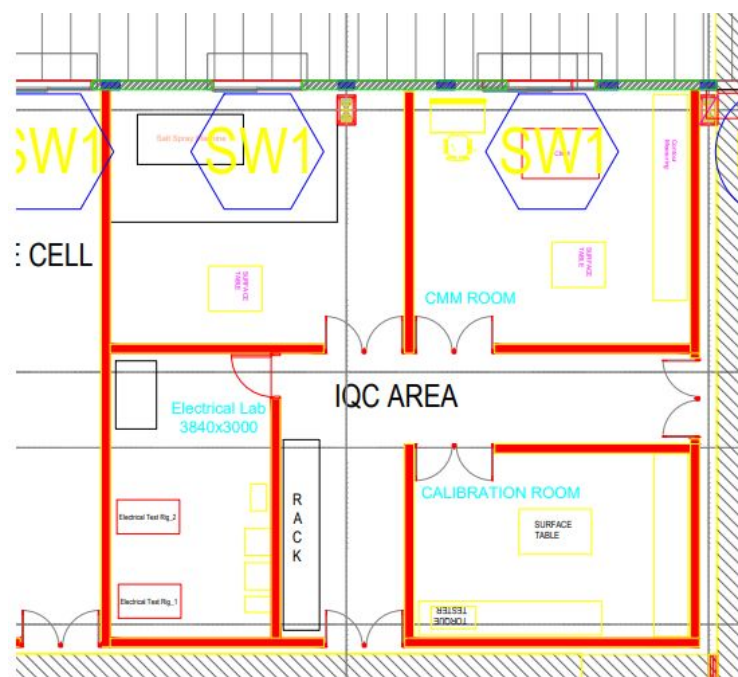
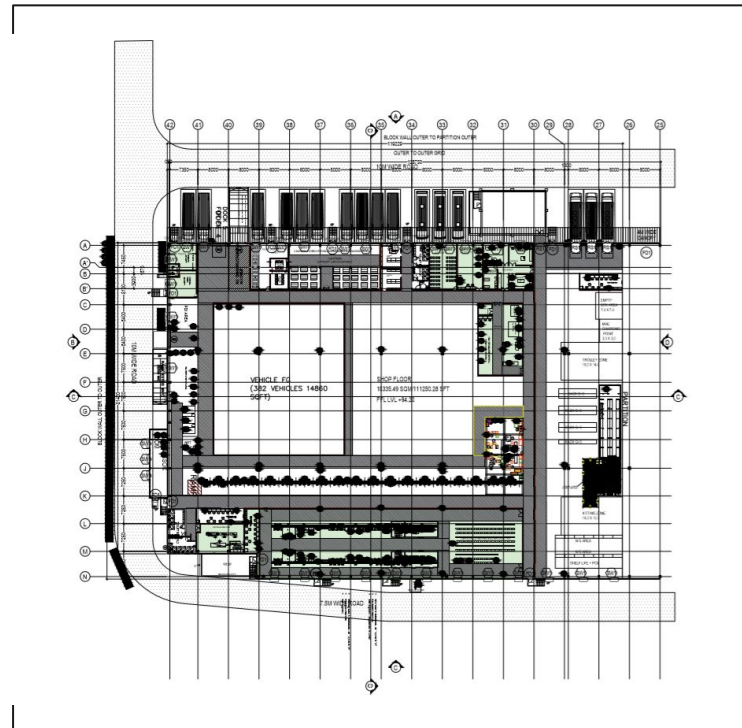


Installation Chart



IQC Room

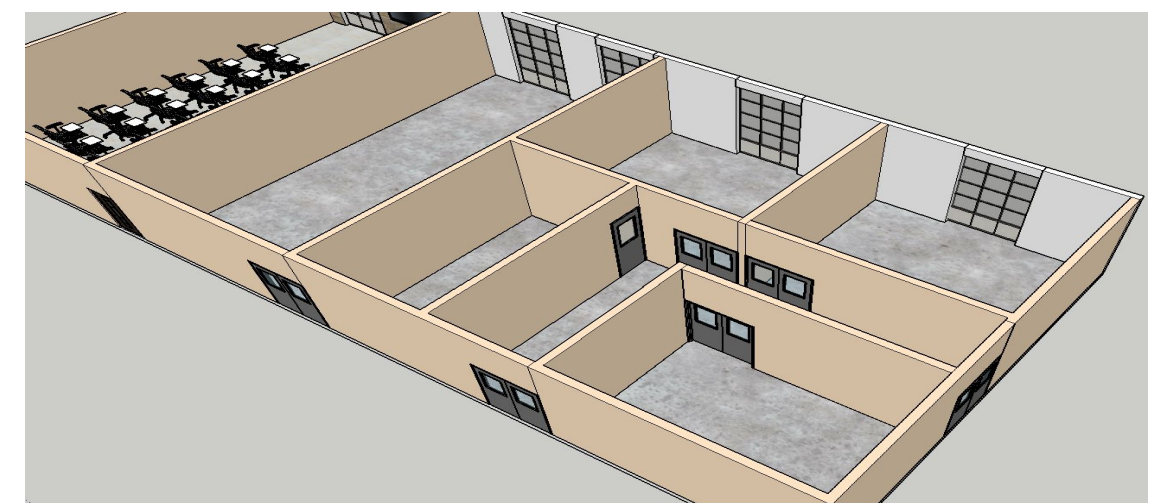
12.81m x 12.1m x 3.5m



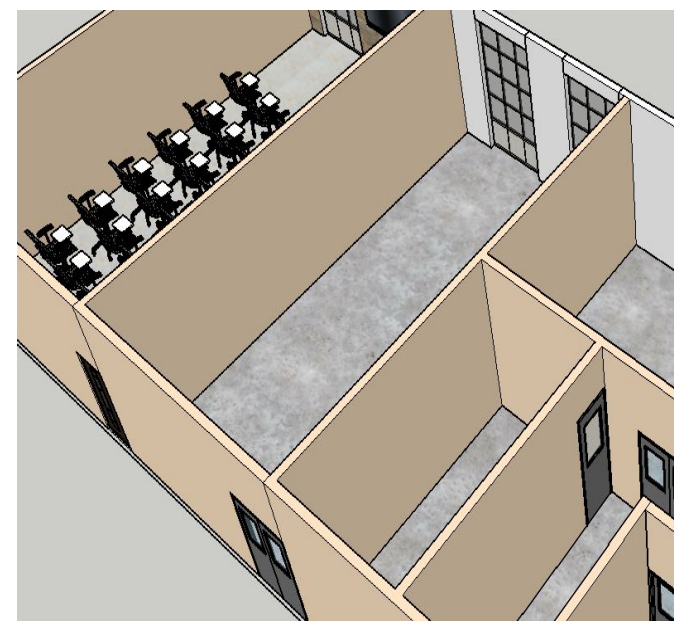
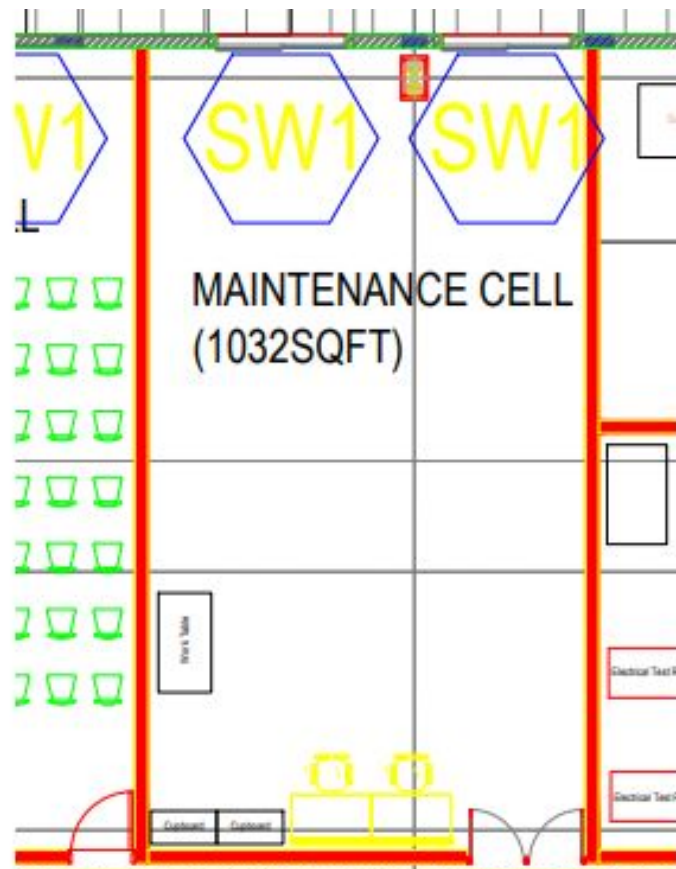
Material	Fibre cement board
Structural Support	Steel Columns
Structural Member	Rafter and Girder
Connection	Vertical Struts; Plate, Nut - Steel Column to floor, screw & interlocking
Access & Safety	Trap door & Fire Resistance
Comfort	Corrosion Resistance, Thermal Insulation, Good Illumination & Ceiling Mounted Air Conditioner
Aesthetics	Textured

Material	Fibre Cement Board
Structural Support	floor
Structural Member	Aluminium Tracks & Studs - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Resistance, Chemical & Saline resistance
Door	Flush doors with vision panel for rooms - Double leaf Fire rated Metal door with vision panel with Access Control System - Main Entry - Double leaf Fire rated Metal door - Single leaf - Electrical room
Aesthetics	Painted finish

Purpose	Problem
Quality Test Lab	- Proper Illumination - Thermal Resistance - Chemical & Saline Resistant - Fire Accidents

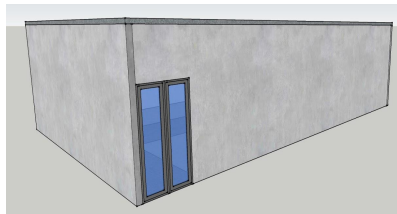


Maintenance room 6.6m x 12.1m x 3.5m

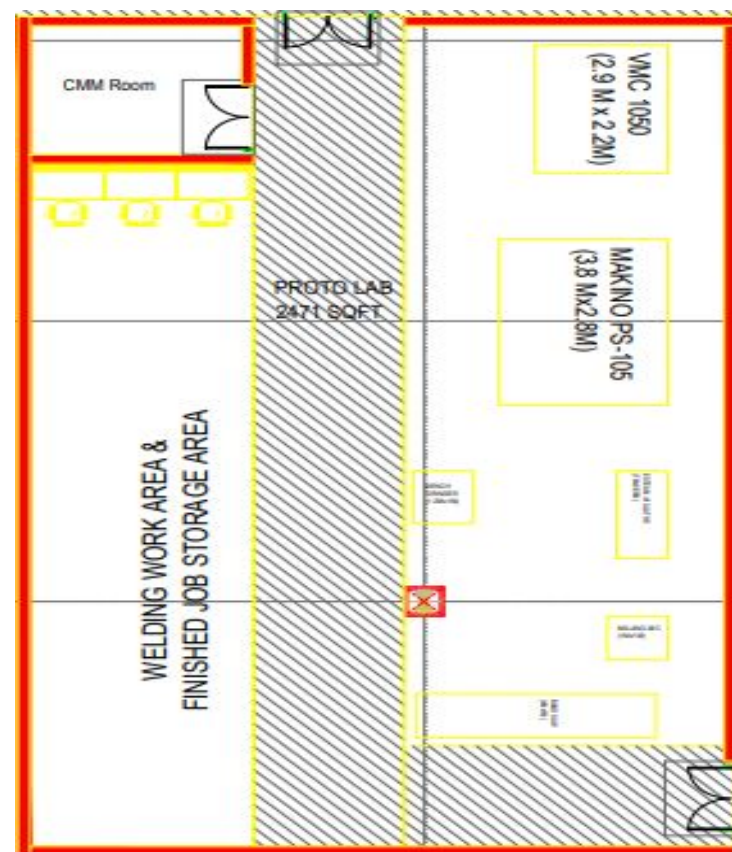


Maintenance room - partition wall

Material	Fibre cement board
Structural Support	floor
Structural Member	Aluminium Tracks & Studs - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Resistance Acoustics
Comfort	Acoustics, Thermal , Proper Illumination
Door	Flush doors with vision panel - Double leaf
Aesthetics	Painted finish

Purpose	Problem
- Welding Room - Vehicular Movement	- Proper Illumination - Impact Resistance - Vibration - Fire Accidents
	
	

Proto lab 11.54m x 18.75m x 3.5m

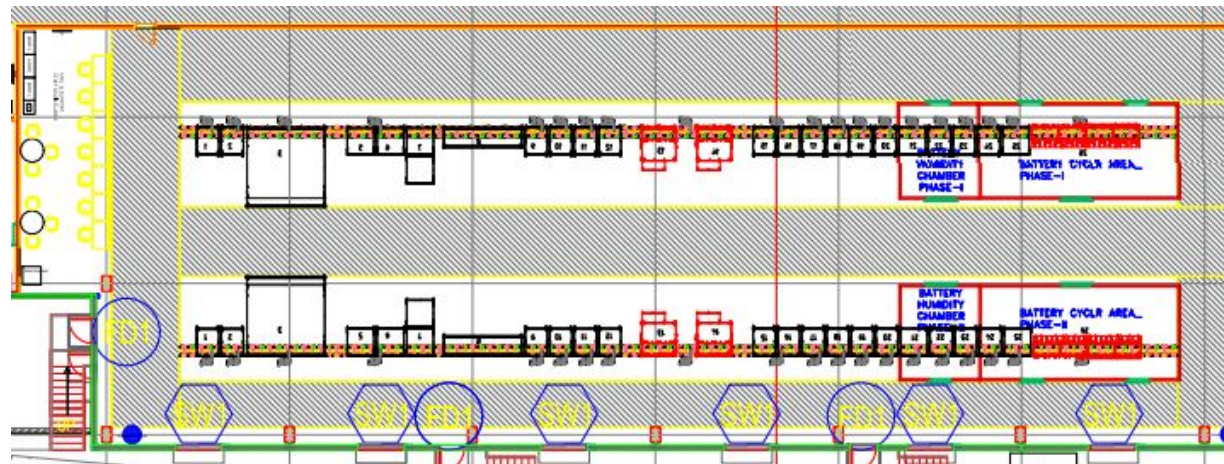


Proto Lab - Partition Material

Material	Fibre cement board
Structural Support	Floor
Structural Member	Aluminium Tracks & Studs - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Resistance - Spark, Acoustics, Chemical Resistant
Comfort	Thermal & Acoustics
Door	Fire rated Upward sliding door + Vision Panel - main entry Fire rated Metal door + Vision Panel - CMM Room
Aesthetics	Paint Finish

Battery assembly area

68.75m x18.17m x 3.5m

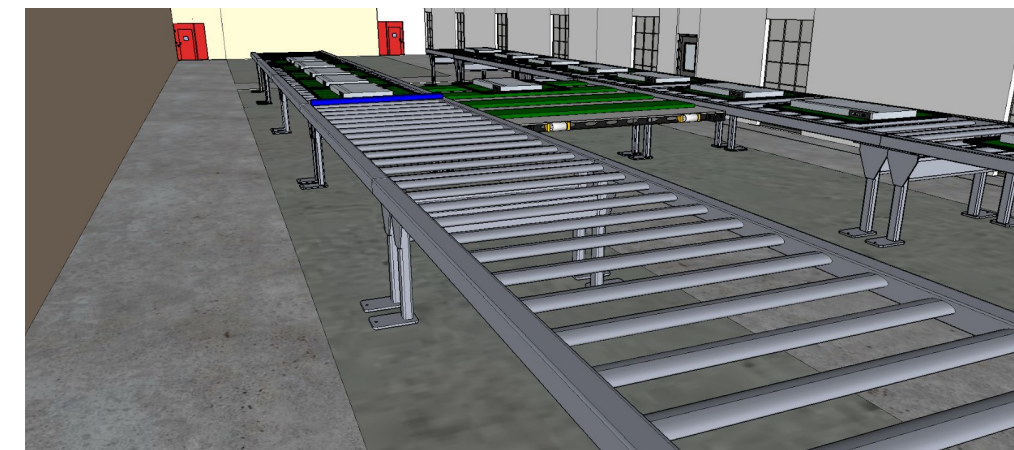
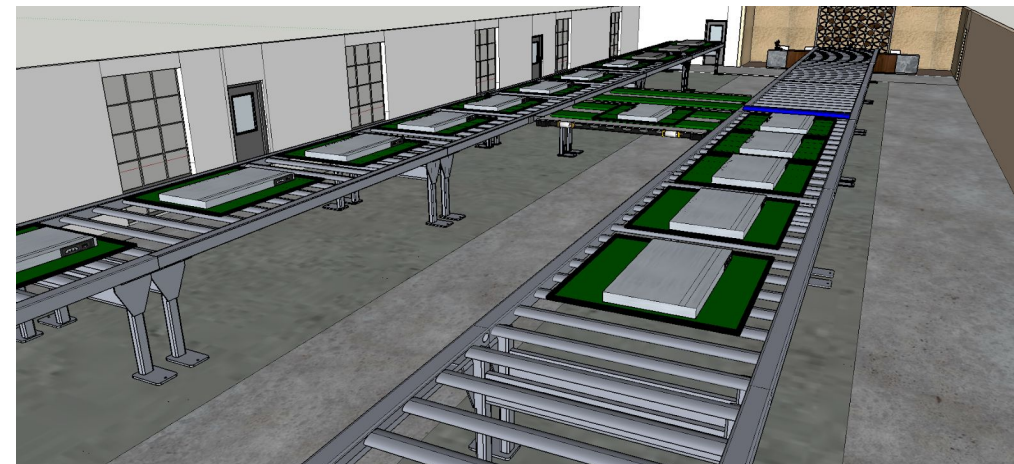


Purpose	Problem
Assembling of battery with vehicle	- Proper Illumination - Impact Resistance - Vibration - Noise - Fire Accidents

Battery assembly area-false ceiling

Material	Calcium silicate panel
Structural Support	Steel Box Section- Column
Structural Member	Rafter and Girder
Connection	Vertical struts ; Plate, Nut - Steel column to floor
Access & Safety	Trap door & Fire resistance
Comfort	Acoustics , good illumination & Ceiling Mounted Air Conditioner
Aesthetics	Painted

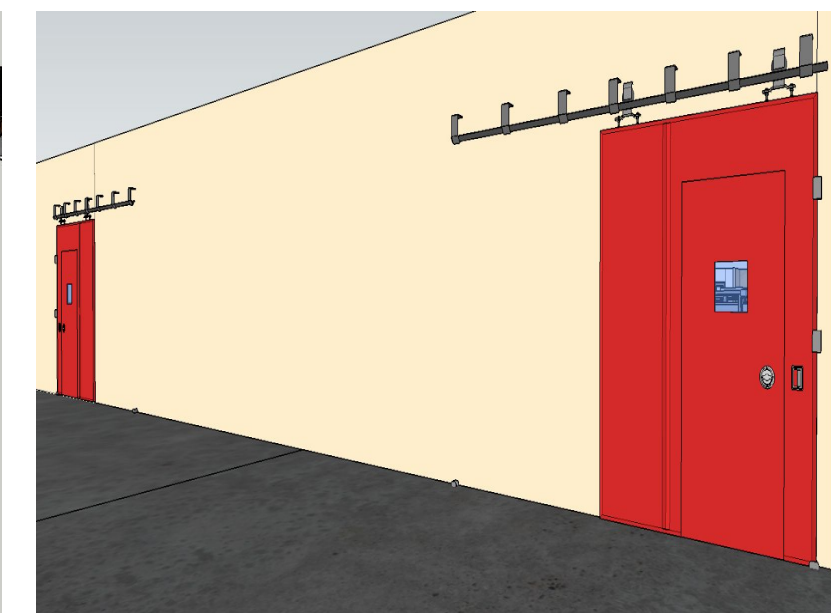
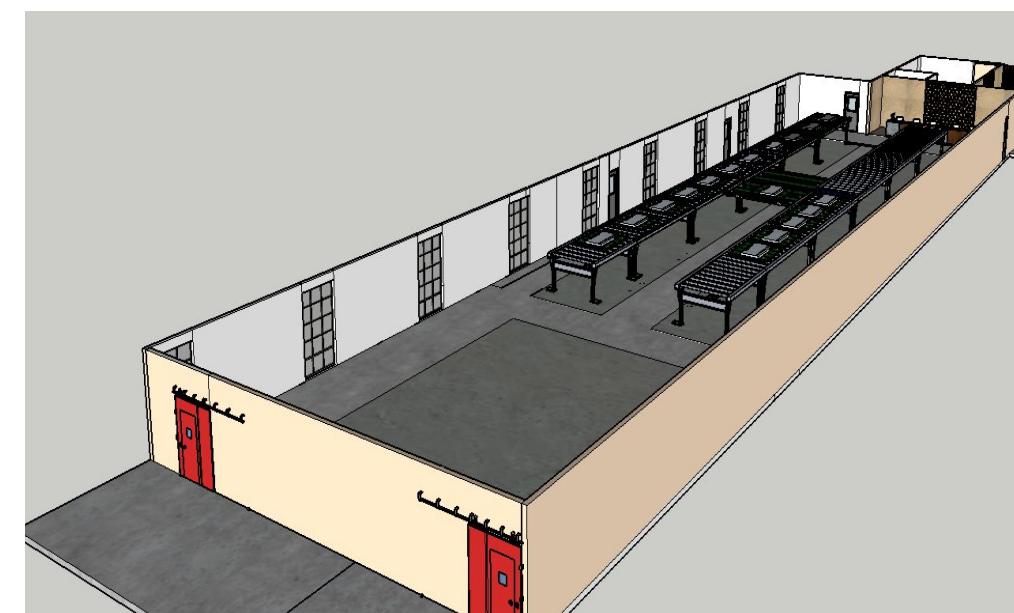
3D VIEWS-BATTERY ASSEMBLY AREA



3D VIEWS-STAFF SUPPORT AREA 1

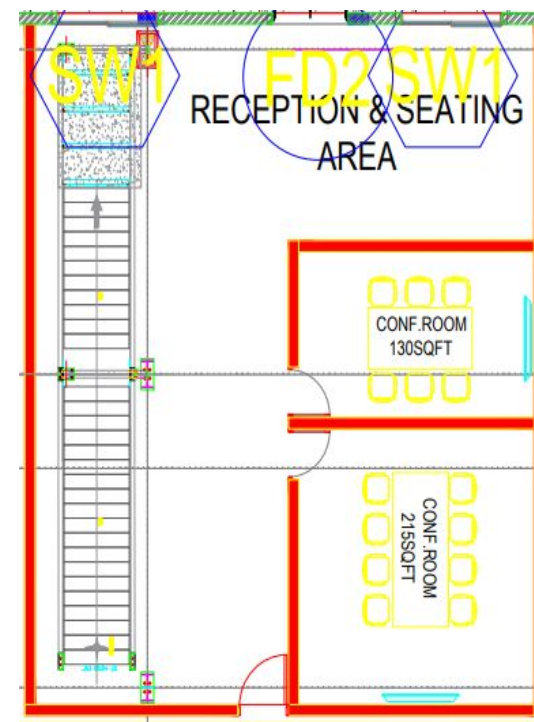


3D VIEWS-BATTERY ASSEMBLY AREA



Battery assembly area-Partition wall

Material	Calcium silicate panel solid (East & West wall) & Calcium silicate panel + Glass (North)
Structural Support	floor
Structural Member	Aluminium Tracks & Studs - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection, Bracing
Access & Safety	Thermal , Good illumination
Door	Sliding door (side)+ Vision panel, Fire Escape --> Fire rated door --> Single Leaf, Access Control System
Aesthetics	Painted finish

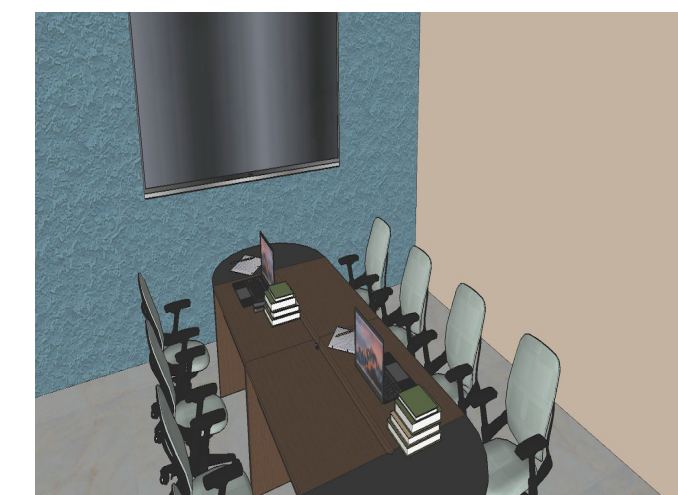


Reception

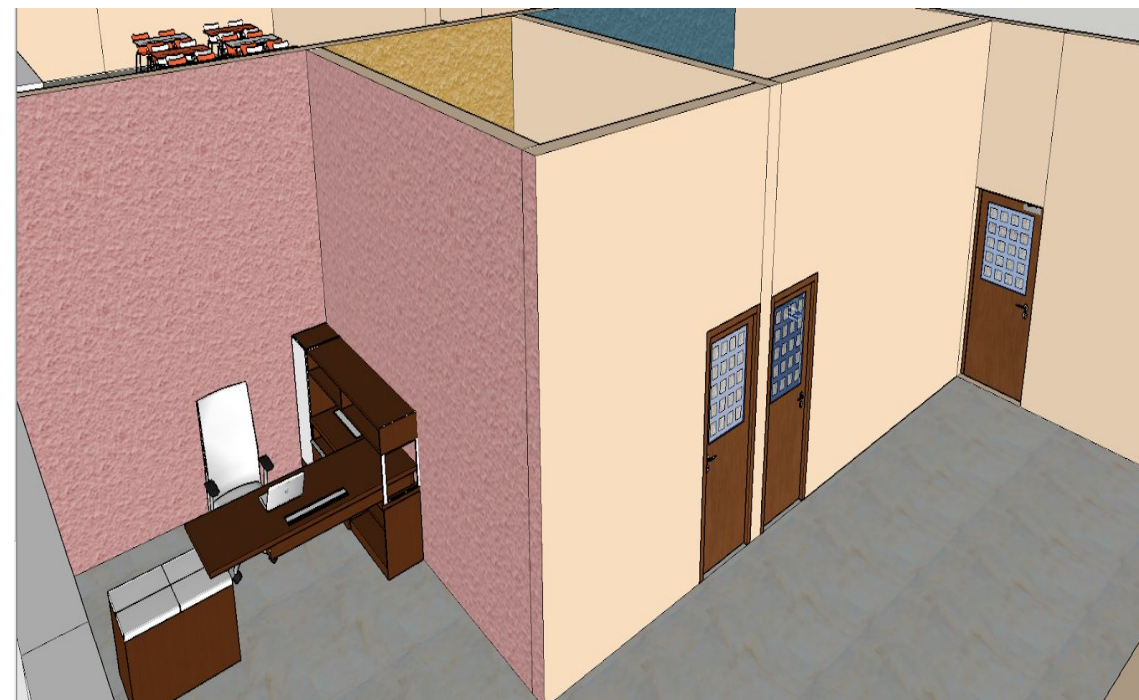
9.8m x 11.9m x 3.5m



Purpose	Problem
Business & Client Meets	- Proper Illumination - Ventilation - Aesthetic Appearance



3D VIEWS-CONFERENCE ROOM 1



3D VIEWS-RECEPTION

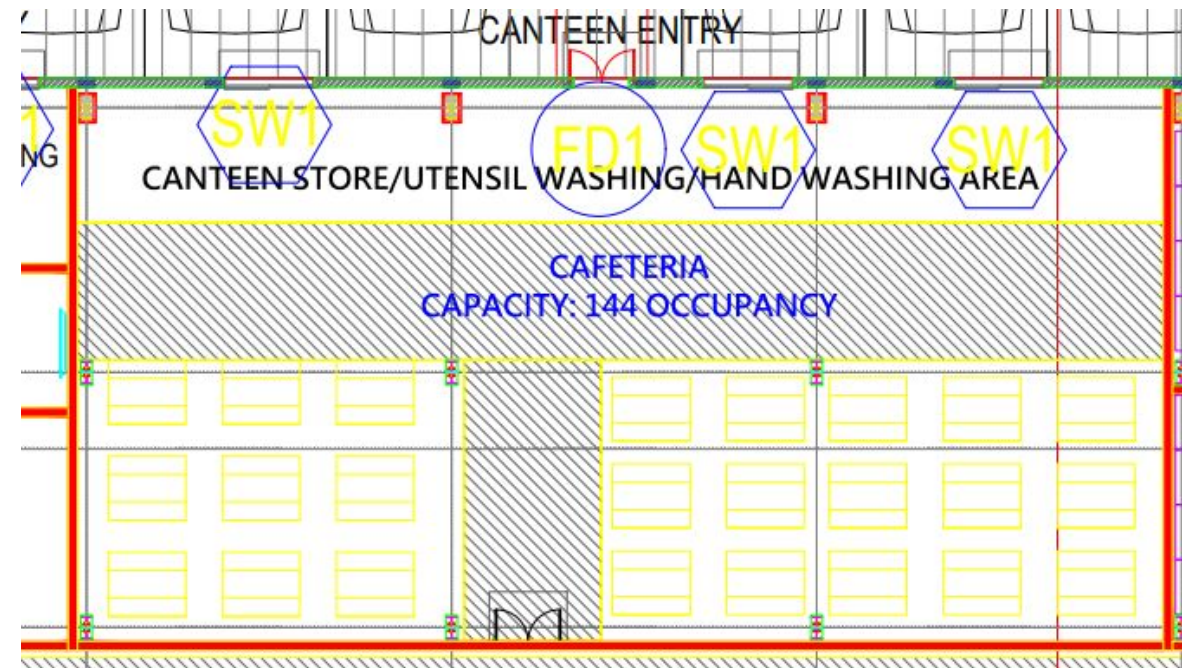


Reception -Partition wall

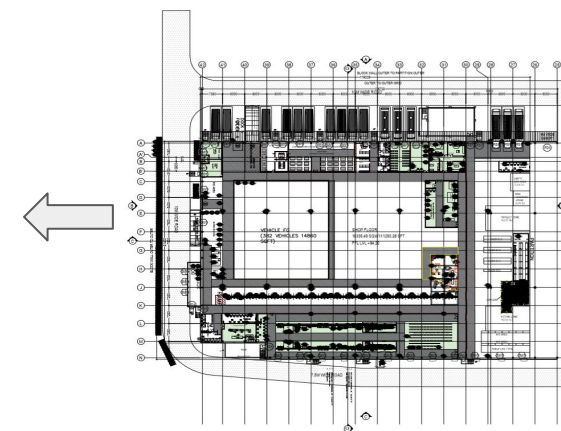
Material	Fibre cement board
Structural Support	floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Acoustics, Thermal
Comfort	Thermal , Good illumination
Door	Flush doors with vision panel with Access Control System - Entry - Double leaf Fire rated glass doors - Conference room - Single leaf Fire rated Metal door with Access Control System - Single leaf
Aesthetics	Painted finish - Textured finish

Canteen

23.8m x12.1m x 3.5m



Purpose	Problem
Consumption & Sale of Consumables	Proper Illumination Ventilation Good Ambience Fire Accidents



3D VIEWS-CANTEEN



Canteen-Partition Wall

Material	Fibre cement board
Structural Support	floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Acoustics, Thermal
Comfort	Thermal , Good illumination , Proper ventilation
Door	Flush doors with vision panel with Access Control System Fire rated Metal door with Access Control System - Double leaf (South)
Aesthetics	Painted finish - Textured finish + Ceramic Tile Cladding

Locker room

Male-5.32m x 5.39m x 3.5m
Female-5.32m x 6.5m x 3.5m



Purpose	Problem
- Storage Area - Changing Area	- Illumination - Privacy - Ventilation - Anti-theft

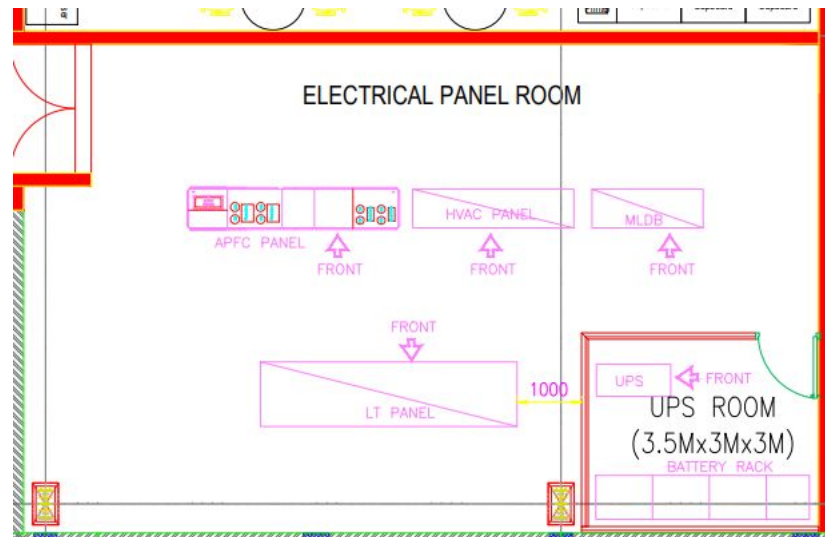
Locker room Female & Male-partition wall

Material	Fibre cement board
Structural Support	Column, Wall & floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Safety
Comfort	Thermal , Good illumination , Proper ventilation
Door	Fire rated metal door + Access control system - Single leaf
Aesthetics	Painted finish

Material	Fibre cement board
Structural Support	Column, Wall & floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Acoustics, Thermal
Comfort	Thermal , Good illumination , Proper ventilation
Door	Flush doors with vision panel for rooms - Double Leaf Fire rated metal door + Access control system -Single Leaf
Aesthetics	Painted finish

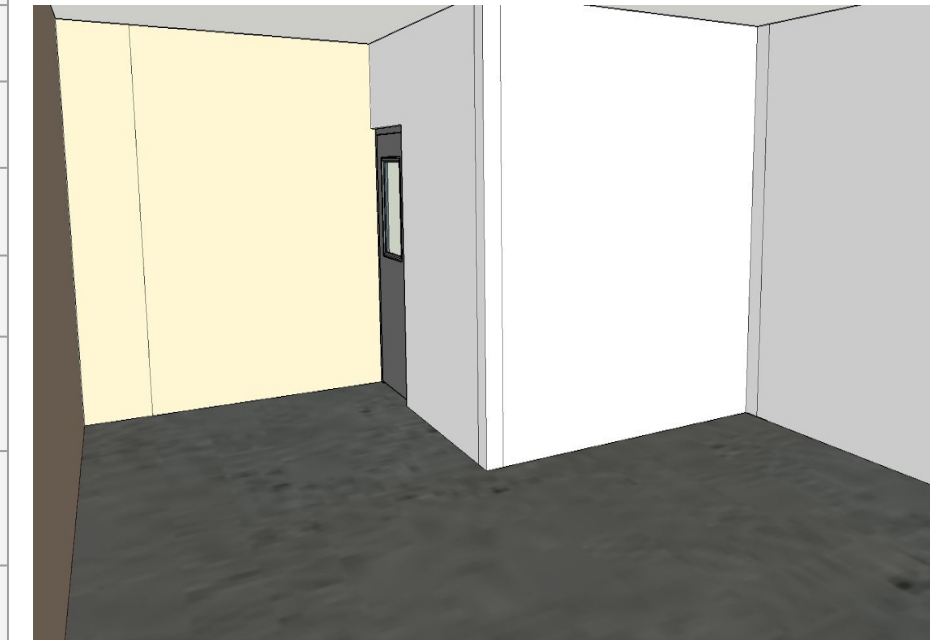
Electrical Room

12.34m x 7.57m x 3.5m



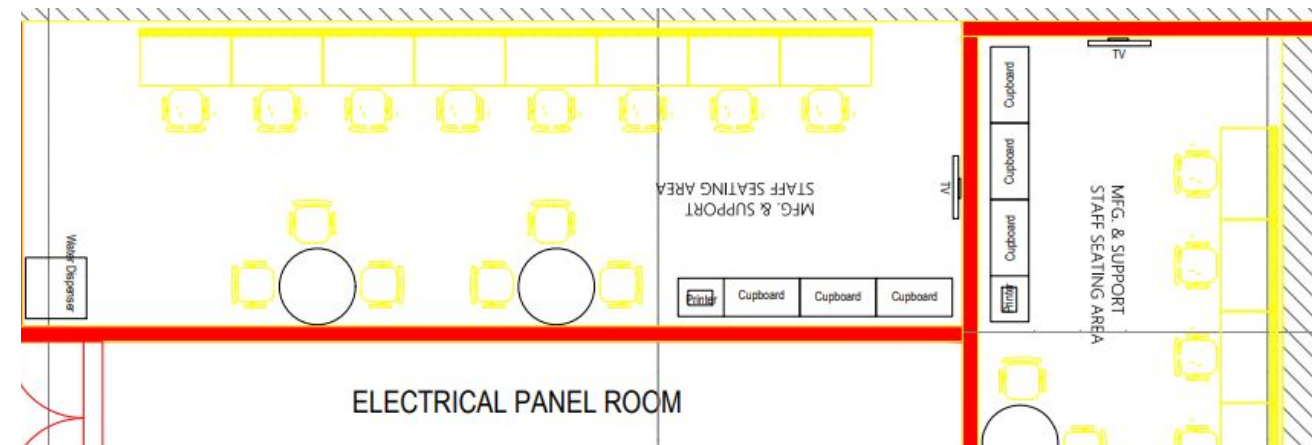
Material	Calcium silicate panel
Structural Support	Wall & floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Safety
Door	Fire rated metal door + Access control system - Single leaf Fire rated metal door + Vision Panel - Single leaf - UPS room
Comfort	Thermal , Good illumination , Proper ventilation, Water & Moist Resistant
Aesthetics	Painted finish

3D View - UPS Room



Purpose	Problem
- Electricity Supplies - UPS	- Illumination - Water & Moisture Resistance - Ventilation - Thermal

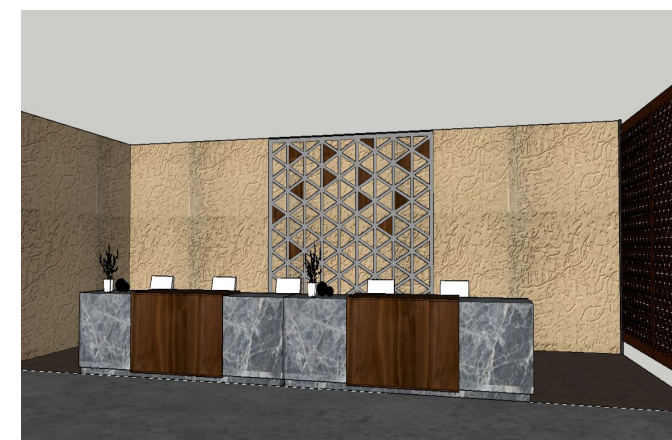
3D View - Electrical Room



Staff support area 2 open 12.34m x 3.9m x 3.5m



Purpose	Problem
- Resting - Gathering - Meeting	- Proper Illumination - Seclusion - Ventilation - Good Ambience



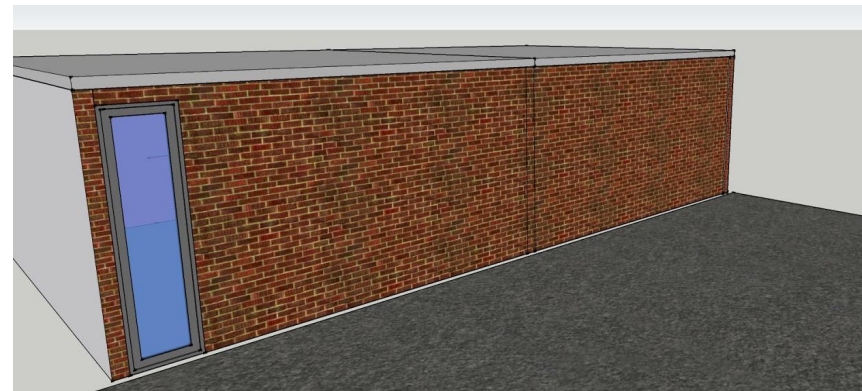
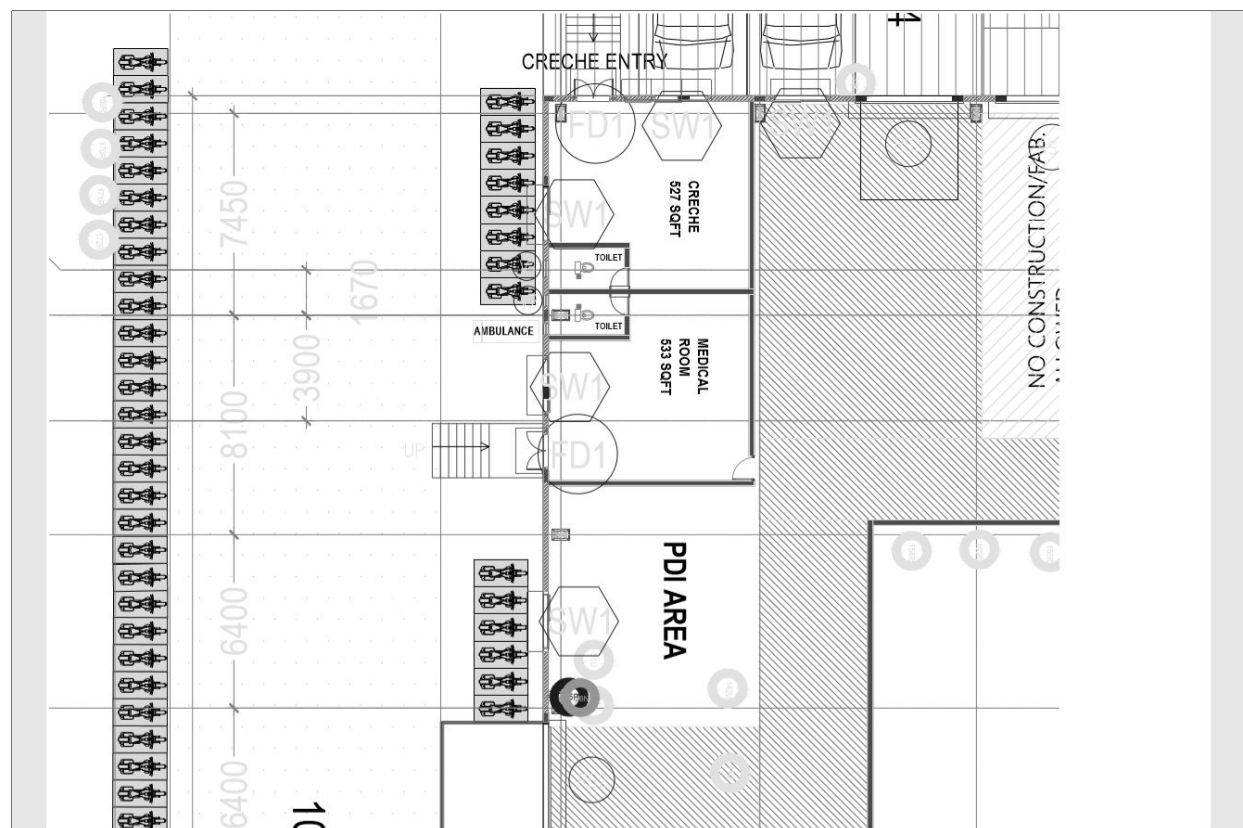
Staff support area 2 (open) - Partition wall

Material	Calcium silicate panel - Electrical Room & Battery Storage
Structural Support	Partition Wall & floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Inclusion & Seclusion
Comfort	Good illumination , Proper ventilation , Pleasant
Aesthetics	Painted finish - Texture finish + Company logo in glass

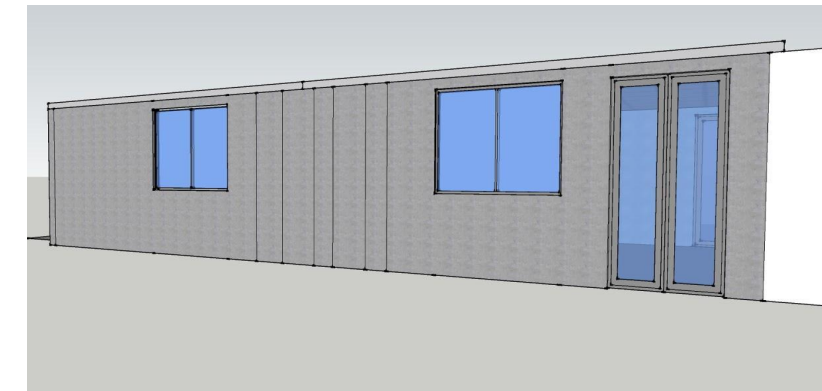
DIMENSIONS: L x B x H

CRECHE: 7.4m x 6.92m x 3.5m

MEDICAL ROOM: 7.4m x 6.87m x 3.5m



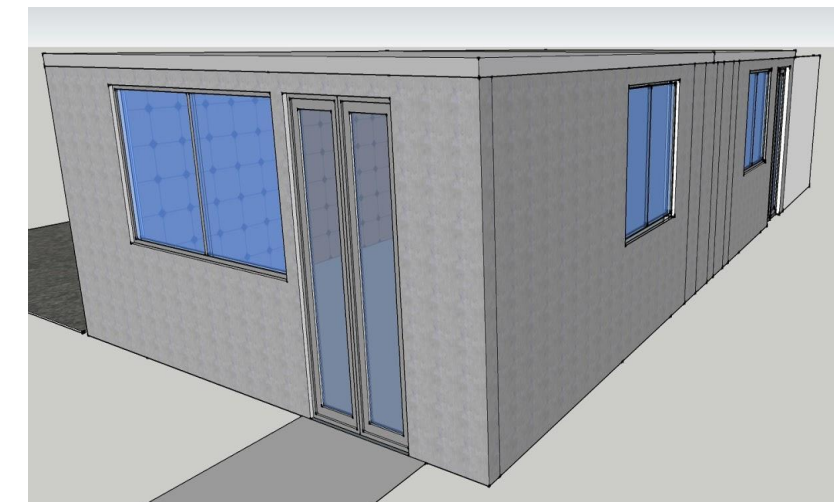
GANGWAY SIDE VIEW
1mm Stone Finish (Laterite Stone) &
Fibre-Cement Board



BACK SIDE VIEW
Fibre-Cement
Board



1mm Stone Finish (Laterite Stone) & Fibre-Cement
Board

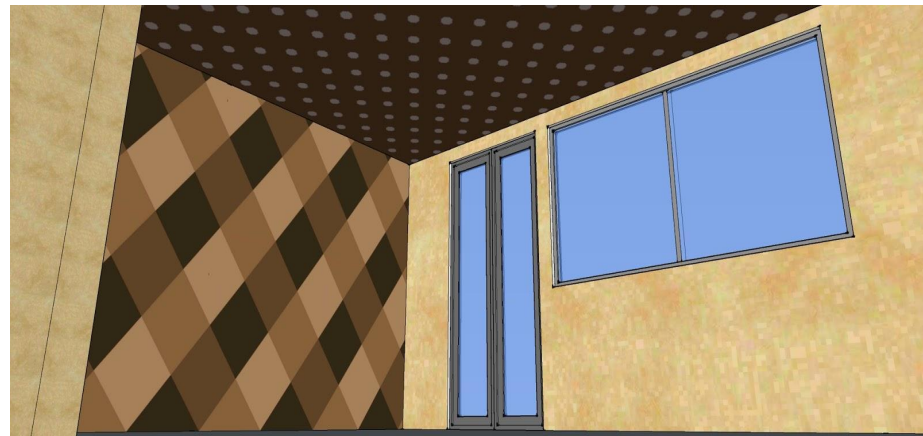


Fibre-Cement Board

Material	Fibre Cement Board
Structural Support	Cross beams, Intermediate Column Support, Grid System
Structural Member	Rafter and Girder
Connection	Vertical Struts; Plate, Nut - Steel Column to floor, screw & interlocking
Access & Safety	Trap door & Fire resistance
Comfort	Acoustics , Cove Lighting
Aesthetics	Theme-based, Stretch false ceiling

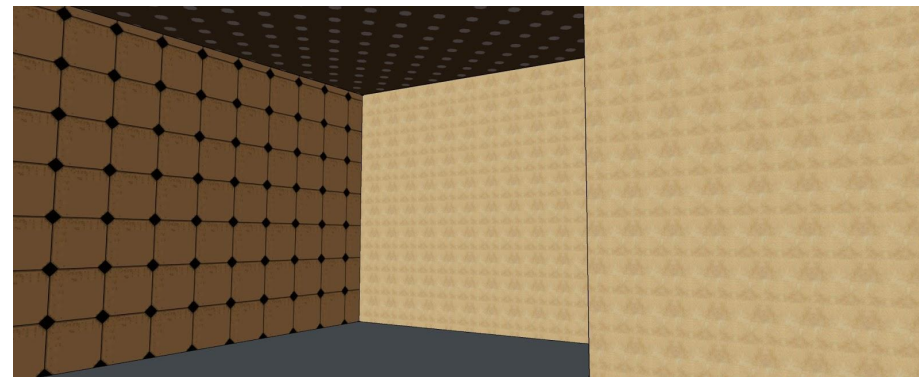


FIBRE-CEMENT BOARD WITH WALLPAPER FINISH & EMULSION PAINT FINISH



THEME-BASED FALSE CEILING

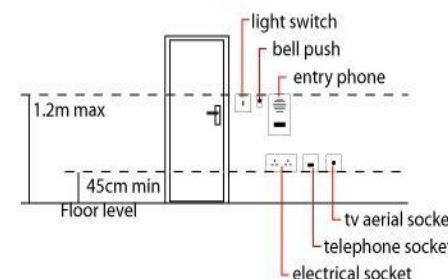
Material	Fibre cement board, Aluminium framed Glass Windows & Doors
Structural Support	Columns anchored to floor, GI framing
Structural Member	Aluminium Tracks & Channels
Connection	Screw & interlocking connection
Access & Safety	Fire resistance
Comfort	Acoustics, Split AC
Aesthetics	Laterite Stone cladding(exterior), Wallpaper, Paint



FIBRE-CEMENT BOARD WITH WALLPAPER FINISH & EMULSION PAINT FINISH

Medical Room - Partition wall

Material	Fibre cement board, Aluminium framed Glass Windows & Doors
Structural Support	Columns anchored to floor, GI framing
Structural Member	Aluminium Tracks & Channels
Connection	Screw & interlocking connection
Access & Safety	Fire resistance
Comfort	Acoustics, Split AC
Aesthetics	Laterite Stone cladding(exterior), Paint

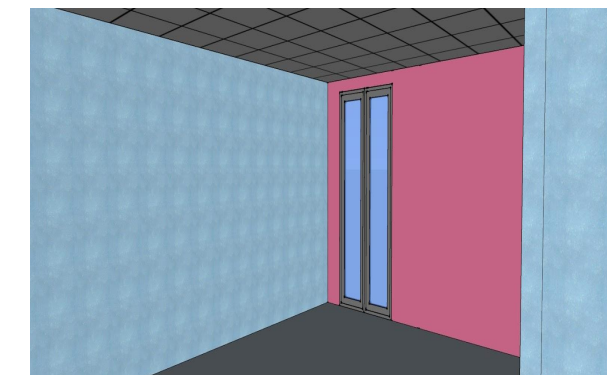


MEDICAL ROOM

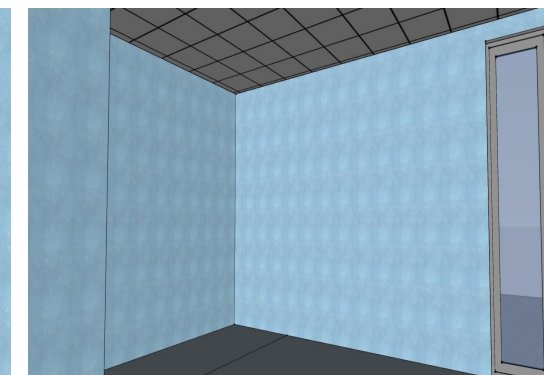
7.4m x 6.87m x 3.5m

Medical Room - False Ceiling

Material	Fibre Cement Board
Structural Support	Intermediate Column Support, Grid System
Structural Member	Rafter and Girder
Connection	Screw & interlocking connection
Access & Safety	Trap door & Fire resistance
Comfort	Acoustics, 2'x2' LED light fixture
Aesthetics	Textured



FIBRE-CEMENT BOARD WITH DIFFERENT EMULSION PAINT SHADES



FIBRE-CEMENT BOARD WITH DIFFERENT EMULSION PAINT SHADES

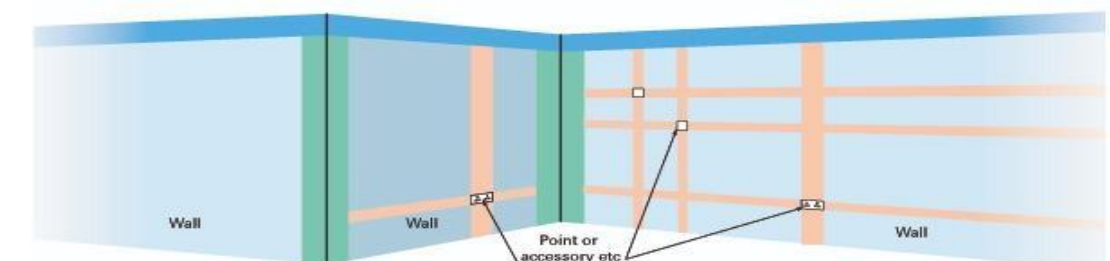


FIG 1 Cables routes in accordance with Regulation 522.6.202.

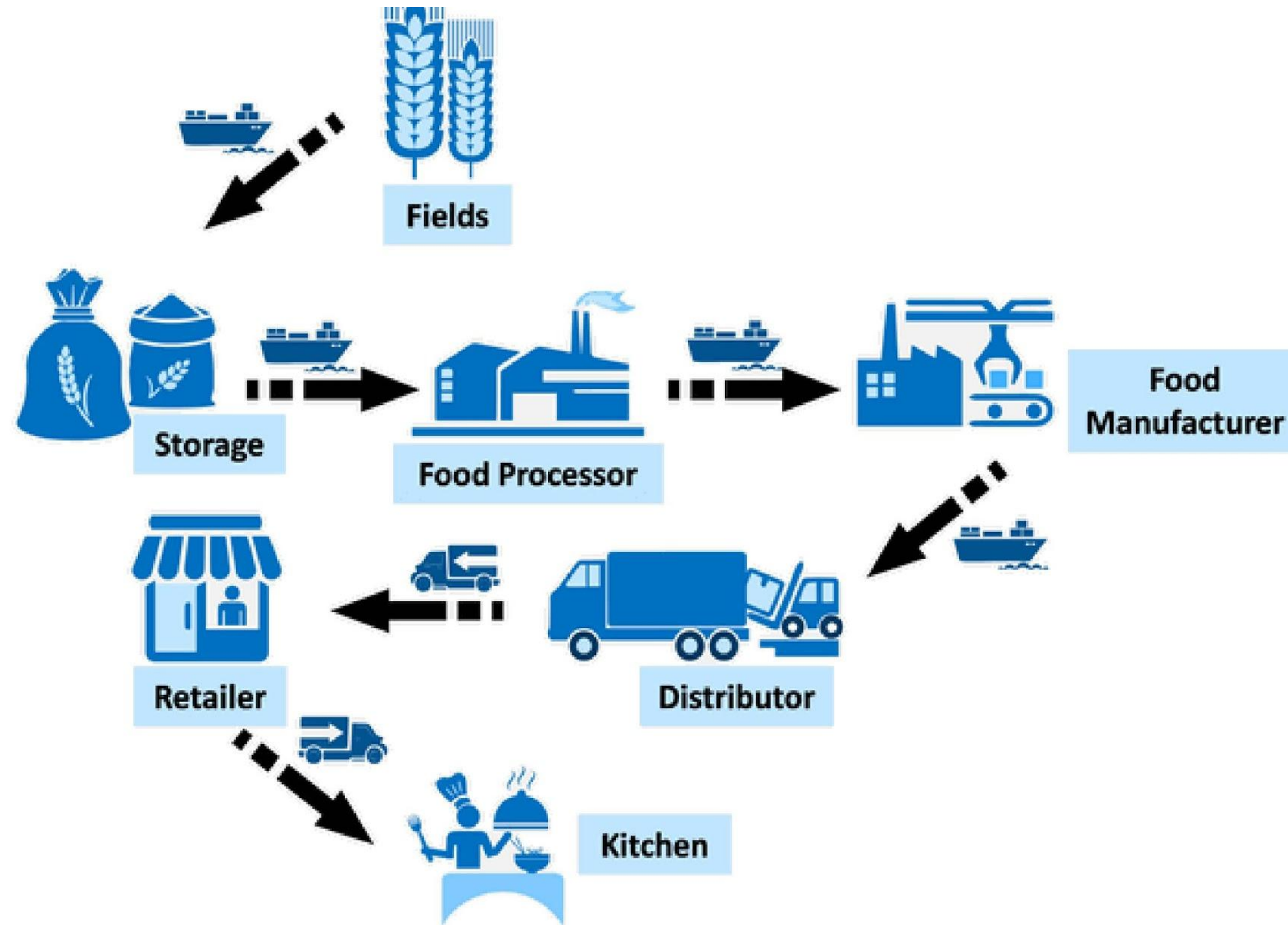
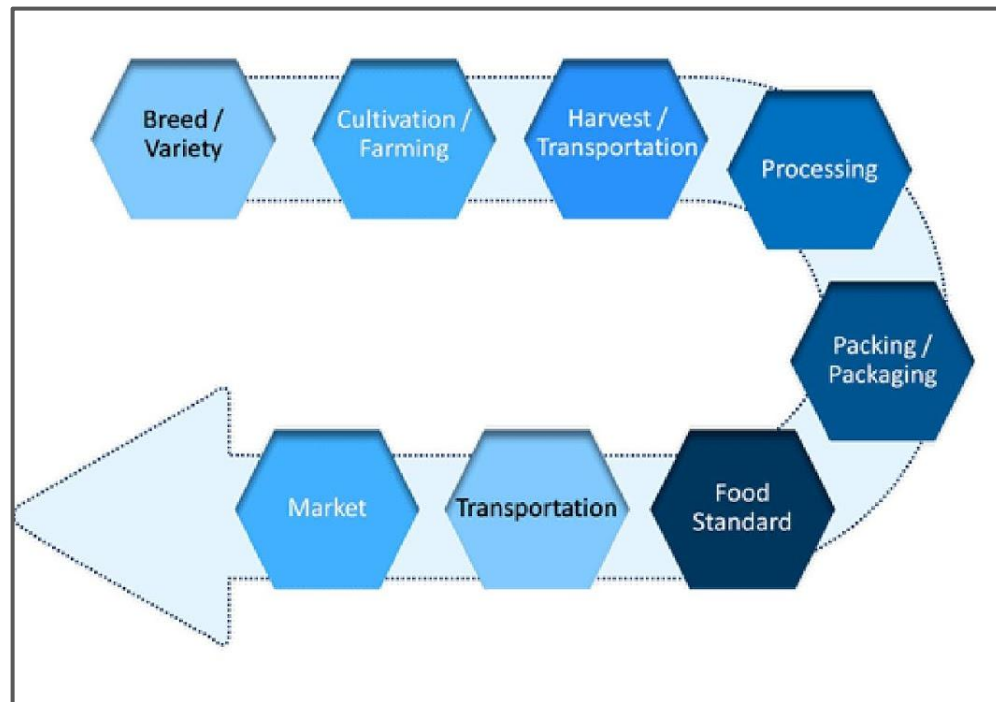
- Zone within 150 mm of the top of the wall - Regulation 522.6.202 (i)
- Zone within 150 mm of an angle formed by adjoining walls or partitions - Regulation 522.6.202 (i)
- Zone either horizontally or vertically, to the point, accessory or switchgear on the surface of the wall or partition, to which the cable is connected - Regulation 522.6.202 (i)



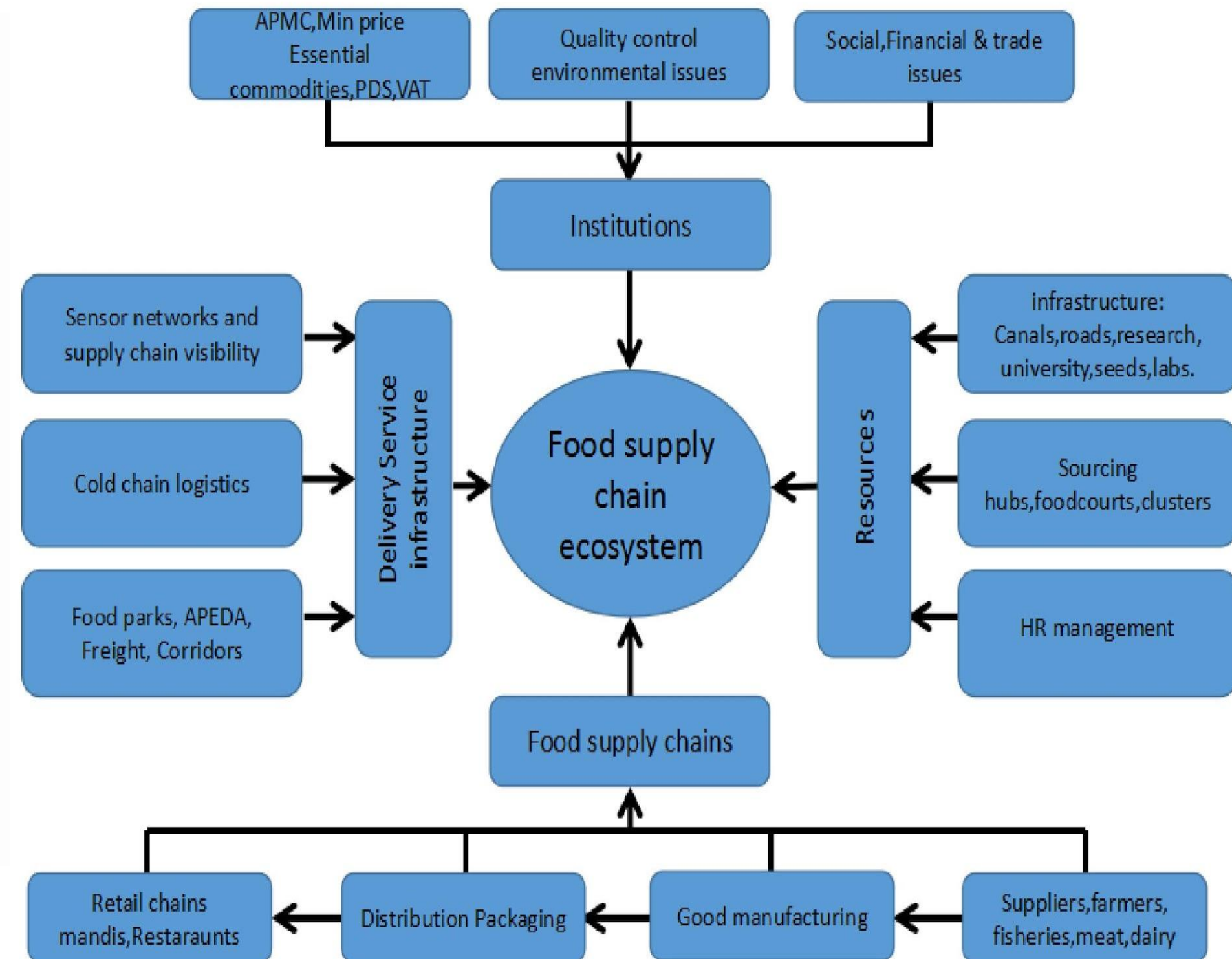
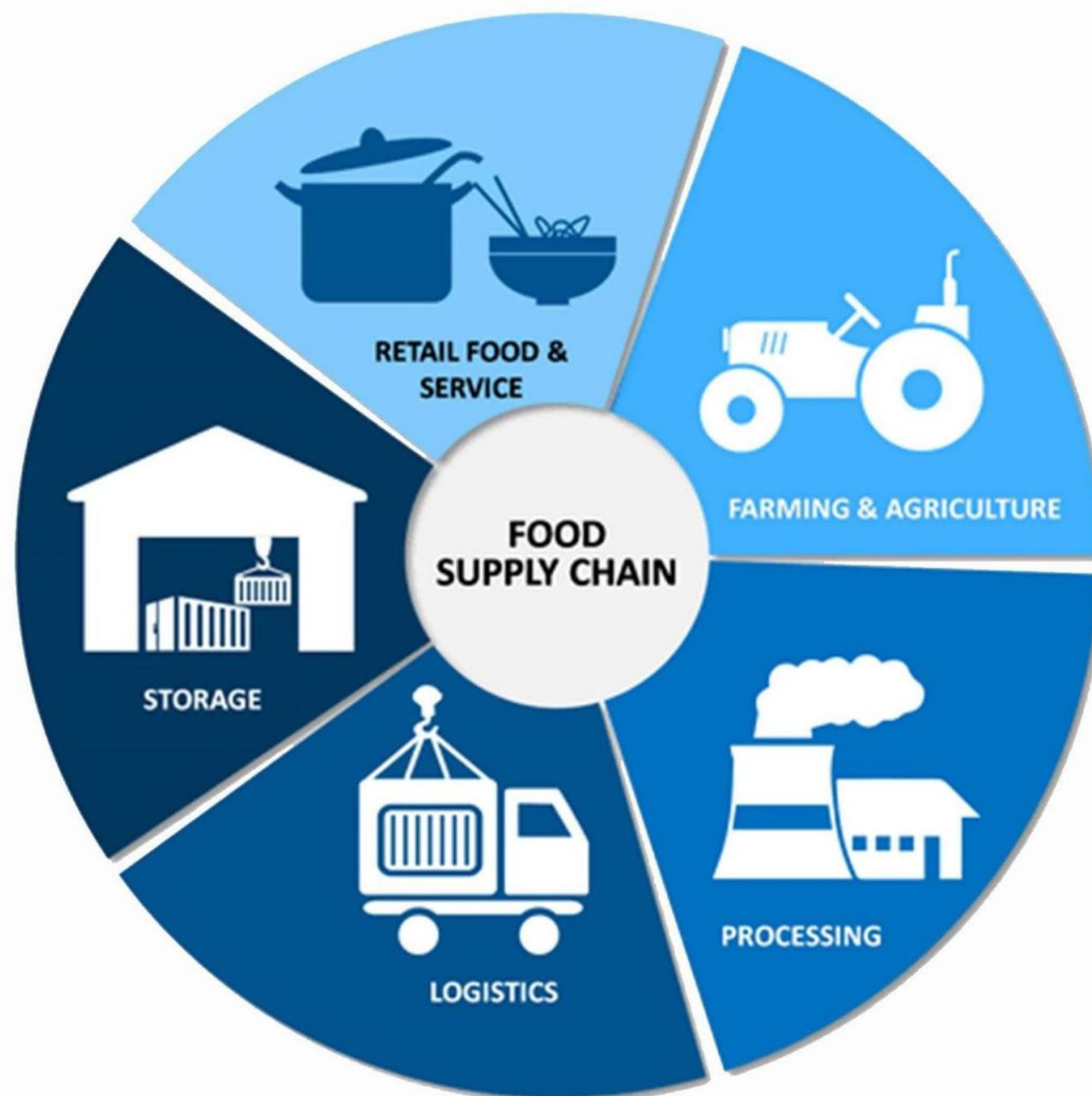
AGRI FOOD SUPPLY CHAIN

Food Supply Chain - Definition

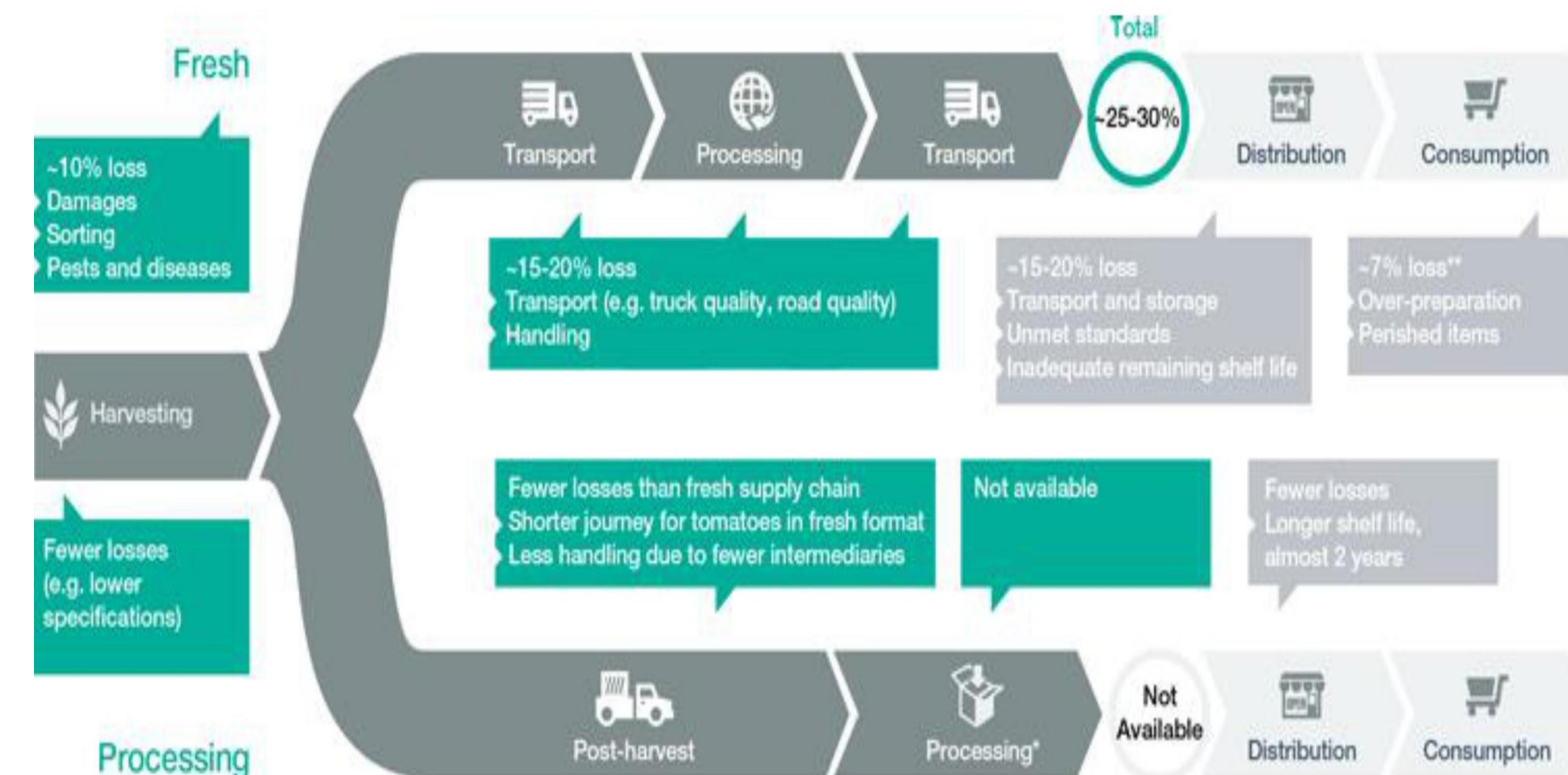
- A food supply chain or food system refers to the processes that describe how food from a farm ends up on our tables.
- The processes include production, processing, distribution, consumption and disposal.
- The food we eat reaches us via food supply chains through which food moves systematically in domino-like motion from producers to consumers
- The money consumers pay for food goes to people who work various stages along the food supply chain in the reverse direction.
- Every step of the supply chain requires human and/or natural resources.
- Food supply chain is domino-like, when one part of the food supply chain is affected, the whole food supply chain is affected, which is often manifested through changes in price.



Food Supply Chain- Ecosystem



TOMATO FOOD SUPPLY CHAIN



INTERESTING FACTS ABOUT TOMATO FARMING IN INDIA:

- 2nd most widely grown vegetable in India after potatoes
- 2nd largest tomato producer worldwide is India
- 17 mn tonnes produced in India in 2014-15
- 20 tons/hectare (ha) Low yields
- World average - 33 tons/ha; China average 48 tons/ha
- 10-15% Indian tomatoes exported in 2015
- 1% of the total production goes to the processing industry, versus approximately 14% in China



HEADING: AGRI FOOD SUPPLY CHAIN- TYPOLOGY

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FOOD SUPPLY CHAIN - TYPOLOGY

