



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 : MONISHA NAGESWARAN

Semester : III

Reg No. : 39840021

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 **MONISHA NAGESWARAN (39840021)** 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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DECLARATION

I Monisha Nageswaran hereby declare that the Professional Training Report 111 Days (19th 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 : 26-01-2021

PLACE : CHENNAI

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

29th January 2021

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

CREATING VALUES FOR YOUR INVESTMENT
An IIT Madras Incubated
Construction Technology Company

Sub: Confirmation Letter for Practical Training at our Office for Ms. Monisha Nageswaran, Regd No: 39840021

Respected Sir/ Madam,

With respect to the above subject we would like to induct Ms. Monisha Nageswaran, (Regd No: 39840021) M.Arch in Building Management, (Sathyabama Institute of Science and Technology) as a Project Management Trainee for a period of 111 days.

Thanking You

For ENGINEERING PROJECT MANAGEMENT CONSULTANCY & RESEARCH PVT LTD.,

S. Kavinkumar.

S KAVINKUMAR
DIRECTOR



CREATING VALUES FOR YOUR INVESTMENT
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Construction Technology Company

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Engineering Project Management Consultancy and Research Private Limited



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



JANUARY 29, 2021

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

CREATING VALUES FOR YOUR INVESTMENT
An IIT Madras Incubated
Construction Technology Company

INTERNSHIP CERTIFICATE

Ms. Monisha Nageswaran, pursuing her Post Graduate Programmes in Architectural Building Management (Regd No: 39840021) at Sathyabama Institute of Technology, Chennai has undergone the Project Management Student training in our company, from May 19, 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 her 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.

S KAVINKUMAR
DIRECTOR



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Construction Technology Company

Engineering Project Management Consultancy and Research Private Limited



Regd. Office: #15, Rajamanickam Street, New Perungalathur, Chennai-600 063.
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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 : Monisha Nageswaran
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 : Open to new concepts and understand project requirements for delivery.

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

S. Kumar



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 : Monisha Nageswaran
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 : Open to new concepts and understand project requirements for delivery.

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

S. Kumar





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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 : Monisha Nageswaran
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	✓				
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 : Open to new concepts and understands project requirements for delivery
8. Signature of the Head of the Office / Organization (With Seal) : S. Karthikumar



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 : Monisha Nageswaran
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	✓				
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 : Open to new concepts and understand project requirements for delivery
8. Signature of the Head of the Office / Organization (With Seal) : S. Karthikumar





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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, 044-2274 3332
3. Name of the student : Monisha Nageswaran
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 : Open to new concepts and understand projects requirements for delivery

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

S. Karun Kumar



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	False Ceiling Design Thinking
23-06-20	Ather Energy Cell Storage Building, Hosur	WBS & Project Schedule	09-07-20	Ather Energy Factory Building, Hosur	False Ceiling 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 - False Ceiling
28-06-20	Ather Energy Cell Storage Building, Hosur	PRD/ URD Revision	14-07-20	Ather Energy Factory Building, Hosur	URD - False Ceiling
29-06-20	Ather Energy Cell Storage Building, Hosur	Presentation Preparation - Explosion Vent & Fire Safety	15-07-20	Ather Energy Factory Building, Hosur	URD - False Ceiling
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	Architecture 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	Architecture 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 & Revision of Architecture Layout	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	PMC: 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	PMC - 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	PMC - 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, Iggaluru	SS Logistics - Drawing & B.o.q Study
22-12-20	SS Logistics, Iggaluru	Scope Preparation
23-12-20	SS Logistics, Iggaluru	WBS Preparation
24-12-20	SS Logistics, Iggaluru	Work flow Chart- Project Management
25-12-20	SS Logistics, Iggaluru	2 Weeks Look Ahead Schedule
26-12-20	SS Logistics, Iggaluru	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. Kannan

Office seal:



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4.	PROJECT 01 - ATHER ENERGY CELL STORAGE BUILDING - ORGANISATION CHART	7
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ENGINEERING PROJECT MANAGEMENT CONSULTANCY AND RESEARCH (EPMCR)



GENERAL

REASON FOR CHOOSING EPMCR PVT. LTD., CHENNAI::

Since EPMCR Pvt. Ltd involves the usage of Lean Project Management System, I was interested on learning the practical application of lean, its principles and tools, Which perhaps can help me for my research and my future endeavors.

Secondly the organization also provides architectural services, Which on collaboration with project management system could give me an opportunity to explore both the field and also would also help me to strengthen my design, technical and management skills

OBJECTIVE OF TRAINING

The Objective is to understand the field works, opportunities to experience the essential practical task emphasized in their professional study and also to provide opportunities to apply their acquired skills and knowledge in the Practical Scenario.

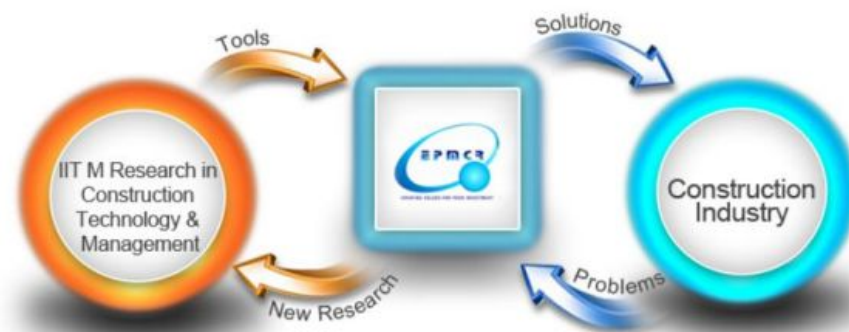
ROLES & RESPONSIBILITIES

1. Has been involved in the research regarding Lean Project Management System and Agri Food Supply Chain.
2. Was working as an Architect and Project Management for the Projects of Ather Energy, Hosur.
3. Has also been involved in Project Scheduling using lean tools, such as big room, Last Planner System, Look ahead Schedule and Weekly Work Planner

HISTORY OF ENGINEERING PROJECT MANAGEMENT CONSULTANCY AND RESEARCH (EPMCR)

ABOUT:

EPMCR(P)LTD is an IIT Madras incubated Engineering and Project Management consulting company offering civil engineering solutions right from Architecture to delivery of the infrastructure facilities to the client. EPMCR(P)LTD offers single point solution for planning, design and construction of all type of Building Infrastructure, Transportation Infrastructure and Water Infrastructure. EPMCR(P)LTD's expert consultants form the core strength of the company



EPMCR(P)LTD acts as an interface between IITM and Construction industry and brings modern cutting technology developed by IITM to construction industry.

"Creating Values for Your Investment"

VISION:

To become world class Engineering & Project Management consultants and professional trainers. Enabling high quality Indian infrastructure development within time and budget. Create innovation in construction technology and Management techniques through our continuous research. Strengthen Indian construction work force through our skill training.

MISSION:

Provide Value creation for our client's Infrastructure Investment through our Engineering, Project Management Consultancy, Research and Training services.

OBJECTIVE:

To help our client to realize the optimum value & quality for their investment in infrastructure projects within the time and budget. Bring innovative & cost effective solution to improve productivity through waste reduction and other new technologies. Offer professional training to young engineers on construction management.

SERVICES:



SECTORS:



BUILDING INFRASTRUCTURE:

- Residential buildings & township
- Institutional buildings
- Commercial buildings
- Industrial buildings
- Retail buildings
- Healthcare buildings
- Hospitality buildings

WATER INFRASTRUCTURE:

- Drinking water supply
- Storm water management
- Sewage water management

TRANSPORTATION INFRASTRUCTURE:

- Road Bridges & Flyover Elevated Corridor



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PROJECTS



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ATHER ENERGY, HOSUR - CELL STORAGE BUILDING

HEADING: ATHER ENERGY CELL STORAGE BUILDING, BANGALORE - INTRODUCTION

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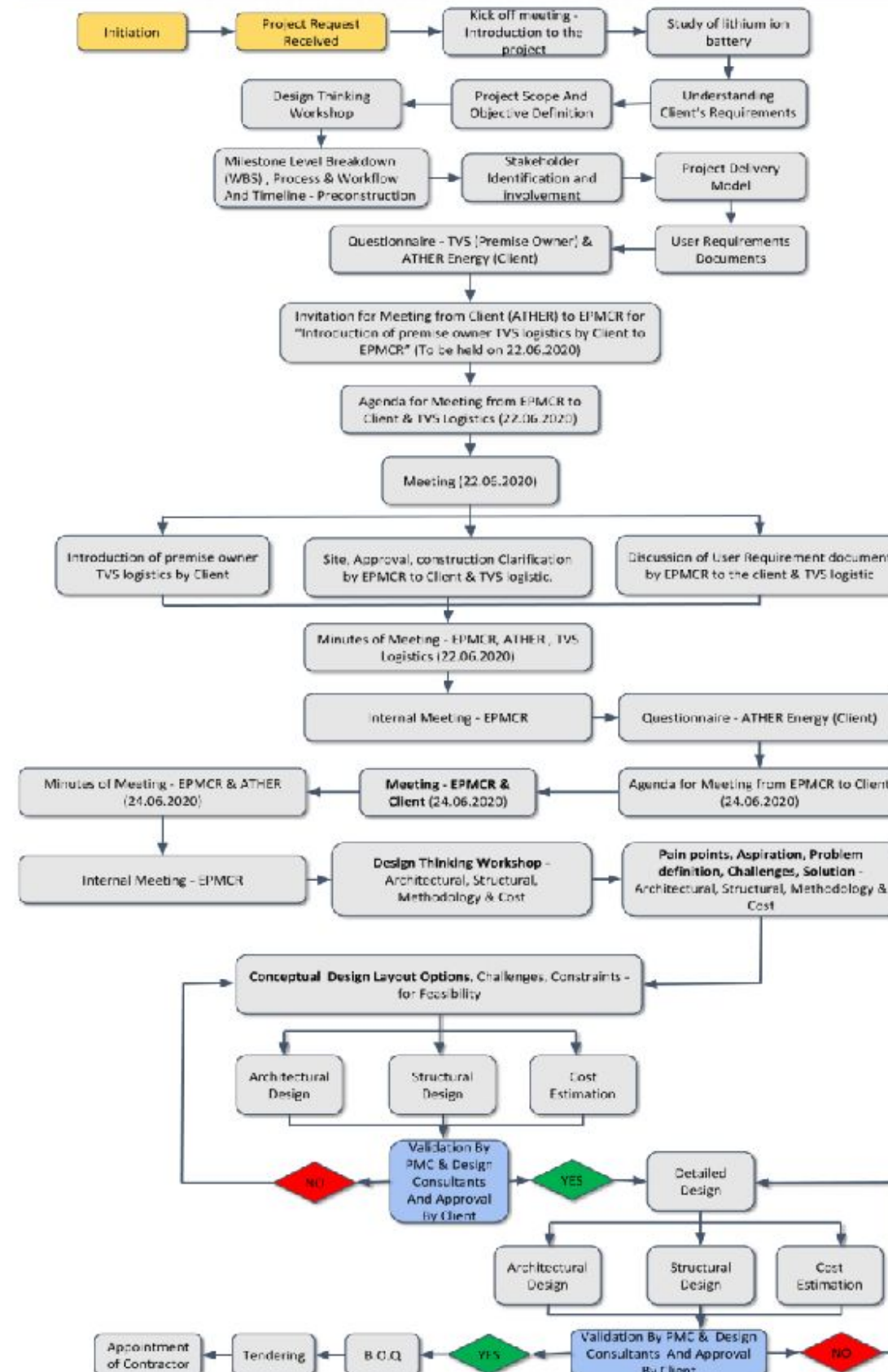
ATHER ENERGY CELL STORAGE BUILDING , HOSUR

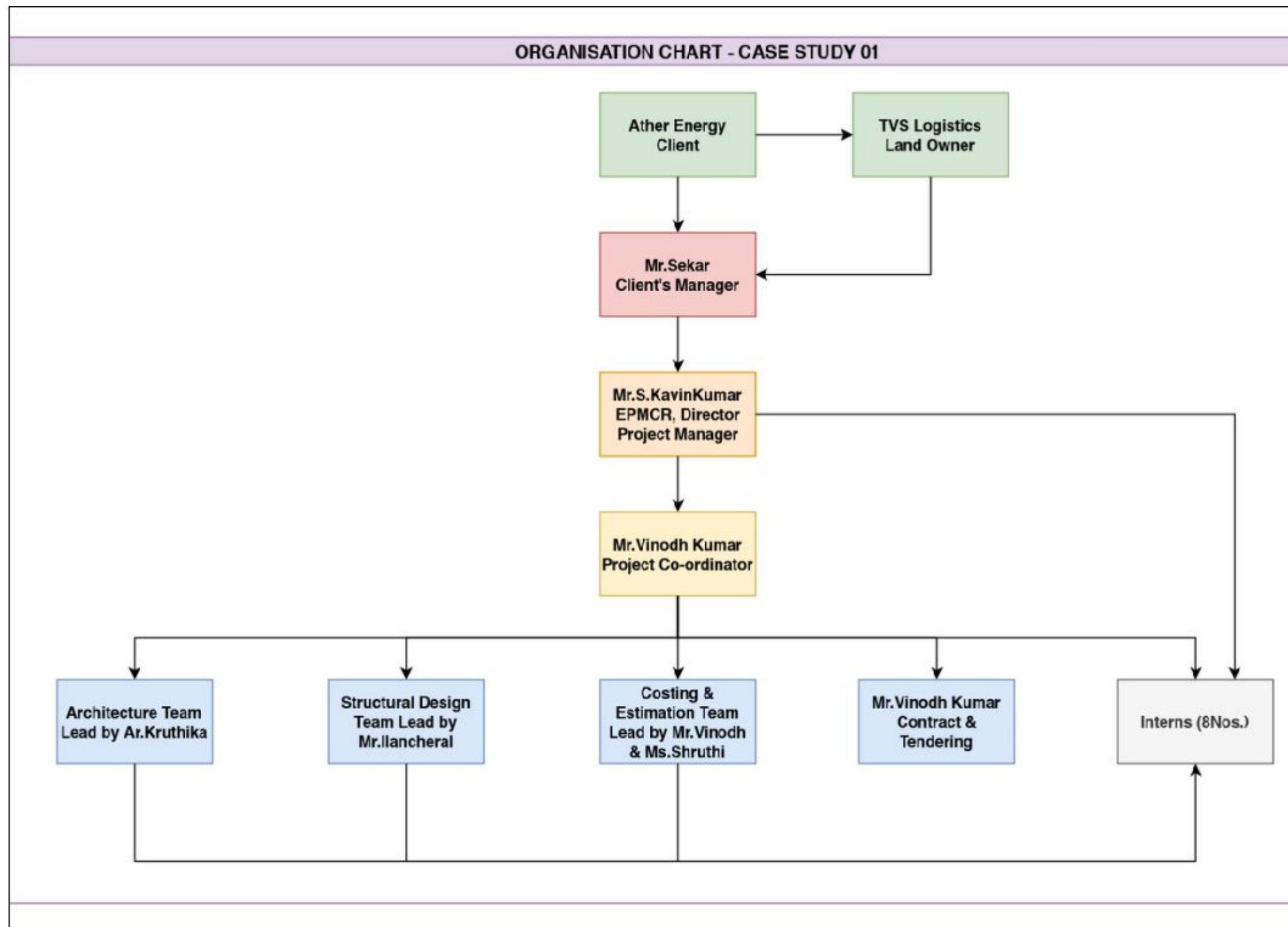
- PROJECT:** ATHER ENERGY CELL STORAGE BUILDING
- TPOLOGY:** HAZARDOUS STORAGE
- LOCATION:** HOSUR, TAMILNADU, INDIA
- CLIENT:** ATHER ENERGY
- LAND OWNER:** TVS LOGISTICS
- CONTRACT TYPE:** DESIGN BUILT (DB)
- PROJECT MANAGEMENT CONSULTANT:** EPMCR, CHENNAI
- PROJECT MANAGEMENT SYSTEM:** LEAN PROCESS & MANAGEMENT SYSTEM
- ARCHITECT:** EPMCR, CHENNAI
- STRUCTURAL CONSULTANT:** EPMCR, CHENNAI
- COSTING & ESTIMATION:** EPMCR, CHENNAI
- CONTRACT & BIDDING :** EPMCR, CHENNAI
- MEP CONSULTANT:** OUT SOURCING
- PROJECT AREA:** 2335 Sq. Ft
- PROJECT START DATE:** APRIL 2020
- PROJECT EXPECTED CLOSE DATE:** NOVEMBER 2020

AIM & RESULTS:

- To construct a cell storage ware house for Ather Energy at the Land which is leased from TVS Logistics at Hosur, Bangalore.
- The cell storage building is located 2.5 meter away from the Ather Energy Factory building.
- Initially the site location had space constraints , which was resolved by collaboration & cross function activities undergone by PMC, Architect, Structural, Costing team and interns along with regular interaction with client on daily basis.
- Expected delivery to be before November or November 1st week, initially the date of completion was estimated as December, by implementing Lean Process and Management system, we were able to crash the days and reduce the duration from December to November first week as per client's requirement.
- Cost was another constraint along with choice of building material for construction as it is temporary structure which has to be relocated to some other site if client in future wants to and to complete the project with in short span of time along with the needs high protection and safety measures owing to its hazardous level.
- In order to achieve the above constraints they have opted for PEB building with required safety measures that satisfies both client & project requirement as well as building bylaws.

PRE-CONSTRUCTION PHASE - PROJECT PROCESS FLOW CHART





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

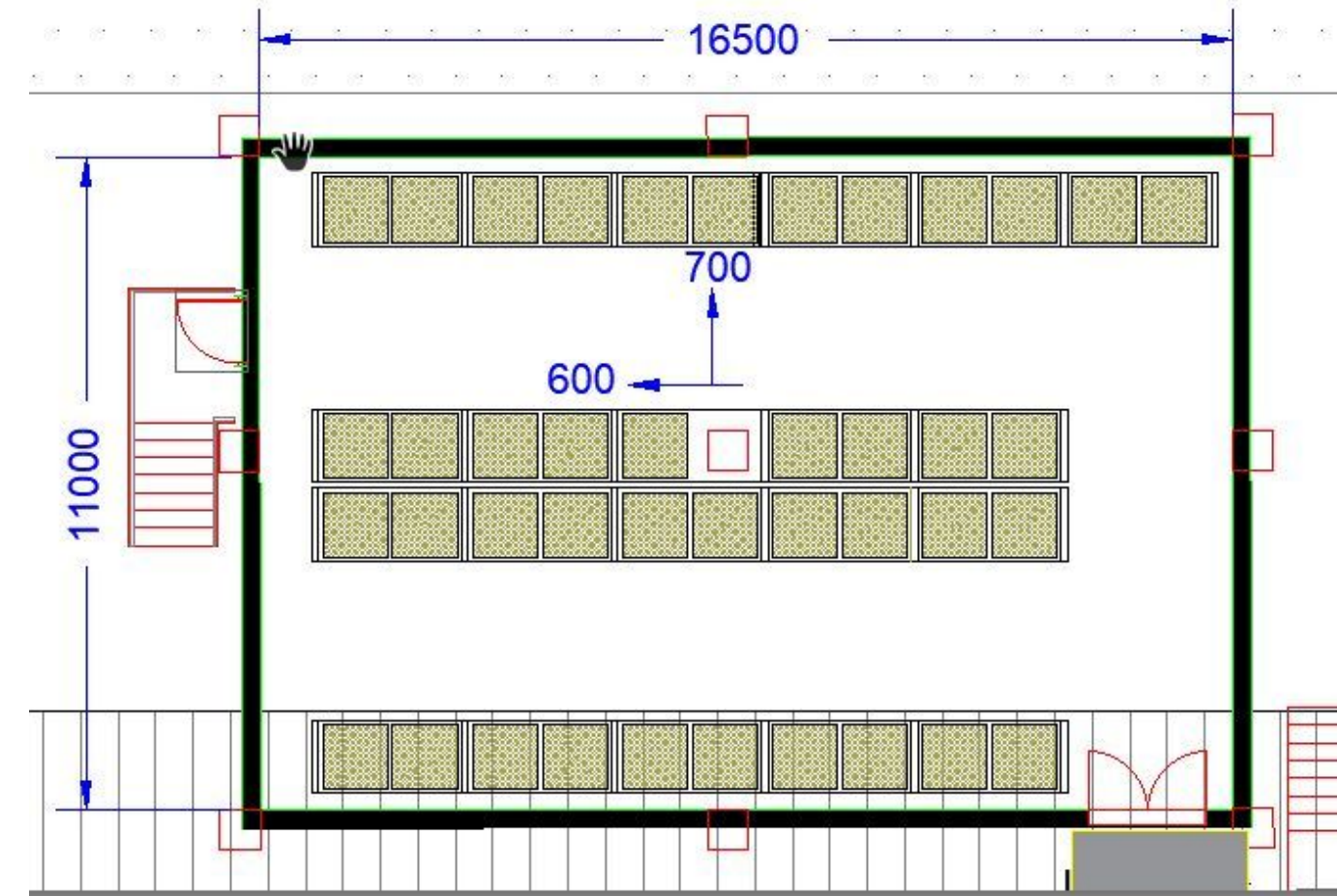
2. Central control panel & room

3. Interconnected alarm system

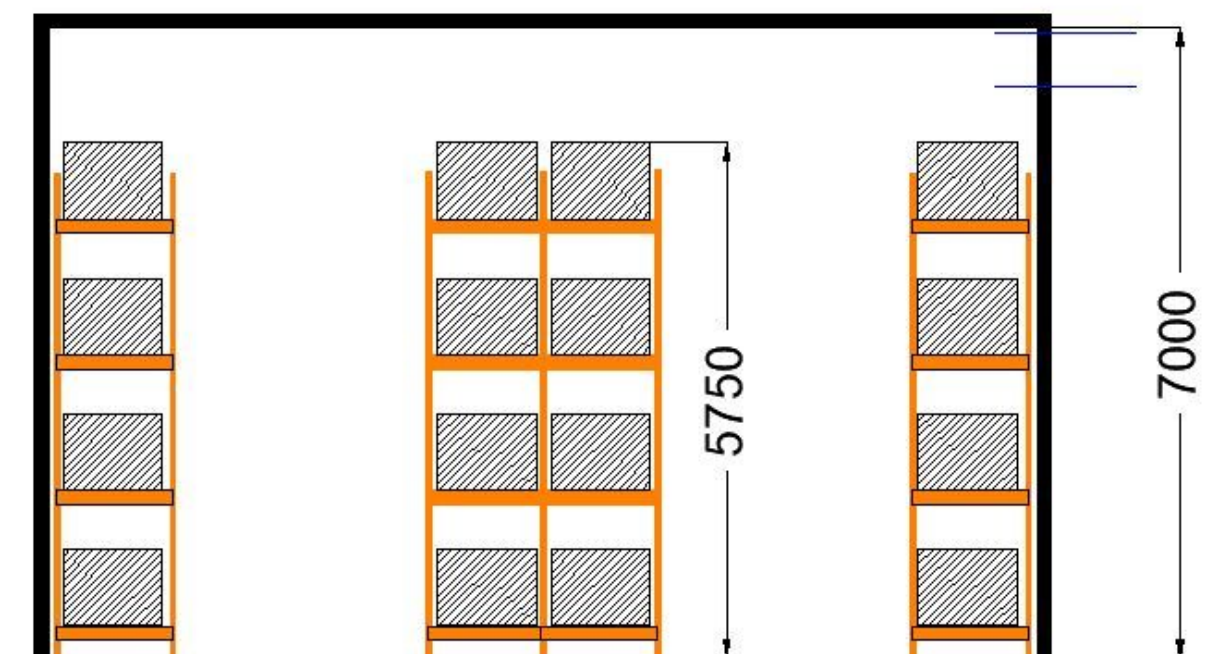
4. Wireless BMS / Automotive Battery Management Sensor:

- 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 re-use industrial and biowaste.
- To protect against pests, Micro and Macro organisms.

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

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			

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.

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)

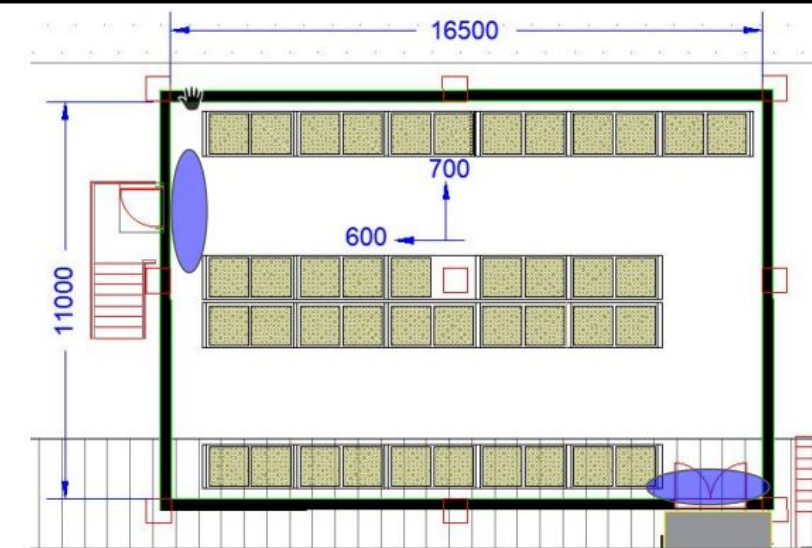


FIG- PLAN - CIRCULATION

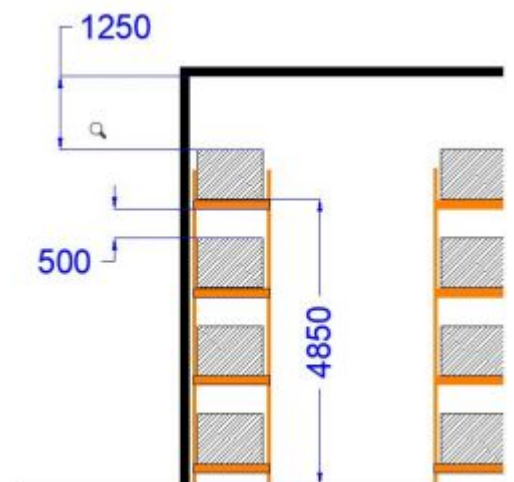


FIG- SECTION WITH RACK

MATERIALS

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				
b	For 75 & 100mm thick wall	db	38 to 40		
	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

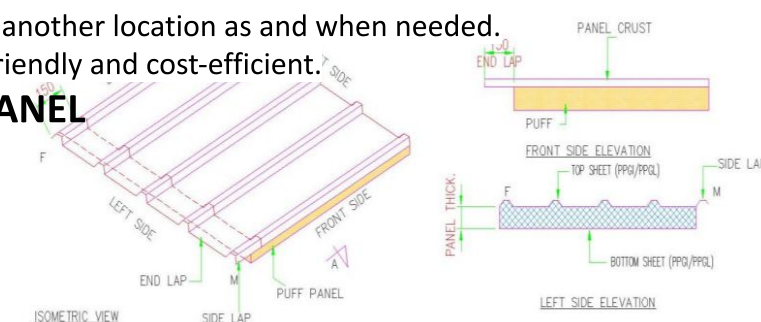
ADVANTAGES

- 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

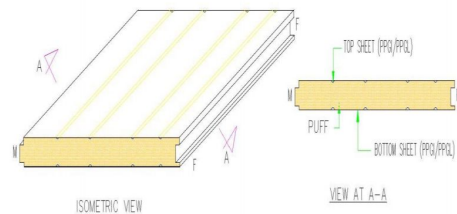


POLYURETHANE FOAM(PUF) PANEL

SIZES

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

ROOF PANEL



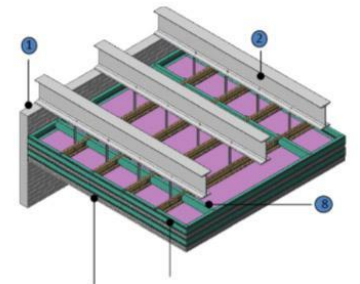
S. No.	Parameters	Test Method	Requirements	Results
1.	Density	ASTM D 1622	40±2 kg/m ³	40.2 kg/m ³
2.	Compressive strength at 10%	IS 11239 (Part 11):1985	≥ 210 KPa	235.6 Kpa
3.	Dimensional stability	IS 11239 (Part 3):2009	2% max.	< 0.5%
4.	Closed cell content	IS 11239 (Part 5):2009	85% min.	92.5%
5.	Thermal 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.

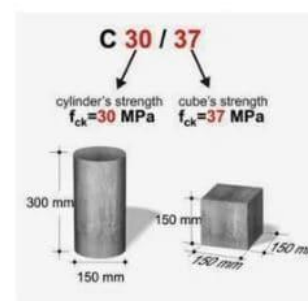
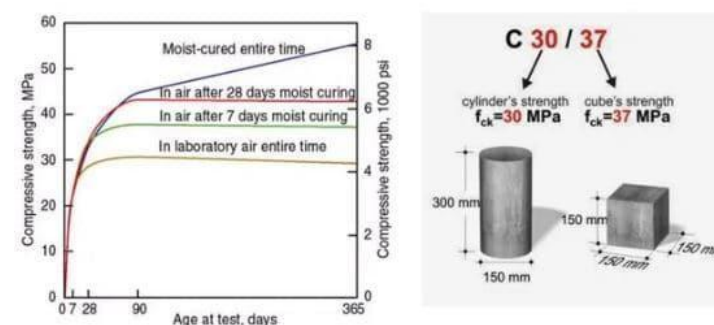
MATERIAL

- 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.

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

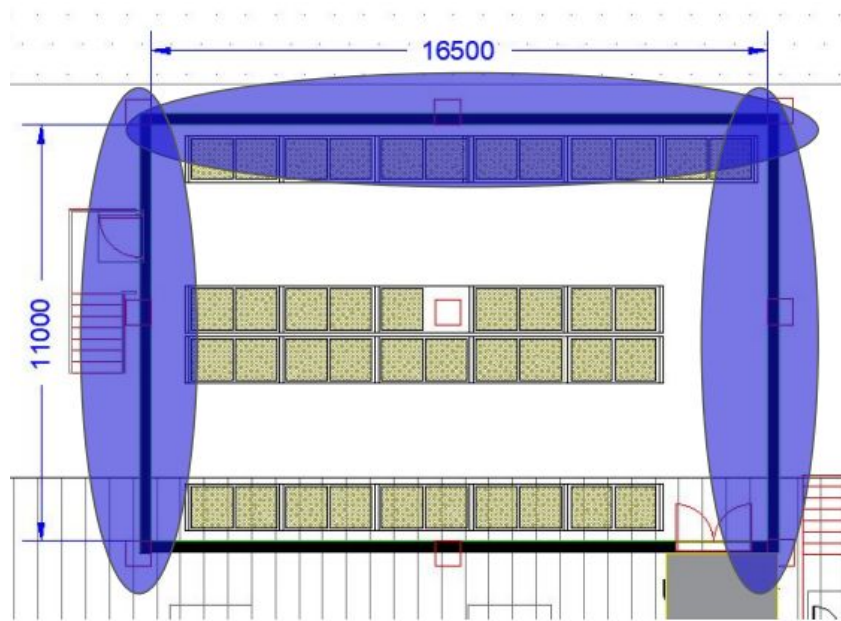


FIG - EXPLOSIVE VENT LOCATION AT PLAN

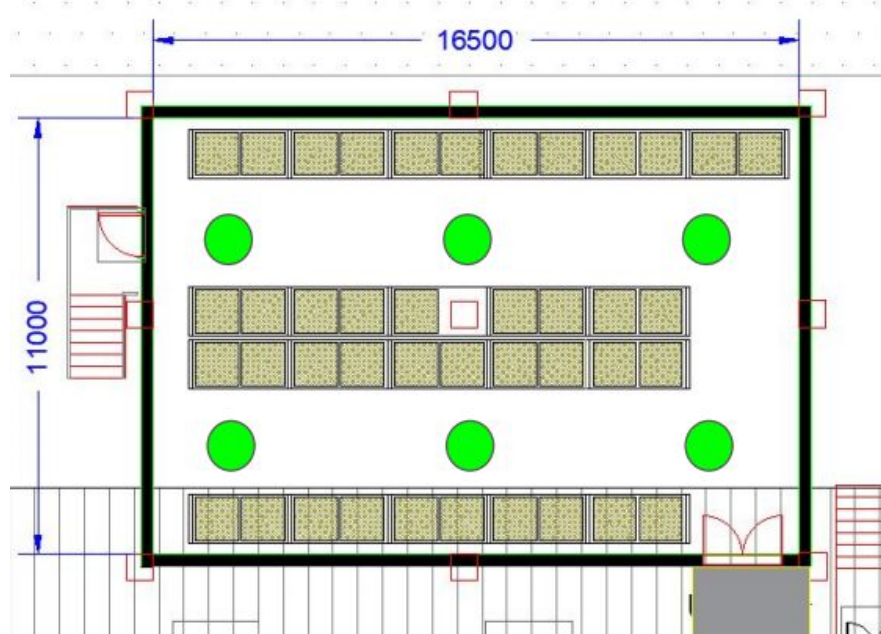


FIG - EXHAUST LOCATION AT PLAN

 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

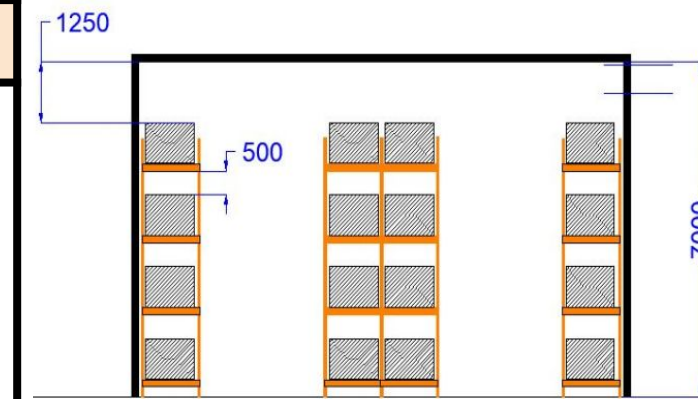


FIG - SECTION - CLEARANCE FOR SPRINKLER UNIT

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

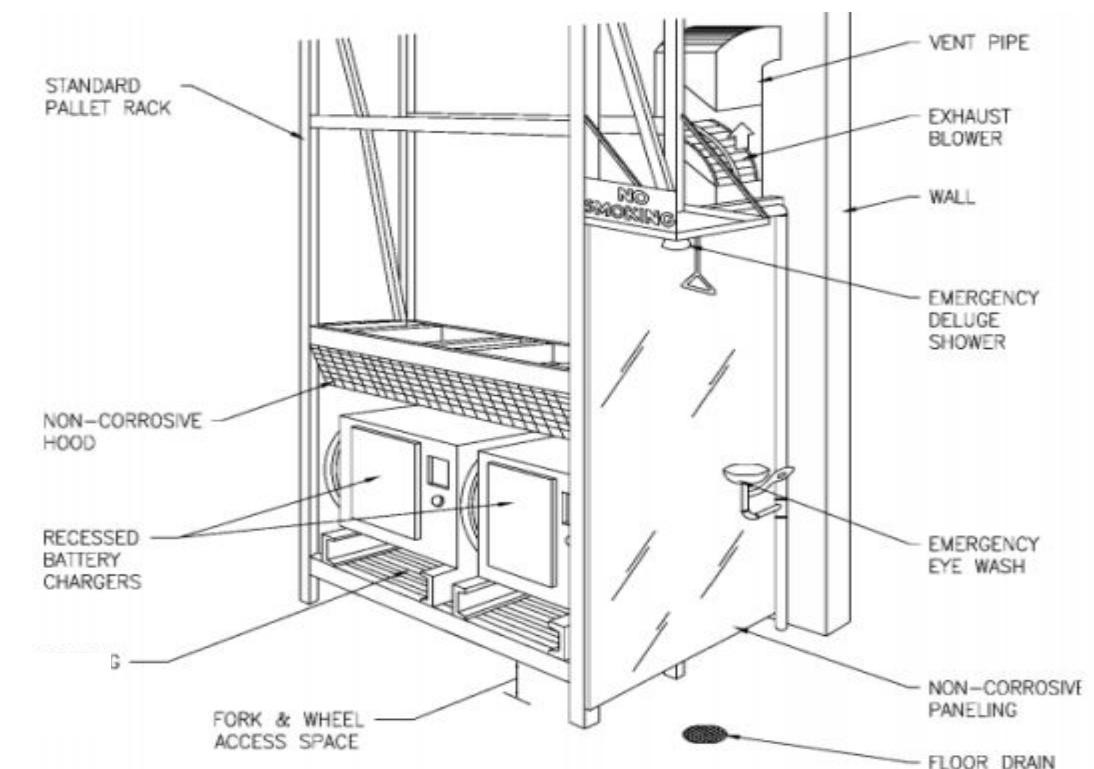
PLUMBING

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)



FIRE SAFETY

Considerations for Construction of Storage facility

- NBC Part -4 deals with the fire protective measures to be taken into consideration.
- NFPA 72 suggests that all fire protection elements to be connected to the fire alarm system.
- 2.2 of Part-4 deals with the Automatic Sprinkler system with the aid of thermo sensitive sensors or materials
- Downcomer
- Dry riser
- Emergency lighting
- Escape lighting
- Suggestion for the construction of a fire wall on the north and south sides in order to prevent the expansion of fire from the Storage facility to the Road and TVS building.
- Our current building comes under the clause 3.1.10 Group J - Hazardous Buildings and falls under Fire zone 3 category.
- They come as type 1 & 2 of construction.

Type - 1 : Fire Resistant

- Generally buildings under the category of 35 ft - 75 ft. But for the extreme conditions, even if it is not a high rise building, type-1 construction can be made.
- Our current project lies at nearly 3.6 metres ie., 11.811 ft.
- Construction materials like Concrete & Steel were to be used, where in the Steel is to be protected with a coating of fire resistant material.
- Cross ventilation should be facilitated as in case of fire, not only vertical but horizontal movement of air should be facilitated.
- Ventilation ducts for Vertical movement can be facilitated by providing the ventilation openings nearer to the roof with a cover of 20mm from the edge of the roof.
- Horizontal movement can be facilitated by provision of pressurised ducts with a non - combustible material such as Aluminium.
- Positive Pressure Ventilation(PPV) technique can be suggested in support to the above statement.

NOTE: The construction of Type-1 and Type-2 is similar except for the fact that in Type-1 construction, the roof is also made up of non-combustible material, where as in Type-2 it is not.

FIRE SAFETY

- For RCC framed structure, for adhering to the fire norms, Reinforced concrete with a minimum cover to a Reinforcement of 2.5cm is 18cm.
- For types 1 to 3 construction, a doorway or opening in a separating wall on any floor shall be limited to 5.6 m² in area with a maximum height/ width of 2.75 m.
- Every wall opening shall be protected with fire-resisting doors having the fire rating of not less than 2h in accordance with accepted standard [F(7)].
- All openings in the floors shall be protected by vertical enclosures extending above and below such openings, the walls of such enclosures and all openings therein being protected with a fire-resisting assembly as specified in 3.4.9.
- Oil fires cannot be extinguished using normal water since many oils tend to float on water. Such fires may often be carried to far off places through drains also.

FIRE SUPPRESSION SYSTEM

FIRE SUPPRESSION:

- To cut down the supply of oxygen
- To cool down the batteries & adjacent area (no reignition)
- To prevent spread of fire

Lithium ion battery

- Class A, B, C fire suppression can be used
- It has less lithium metal, so less reactive to water, Therefore one go for water for suppression. But if it is heavy one go for water with copper particles.
- Water is cheap but water with copper is costly....
- Other suppression system: Nitrogen Extinguisher, ABC Extinguisher, Foam type, CO₂, copper powder/ soda, powdered graphite.

Lithium metal batteries

- Class D fire suppression system
- They are highly reactive to water.

FEASIBILITY OPTIONS FOR FIRE SUPPRESSION SYSTEM

OPTIONS	SUPPRESSION SYSTEM	INFORMATION	FEASIBILITY
1	Water	Cut down the supply of oxygen, Cool down the batteries & adjacent area (no reignition of batteries), Prevent spread of fire	FEASIBLE
2	Water with Copper Particles	Similar to option 1 but used for heavy fire, costly	FEASIBLE FOR HEAVY FIRE
3	Foam	Similar to option 1 but more safe than water.	MOST FEASIBLE
4	Nitrogen Extinguisher	Similar to option 1, better than water.	MOST FEASIBLE
5	ABC Dry Extinguisher	Similar to option 1, better than water.	MOST FEASIBLE
6	CO ₂	Does not cool, leads to reignition	LESS FEASIBLE

FIRE SUPPRESSION SYSTEM

Foam is generally classified in two ways:

- (a) By expansion: The three types of foam by expansion are:
- Low expansion foam--expansion up to 20
 - Medium expansion foam--expansion from 50 to 250/500
 - High expansion foam--expansion up to 500 to 1000
- Fixed low expansion foam systems** are the most commonly used for fire protection in oil installations, refineries, aircraft fire fighting etc.
 - Medium expansion foam** is more often used with portable foam making branches and are suitable for spill fires etc. due to greater coverage.
 - High expansion foam systems** are suitable for fires in confined areas like ship holds, cable tunnels, mines and also for fires in LNG and other cryogenic liquids.

FIRE SUPPRESSION SYSTEM

(b) Foam is also known by the different types of constituents from which it is made. The main types are:

- Protein Foam(P)
- Fluoro-Protein Foam(FP)
- Aqueous Film Forming Foam(AFFF)
- Film Forming Fluoro Protein Foam(FFFP)
- Alcohol Resistant Foam(ARF, Suitable for Polar solvents/water miscible liquids).

FIRE RATED MATERIAL

Table 1 Fire Resistance Ratings of Structural and Non-Structural Elements (minutes)
(Clauses 3.3.1 and 3.3.2)

Sl No.	Structural Element	Fire Resistance Ratings (min) for Type of Construction			
		Type 1 (3)	Type 2 (4)	Type 3 (5)	Type 4 (6)
(1)	(2)	(3)	(4)	(5)	(6)
i)	Exterior walls:				
	a) Fire separation less than 3.7 m:				
	1) Bearing	240	120	120	60
	2) Non-bearing	120	90	60	60
	b) Fire separation of 3.7 m or more but less than 9 m:				
	1) Bearing	240	120	120	60
	2) Non-bearing	90	60	60	60
	c) Fire separation of 9 m or more:				
	1) Bearing	240	120	120	60
	2) Non-bearing	60	60	60	60
ii)	Fire separation assemblies (like fire check doors)	120	120	120	120
iii)	Fire enclosures of exits	120	120	120	120
iv)	Shafts for services, lift hoistway and refuse chutes	120	120	120	120
v)	Vertical separation between adjacent tenant spaces	60	60	60	60
vi)	Dwelling unit separation:				
	a) Load bearing	120	120	60	60
	b) Non-load bearing	60	60	30	30
vii)	Interior bearing walls, bearing partitions, columns, beams, girders, trusses (other than roof trusses) and framing:				
	a) Supporting more than one floor	240	120	120	120
	b) Supporting one floor only	180	90	60	60
	c) Supporting a roof only	180	90	60	60
viii)	Walls supporting structural members	180	90	60	60
ix)	Floor construction	120	90	60	60
x)	Roof construction:				
	a) 5 m or less in height to lowest member	120	90	60	60
	b) More than 5 m but less than 6.7 m in height to lowest member	60	60	60	60
	c) 6.7 m or more in height to lowest member	0	0	0	0

NOTES

1 The above fire resistance rating shall be required to achieve the respective type of construction unless otherwise specified in the respective clauses for different applications/use.

2 In case of lift bank, the partition wall, if any, need not be of fire rating specified in this table.

Sl No.	Type of Building Occupancy	Type of Installation								Water Supply (litre)		Pump Capacity (litre/min)	
		Fire Extinguisher	First Aid Hose Reel	Wet Riser	Down Corner	Yard Hydrant	Automatic Sprinkler System	Manually Operated Electronic Fire Alarm System (see Note 1)	Automatic Detection and Alarm System (see Note 2)	Under-ground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps	Terrace Tank over Respective Tower Terrace	Pump Near Underground Static Water Storage Tank (Fire Pump) with Minimum Pressure of 3.5 kg/cm ² at Remote Location	At the Terrace Tank Level with Minimum Pressure of 3.5 kg/cm ²
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	iii) More than ground plus one floor	R	R	R	NR	R	R	R	R	100 000	10 000	(see Note 10)	450
3)	Multi-Level Car Parking (MLCP)	R	R	R	NR	R	R	R	NR	150 000	10 000	(see Note 11)	900

HAZARDOUS BUILDINGS (I) (see Note 20)

1)	Up to 15 m in height												
i)	Single Storey Building	R	R	R	NR	R	R	R	R	Minimum 240 min firefighting requirements	NR	(see Note 21)	NR
ii)	More than one floor building but not exceeding 15 m	R	R	R	R	R	R	R	R	Minimum 240 min firefighting requirements	50 000	(see Note 21)	900

R - Required
NR - Not Required

NOTES

1 MGEFA System shall also include talk-back system and public address system for the occupancies given in the table for (i) (1) (iii) under A-5, (a) (1) (iv) and (a) (2) under C-1, and (a) (2) under D-1 to D-5, in all buildings 15 m and above in height, except for A-3 and A-4 occupancies where these shall be provided for buildings of height 24 m and above. These shall also be provided in car parking areas more than 300 m² and in multi-level car parking irrespective of their areas.

2 Automatic detection and alarm system is not required to be provided in car parking area. Such detection system shall however be required in other areas of car parking such as electrical rooms, cabins and other areas.

3 Buildings above 15 m in height are not to be permitted for occupancies A-1 and A-2.

4 Required to be installed in basement, if area of basement exceeds 200 m².

5 Required to be provided if basement area exceeds 200 m².

FIRE & EXPLOSION VENTING - REQUIREMENT

REQUIREMENT

The requirements of fire & explosion venting of industrial buildings:

1. Smoke and fire venting
2. Explosion relief vents

REQUIREMENT

- The time consumed for the building to be filled with hot smoky gases maybe only a few minutes, depending on variables like type of materials on fire, process/storage conditions involved.
- Automatic venting systems are complementary to the fire extinguishing systems, and automatic sprinklers, where provided, should operate before the operation of the vents; otherwise, venting may delay sprinkler operation.
- Venting is particularly desirable in large area industrial buildings or warehouses, windowless buildings, underground structures or in areas housing hazardous operations. Automatic fire vents shall be provided for all industrial occupancies including storage buildings.
- These provisions do not cover other aspects, of ventilation (or lighting) designed for regulation of temperature within a building for personal comfort or meeting process needs.

REQUIREMENT

- The rate of combustion varies appreciably according to the nature, shape, size and packaging of the combustible materials as well as the size, height and disposition of the stacks of materials.
- Of the two types of building ventilation, namely, vertical and horizontal, vertical ventilation is the one commonly adopted in the case of single storey industrial buildings.
- Combustible roof linings shall be avoided, as they themselves will contribute to the spread of fire, thereby multiplying the venting problems.

VENTING AREA

- The effective area shall be the minimum cross sectional area through which the hot gases must flow out to the atmosphere.

REQUIREMENT

TYPES OF VENTS

- Venting shall be accomplished by any of the types such as monitors continuous gravity vents.
- Where monitors or unit type vents are used, the panels shall be hinged at the bottom and designed to open automatically. Both sides of the vents shall be designed to vent simultaneously to ensure that their effectiveness at the time of fire is not in any way impeded by wind direction.
- Where movable shutters are provided for continuous gravity vents, these shall open automatically in the event of fire.

REQUIREMENT

VENT OPERATIONS

- The automatic operation of vents shall be achieved by actuation of fusible links or other types of heat and smoke detectors, or by interlocking with operation of sprinkler system or any other automatic fire extinguishing system covering the area.
- Automatic fire alarm system, where installed, shall be coupled to the automatic vents to ensure simultaneous operation.

REQUIREMENT

VENT OPERATIONS

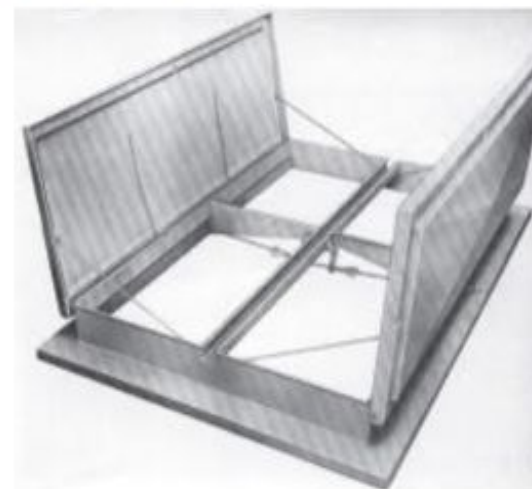


Fig. 10. A twin-door roof vent operated by a fusible link.

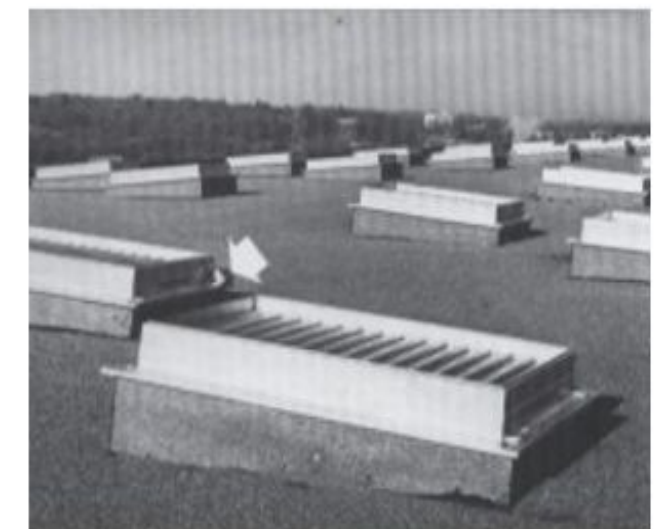


Fig. 09. Automatic Fire Vents on the roof of a warehouse

REQUIREMENT

Disposition, Size & Spacing Of Vents

- Vents shall be correctly sited to ensure their functional efficiency.
- Vents shall, as far as possible, be located immediately above the risk to be protected so as to allow free and speedy removal of smoke and other combustion products in the event of fire.
- The minimum dimension for an effective vent opening shall be not less than 1.25 m in any direction.
- Vents shall be placed in a sheltered situation where advantage can be taken of the prevailing wind. The design of the vent shall be such as to produce a suction effect.

REQUIREMENT

Design, Size and Disposition of Vents

The required area of explosion vents shall ordinarily depend on:

- The expected maximum intensity of an explosion in the occupancy,
- The strength of the structure,
- The type of vent closure and other factors.

REQUIREMENT

- In congested locations, substantial ducts or diverters shall be provided to direct the blast.
- When ductwork is used, the ducts shall be of sufficient strength to withstand the maximum expected explosion pressure.
- Where explosions are likely within duct and piping systems, they shall be vented by the use of suitable diaphragms designed to blow out at a predetermined pressure.
- Obstructions of any kind blocking the vents from the risk covered shall be avoided, particularly where risks of rapid violent explosions are present.
- Vents shall be of such size and design as to prevent rupture of the protected device or apparatus.

REQUIREMENT

- Flexible plastic sheets when used for vent closures shall be installed in slotted frames in such a way that pressure from within bulges the sheets and releases them from the holding frame.
- Fragile sheets made of plastic, when used for vent closures, shall be thin sheets that will crack or rupture under less pressure than single strength glass. For this reason use of transparent or translucent plastic sheets is more advantageous than use of glass in window sash.
- If closed vents are used they shall be larger in area than unenclosed vents to provide equivalent explosion pressure relief.

REQUIREMENT

Vents for the protection of buildings and equipment shall be installed on the following basis:

- Fairly large enclosures of 30 to 700 m³:
 - 1 000 cm² for each 0.9 m³ to 1.5 m³.
 - In these cases, attempt shall be made to the extent possible to predict the likely point of origin of the explosion in relation to the vent.
- In order to obtain these ratios, the size of the building or room must be limited. For some hazardous materials, such as hydrogen, acetylene, carbon disulphide, etc, these limits are extremely low.
- Interior walls of light construction, such as tile, shall be avoided in hazardous locations, since they can cause injuries to personnel in the event of an explosion.

SPILL CONTAINMENT

REQUIREMENT

Means of providing containment and removal must be provided in the event of spills.

Exterior Containment:

- Exterior containment areas must be graded in a manner to divert possible spills away from buildings or other exposures or be surrounded by a curb at least 6 inches high.
- When curbs are used, provisions must be made for draining of accumulations of ground or rain water or spills of flammable liquids.
- Drains are to terminate at a safe location and must be accessible to operation under fire conditions.

REQUIREMENT

Interior Containment:

- Inside storage rooms must be constructed to meet the required fire-resistive rating for their use.
- Openings to other rooms or buildings are to be provided with noncombustible liquid-tight raised sills or ramps at least 4 inches in height or the floor in the storage area must be at least 4 inches below the surrounding floor.
- Openings must be provided with approved self-closing fire doors.
- The room must be liquid-tight where the walls join the floor.
- A permissible alternate to the sill or ramp is an open-grated trench inside of the room that drains to a safe location.

REQUIREMENT

Floor Trenches and Capture Systems:

- Where a continuous floor trench with grating is used in areas of hazardous materials storage for the capture and control of hazardous chemical spills.
- All spill containment systems must provide separate containment
- Secure grate frame support channels to concrete floors.
- Grate design must provide for the ability to latch the removable grate sections at aisle crossings and cargo doors to ensure that grates will remain firmly in place when material handling equipment moves over them.
- This protects the edges of concrete around grate frames from impact damage from the wheels of materials handling equipment.
- Where a trench passes in front of a personnel door use concrete cover or solid concrete plates sufficient to prevent a fire in the trench from blocking the exit door.

REQUIREMENT

Dikes:

- Dikes must be used for containment of spills for gasoline and/or diesel fork truck refueling stations and commodities stored or handled outside of buildings.
- Their volume must be not less than 110% of liquid that can be released from a fork truck or the largest storage container within the diked area or a 10% minimum of all materials to be stored in the area, whichever is greater.

REQUIREMENT

Recessed Floor:

- Specific design or containment needs, interior storage floor surfaces may be recessed 6 inches below the level of adjoining dock, office, and support areas to prevent the flow of spilled hazardous liquids into these areas.
- Vehicle access ramps must be provided at all doorways into such areas.

REQUIREMENT

Containment:

- Grate-covered interior 350 gallon sumps in conjunction with the trench system to provide spill or leakage.
- Containment for the lesser of 1,000 gallons or 10 percent of the total free flowing liquid volume of all containers stored in each segregated area.
- Provide a containment capacity of 1,000 gallons at the truck apron adjacent to the shipping and receiving area. prevent spilled or leaking materials from entering the environment.
- Drainage Install pallet racks and associated mechanical vehicle guidance systems so as to permit the unimpeded flow of spilled liquids to collecting trenches.
- Maintain floor flatness requirements. Floor drains connecting to the sanitary sewer are not permitted in storage areas of hazardous materials.

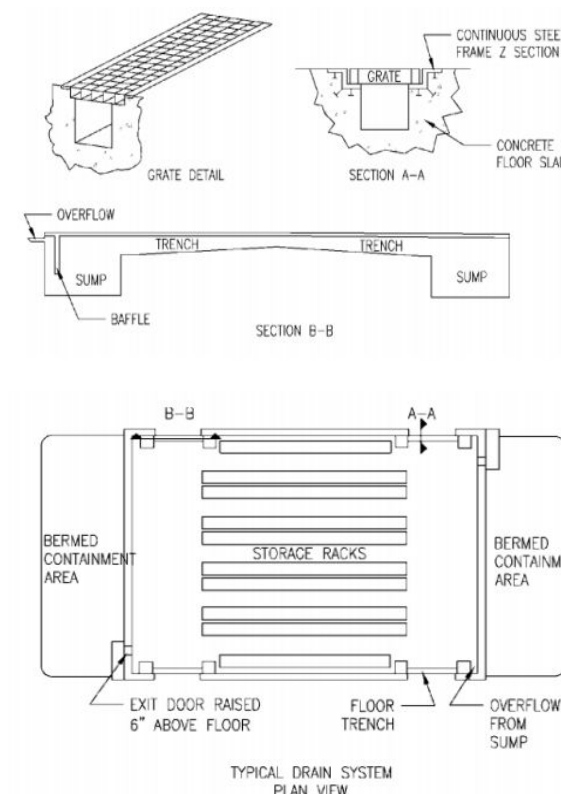
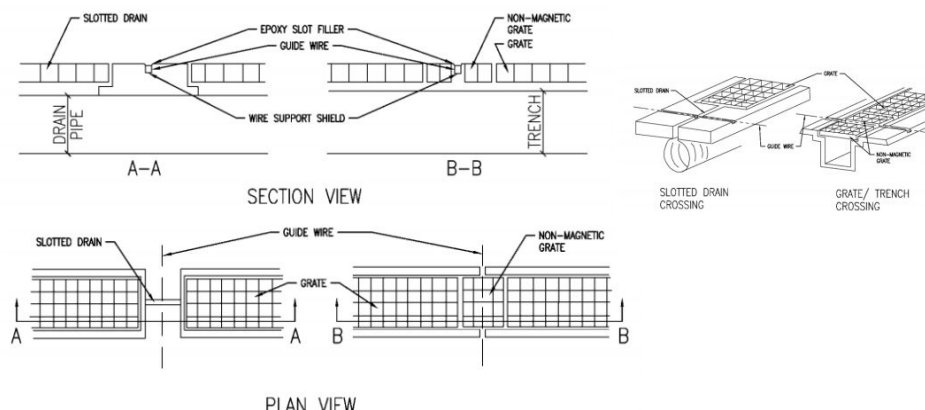


FIG - FLOOR TRENCHES AND CAPTURE SYSTEMS

REQUIREMENT

Electronic Guide Wire Crossing:

- When floor-buried electronic guide wire is used to guide material handling vehicles across trench grates that cross aisles or are at cargo doors.
- Use a nonmagnetic grate section extending at least 6 inches (150 mm) on each side of the wire path so that the magnetic field of the guide wire is not distorted by passing the wire through a ferrous or magnetic grate.
- Alternatively, use slotted drains and pass the guide wire under the drains and shield the guide wire when passing through ferrous or magnetic grates for drains.



ELECTRICAL REQUIREMENTS

REQUIREMENT

- Fire rated wirings (FRSL), Conduits & Accessories shall be provided.
- All electrical equipment must be intrinsically safe to reduce the risk of arcing, flashing or ignition.
- All cables shall be Concealed conduit system (Electrical, Data, Signal cables)
- Battery rooms shall be equipped with a centralized Emergency Power-Off (EPO) system than can disconnect power to the load centres
- EPO device should be located at all egress points from the room and be tied into the central alarm system and monitored.
- All battery racks and cabinets associated with UPS systems should have NEC code green wire grounds linking all battery racks.
- Type AC, NM, NMC, NMS and UF cables shall not be used in battery rooms.
- No flexible metal conduit or flexible metallic tubing shall be used.
- Power:** Provide separate dedicated panel boards to serve each separate user area.

ELECTRICAL - CONDUCTORS TYPES, LOCATION AND THEIR MINIMUM NOMINAL SIZE

SL.NO	TYPE OF WIRING SYSTEM	USE OF THE CIRCUIT	MATERIAL	MINIMUM CROSS SECTION AREA
1	CABLES & INSULATED CONDUCTORS	LIGHTING CIRCUITS	COPPER	1.5
2		POWER CIRCUITS	COPPER	2.5
3			ALUMINIUM	10
4		SIGNALLING & CONTROL CIRCUIT	COPPER	0.5
5	BARE CONDUCTORS	POWER CIRCUITS	COPPER	10
6			ALUMINIUM	16
7		SIGNALLING & CONTROL CIRCUIT	COPPER	4
8	FLEXIBLE CONNECTION- INSULATED CONDUCTORS & CABLE	FOR SPECIFIC APPLIANCES	COPPER	TABLE 3
9		FOR ANY OTHER APPLICATION		0.5
10		EXTRA LOW VOLTAGE, SPECIAL USE		0.5

DIFFERENCES

SL. NO.	ALUMINIUM CONDUCTOR - ABOVE 10 MM SQ (PERMISSIBLE)	COPPER CONDUCTOR
1	PURCHASE & RECYCLE COST - LOW	PURCHASE & RECYCLE COST - HIGH
2	LESS DURABILITY COMPARATIVELY	HIGH DURABILITY
3	AFFINITY TO CORROSION IS LESS	AFFINITY TO CORROSION IS HIGH
4	LARGE DIAMETER , LARGE LOAD	HIGH LOAD CARRYING CAPACITY WITH IN SMALL DIAMETER OF CONDUCTOR
5	EXCELLENT DUCTILE IN PROPERTY, SO USED ONLY AT SOLID CONDUCTORS	HIGHLY MALLEABLE , USED AS FLEXIBLE CONDUCTOR
SL. NO.	XLPE (CROSS- LINKED POLYETHYLENE) INSULATION	PVC (POLYVINYL CHLORIDE) INSULATION
1	USED : HIGH TEMPERATURE & HIGH VOLTAGE	USED: LOW TEPERATURE & LOW VOLTAGE
2	EG.: HT PANEL , UNDERGROUND CABLING	EG.: LT PANEL , INTERNAL CIRCUIT PANEL, INTERNAL DISTRIBUTION CABLES
3	HIGH RESISTANCE TO : CHEMICAL, MOISTURE, HIGH WEAR & TEAR	LESS RESISTANCE TO : CHEMICAL, MOISTURE, HIGH WEAR & TEAR

ELECTRICAL - COLOR CODES

FLEXIBLE CABLES CORE'S COLOR CODE (TABLE 6)

SL. NO	NUMBER OF CORE	FUNCTION OF CORE	COLOR OF CORE
1	1	PHASE	BROWN
2		NEUTRAL	(LIGHT) BLUE
3		EARTHING	GREEN & YELLOW
4	2	PHASE	BROWN
5		NEUTRAL	(LIGHT) BLUE
6	3	PHASE	BROWN
7		NEUTRAL	(LIGHT) BLUE
8		EARTHING	GREEN & YELLOW
9	4	PHASE	BROWN / BLACK
10		NEUTRAL	(LIGHT) BLUE
11		EARTHING	GREEN & YELLOW

COLOR CODE FOR PVC CONDUITS USED HERE AS PER NBC 2016 (TABLE 7):

SL.NO	CONDUIT TYPE	COLOR CODE
1	POWER CONDUIT	BLACK
2	SECURITY CONDUIT	BLUE
3	FIRE ALARM CONDUIT	RED
4	LOW VOLTAGE CONDUIT	BROWN
5	UPS CONDUIT	GREEN

ELECTRICAL- INDOOR LIGHTING

REQUIREMENT	OPTIONS
• Illuminance levels in the battery room with a minimum illumination level of 300 lux. • Parallel wall mounted / pendant lights / Ceiling mounted • Explosion proof luminaire • Not Mounted directly over the battery stand & shall be placed parallel With battery stands • Lamp protection fixture by shatterproof lenses / wire guard • Corrosive resistance(To acid vapour) • Receptacles & lighting switches • Luminaires & lamps of minimal heat output	• LED lighting - 300 Lux • Wall mounted / pendant lights / Ceiling mounted • 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 (Daylight) • Emergency Lightings (30%)

ELECTRICAL - OUTDOOR LIGHTING

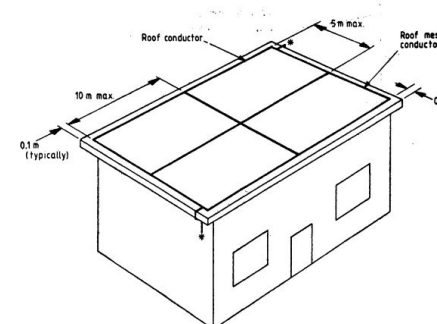
REQUIREMENT	OPTIONS
1. Lighting for dock every (8m) & for each truck dock 2. Mounting Height = $\frac{1}{2}$ (Distance between two Lamp) 3. Lighting for Performance of work, Safety & Security & Decorative (parking lots, maneuvering areas, fence lighting, etc) 4. Luminaires & lamps of minimal heat output & use of solar lamps	• Solar Lamps • Pole lighting • Path lighting -Bollard Light • Landscape lighting • Signage lighting • Type of pole- Aluminium • Type of Light - LED • Lumen / Watt- 70 to 160 W • White Light

ELECTRICAL- LIGHTNING ARRESTERS- OPTION 1

REQUIREMENT

Air Termination Network with Horizontal Conductors:

- Horizontal conductors mesh size should be 5m x 10m or Smaller,according to the risk.
- Clarity down conductors are omitted.

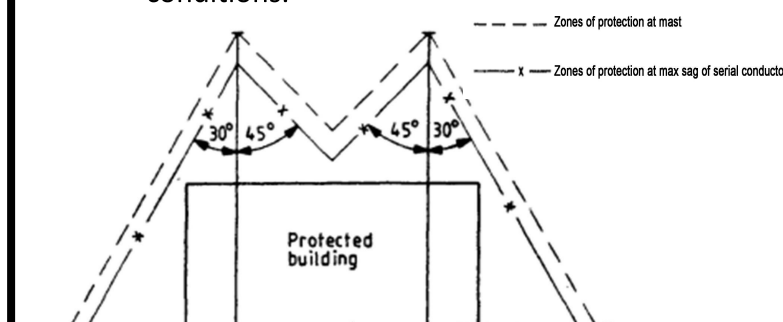


ELECTRICAL- LIGHTNING ARRESTERS- OPTION 1

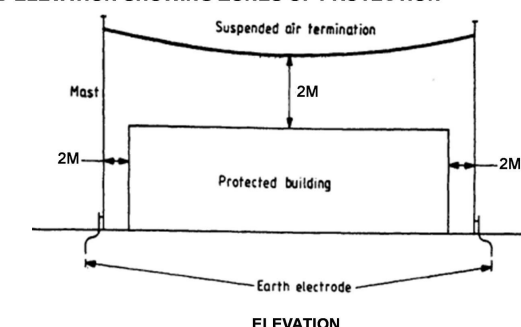
REQUIREMENT

Air Termination with Twin Suspended Horizontal Conductors & Zone of Protection:

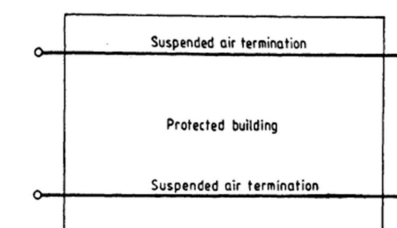
- Two or more suspended horizontal conductors are employed.
- A protective angle or 45° may be used in the space bounded by the conductors.
- the protective angle is limited to 30° .
- To prevent flashover between mast/conductor and protected building,
- The minimum clearance distance has to be 2 m or greater.
- Clearance has to be as above under maximum sag conditions.



END ELEVATION SHOWING ZONES OF PROTECTION



ELEVATION



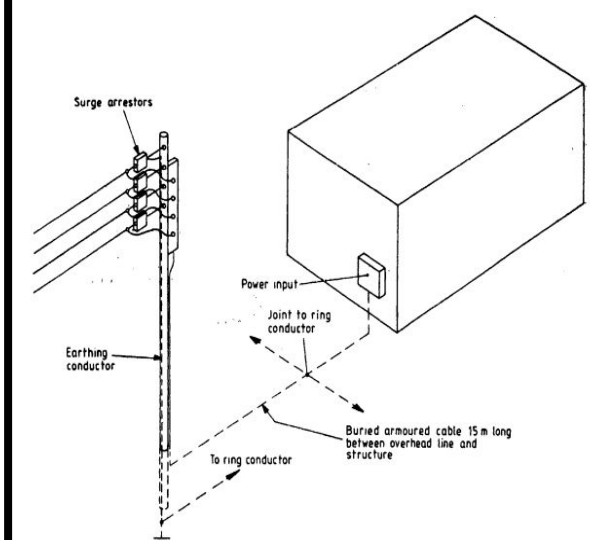
PLAN

ELECTRICAL- LIGHTNING SURGE ARRESTER

REQUIREMENT

Exceptional protection against overvoltage:

- Electrical conductors are connected to an overhead electricity supply line.
- 15 m length of buried armoured cable should be inserted between the overhead line and the point of entry to the structure.
- Overhead supply lines are liable to have large surges from lightning Discharges.
- Allow a large part of the lightning current to be discharged to earth at a safe distance from the structure.



IBMS - REQUIREMENT

REQUIREMENT

1. **Alarm Systems**
 - a. Provide fire, hydrogen, ventilation failure, hazardous chemical spill, neutralizer tank and security alarms.
2. **Fire Alarms**
 - a. Provide storage facilities with fire alarm system that transmits a signal to the fire department
3. **Hazardous Chemical Spill Alarms**
 - a. Provide hazardous chemical storage areas with alarms signaling release or spillage of stored chemicals.
4. **Security Alarms**
 - a. Protect stored materials with Electronic Security Systems (ESS)

OPTIONS

1. **Alarms & Instrumentation to measure:**
 - Battery voltage & 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

OPTIONS

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

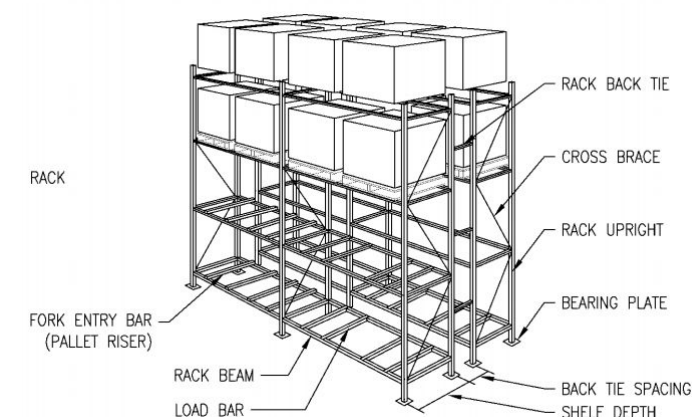
STORAGE RACKS

RACKS

REQUIREMENT

Pallet Racks:

- Consist of uprights, pallet beams, bracing, and miscellaneous accessories.
- Minimum design load must be 3,000 pounds (1360 kg) per pallet.
I spacing averages 48 inches.



Stability:

- Rack stability is influenced by loading conditions, attachment, and rack assembly.
- Racks exceeding a 6:1 height to depth ratio must be securely anchored or braced externally.
- Racks exceeding 20 feet in height.

Flue Space:

- Fire protection requirements dictate a minimum longitudinal flue space of 6 inches.
- Flues must be 12 inches deep in refrigerated areas.
- In hazardous materials storage areas, provide 12-inch flues between back-to-back racks.
- Flues of 8-12 inches must be provided between backs of racks and walls.
- Standard pallet racks provide a minimum 4-inch transverse flue space.

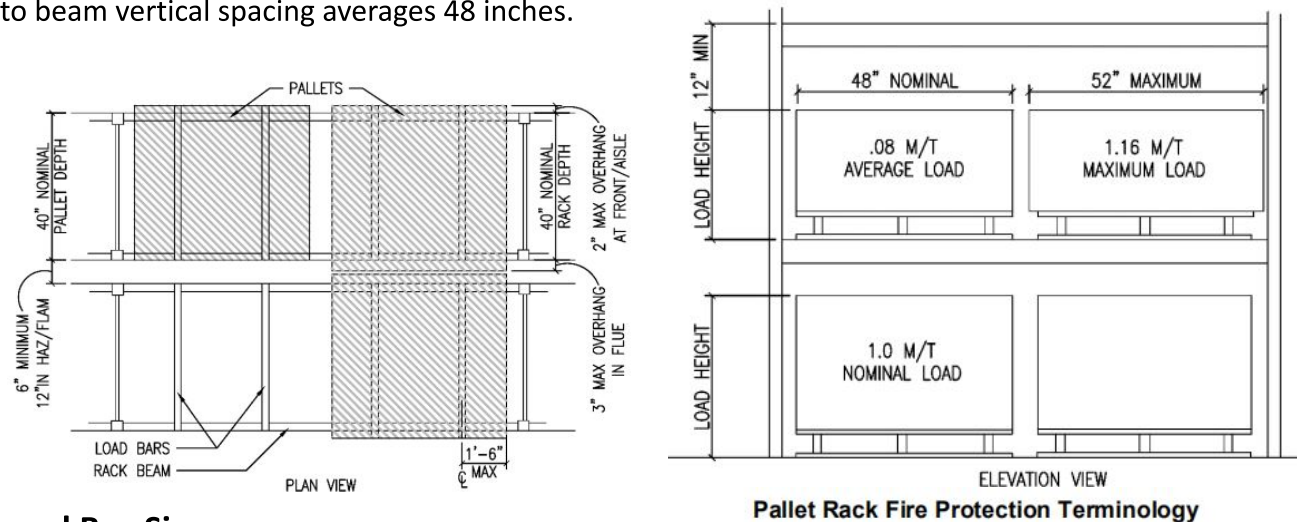
OPTIONS

- 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

REQUIREMENT

Dimensions:

- Pallet racks must have a 40-inch depth and accommodate standard 40- x 48-inch pallets without front or rear pallet overhang.
- Other sizes of pallet racks or pallets must be documented and justified. Beam to beam vertical spacing averages 48 inches.



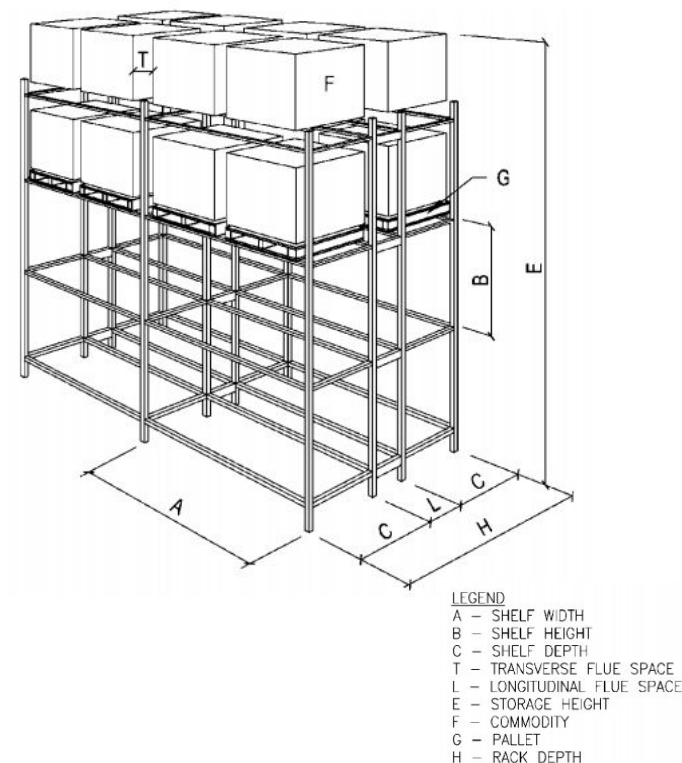
Pallet Rack Fire Protection Terminology

Universal Bay Size:

- The universal pattern will not represent the optimum spacing for all systems.
- The facility may be costlier than necessary because of the inefficient use of space.
- A smaller building can generally be constructed if the optimum column spacing is used.
- Use of the universal pattern will permit the building to fulfill a variety of missions due to its ability to function with many materials handling systems.

Optimum Bay Size:

- Use of the optimum bay size will reduce the size of the required building due to more efficient use of the building space.
- Ultimate versatility of the facility will be reduced because the column pattern will not fit every system.



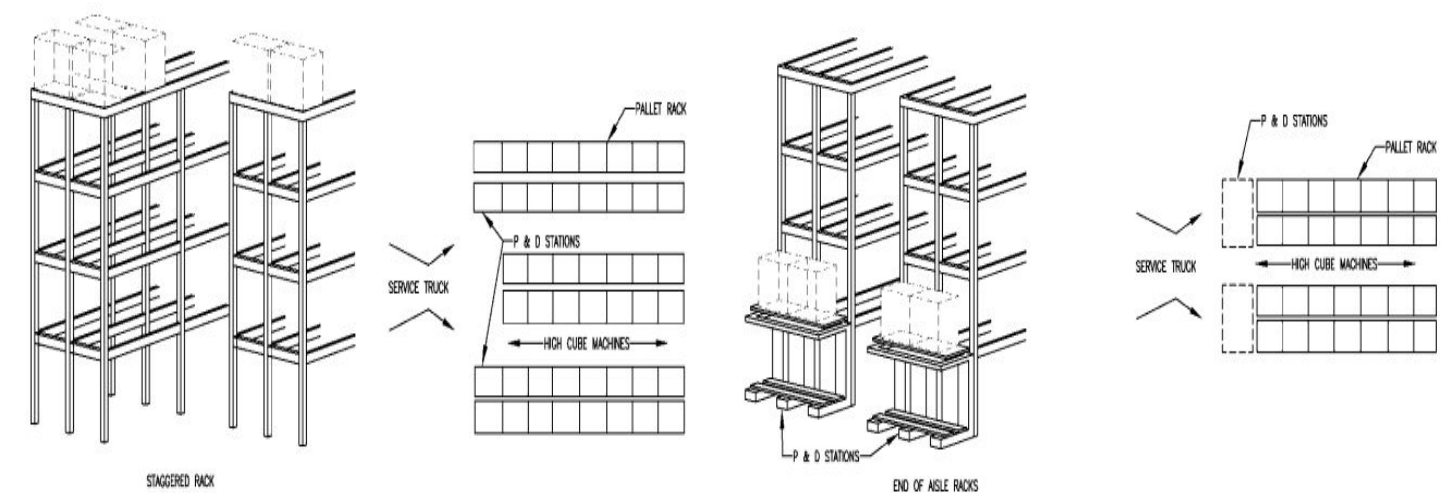
REQUIREMENT

Attachment:

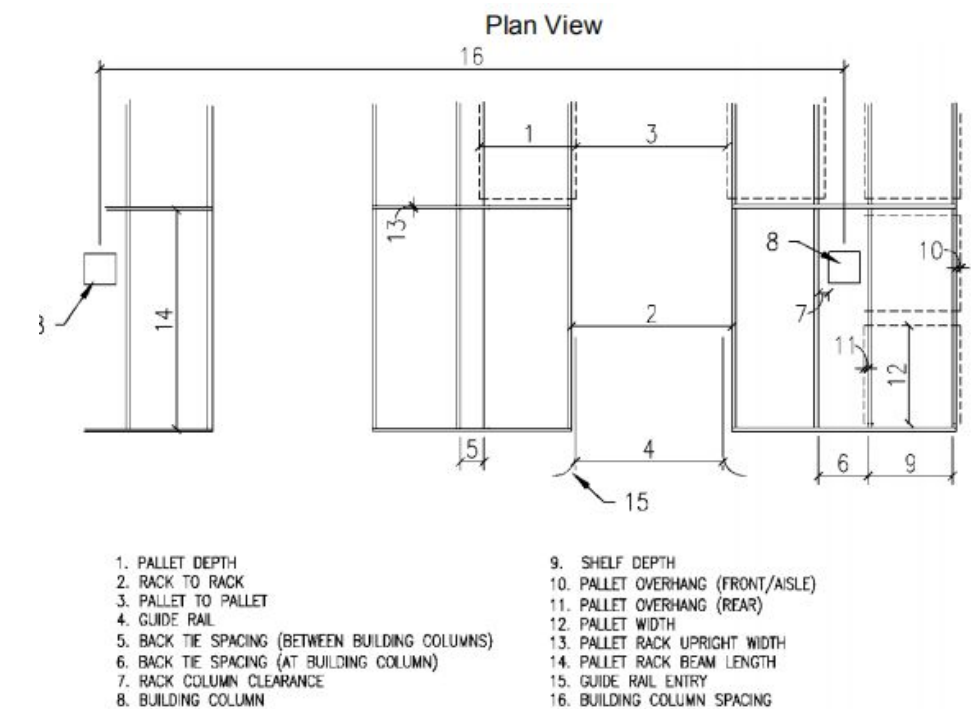
- Securely attach all pallet racks to floors, walls, and each other, to ensure stability and safety.

System Interface:

- Interface operations with pallet rack using pickup and delivery (P&D) stations.



- The relationship between column spacing, rack dimensions, aisle patterns, machinery and operations.
- A 33ft. x 64 ft. bay size when warehouse construction must be planned without knowledge of specific warehousing systems to be installed within new facilities.
- The universal bay size will not represent the optimum column spacing for every system.



SAFETY & HAZARD FACTORS OF THE CELL

1.HAZARDS

Explosion of batteries

Impacts:

- Fire
- Vibrations can cause heat
- Structural damage

Hazards:

- Chemical Hazard
 - Chemical spillage of the electrolyte;
 - Exposure to toxic, corrosive and/or flammable solutions or gases
- Electrical Hazard
- Thermal runaway
- Electrolyte Spill

4.HAZARDS - CELL THERMAL RUNAWAY

CELL THERMAL RUNAWAY :

1. Cell internal temperature increases
2. Cell internal pressure increases
3. Cell undergoes venting
4. Cell vent gases (Carbon Dioxide, Carbon monoxide, Hydrogen, Hydrocarbon) may ignite
5. Cell contents may be ejected
6. Cell thermal runaway may propagate to adjacent cells

This leads to :

- Thick smoke
- Flare
- Burnes
- Fireballs
- Explosion

Severity is based on:

- Battery size
- Battery construction / Design
- Battery chemistry
- Battery state of charge

5.HAZARDS - THERMAL RUNAWAY

Thermal Runaway- Causes:

- a. Mechanical abuse – cells being crushed, punctured, dropped
- b. Electrical abuse – short circuiting improperly packaged cells/ packs
- c. Thermal abuse – external fire / Heating/ Increase in Temperature
- d. Internal fault & Manufacturer's defects

Thermal Runaway- Effects:

- a. Thermal Abuse: The most direct way to exceed the thermal stability limits of a Li-ion cell is to subject it to external heating
- b. Mechanical Abuse: It can cause shorting between cell electrodes, leading to localized cell heating that propagates to the entire cell and initiates thermal runaway;
- c. Electrical Abuse: Overcharge, External Short Circuit, Over-discharge
- d. Internal Cell Faults
- e. Manufacturer's defects: Imperfection & Contamination

2.HAZARDS - RISK MATRIX

	Not Significant	Minor	Moderate	Major	Severe
Almost Certain	Handling errors				
Likely		Water or chemical spilling	Temperature changes		
Possible		Vibrations	Humidity changes	An explosion of a battery	Fire break-out
Unlikely			Leakages from battery		
Rare					Earthquake

3.HAZARDS - ELECTROLYTE SPILL

Electrolyte Spill

- Always ensure to wear adequate protective clothing (goggles, closed shoes and gloves) during clean-up of spills
- Advise and warn co-workers.
- Evacuate the area immediately.
- Restrict the access to the area.
- Notify Security, providing them with the following information:
 - Location of the spill
 - Name of hazardous material
 - Quantity involved
 - Related health risks and precautions to be taken.
- Provide the Safety Data Sheets (SDS) or appropriate documentation.

Human Exposure

- Inhalation
- Eye contact
- Skin contact

SAFETY & HAZARD FACTORS OF THE CELL

OTHER REQUIREMENT

Things to be taken care:

- Protective packaging (i.e, hard plastic / equal).
- Storing of batteries in fire resistant storage / Metal storage cabinet/ Hazardous goods cabinet / Safe storage Cabinets With inbuilt Automation system.
- Keep batteries away from conductive material, water, seawater, strong oxidizers & strong acids.
- Do not place batteries under direct sunlight/ on hot locations.
- Visual inspection of the battery storage area at least weekly once.
- Keep flammable materials away from the operation area.
- In case fire: Water or other aqueous agents should be used to suppress the fire.
- In case of water exposure:
 1. Immediately dry the battery using clean cloth.
 2. Store the battery in a fire-resistant container, away from the flammable substance, for a minimum of 24 hrs.
 3. If damage is apparent, dispose of it.

REQUIREMENT

- **In case of salt water:**
 1. They should be disposed of.
 2. When not handled properly, they form an electrical path & may ignite
 3. They are delayed & unexpected reaction
 4. Leading to unexpected fire at site/ disposal site
 5. If they come in contact with saltwater, rinse the battery with distilled/ deionised water, followed with wipe down with clean cloth and store the battery in a fire resistant container, away from flammable substance, for minimum 24 hrs.
- **In Case of crash:**
 1. Handle those batteries with extreme caution
 2. Although it appears as no physical damage, they have delayed chemical reaction.
 3. They have to be stored in fire resistant container for minimum 24 hrs.
 4. Dispose them if damage occurred.
- Dispose batteries / cells that no longer holds substantial charge.
- Dispose batteries through - E.Media bin / Online Chemical waste collection request.

	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

- 4hrs 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.

HEADING: ATHER ENERGY CELL STORAGE BUILDING, BANGALORE - MINUTES OF MEETING

Page No.: 31

- 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 4hrs 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 - An IIT Madras incubated company	
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.: 35

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

Page No.: 36

	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 / types?	
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 level)?	
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?	

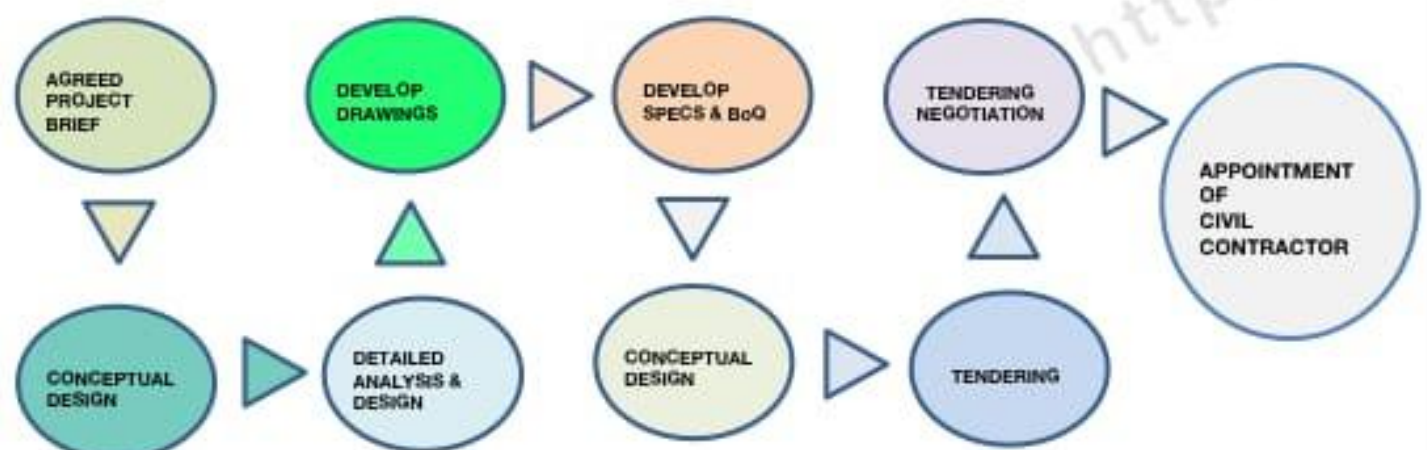


HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Technical Queries for Clarification- CLIENT

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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			

 Engineering Project Management Consultancy and Research (EPMCR) Private Limited An IIT Madras incubated company		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.		Signing 		
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



ARCHITECTURAL TEAM - ARCHITECTURAL LAYOUT OPTIONS

PROJECT PROBLEM – CHALLENGES – SOLUTION, CONCEPTUAL LAYOUT OPTIONS FOR FEASIBILITY AND COMPARISION BETWEEN VARIOUS LAYOUTS

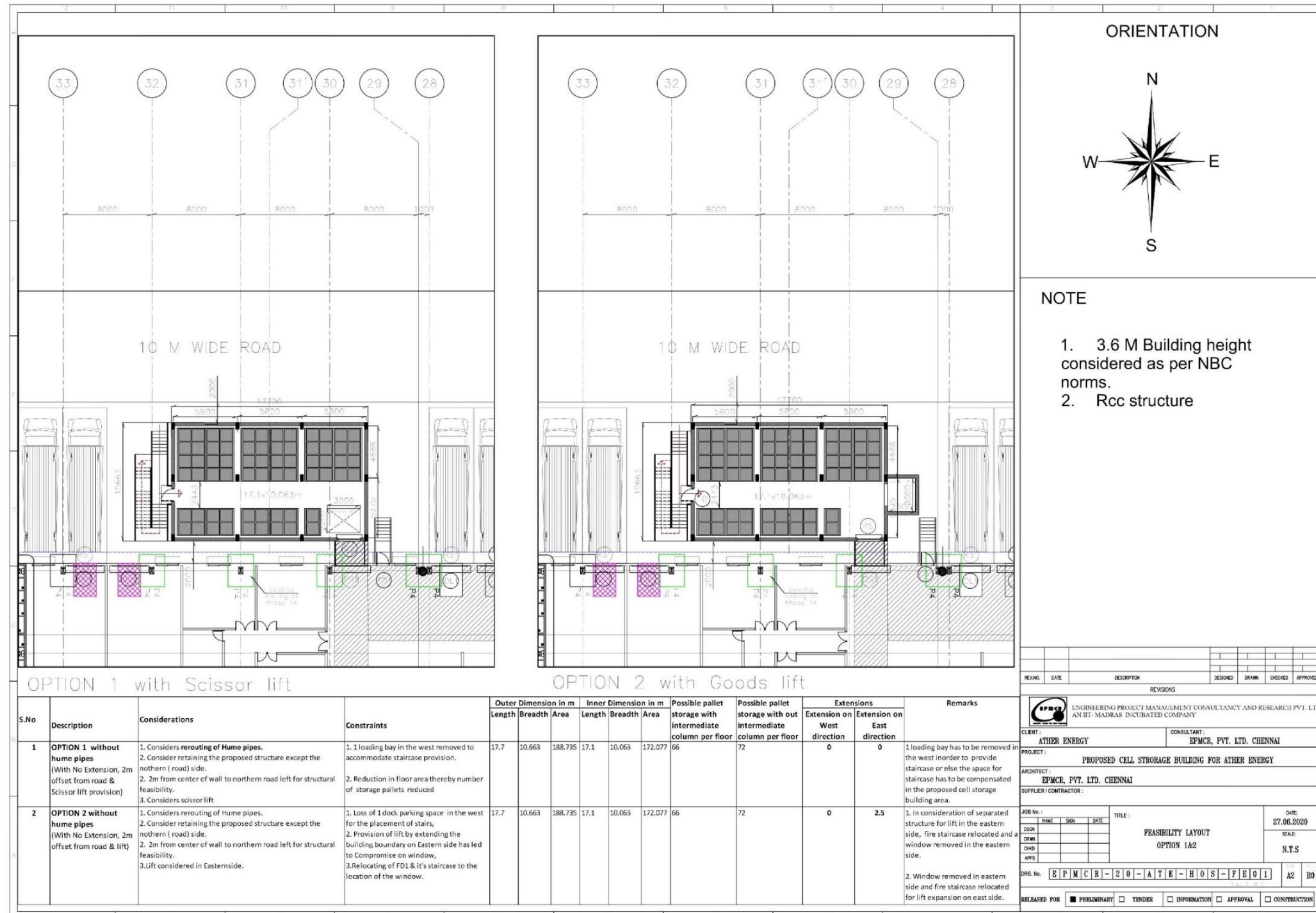
PROBLEM - CHALLENGES - SOLUTION			
S.NO.	PROBLEM TO BE SOLVED	CHALLENGES	SOLUTION
1	Location		
	Locating the building between road and factory	Footing interference	Check with Structural team and derive with possible options
		Fire engine access	Get opinion from firefighter
		Government regulations	To confirm with approval athority(Assumed as approved area)
2	Safety for Building and Battrey		
2.1	Safety against fire (Main concern- for which design evolves)		
2.1.1	Prevention of fire	Maintain ambient temperature. Humidity and pressure	Efficient HVAC design considending the door opening time also.
		Height of 1 floor to be 3.6 m with Air-conditioning & 3 m for non air-conditioning building	
		Explosion vent - 0.1 Sq. m. per 0.9 cu.m	
		Smoke & fire vent - minimum 1.25m	
		safe handling of battery	Methodology to be developed for efficient handling
		Natural Calamities	Earthquake: Shear wall Bracing system - wall Bracing of pallets Earthquake resistant structure. Flood: Proper rainwater drainage system Lightning Arrestor provision Proper Surge Arrestor & Earthing provision.
		Waste Battery Disposal	Dispose batteries through - E.Media bin / Online Chemical waste collection request

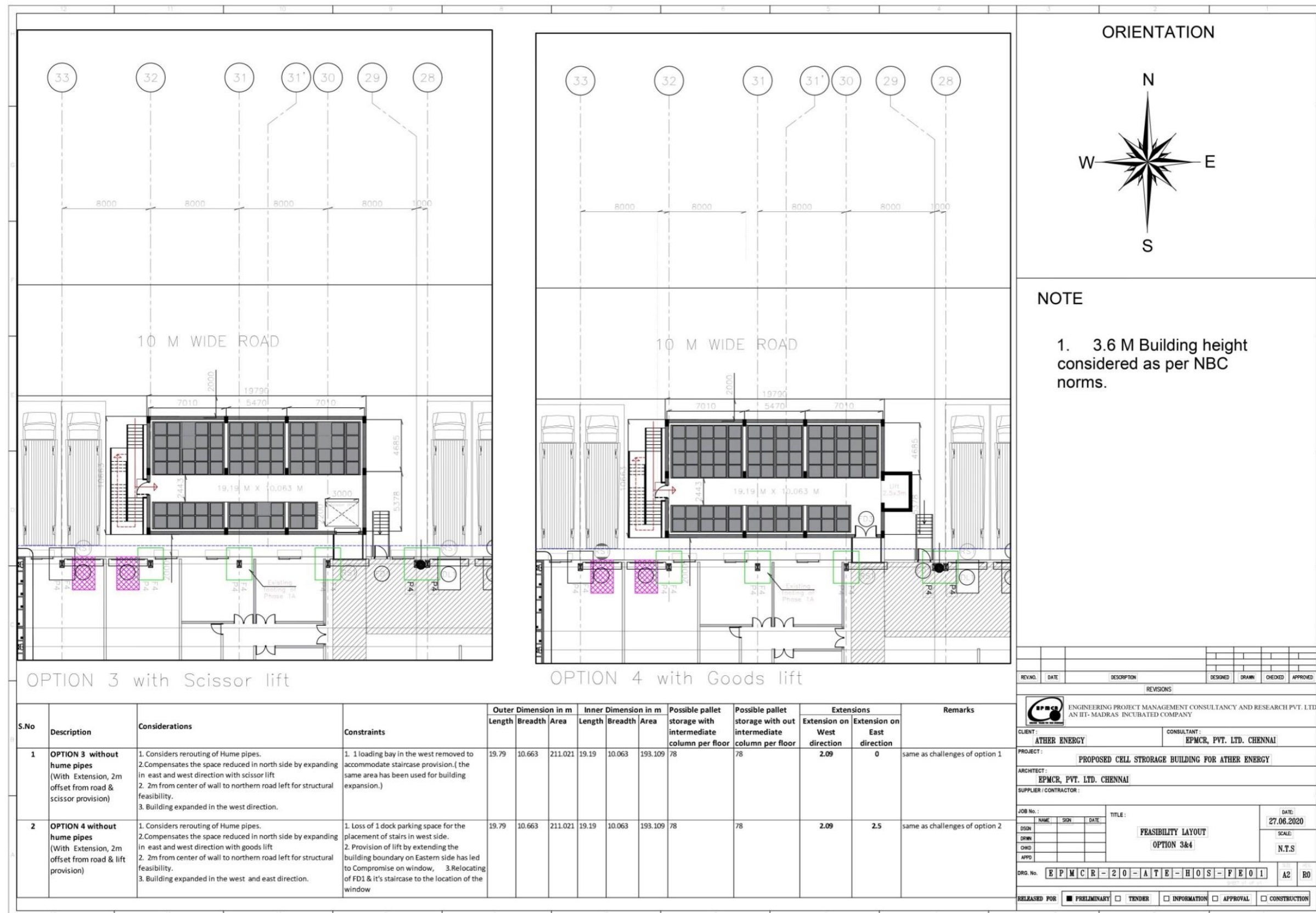
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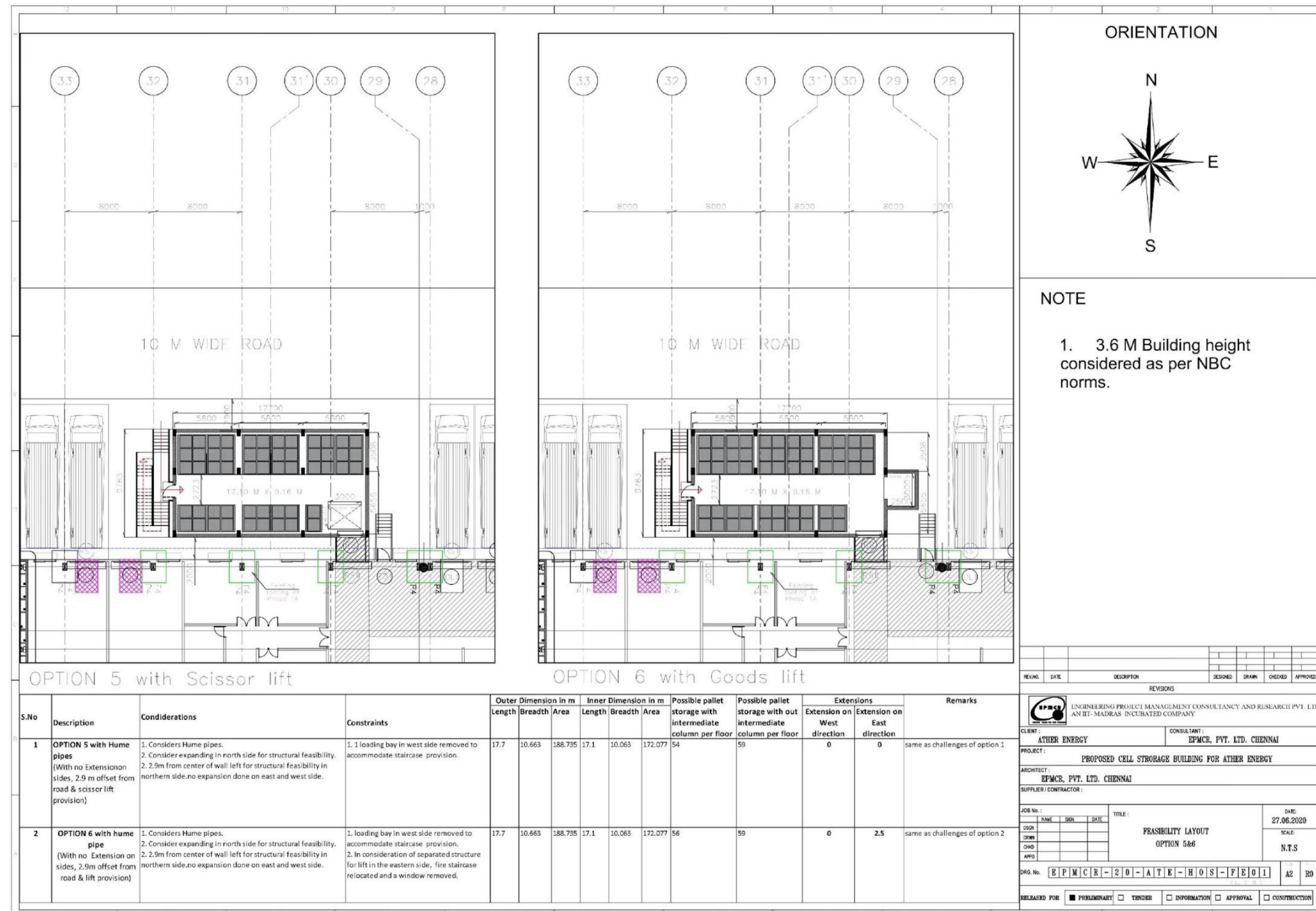
1.Efficient HVAC, exhaust, fire design with automation facilities shall lower the risk of fire outbreak (Temperature/humidity control monitoring, smoke detector linked with automated/manual exhaust vent, Dry/water sprinklers, Usage of fire rated materials)

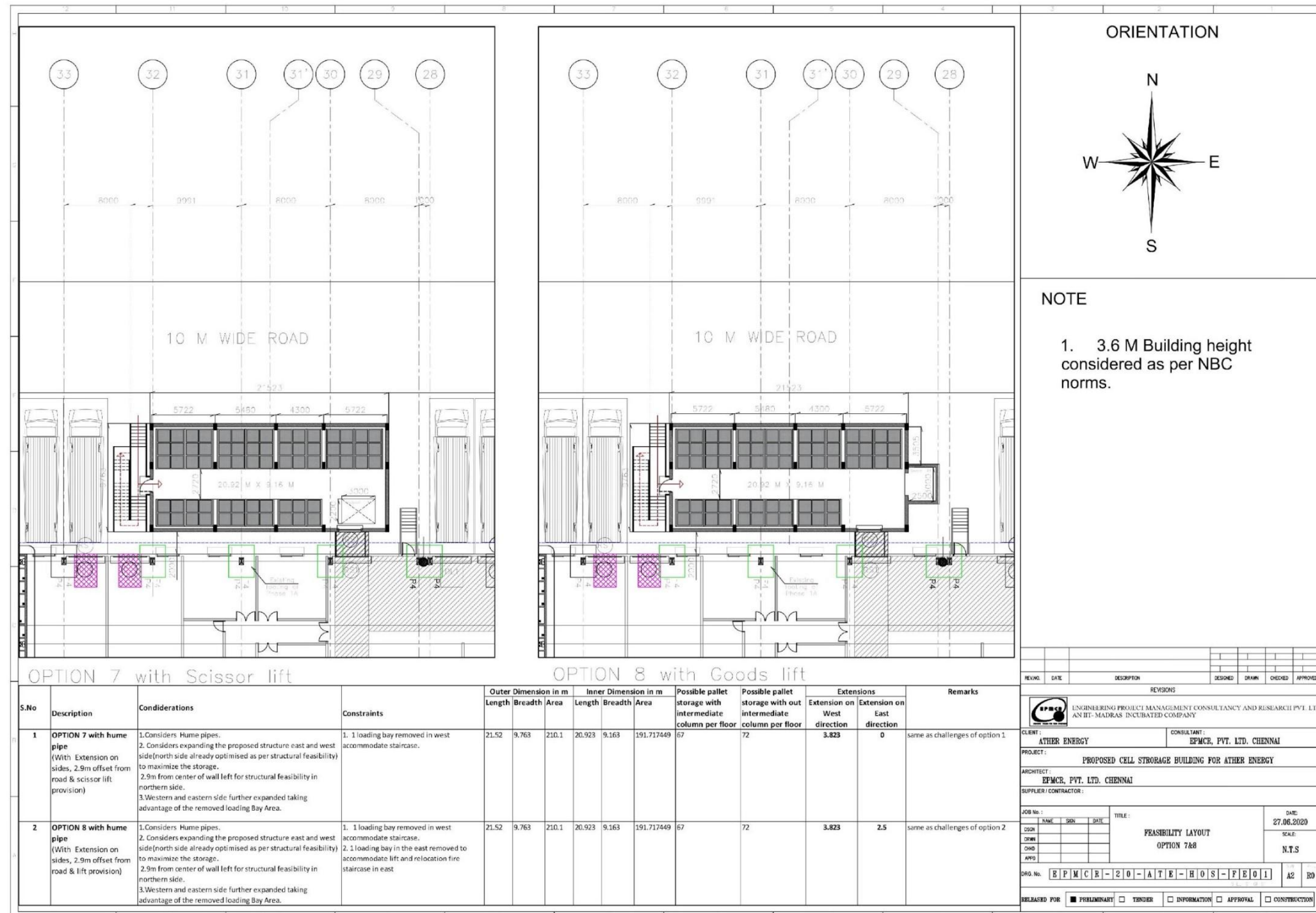
2. Calculation for the same has to be done

PROBLEM - CHALLENGES - SOLUTION			
S.NO.	PROBLEM TO BE SOLVED	CHALLENGES	SOLUTION
2.1.2	If Fire triggered/ Short Circuit happens within cells	Toxic fumes	Exhaust vent Smoke detectors linked with vents to automatic let out the fumes
		Triggering of other cells	Sprinkler - Dry/ water based on recommendations
			Fire resistive partitions between each pallets shall be provided which automatically/manually drops from ceiling.
2.1.3	If huge explosion happens	Safeguard the neighbourhood building and surrounding and the building itself	Fire resistant structures (wall, floors and ceilings)
		Avoid traveling to next floors	Proper sealing of openings to next floor to be ensured.
			Enable fire engine movement
2.2	Safety against theft	Man movement monitoring	Provision of CCTV camera surveillance facility
2.3	Protection against water	Canopy for bridge	Canopy with rain water drainage or gutter
		Lithium ion battery's reactivity towards water	Provision of spill containment
			Provision of floor trap for nominal slope of flooring
			Outdoor sump for sprinkler water collection
3	Access		
	At different levels	Area constraints	Lift, staircase, or any other
	At floor level	Man and machine movement, fire resistive	Sufficient wide opening door
		Cell inspection all around	Space for manual inspection
		Ease of access of loading/unloading machine	Provide sufficient corridor width & turning radius
4	Maximize storage	Footing may interfere	Increase in floor levels if possible confirm with structural team









COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
1	OPTION 1 without Hume pipes (With No Extension, 2m offset from road & Scissor lift provision)	1. Considers rerouting of Hume pipes. 2. Consider retaining the proposed structure except the northern (road) side. 3. 2m from center of wall to northern road left for structural feasibility. 4. Considers scissor lift	1. 1 loading bay in the west removed to accommodate staircase provision. 2. Reduction in floor area thereby number of storage pallets reduced	17.7	10.66	188.73	17.1	10.063	172.0773	66	72	0	0	1 loading bay has to be removed in the west in order to provide staircase or else the space for staircase has to be compensated in the proposed cell storage building area.

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
2	OPTION 2 without Hume pipes (With No Extension, 2m offset from road & lift)	1. Considers rerouting of Hume pipes. 2. Consider retaining the proposed structure except the northern (road) side. 3. 2m from center of wall to northern road left for structural feasibility. 4. Lift considered in Eastern Side.	1. Loss of 1 dock parking space for the placement of stairs, 2. Provision of lift by extending the building boundary on Eastern side has led to Compromise on window, 3. Relocating of FD1 & its staircase to the location of the window.	17.7	10.663	188.735	17.1	10.063	172.0773	66	72	0	2.5	1. In consideration of separated structure for lift in the eastern side, fire staircase relocated and a window removed in the eastern side. 2. Window removed in eastern side and fire staircase relocated for lift expansion on east side.

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
3	OPTION 3 without Hume pipes (With Extension, 2m offset from road & scissor provision)	1. Considers rerouting of Hume pipes. 2. Compensates the space reduced in north side by expanding in east and west direction with scissor lift 3. 2m from center of wall to northern road left for structural feasibility. 4. Building expanded in the west direction.	1. 1 loading bay in the west removed to accommodate staircase provision. (The same area has been used for building expansion.)	19.79	10.663	211.02077	19.19	10.063	193.10897	78	78	2.09	0	same as challenges of option 1

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
4	OPTION 4 without Hume pipes (With Extension, 2m offset from road & lift provision)	1. Considers rerouting of Hume pipes. 2. Compensates the space reduced in north side by expanding in east and west direction with goods lift 3. 2m from center of wall to northern road left for structural feasibility. 4. Building expanded in the west and east direction.	1. Loss of 1 dock parking space for the placement of stairs in west side. 2. Provision of lift by extending the building boundary on Eastern side has led to Compromise on window, 3. Relocating of FD1 & its staircase to the location of the window	19.79	10.663	211.02077	19.19	10.063	193.10897	78	78	2.09	2.5	same as challenges of option 2

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
5	OPTION 5 with Hume pipes (With no Extension On sides, 2.9 m offset from road & scissor lift provision)	1. Considers Hume pipes. 2. Consider expanding in north side for structural feasibility. 3. 2.9m from center of wall left for structural feasibility in northern side.no expansion done on east and west side.	1. 1 loading bay in west side removed to accommodate staircase provision.	17.7	10.663	188.7351	17.1	10.063	172.0773	54	59	0	0	same as challenges of option 1

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT

	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
6	OPTION 6 with hume pipe (With no Extension on sides, 2.9m offset from road & lift provision)	1. Considers Hume pipes. 2. Consider expanding in north side for structural feasibility. 3. 2.9m from center of wall left for structural feasibility in northern side.no expansion done on east and west side.	1. loading bay in west side removed to accommodate staircase provision. 2. In consideration of separated structure for lift in the eastern side, fire staircase relocated and a window removed.	17.7	10.663	188.7351	17.1	10.063	172.0773	56	59	0	2.5	same as challenges of option 2

COMPARISON - LAYOUT OPTIONS

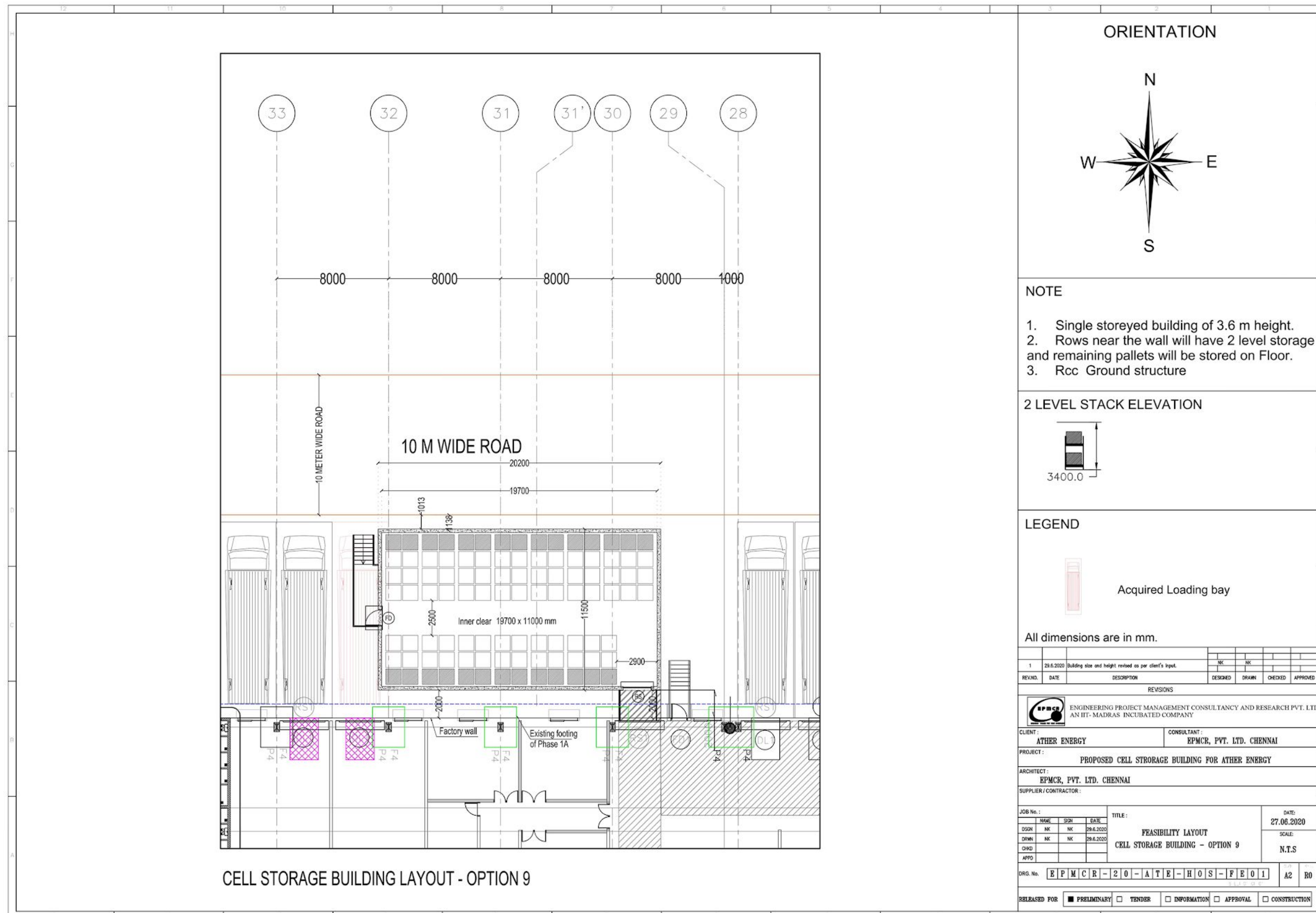
FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT														
	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
7	OPTION 7 with hume pipe (With Extension on sides, 2.9m offset from road & scissor lift provision)	1. Considers Hume pipes. 2. Considers expanding the proposed structure east and west side(north side already optimised as per structural feasibility) to maximize the storage. 3. 2.9m from center of wall left for structural feasibility in northern side. 4. Western and eastern side further expanded taking advantage of the removed loading Bay	1. 1 loading bay removed in west accommodate staircase.	21.52	9.763	210.09976	20.923	9.163	191.717449	67	72	3.823	0	same as challenges of option 1

COMPARISON - LAYOUT OPTIONS

FEASIBILITY FOR VARIOUS OPTIONS OF LAYOUT														
	Description	Considerations	Constraints	Outer Dimension in m			Inner Dimension in m			Possible pallet storage with intermediate column per floor	Possible pallet storage without intermediate column per floor	Extensions		Remarks
				Length	Breadth	Area	Length	Breadth	Area			Extension on West direction	Extension on East direction	
8	OPTION 8 with Hume pipe (With Extension on sides, 2.9m offset from road & lift provision)	1.Considers Hume pipes. 2. Considers expanding the proposed structure east and west side(north side already optimised as per structural feasibility) to maximize the storage. 3. 2.9m from center of wall left for structural feasibility in northern side. 4. Western and eastern side further expanded taking advantage of the removed loading Bay	1. 1 loading bay removed in west to accommodate staircase. 2. 1 loading bay in the east removed to accommodate lift and relocation fire staircase in east	21.52	9.763	210.09976	20.923	9.163	191.717449	67	72	3.823	2.5	same as challenges of option 2



FINALISED LAYOUT OPTION





ATHER ENERGY CELL STORAGE BUILDING, BANGALORE - WBS & PROJECT SCHEDULE

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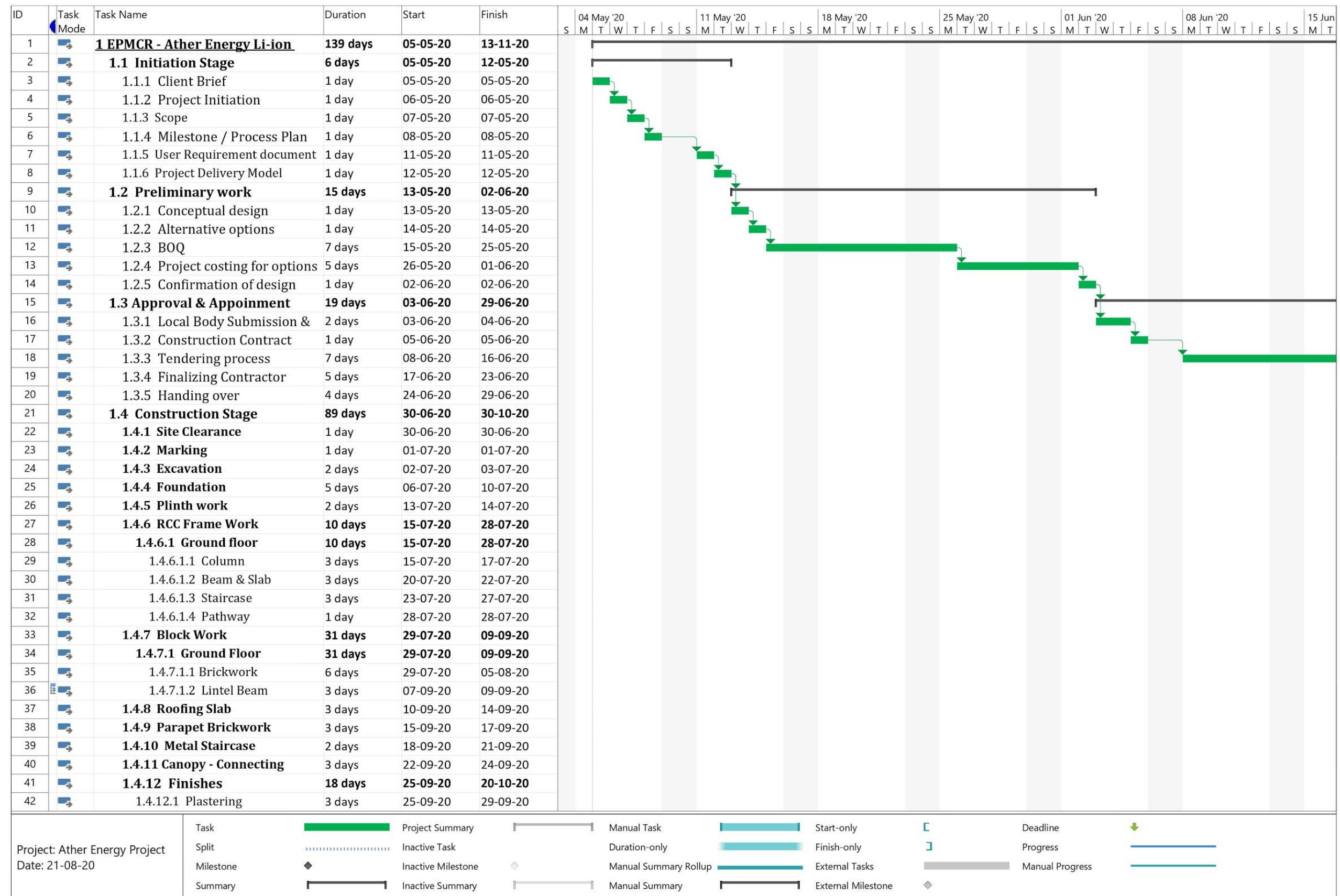
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CIVIL WORK:

- | | | |
|--|---|--|
| <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 |
|--|---|--|

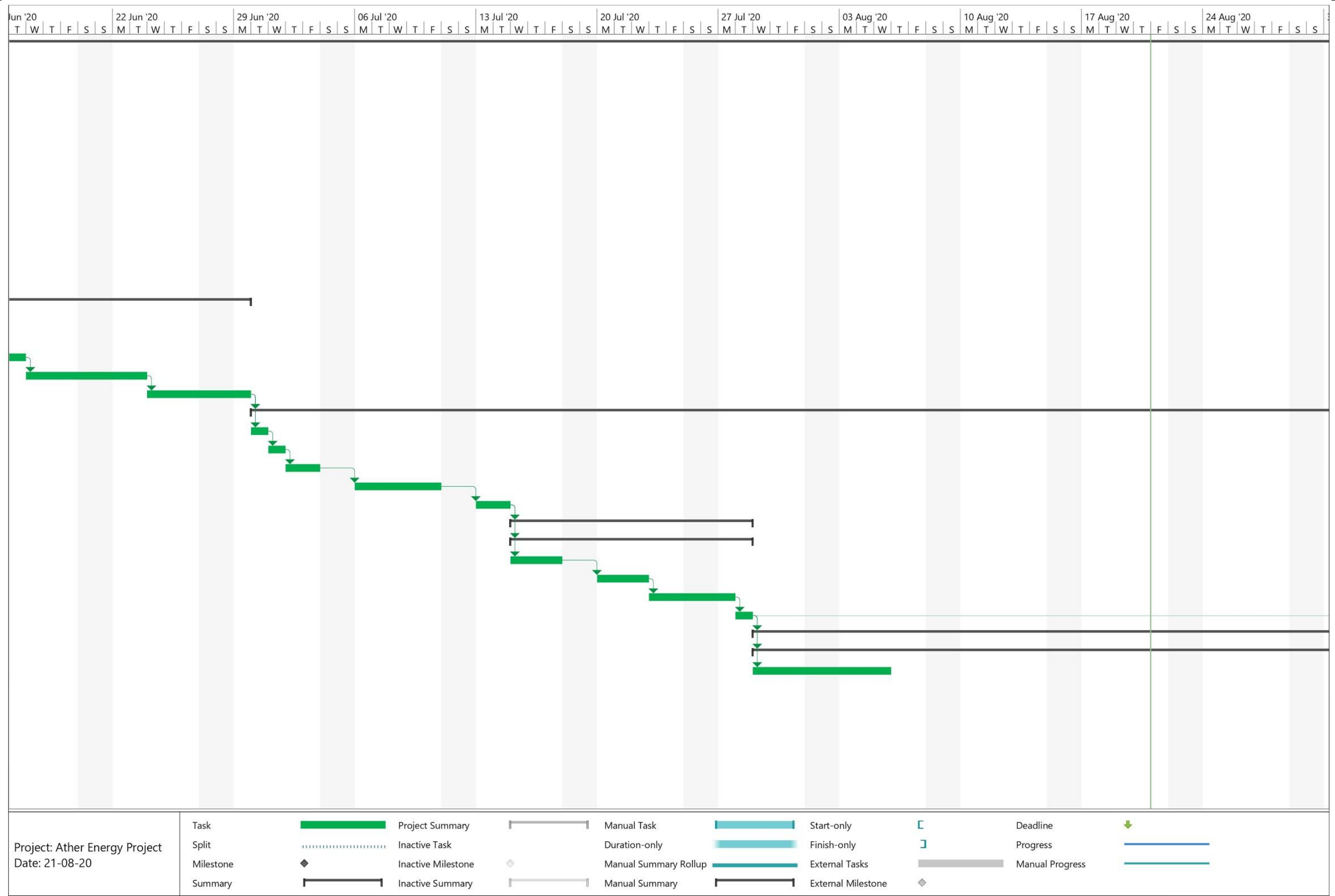
HEADING: ATHER ENERGY CELL STORAGE BUILDING, BANGALORE - PROJECT SCHEDULE

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HEADING: ATHER ENERGY CELL STORAGE BUILDING, BANGALORE - PROJECT SCHEDULE

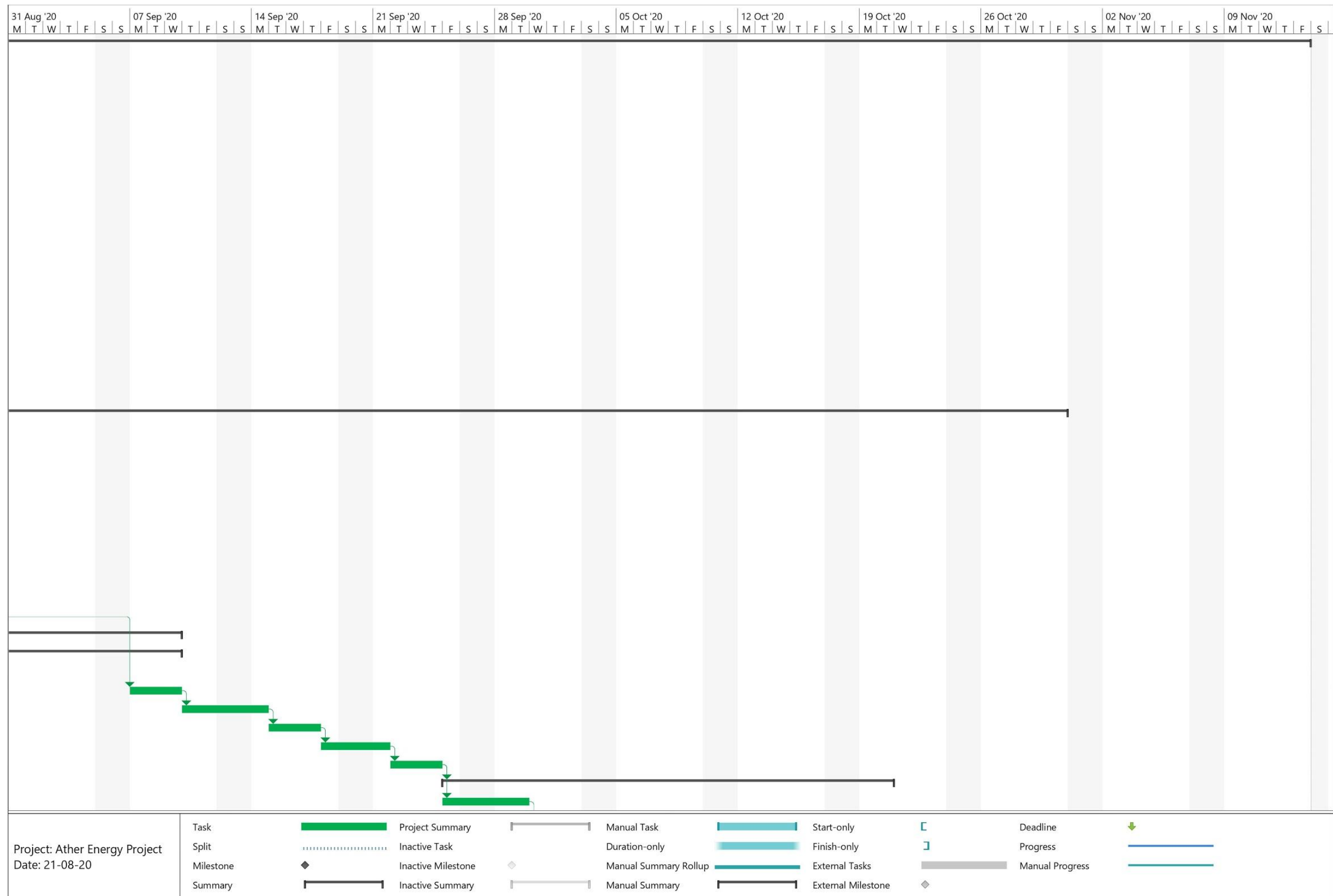
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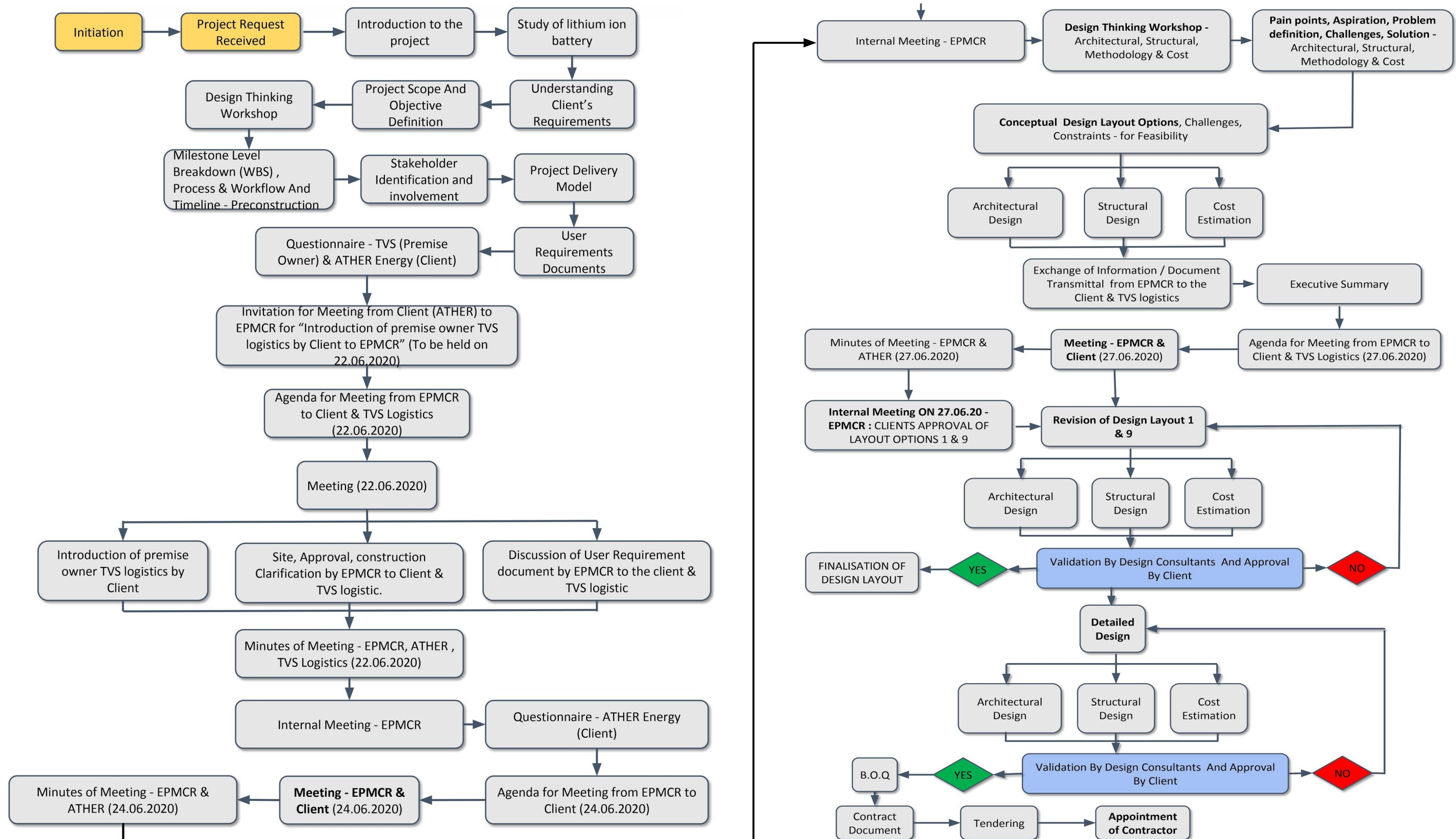
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HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- PRE-CONSTRUCTION PHASE - FLOW CHART

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ATHER ENERGY FACTORY BUILDING , HOSUR - FALSE CEILING & INTERIOR PARTITION

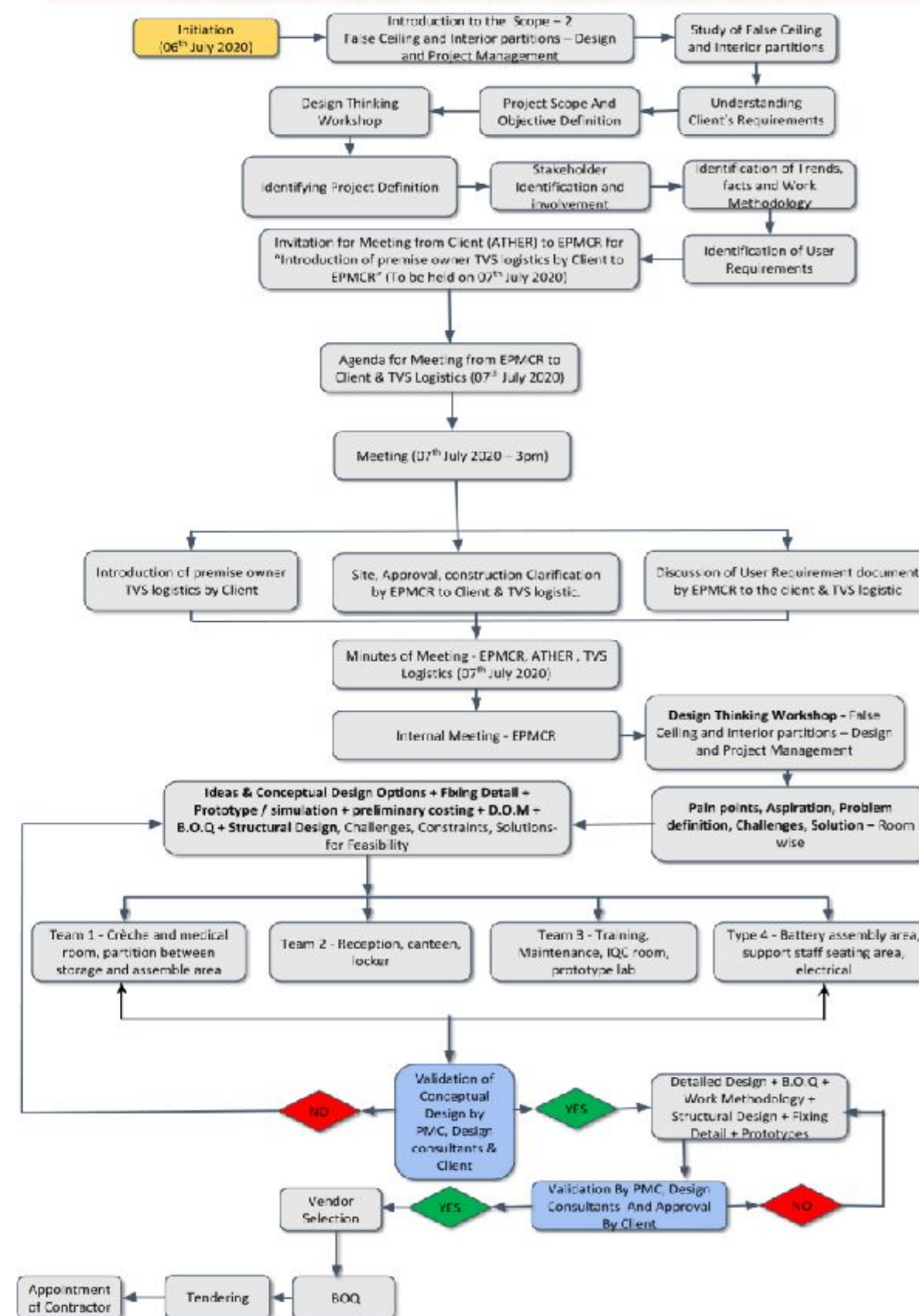
FALSE CEILING & PARTITION WALL FOR ATHER ENERGY FACTORY BUILDING

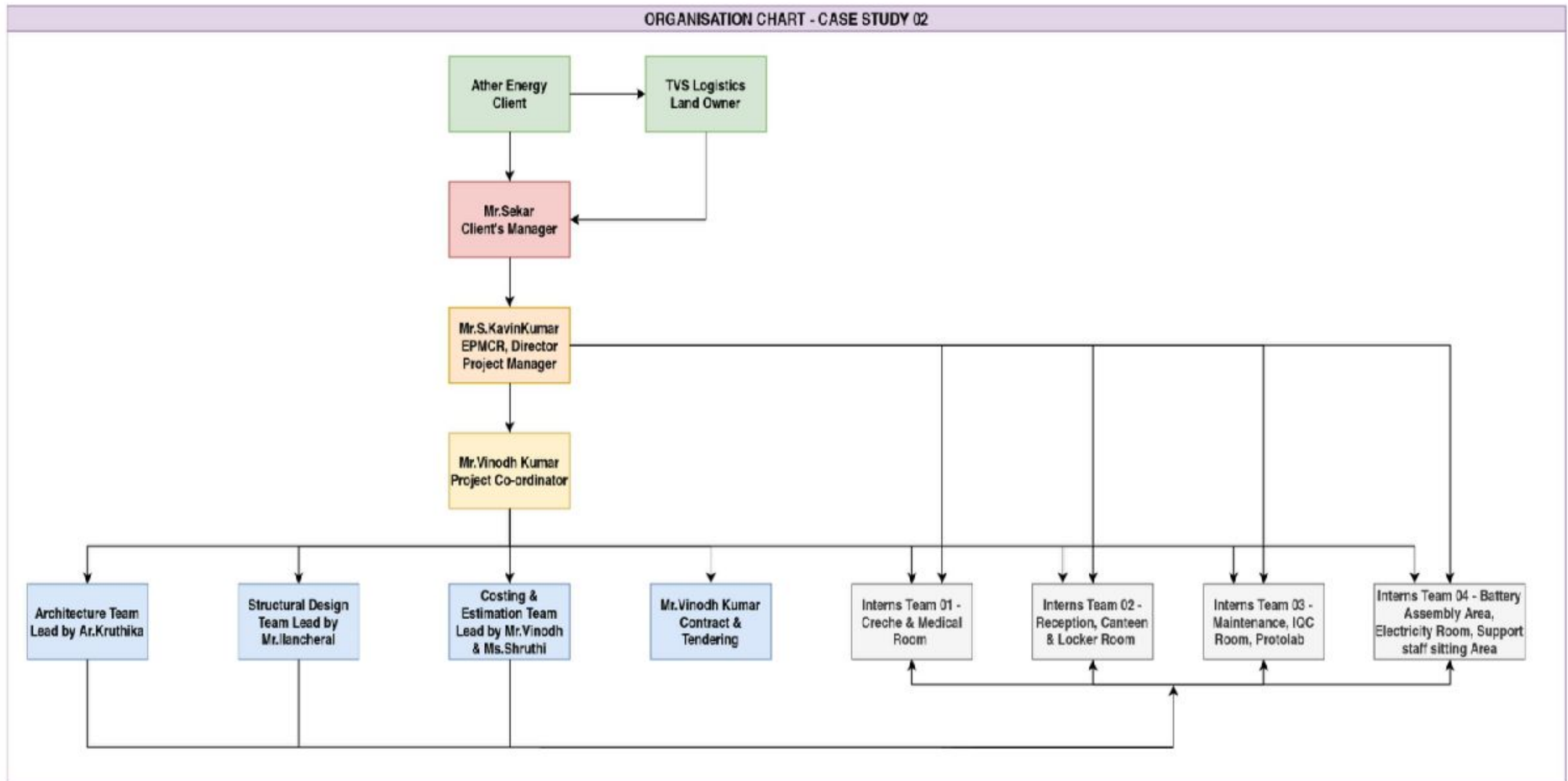
- **PROJECT:** FALSE CEILING & PARTITION WALL FOR ATHER ENERGY FACTORY BUILDING
- **TPOLOGY:** INDUSTRIAL BUILDING
- **LOCATION:** HOSUR, TAMILNADU, INDIA
- **CLIENT:** ATHER ENERGY
- **LAND OWNER:** TVS LOGISTICS
- **CONTRACT TYPE:** DESIGN BUILT (DB)
- **PROJECT MANAGEMENT CONSULTANT:** EPMCR, CHENNAI
- **PROJECT MANAGEMENT SYSTEM:** LEAN PROCESS & MANAGEMENT SYSTEM
- **ARCHITECT:** EPMCR, CHENNAI
- **STRUCTURAL CONSULTANT:** EPMCR, CHENNAI
- **COSTING & ESTIMATION:** EPMCR, CHENNAI
- **CONTRACT & BIDDING :** EPMCR, CHENNAI
- **MEP CONSULTANT:** OUT SOURCING
- **PROJECT START DATE:** JUNE 2020
- **PROJECT EXPECTED CLOSE DATE:** NOVEMBER 2020

AIM & RESULTS:

- To design False ceiling & Partition for Ather Energy at the factory building which is a PEB Building and is leased from TVS Logistics at Hosur, Bangalore.
- The Building Height is 14 meters & support for false ceiling and partition wall can not be taken from existing roof & wall structure, to reduce material wastage, reduce cost & to avoid the additional load that acts on wall & existing foundation.
- As it is temporary structure which has to be relocated to some other site if client needs so in future and to complete the project with in short span of time along with the needs high protection and safety measures owing to its hazardous level
- Lean Practices, such as LPS, Evidence Based Design, TVD, Set Based Design, A3 Design Thinking, collaboration & cross function activities undergone by, PMC, Architect, Structural, Costing team and interns along with regular interaction with client on daily basis.
- Cost was main constraint along with choice of building material to be used for false ceiling & partition for individual spaces as each spaces has different requirements in terms of Acoustics insulation, thermal insulation, fire resistance, water proofing, Aesthetics & Certain room has heavy equipment which requires special thermal insulation.
- North side of building – High Fire resistance (4hrs) ; High thermal, Acoustics & Water proofing Required – Therefore they are opted with Calcium Silicate board Partition & False ceiling
- South side of building – Less Fire resistance (2hrs) ; less thermal, Acoustics & Water proofing Required – Therefore they are opted with Fibre cement board Partition & False ceiling
- Supports are taken from floor & Introducing Steel Columns & Beams for partition & false ceiling

FALSE CEILING AND INTERIOR PARTITIONS - PROJECT PROCESS FLOW CHART





ATHER ENERGY - FALSE CEILING:

DEFINITION, LOCATION, DIMENSION, STAKEHOLDERS, FEASIBILITY, CHALLENGES, ASPIRATION, MATERIAL FEASIBILITY, TRENDS & TECHNOLOGIES

PROBLEM DEFINITION:

1. Identification of right false ceiling material and **assembly system** that can provide Cost-effectiveness, fire safety, Structural Safety, aesthetics, comfort (Lighting, Thermal, and acoustics).and unique identity for the place.
2. Providing Structural support for the false ceiling & Utilities above and below the false ceiling at 3.6m height with the PEB roof at 14m height.
3. providing access for maintaining utilities above a false ceiling.
4. The false ceiling material and assembly system shall be suitable for dismantling & reused in other buildings.
5. The false ceiling material shall be energy efficient & eco friendly.
6. The internal partitions are required to separate the work zones based on functionality.
7. Identification of the suitable dimension (thickness) of the internal partition wall to be considering the activities inside the partition area.
8. Identification of suitable material for interior partition walls and **assembly system** which can provide structural, chemical and fire safety, transparency/opaqueness, comfort(Lighting, Temperature, ventilation, and acoustics) and aesthetics.
9. Identification of the interior partition walls which can give access and monitor the outside activity within the room.
10. Identification of the interior partition walls which can give access and private space for activities inside the building.
11. Identification of suitable structural framing system (assembly) for providing structural support for internal partition wall considering the self-weight, live loads, suspension loads, impact loads, etc
12. Consideration of false ceiling and internal partitions loads in the PEB structure and Civil structure design.

STAKEHOLDER LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY:

A. INTERNAL STAKEHOLDERS:

- Ather Energies Top Management
- Ather Energy Operation Manager
- Ather Energy Staff
- TVS Logistics
- Interior Designer
- EPMCR
 - Project Manager (PMC)
 - Structural Consultant
- False Ceiling Consultant
- HVAC Consultant
- Mechanical Electrical and Plumbing Consultant
- Fire Consultant
- Accountant.
- Site Office Manager
- Civil Contractors
- Maintenance workers
- Interior Contractor
- Sub Contractors
- Labors
- Manufacturers
- Vendors:
 - Gypsum False ceiling Vendors
 - Metal false Ceiling
 - PVC false ceilings
 - Steel contractor,
 - Interior contractor
 - UPS Vendors
 - Electrical Vendors
 - Lighting Vendors
- Security
- Transport / Logistics
- Financier
- Material / Equipment Suppliers
- GYPSUM
- PUF
- CALCIUM SILICATE
- STEEL SUPPLIER
- POP
- PVC

B. EXTERNAL STAKEHOLDERS:

- TVS Logistics
- Public Utilities
- Technical Institutes
- Special Interest Groups
- Marketing
- Customers of Ather Energy
- Visitors of Ather Energy
- Suppliers
- Vendors
- Subcontractor
- Industrial safety
- Fire Department
- General Public
- Other Competitors

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 OF FALSE CEILING , DIMENSION , FEASIBLE MATERIAL , ASPIRATIONS & CHALLENGES:

LEGEND:

- Green - feasible - Client requirement
- Blue - optional - Not in Client Requirement
- Yellow - Not Feasible - Client Requirement

LOCATION / ROOM	SIZE			False Ceiling Type
	L	B	H	
Creche	7.4	6.92	3.5	Gypsum / PUF
Toilet block with in Creche	2.8	1.5	3.5	Gypsum / PUF
Medical Room	7.4	6.87	3.5	Gypsum / PUF
Toilet Block with in Medical Room	2.8	1.5	3.5	Gypsum / PUF
Receptions & seating area	9.8	11.9	3.5	Gypsum / PUF
Conference room 1	4.62	2.95	3.5	Gypsum / PUF
Conference room 2	4.6	4.9	3.5	Gypsum / PUF
Canteen/washing area	23.8	12.1	3.5	Gypsum / PUF
Training Cell	7.1	12.1	3.5	Gypsum / PUF
Maintenance Cell	6.6	12.1	3.5	Gypsum / PUF
IQCAREA	12.81	12.1	3.5	Gypsum / PUF
Salt Spraying Room	6.5	5.61	3.5	Gypsum / PUF
Electrical Lab	3.5	6.2	3.5	Gypsum / PUF
CMM Room	6.1	5.6	3.5	Gypsum / PUF
Calibration Room	6.1	4.08	3.5	Gypsum / PUF
MFG & Support Staff Seating Area	4	11.57	3.5	Gypsum / PUF
Battery Vehicle Area	68.75	18.17	3.5	Gypsum / PUF / Metal
Re-work& Repair Battery FG	11.19	19.13	3.5	Gypsum / PUF / Metal
Battery Cycle Area Phase-1	8.6	4	3.5	Gypsum / PUF / Metal
Battery Humidity Chamber -1	3.4	4	3.5	Gypsum / PUF / Metal
Battery Cycle Area Phase-2	8.6	4	3.5	Gypsum / PUF / Metal

Aspiration for Green:

1. Good ambience & Comfort
2. Accident safe
3. Use of reusable Material - Can be able to dismantle
4. Fire & hazard protection
5. Health & life safety
6. fire compartmentalisation
7. Thermal insulation
8. Sound insulation
9. Quality & Cost Efficient
10. Lightweight
11. Energy Efficiency
12. Good Hospitality
13. Pleasant & Welcoming
14. Functional
15. Self Directing
16. Comfortable work area
17. Maintenance & Accessibility for Utility & Service line

Challenges For Green:

1. Faster construction and easy customization
2. Height of the Building - 14, While Height of false ceiling - 3.6 m FFL
3. The Structural support for False ceiling at 3.6m FFL to be taken from Column, Partition, PEB structure & concrete floor
4. Maintenance of utility & Service Line - Trap Door
5. Supporting structure for false ceiling to support the utility lines
6. Thermal & Sound insulation
7. Cost control
8. false ceiling material can be dismantled & reused in other buildings.
9. Identification of right Material

Aspiration for Yellow:

1. Good ambience & Comfort
2. Accident safe
3. Use of reusable Material - Can be able to dismantle
4. Fire & hazard protection
5. Health & life safety
6. fire compartmentalisation
7. Thermal insulation
8. Sound insulation
9. Quality & Cost Efficient
10. Lightweight
11. Energy Efficiency
12. Good Hospitality
13. Pleasant & Welcoming
14. Functional
15. Self Directing
16. Comfortable work area
17. Maintenance & Accessibility for Utility & Service line

Challenges For Yellow:

1. Faster construction and easy customization
2. Height of the Building - 14, While Height of false ceiling - 3.6 m FFL
3. The Structural support for False ceiling at 3.6m FFL to be taken from Column, Partition, PEB structure & concrete floor
4. Maintenance of utility & Service Line - Trap Door
5. Supporting structure for false ceiling to support the utility lines
6. Thermal & Sound insulation
7. Cost control
8. false ceiling material can be dismantled & reused in other buildings.
9. Identification of right Material
10. Accidents due assembling of batteries to be taken care
11. Welding & Electrical Area to be taken care

FALSE CEILING MATERIAL FEASIBILITY OPTIONS:

False Ceiling Material	Cost	Fire Resistant	Light weight, Life Span & High Strength	Access & Ease to fix / Detachable	Thermal Comfort & Weather Proof	Sound Insulation	Maintenance	Ease of Installation	Eco Friendly
1. Gypsum		2 - 4 HRS							
2. PUF (Polyurethane foam) Panel		2 - 4 HRS							
3. Plaster Of Paris									
4. Wooden									
5. Glass									
6. Metal	Low & high	2 - 4 HRS							
7. Fiber									
8. PVC								Small ht.	Cl2 release

LEGEND:

	MOST FEASIBLE
	CAN BE CONSIDERED
	VULNERABLE

MOST FEASIBLE MATERIAL - GYPSUM & PUF PANEL

FACTS

- Fire protection (high quality gypsum can withstand upto 4 hrs fire rating)
- Thermal Insulator (helps in keeping the room cooler)
- Sound insulation (only when gypsum mixed with raw materials like rockwool)
- Light weight (gypsum board are lightweight compared to other materials)
- Vision Panels; Faster construction and easy customization
- Height of false ceiling - 3.5 m FFL
- Height of Building ceiling - 14 m FFL
- Supporting structure for false ceiling to support the utility lines
- The support has to be taken from PEB structure & concrete floor

TRENDS & TECHNOLOGIES

- PUF panels; Gypsum FRMR Board (Fire & Moisture resistant)
- Fireline Board; Passive fire protection
- A hydrated sulphate of calcium, **gypsum** - it is lightweight, **fire-resistant**.
- Glass False Ceiling; POP false ceiling - Fire Rated
- Duct; Duct Hangers & Supporting system
- Cable Support System- Trunking system
- Cable tray - Ladder, Perforated , Solid, Wire Mesh, Channel
- Hook, Retaining Clip, Hanger wire, Angles & Tees
- Fire Protection & Safety- Sprinkler, Fire Alarm & Detectors, etc

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

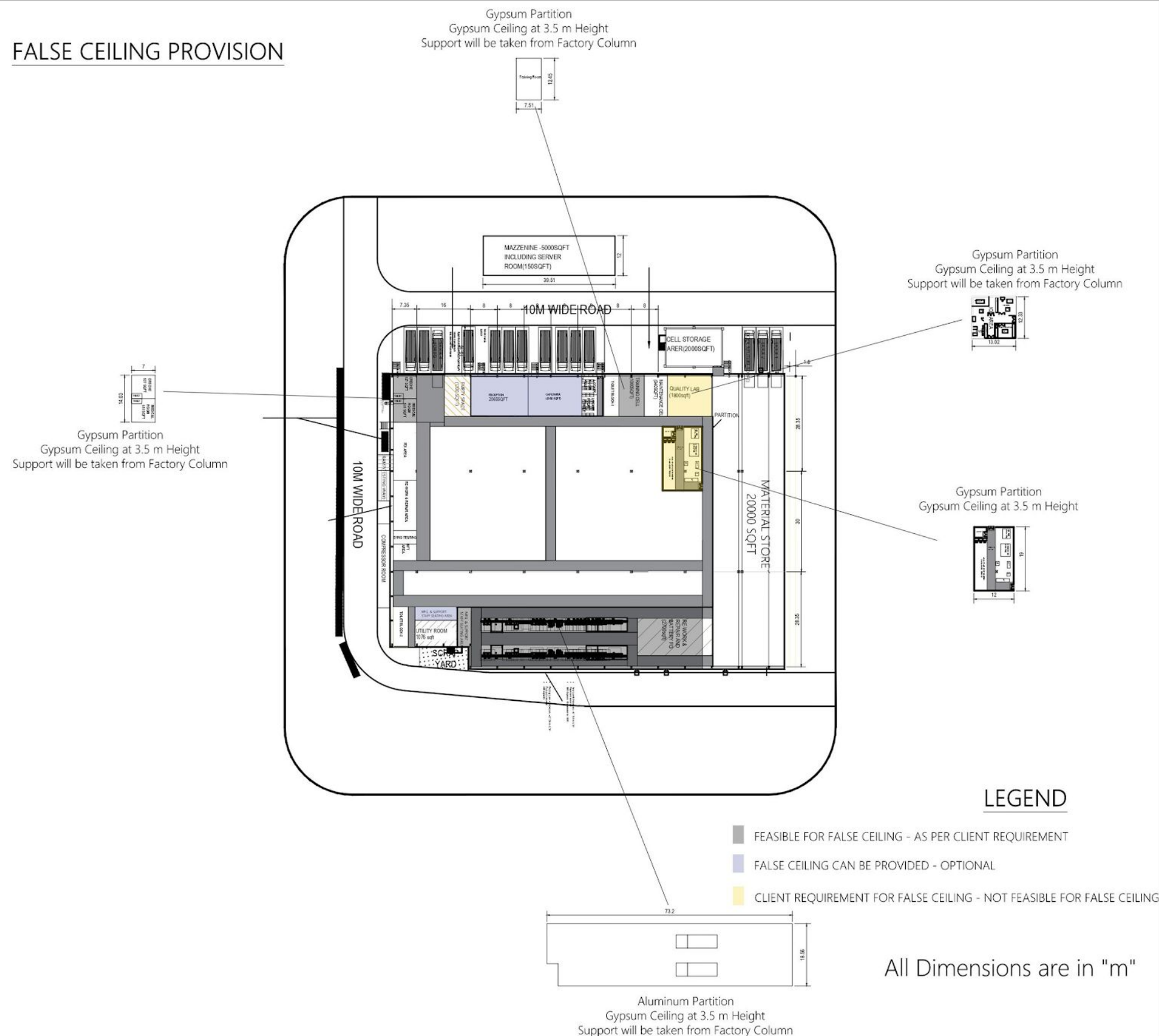


HEADING:LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Internal Partition Walls & False ceiling - Client Requirement

Page No.: 71

LOCATION / ROOM	SIZE			HANGING LOADS ON WALL (fire extinguisher, other pls specify)	VENTILATION TYPE	TEMPERATURE	ACCOUSTICS	ACCESS, SAFETY & SECURITY (STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING)	MONITORING CONTROL (OPAQUE WALL OR TRANSPARENT WALL	PARTITION		FALSE CEILING		PROVISIONS FOR FALSE CEILING			
	L	B	H							REQUIRED/ NOT	TYPE OF PARTITION WALL PREFERRED	REQUIRED/ NOT	TYPE OF FALSE CEILING PREFERRED	TEMPERATURE	ACCOUSTICS	HVAC - DUCTING	ELECTRICAL
Creche	7.4	6.92	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, VANDALISM, EAVES DROPPING	Transparent	YES	Dry-Wall + Vision Panel	YES	Gypsum/ PUF	Yes	No	YES	YES
5.1 Toilet block within creche	2.8	1.5	3.5	No	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, EAVES DROPPING	Opaque	No		YES	Gypsum/ PUF	Yes	No	YES	YES
Medical room	7.4	6.87	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, VANDALISM, EAVES DROPPING	Transparent + Opaque	YES	Dry-Wall + Vision Panel	YES	Gypsum/ PUF	Yes	No	YES	YES
7.1 Toilet block within Medical Room	2.8	1.5	3.5	No	Natural Ventilation, HVAC	Yes	No	STRUCTURAL,EAVES DROPPING	Opaque	No		YES	Gypsum/ PUF	Yes	No	YES	YES
Receptions & seating area	9.8	11.9	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Transparent	YES	Dry-Wall + Vision Panel	Optional	Gypsum/ PUF	Yes	No	YES	YES
9.1 Conference room 1	4.62	2.95	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, EAVES DROPPING	Opaque	YES	Dry-Wall	No	NA	NA	NA	NA	NA
9.2 Conference room 2	4.6	4.9	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, EAVES DROPPING	Opaque	YES	Dry-Wall	No	NA	NA	NA	NA	NA
Canteen/washing area	23.8	12.1	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	Dry-Wall	No	NA	NA	NA	NA	NA
Locker Room - Female	5.32	6.5	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	Dry-Wall	No	NA	NA	NA	NA	NA
Locker Room - Male	5.32	5.39	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	Dry-Wall	No	NA	NA	NA	NA	NA
Training Cell	7.1	12.1	3.5	Yes	Natural Ventilation, HVAC	Yes	Yes	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Opaque	YES	Dry-Wall	YES	Gypsum/ PUF	Yes	Yes	YES	YES
Maintenance Cell	6.6	12.1	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	Optional	Gypsum/ PUF	No	No	YES	YES
IQC AREA	12.81	12.1	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Opaque	YES		YES	Gypsum/ PUF	Yes	No	YES	YES
17.1 Salt Spraying Room	6.5	5.61	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Opaque	YES	Acid-proof Brick	YES	Gypsum/ PUF	Yes	No	YES	YES
17.2 Electrical Lab	3.5	6.2	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, Theft, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum/ PUF	Yes	No	YES	YES
17.3 CMM Room	6.1	5.6	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum/ PUF	Yes	No	YES	YES
17.4 Calibration Room	6.1	4.08	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum/ PUF	Yes	No	YES	YES
Proto Lab Area	11.54	18.75	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES		NO	NA	NA	NA	NA	NA
22.1 CMM Room	3.52	2.95	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	NO	NA	NA	NA	NA	NA
Re-work & Repair Battery FG	11.19	19.13	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum / PUF / Metal	Yes	No	YES	YES
Battery Cycle Area Phase-1	8.6	4	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum / PUF / Metal	Yes	No	YES	YES
Battery Humidity Chamber -1	3.4	4	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum / PUF / Metal	Yes	No	YES	YES
Battery Cycle Area Phase-2	8.6	4	3.5	Yes	Natural Ventilation, HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum / PUF / Metal	Yes	No	YES	YES
Electrical Panel Room	12.54	7.5	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Transparent+Opaque	YES	AAC + Vision Panel	No	NA	NA	NA	NA	NA
MFG. & Support Staff seating	4	11.57	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Transparent	YES	Dry-Wall + Vision Panel	No	NA	NA	NA	NA	NA
MFG. & Support Staff seating -2	12.34	3.99	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Transparent	YES	Dry-Wall + Vision Panel	No	NA	NA	NA	NA	NA
Compressor Room	4.55	17.63	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	YES	AAC	YES	Gypsum / PUF	Yes	No	YES	YES
Vehicle FG Area	34.1	39.62	3.5	Yes	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Transparent	YES	Dry-Wall	No	NA	NA	NA	NA	NA

FALSE CEILING PROVISION



HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Internal Partition Walls & False ceiling - SOLUTION

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LOCATION / ROOM	SIZE			CHALLENGES / ASPIRATIONS	VENTILATION	TEMPERATURE	ACCOUSTICS	ACCESS, SAFETY & SECURITY (STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVESDROPPING)	MONITORING CONTROL (OPAQUE WALL OR TRANSPARENT WALL	TYPE OF PARTITION WALL PREFERRED	TYPE OF FALSE CEILING PREFERRED
	L	B	H								
Creche	7.4	6.92	3.5	1. Safety 2. Monitoring the creche 3. Accoustical proof - Noise control 4. Thermal control 5. Comfort 6. Interference of equipmemts and utilities	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall + Vision Panel	Gypsum/ PUF
Medical room	7.4	6.87	3.5	1. Easy maintainace walls 2. Acoustical and thermal control 3. Cost-efficient 4. Privacy for checkups 5. Visible to check doctor availability	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, EAVES DROPPING	Transparent	Dry-Wall + Vision Panel	Gypsum/ PUF
Receptions & seating area	9.8	11.9	3.5	1. Ambience 2. Comfort 3. Accostical and thermal control 4. Maintainace	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall + Vision Panel	Gypsum/ PUF
Confrence room 1	4.62	2.95	3.5	1. Acoustical and thermal control. 2. Safety 3. Comfort	Natural Ventilation,HVAC	Yes	No	STRUCTURAL,EAVES DROPPING	Opaque	Dry-Wall	Gypsum/ PUF
Confrence room 2	4.6	4.9	3.5	1. Acoustical and thermal control. 2. Safety 3. Comfort	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall	Gypsum/ PUF
Canteen/washing area	23.8	12.1	3.5	1. Cost-efficient 2. Easy maintenance	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, EAVES DROPPING	Opaque	Dry-Wall	No
Cafetaria	23.8	9.1	3.5								
Locker Room - Female	5.32	6.5	3.5	1. Ambience 2. Comfort 3. Cost-efficient 4. Easy maintainace	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, EAVES DROPPING	Opaque	Dry-Wall	No
Locker Room - Male	5.32	5.39	3.5	1. Safety 2. Comfort	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	Dry-Wall	No
Training Cell	7.1	12.1	3.5		Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	No
Maintenance Cell	6.6	12.1	3.5	1. Acoustical and thermal control.	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Opaque	AAC	No
IQC AREA	12.81	12.1	3.5		Natural Ventilation,HVAC	Yes	Yes	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque		Gypsum/ PUF
15.1 Salt Spraying Room	6.5	5.61	3.5	1. Safety 2. Chemical-resistant 3. Life-safety		Yes	No			Acid-proof Brick	Gypsum/ PUF
15.2 Electrical Lab	3.5	6.2	3.5	1. Structural safety 2. Fire-resistant 3.Life-safety	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
15.3 CMM Room	6.1	5.6	3.5	1. Structural staility 2. Acoustical & Vibration control 3. Fire-resistant 4. Maintaining accurate temperature 5. Dust-proof	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, Theft, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF

HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Internal Partition Walls & False ceiling - SOLUTION

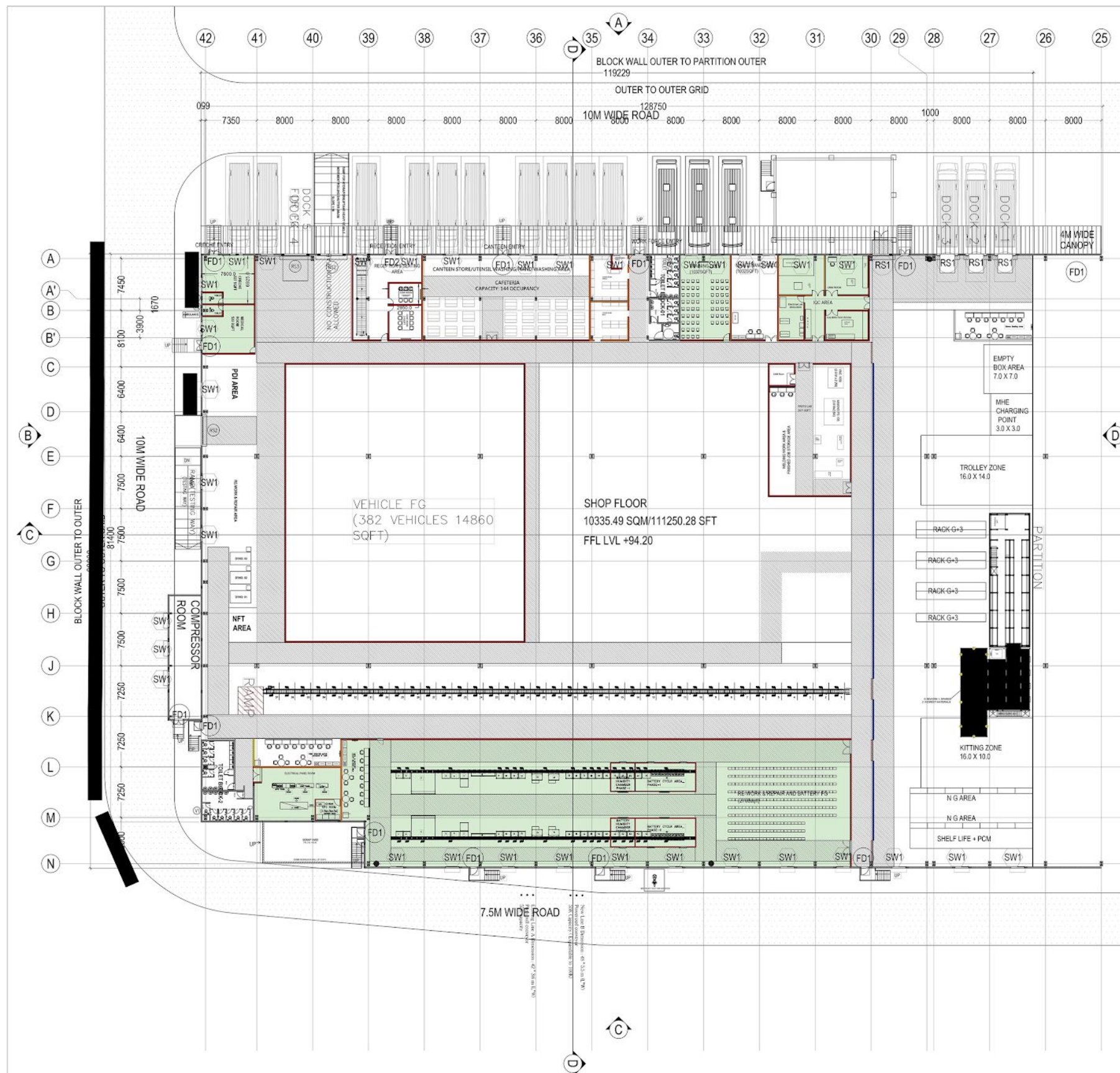
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15.4 Calibration Room	6.1	4.08	3.5	1. Structural staility 2. Acoustical & Vibration control 3. Fire-resistant 4. Maintaining accurate temperature 5. Dust-proof	HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
Proto Lab Area	11.54	18.75	3.5		HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque		Gypsum/ PUF
21.1 CMM Room	3.52	2.95	3.5	1. Structural staility 2. Acoustical & Vibration control 3. Fire-resistant 4. Maintaining accurate temperaure 5. Dust-proof		Yes	No			AAC	Gypsum/ PUF
21.2 Welding work Area	3.72	15.6	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF/ Metal
21.3 VMC	2.9	2.2	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
21.4 Makino	3.8	2.8	3.5		HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING			Gypsum/ PUF
21.5 Esteam	1	0.85	3.5		HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING			Gypsum/ PUF
21.6 Milling	1	1	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
21.7 Band Saw	4	1	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant 4. Safety in terms of electric equipments	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
21.8 Bench Grinder	1.2	1	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant 4. Safety in terms of electrical equipments	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Opaque	AAC	Gypsum/ PUF
Re-work & Repair Battery FG	11.19	19.13	3.5	1. Safety 2. Explosion-resistant 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, VANDALISM, EAVES DROPPING	Transparent+Opaque	AAC	Gypsum/ PUF
Battery Cycle Area Phase-1	8.6	4	3.5	1. Safety 2. Explosion-resistant 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL,EAVES DROPPING	Transparent+Opaque	AAC	Gypsum/ PUF
Battery Humidity Chamber -1	3.4	4	3.5	1. Safety 2. Explosion-resistant 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Transparent+Opaque	AAC	Gypsum/ PUF
Battery Cycle Area Phase-2	8.6	4	3.5	1. Safety 2. Explosion-resistant 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, EAVES DROPPING	Transparent+Opaque	AAC	Gypsum/ PUF
South side Partiton Wall								STRUCTURAL, FIRE, EAVES DROPPING	Transparent	Open-Mesh	Gypsum/ PUF

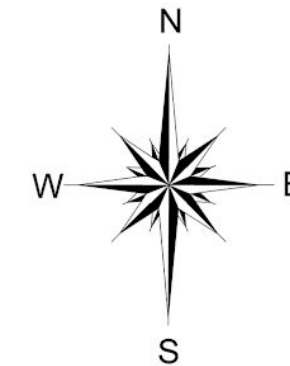
HEADING: LITHIUM-ION BATTERY WAREHOUSE, ATHER ENERGY- Internal Partition Walls & False ceiling - SOLUTION

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East side Partiton Wall								STRUCTURAL, FIRE, CHEMICAL, THEFT, VANDALISM, EAVES DROPPING	Transparent	Open-Mesh	Gypsum/ PUF
Electrical Panel Room	12.54	7523	3.5	1. Life-safety 2. Acoustical & Vibration control 3. Fire-resistant 4. Safety in terms of electrical equipments	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Transparent+Opaque	AAC + Vision Panel	Gypsum/ PUF
MFG. & Support Staff seating	4	11571.7	3.5	1. Ambience 2. Comfort 3. Safety	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall + Vision Panel	Gypsum/ PUF
MFG. & Support Staff seating -2	12.34	3.99	3.5	1. Ambience 2. Comfort 3. Safety	Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall + Vision Panel	Gypsum/ PUF
Toilet Block - 2	7.26	11.4	3.5		Natural Ventilation,HVAC	Yes	No	STRUCTURAL, FIRE, THEFT, VANDALISM, EAVES DROPPING	Opaque	Dry-Wall	Gypsum/ PUF
Compressor Room	4.55	17.63	3.5	1. Safety 2. Explosion-resistant 3. Fire-resistant	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Transparent	AAC	Gypsum/ PUF
Vehicle FG Area	34.1	39.62	3.5	1. Structural safety, 2. Fire-resistant 3.Life-safety	HVAC	Yes	No	STRUCTURAL, FIRE, CHEMICAL, VANDALISM, EAVES DROPPING	Transparent	Dry-Wall	Gypsum/ PUF



ORIENTATION



LEGEND

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

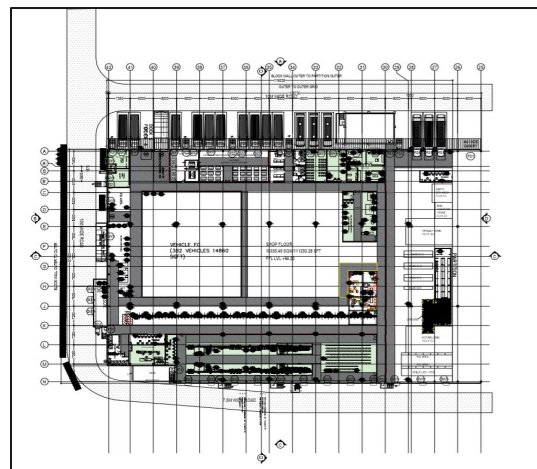
All dimensions are in mm.

MATERIALS VENDORS

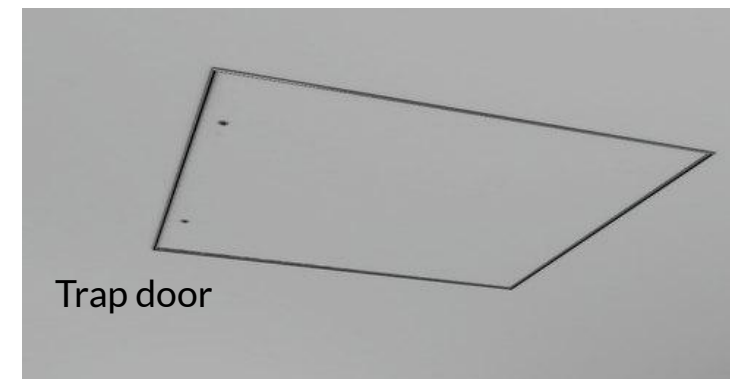
MATERIAL	PRODUCT	BRAND
Fibre cement board	Rapicon Wall Panel	
Calcium silicate board	Hilux	

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



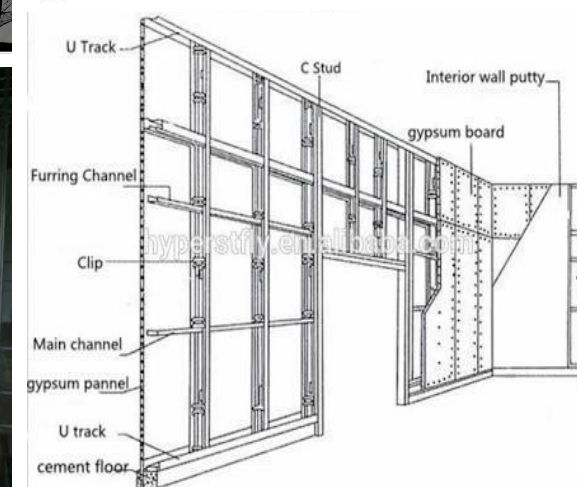
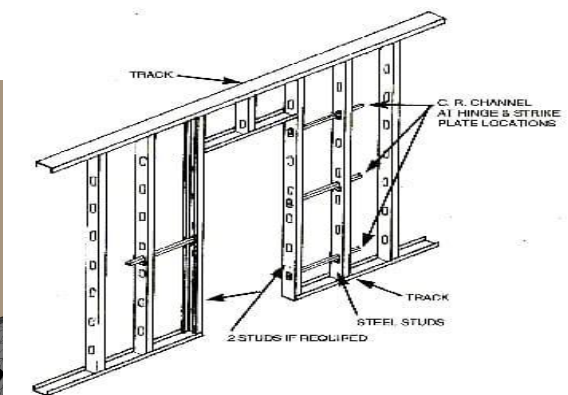
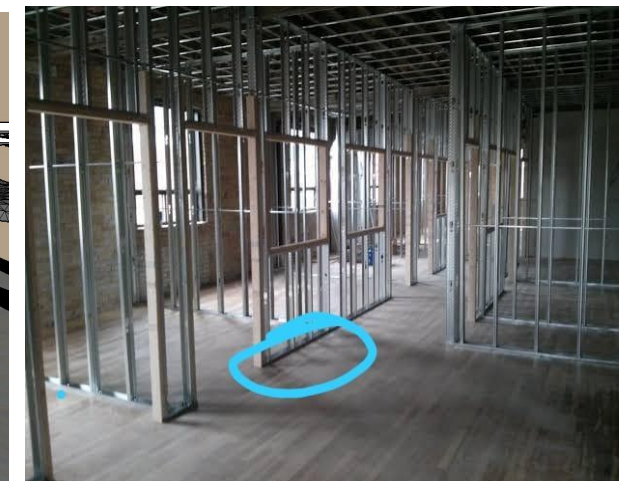
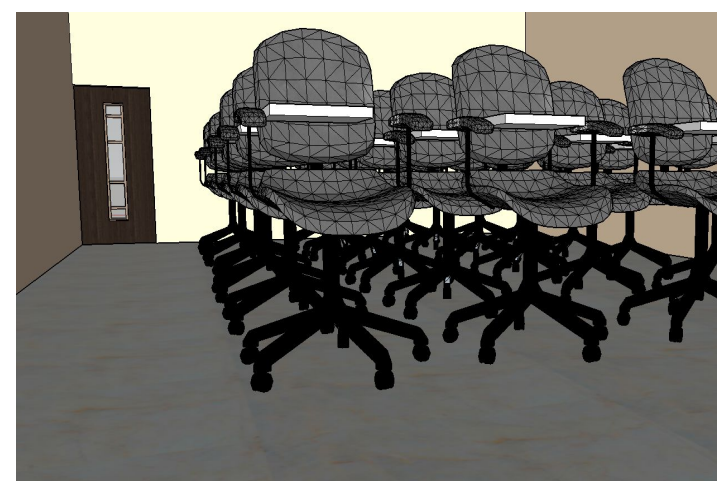
Purpose	Problem
- Lectures - Meetings - Presentation	- Acoustic - Thermal Insulation - Good Ambience - Illumination - Ventilation



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

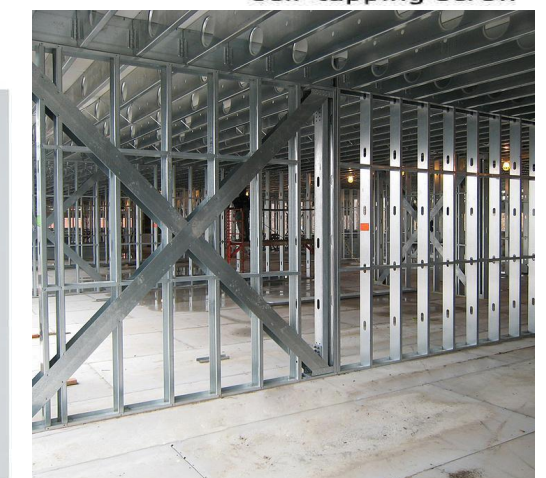
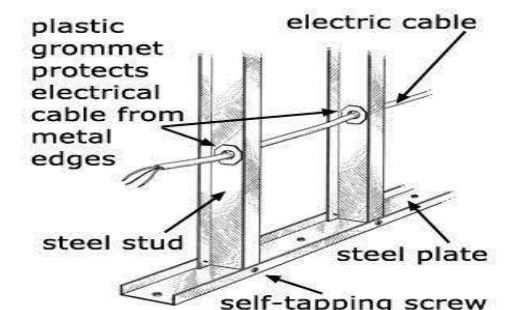


Training room-Partition wall

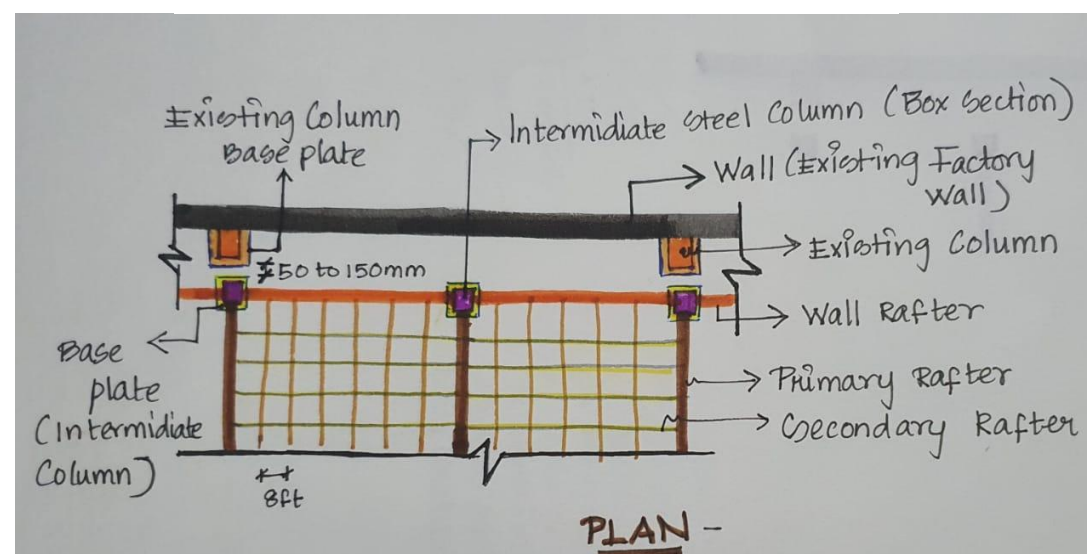
Material	Fibre cement board
Structural Support	Floor
Structural Member	Aluminium Tracks & Channels
Connection	Screw & interlocking connection
Access & Safety	Fire resistance
Comfort	Acoustics , good illumination
Door	Sliding door - Side Access Control System
Aesthetics	Textured



Installation Chart

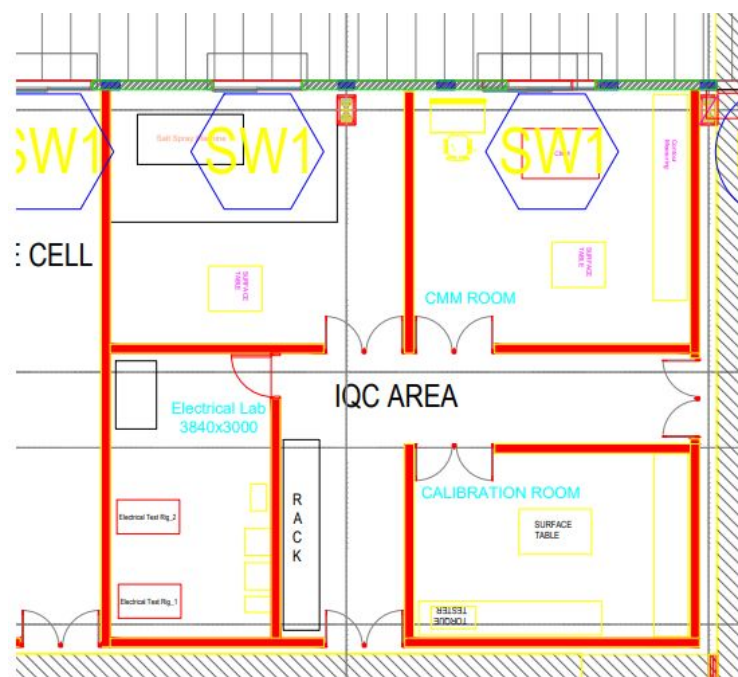
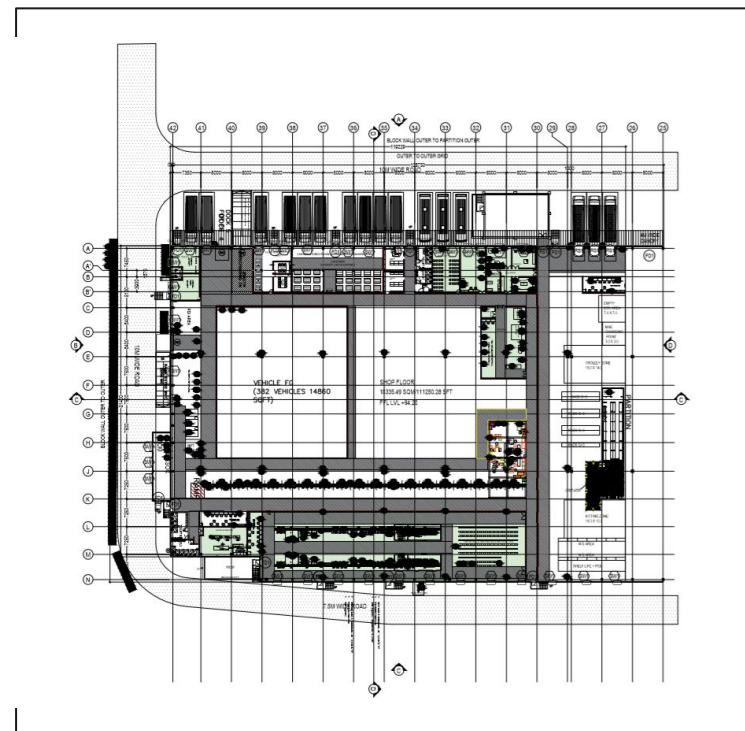


False ceiling framework - plan



IQC Room

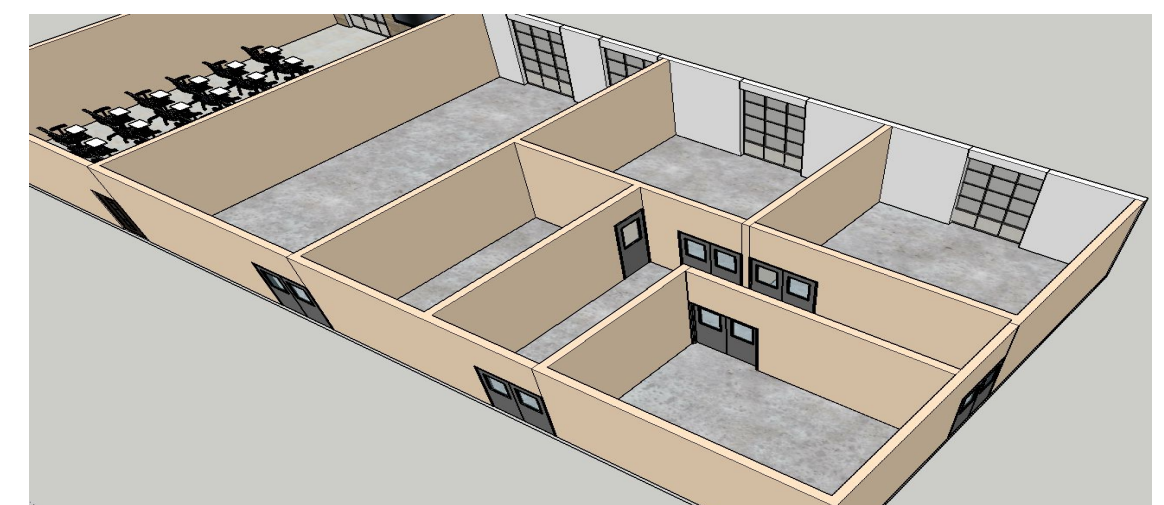
12.81m x 12.1m x 3.5m



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

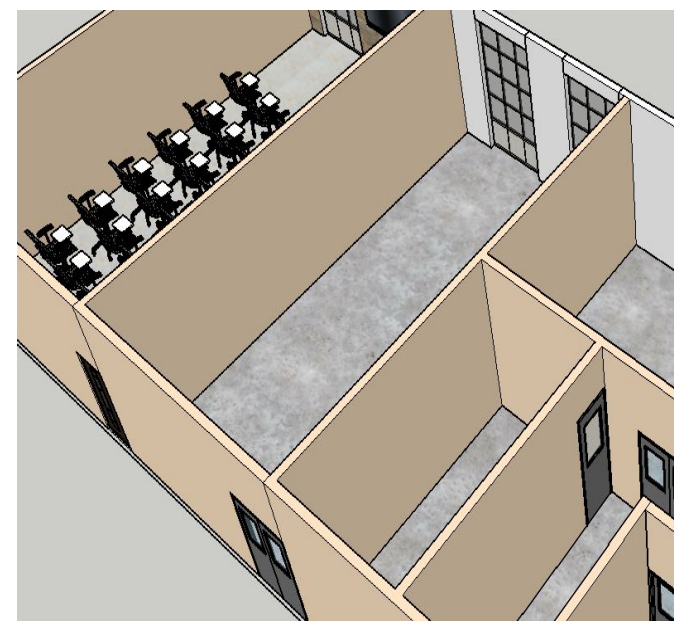
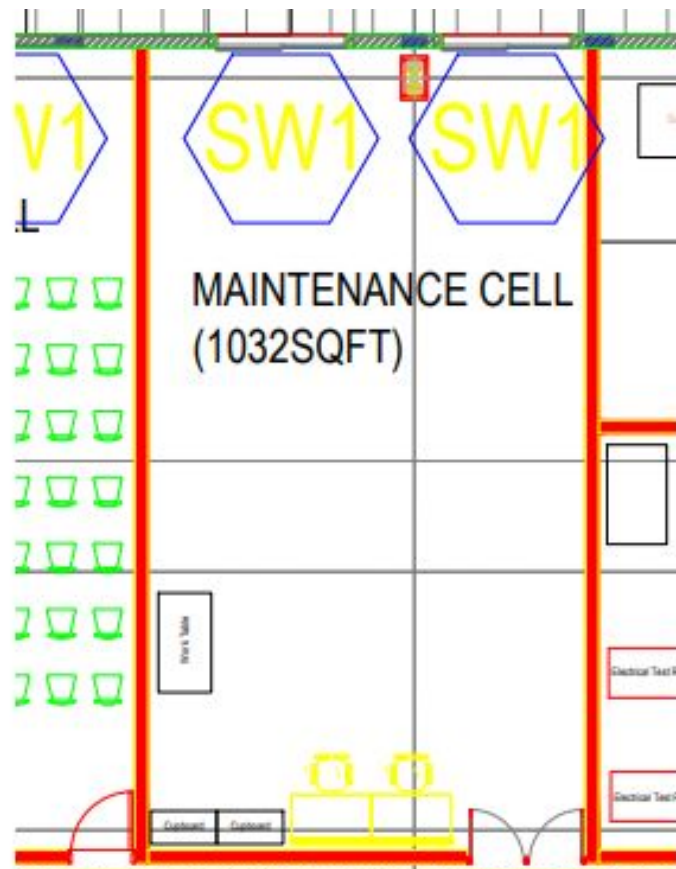
Purpose	Problem
Quality Test Lab	- Proper Illumination - Thermal Resistance - Chemical & Saline Resistant - Fire Accidents



HEADING: ATER ENERGY FACTORY- SOLUTION 02 - FOR FALSE CEILING & INTERIOR PARTITION

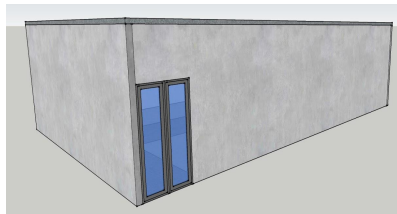
Page No.:80

Maintenance room 6.6m x 12.1m x 3.5m

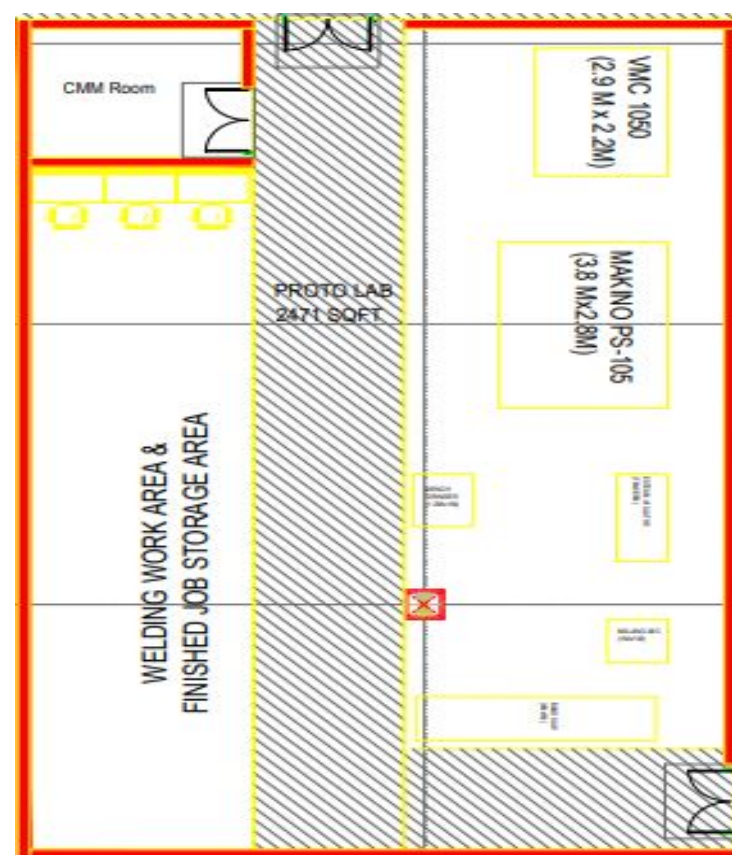


Maintenance room - partition wall

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

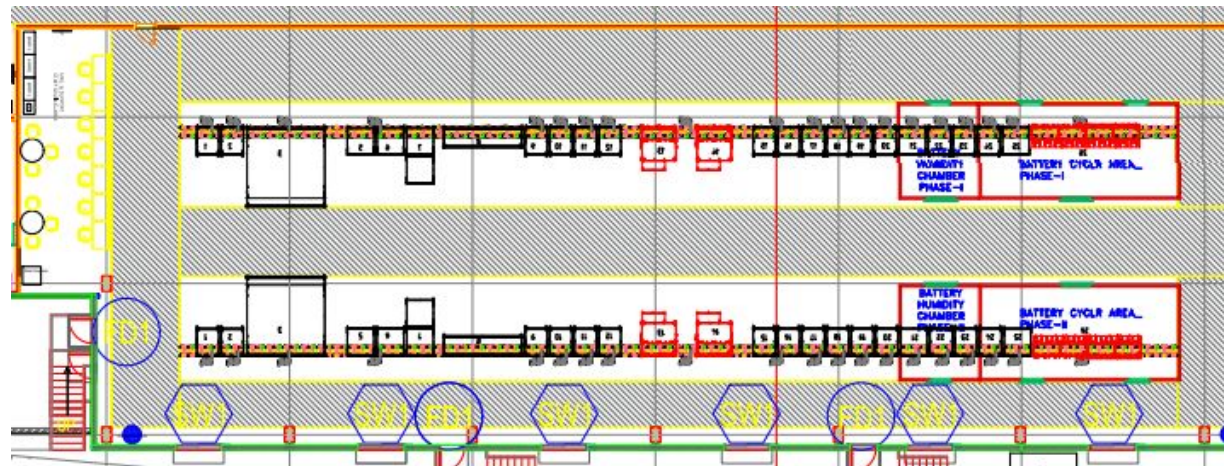


Proto Lab - Partition Material

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

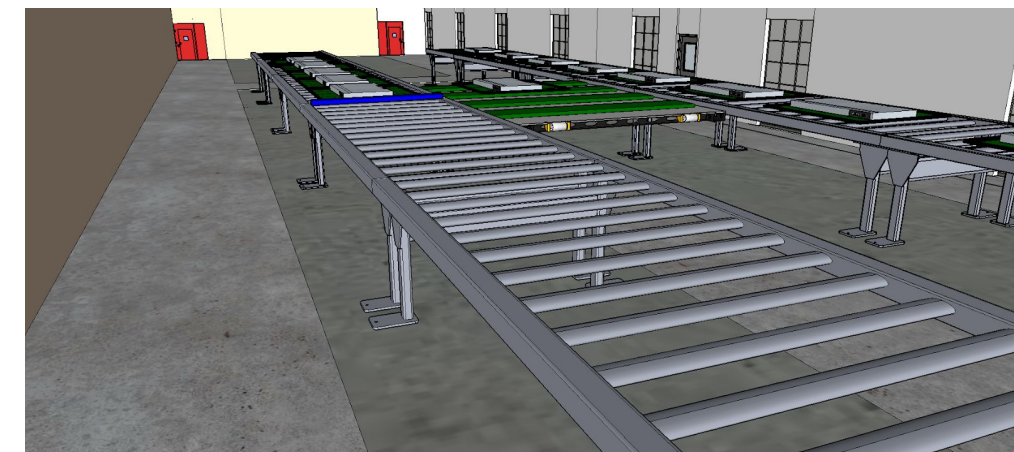
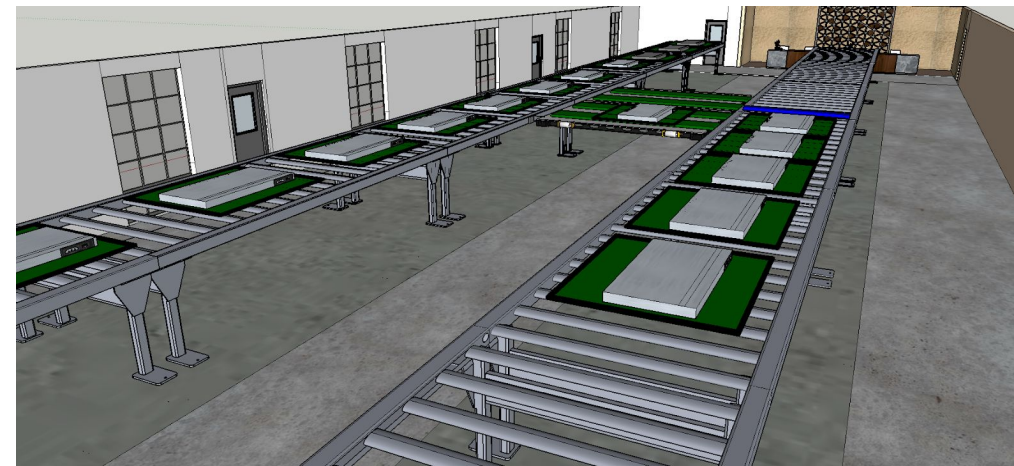


Purpose	Problem
Assembling of battery with vehicle	- Proper Illumination - Impact Resistance - Vibration - Noise - Fire Accidents

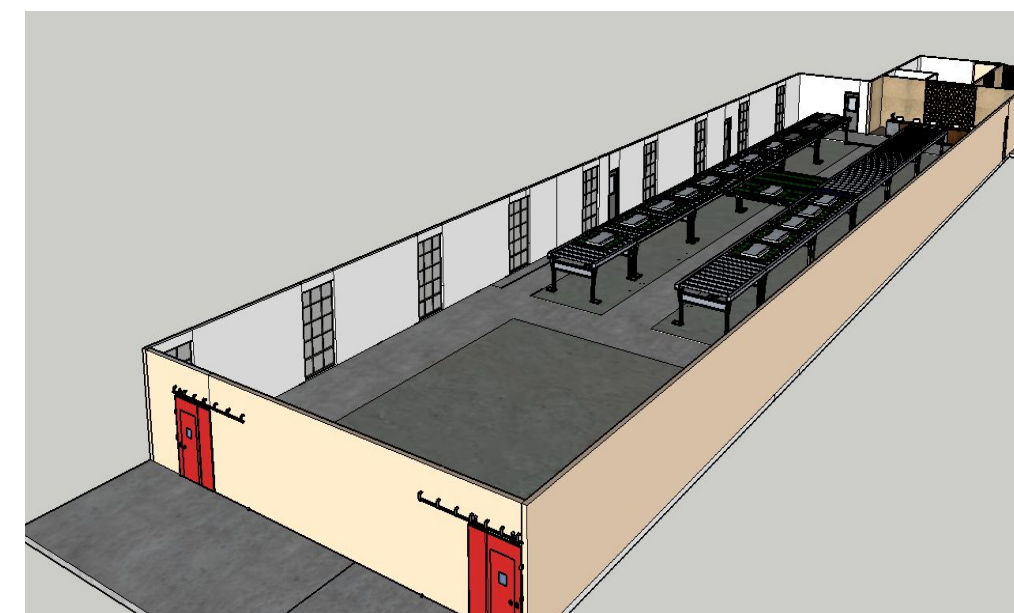
Battery assembly area-false ceiling

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

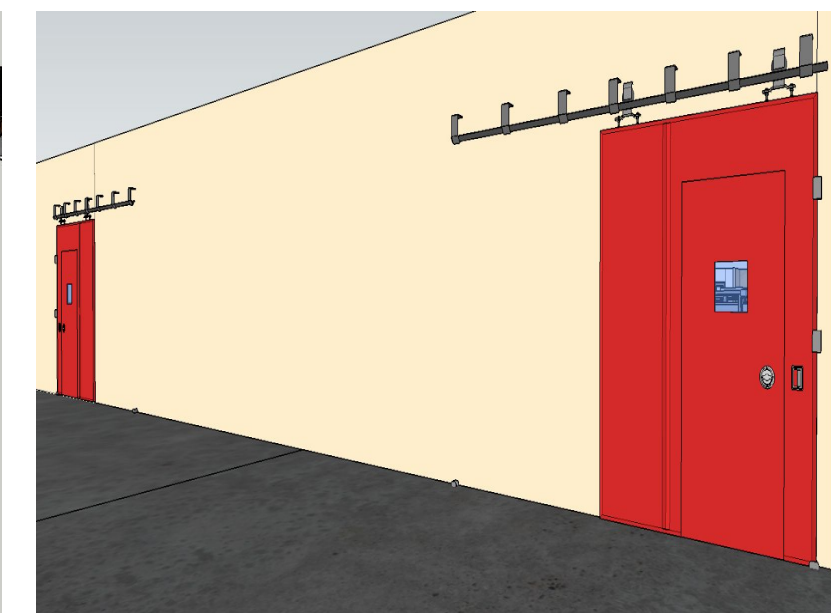
3D VIEWS-BATTERY ASSEMBLY AREA



3D VIEWS-BATTERY ASSEMBLY AREA

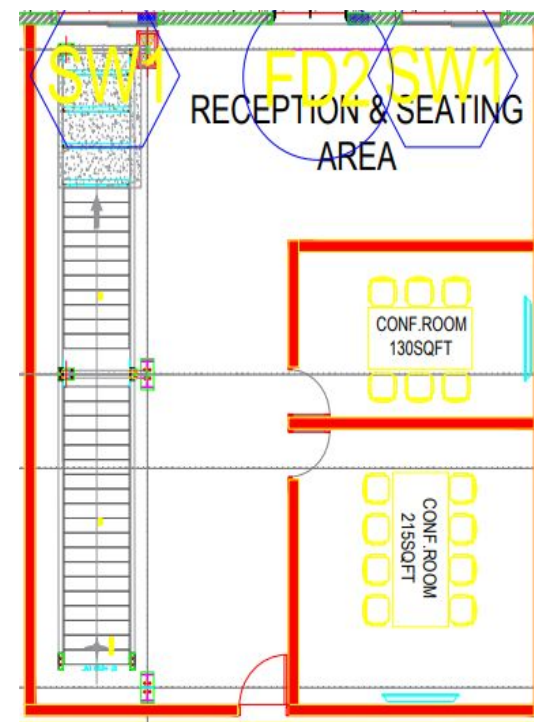


3D VIEWS-STAFF SUPPORT AREA 1



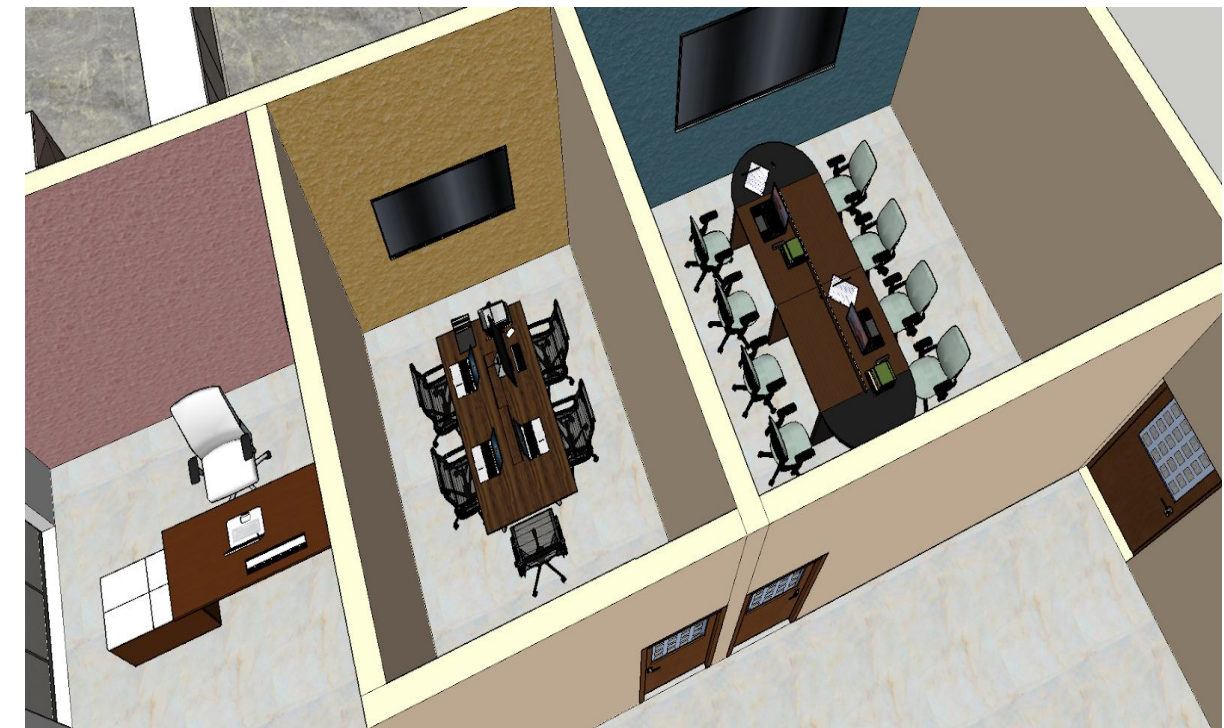
Battery assembly area-Partition wall

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

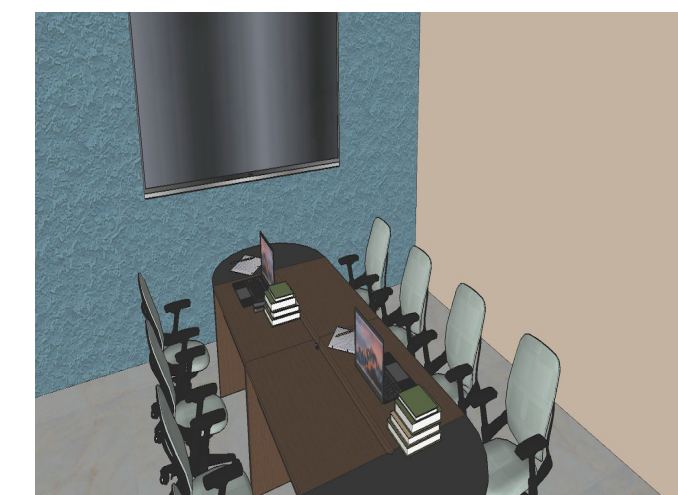


Reception

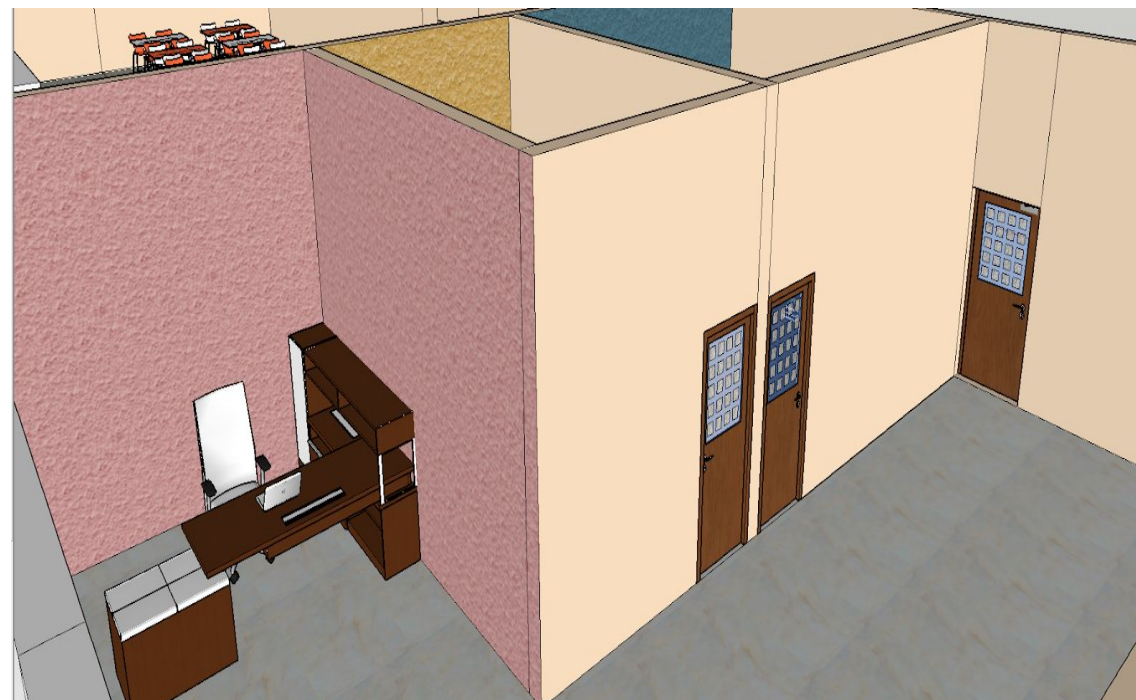
9.8m x 11.9m x 3.5m



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



3D VIEWS-CONFERENCE ROOM 1



3D VIEWS-RECEPTION

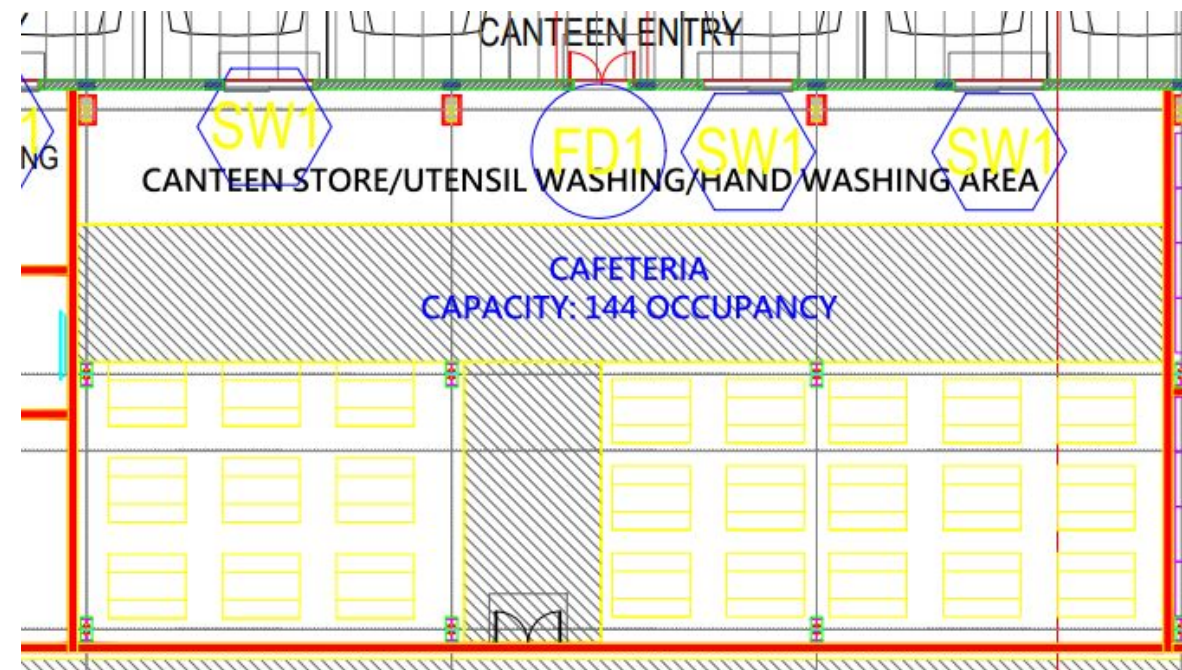


Reception -Partition wall

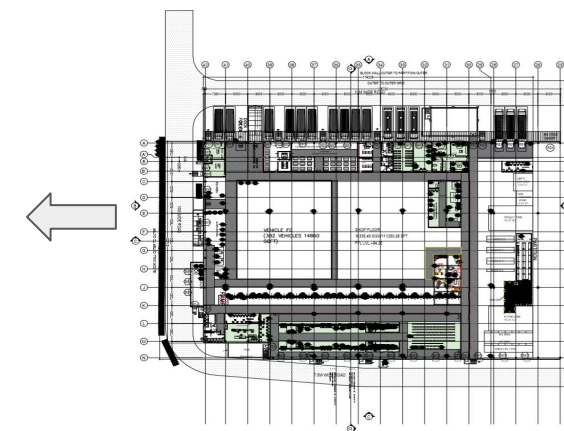
Material	Fibre cement board
Structural Support	floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Acoustics, Thermal
Comfort	Thermal , Good illumination
Door	Flush doors with vision 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

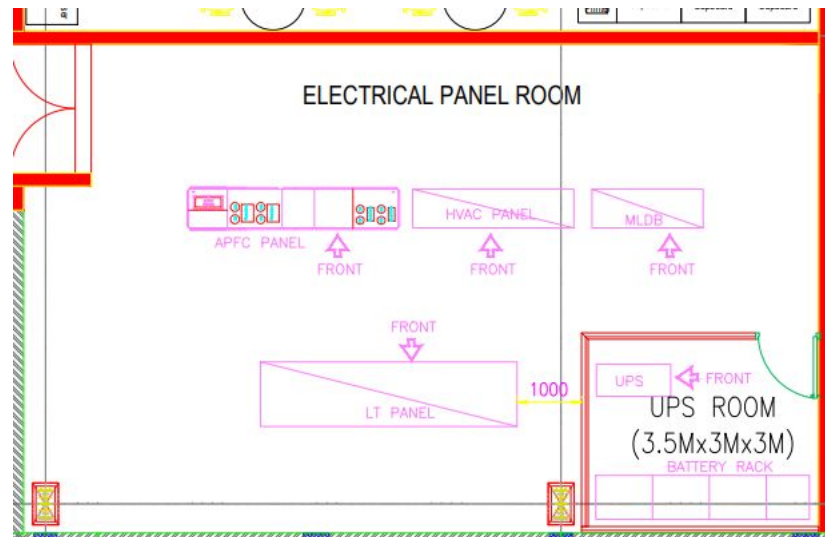
Locker room Female & Male-partition wall

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

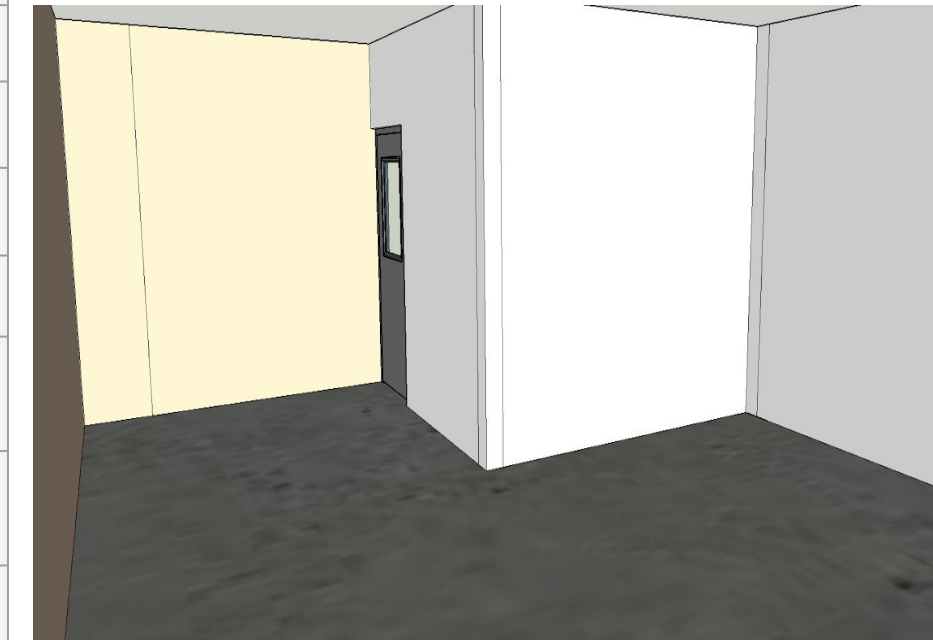
Electrical Room

12.34m x 7.57m x 3.5m



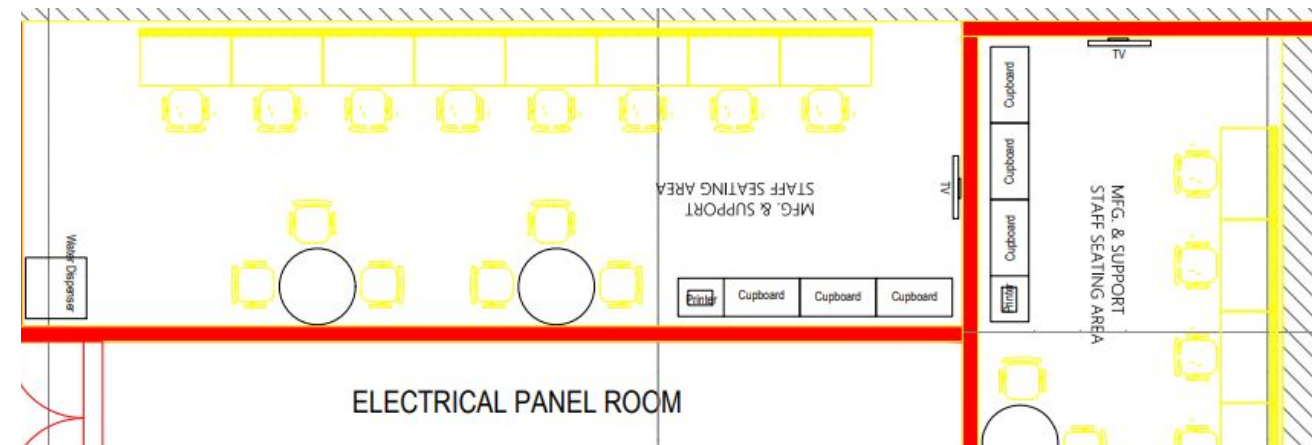
Material	Calcium silicate panel
Structural Support	Wall & floor
Structural Member	Aluminium Tracks & Channel - box , I section & C section
Connection	Nut (partition wall to floor) , screw & interlocking connection
Access & Safety	Fire Protection & Safety
Door	Fire rated metal door + Access control system - 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

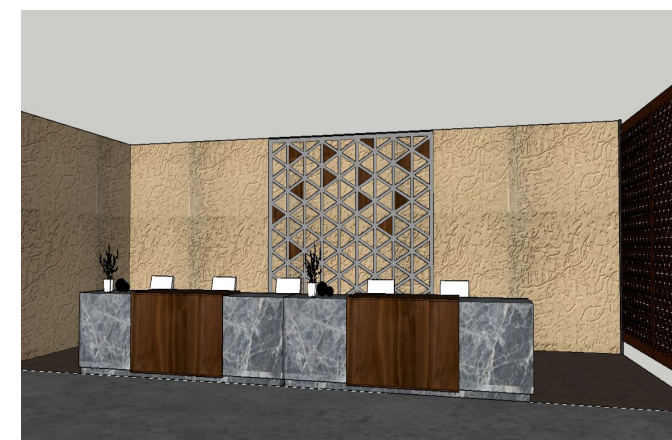
3D View - Electrical Room



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



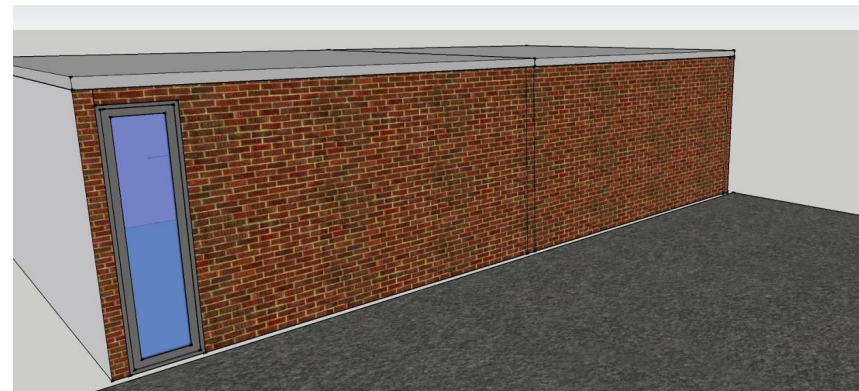
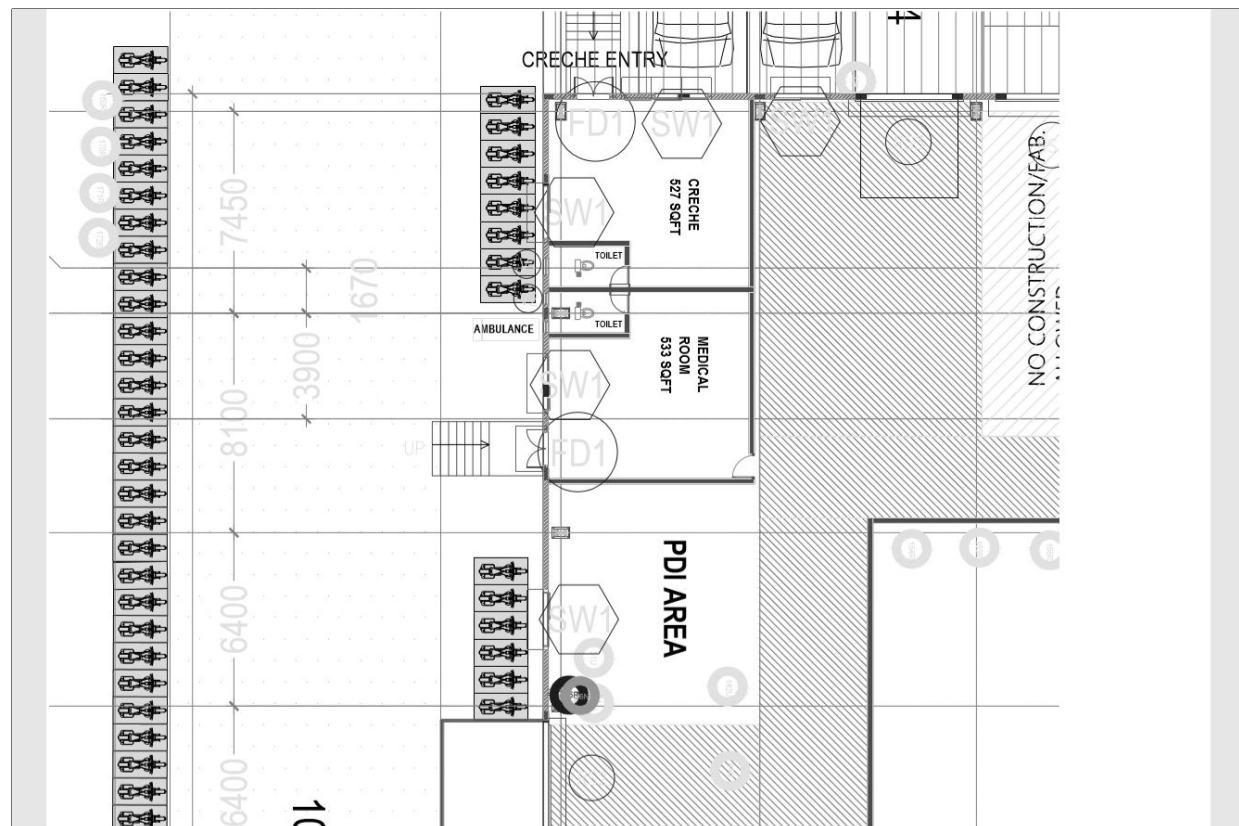
Purpose	Problem
- Resting - Gathering - Meeting	- Proper Illumination - Seclusion - Ventilation - Good Ambience



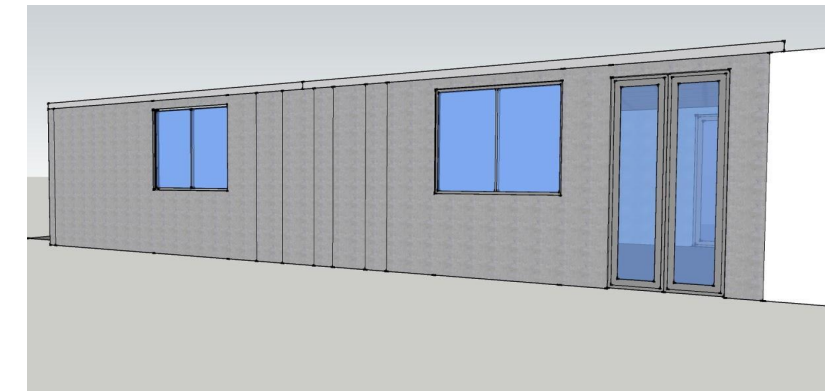
Staff support area 2 (open) - Partition wall

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



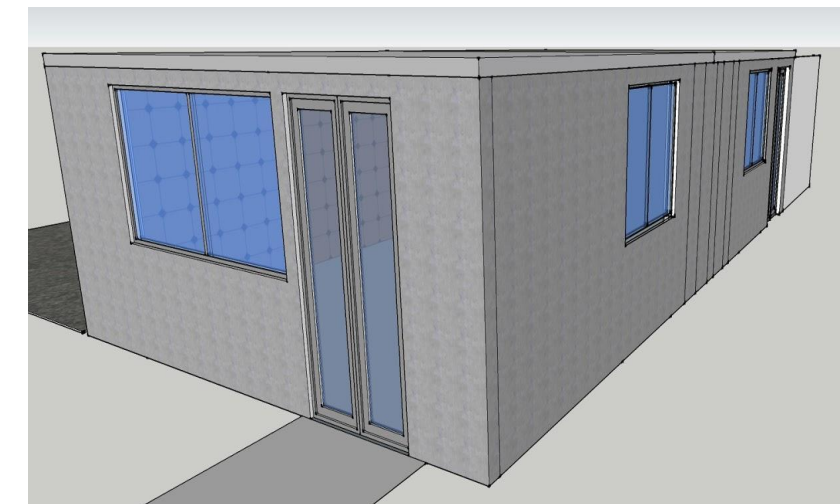
GANGWAY SIDE VIEW
 1mm Stone Finish (Laterite Stone) &
 Fibre-Cement Board



BACK SIDE VIEW
 Fibre-Cement
 Board



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

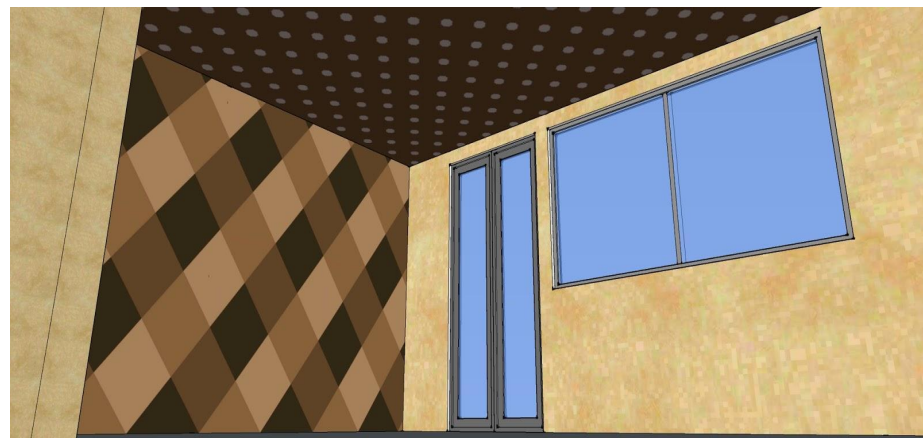


Fibre-Cement Board

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

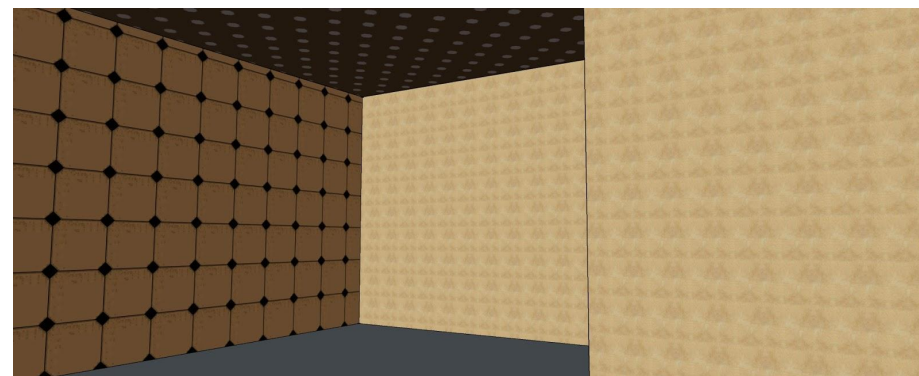


FIBRE-CEMENT BOARD WITH WALLPAPER FINISH & EMULSION PAINT FINISH



THEME-BASED FALSE CEILING

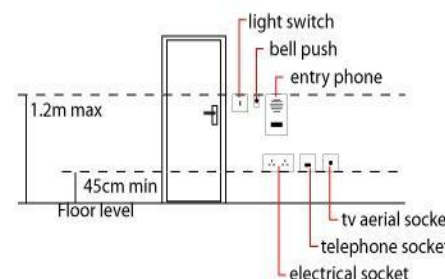
Material	Fibre cement board, Aluminium framed Glass Windows & Doors
Structural Support	Columns anchored to floor, GI framing
Structural Member	Aluminium Tracks & Channels
Connection	Screw & interlocking connection
Access & Safety	Fire resistance
Comfort	Acoustics , Split AC
Aesthetics	Laterite Stone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

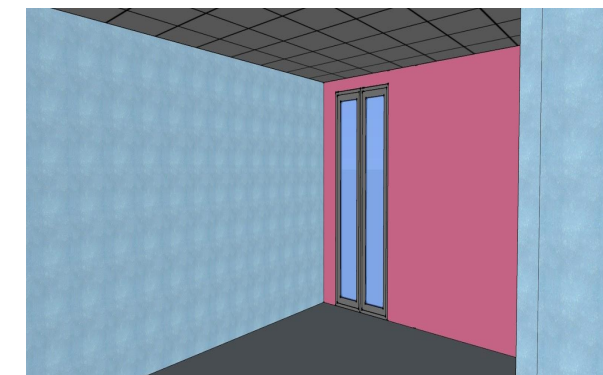


MEDICAL ROOM

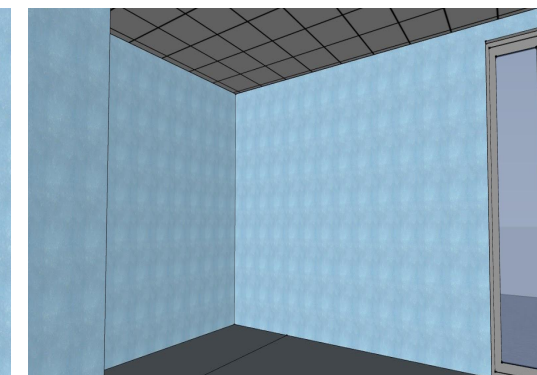
7.4m x 6.87m x 3.5m

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

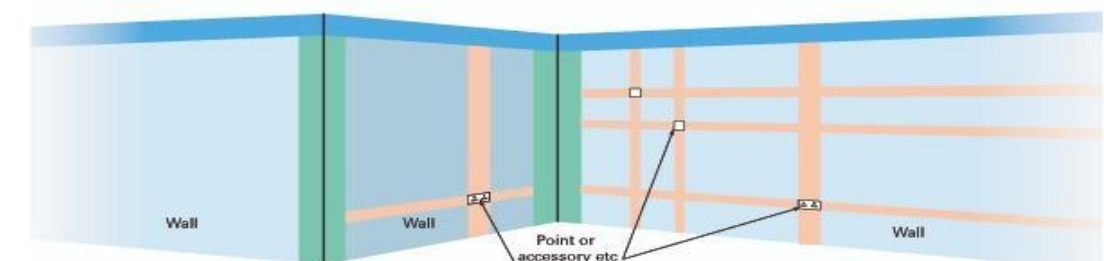


FIG 1 Cables routes in accordance with Regulation 522.6.202.

- 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)



HEADING: ATHER ENERGY FACTORY BUILDING , HOSUR - DOOR SPECIFICATION

Page No.: 88

Detail of Measurements - Door									
Item	Description of works	Unit	Nos	L	B	H	Qty	Add 5%	Total Qty
RECEPTION - DOORS									
A	Double Leaf Fire Rated Door - 2 hrs Fire Rating with Vision Panels								
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Double Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation	Sqm	1	1.5		2.1	3.15	0.1575	3.3075
B	Single Leaf Glazed Metal Fire Rated Door with Vision Panels								
	Glazed Metal Fire Rated Door with Fixed Partition with 120 mins fire rating, Shutter thickness of 60 mm. Following standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material. Steel Frame Profile Design, Frame Thickness – 1.6mm Galvanised Steel, Shutter Sheet Thickness – 1.6mm Galvanised Steel, Glass –2hrs Fire rated clear Glass & Shutter Infill Insulation – Mineral Wool Insulation. Recommended Hardware includes SS Ball Bearing Hinges – SUS 304 of Size 102mm x 89mm x 3mm, Door Closer – Fire rated, Tower / Flush Bolt, Mortise DeadLock Set with Cylinder- complete with D Shape Pull handle for Push / Pull Operations and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	2	0.9		2.1	3.78	0.189	3.969
C	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels								
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	1		2.1	2.1	0.105	2.205
CANTEEN									
A	Double Leaf Fire Rated Door - 2 hrs Fire Rating with Vision Panels								
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Double Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation	Sqm	2	1.5		2.1	6.3	0.315	6.615
TRAINING ROOM									
A	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels								

	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation	Sqm	1	1		2.1	2.1	0.105	2.205
MAINTANENCE ROOM									
A	Auto Sliding Single leaf Fire Rated Doors (120 Minutes) with Vision Panels								
	Auto Sliding Single leaf Fire Rated Doors (120 Minutes), Conforms To Is: 3614 (Part - ii), 1992 & Bs: 476 (Part 20 & 22). This type of door is fabricated from GI of 1.219 mm with overall panel thickness of 42 mm. Mineral Wool is used as an infill material to provide integrity, stability and insulation. This door can be made in Single leaf and it comprises Sliding Rail to guide the panel, fusible link (fire rated at 68 deg.C), wire rope, bottom rollers to guide the panel at the bottom, counter weights etc. This door is always kept into open position and at the time of fire break, fusible link melts which allows the counter weight hung to the wire rope to pull the panel automatically close and to prevent fire from spreading further. Standard accessories are to be included in the supply.The door is primed with Zinc-Phosphate Stoving Primer and finished with two coats of Polyurethane paint as required up to a minimum of 70 microns	Sqm	2	1.8		2.4	8.64	0.432	9.072
FEMALE LOCKER ROOM									
A	Double Leaf Fire Rated Door - 2 hrs Fire Rating with Vision Panels								
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Double Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation	Sqm	1	2		2.1	4.2	0.21	4.41
B	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels								
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	2	0.9		2.1	3.78	0.189	3.969
MALE LOCKER ROOM									
B	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels								



HEADING: ATER ENERGY FACTORY BUILDING , HOSUR - DOOR SPECIFICATION

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	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	2	0.9	2.1	3.78	0.189	3.969
CRECHE								
A	Double Leaf Fire Rated Door - 2 hrs Fire Rating with Vision Panels							
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Double Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	1.5	2.1	3.15	0.1575	3.3075
B	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels							
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	0.78	2.1	1.638	0.0819	1.7199
MEDICAL ROOM								
A	Double Leaf Fire Rated Door - 2 hrs Fire Rating with Vision Panels							
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Double Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	1.5	2.1	3.15	0.1575	3.3075
B	Single Leaf fire rated door - 2 hrs fire rating with Vision Panels							

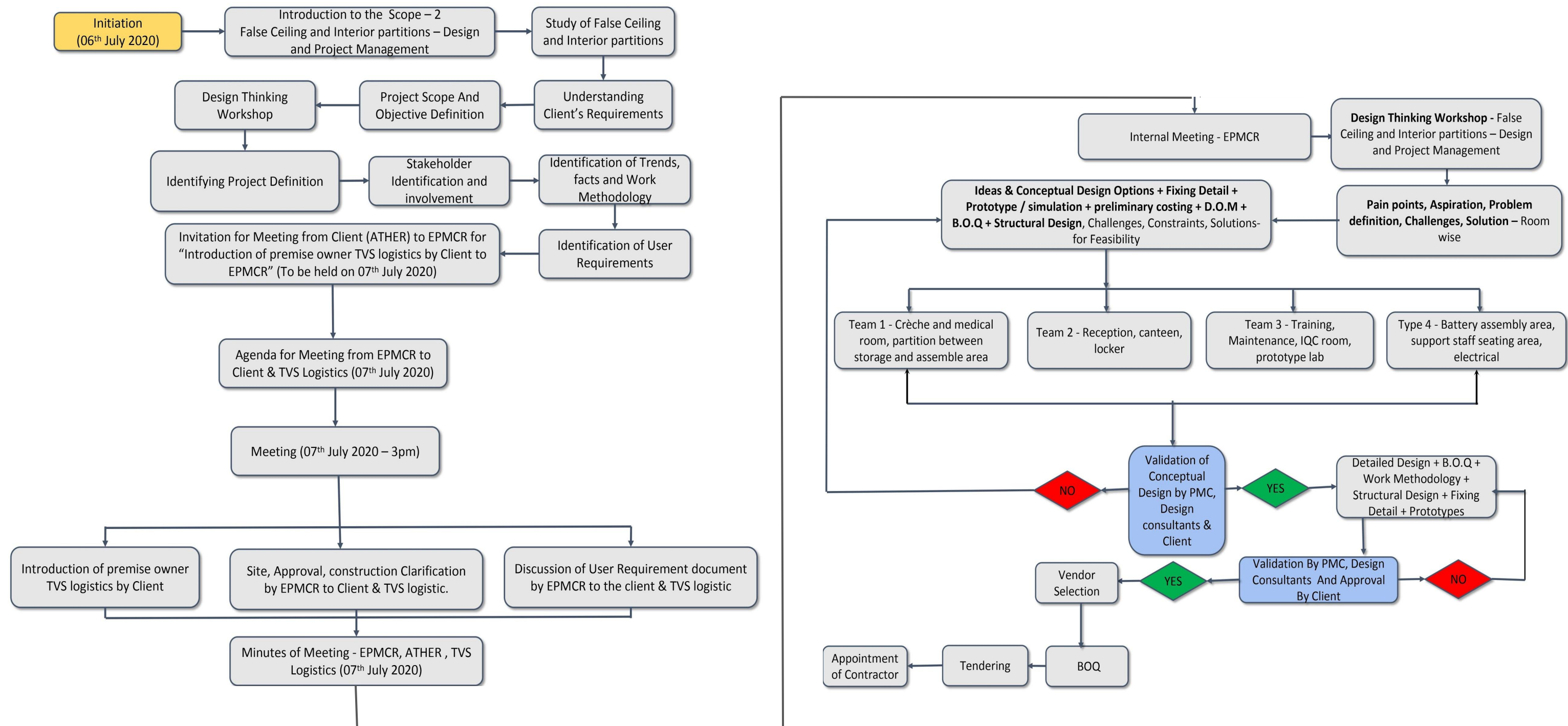
	Supply and Installation of Wooden Fire Rated Door, 120 mins fire rating, 55mm shutter thickness, Conforming to standards BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material, 140mm x 70 mm frame size, Fire Retardant wooden Door Frame made out of 2nd class seasoned Ghana Teakwood of required size (Nominal) in Single Leaf suitable for mounting shutters and shall be chemically treated with one shop coat (clear) of approved make anti-termite & fire retardant Primer/sealer FR -911 (clear) including making grooves on all the three sides of the Frame shutters except bottom. (Cost of Fire & smoke seal 10x4mm of approved Imported make to be fixed in the groove shall be paid separately).Shutter Insulation - Sandwich type Fire rated mineral wool treated with fire retardant paint & Calcium silicate board. Vision Panel – 2hrs. Fire rated clear Glass.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	0.78	2.1	1.638	0.0819	1.7199
ELECTRICAL ROOM								
A	Auto Sliding Single leaf Fire Rated Doors (120 Minutes) with Vision Panels							
	Auto Sliding Single leaf Fire Rated Doors (120 Minutes), Conforms To Is: 3614 (Part - ii), 1992 & Bs: 476 (Part 20 & 22). This type of door is fabricated from GI of 1.219 mm with overall panel thickness of 42 mm. Mineral Wool is used as an infill material to provide integrity, stability and insulation. This door can be made in Single leaf and it comprises Sliding Rail to guide the panel, fusible link (fire rated at 68 deg.C), wire rope, bottom rollers to guide the panel at the bottom, counter weights etc. This door is always kept into open position and at the time of fire break, fusible link melts which allows the counter weight hung to the wire rope to pull the panel automatically close and to prevent fire from spreading further. Standard accessories are to be included in the supply.The door is primed with Zinc-Phosphate Stoving Primer and finished with two coats of Polyurethane paint as required up to a minimum of 70 microns.	Sqm	1	2	2.4	4.8	0.24	5.04
B	Single Leaf Fire Rated Metal Door with Vision Panels							
	Providing and fixing metal fire rated doors as per BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material and Pressed Galvanized steel conforming to IS 277 of standard.120 mins fire rating, Shutter thickness of 46 mm, Frame size of 143 x 57mm Double Rebate . Frame Thickness of 1.20 mm/ 1.60 mm Galvanized Steel & Shutter Sheet Thickness of 1.0 / 1.2 mm Galvanized Steel with Vision Panel of 2 Hrs Fire rated Toughened clear Glass Shutter Infill Insulation is Fire Rated Insulation and Finish powder coated finish in desired shade.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	1	2.1	2.1	0.105	2.205
BATTERY ASSEMBLY AREA								
A	Auto Sliding Single leaf Fire Rated Doors (120 Minutes) with Vision Panels							
	Auto Sliding Single leaf Fire Rated Doors (120 Minutes), Conforms To Is: 3614 (Part - ii), 1992 & Bs: 476 (Part 20 & 22). This type of door is fabricated from GI of 1.219 mm with overall panel thickness of 42 mm. Mineral Wool is used as an infill material to provide integrity, stability and insulation. This door can be made in Single leaf and it comprises Sliding Rail to guide the panel, fusible link (fire rated at 68 deg.C), wire rope, bottom rollers to guide the panel at the bottom, counter weights etc. This door is always kept into open position and at the time of fire break, fusible link melts which allows the counter weight hung to the wire rope to pull the panel automatically close and to prevent fire from spreading further. Standard accessories are to be included in the supply.The door is primed with Zinc-Phosphate Stoving Primer and finished with two coats of Polyurethane paint as required up to a minimum of 70 microns.	Sqm	2	2	2.4	9.6	0.48	10.08
B	Single Leaf Fire Rated Metal Door with Vision Panels							
	Providing and fixing metal fire rated doors as per BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material and Pressed Galvanized steel conforming to IS 277 of standard.120 mins fire rating, Shutter thickness of 46 mm, Frame size of 143 x 57mm Double Rebate . Frame Thickness of 1.20 mm/ 1.60 mm Galvanized Steel & Shutter Sheet Thickness of 1.0 / 1.2 mm Galvanized Steel with Vision Panel of 2 Hrs Fire rated Toughened clear Glass Shutter Infill Insulation is Fire Rated Insulation and Finish powder coated finish in desired shade.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	2	1.2	2.4	5.76	0.288	6.048
C	Single Leaf Fire Rated Metal Door with Vision Panels							

HEADING: ATHER ENERGY FACTORY BUILDING , HOSUR - DOOR SPECIFICATION

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	Providing and fixing metal fire rated doors as per BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material and Pressed Galvanized steel conforming to IS 277 of standard.120 mins fire rating, Shutter thickness of 46 mm, Frame size of 143 × 57mm Double Rebate . Frame Thickness of 1.20 mm/ 1.60 mm Galvanized Steel & Shutter Sheet Thickness of 1.0 / 1.2 mm Galvanized Steel with Vision Panel of 2 Hrs Fire rated Toughened clear Glass Shutter Infill Insulation is Fire Rated Insulation and Finish powder coated finish in desired shade.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	0.9		2.4	2.16	0.108	2.268
	IQC								
A	Single Leaf Fire Rated Metal Door with Vision Panels								
	Providing and fixing metal fire rated doors as per BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material and Pressed Galvanized steel conforming to IS 277 of standard.120 mins fire rating, Shutter thickness of 46 mm, Frame size of 143 × 57mm Double Rebate . Frame Thickness of 1.20 mm/ 1.60 mm Galvanized Steel & Shutter Sheet Thickness of 1.0 / 1.2 mm Galvanized Steel with Vision Panel of 2 Hrs Fire rated Toughened clear Glass Shutter Infill Insulation is Fire Rated Insulation and Finish powder coated finish in desired shade.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	1	1		2.4	2.4	0.12	2.52
B	Double Leaf Fire Rated Metal Door-2hrs Fire Rating with Vision Panels								
	Providing and fixing metal fire rated doors as per BS 476 Part 20-22, IS 3614 Part 2 for Stability, Integrity & With Insulation Material and Pressed Galvanized steel conforming to IS 277 of standard.120 mins fire rating, Shutter thickness of 46 mm, Frame size of 143 × 57mm Double Rebate . Frame Thickness of 1.60 mm Galvanized Steel & Shutter Sheet Thickness of 1.2 mm Galvanized Steel with Vision Panel of 2 Hrs Fire rated Toughened clear Glass Shutter Infill Insulation is Fire Rated Insulation and Finish powder coated finish in desired shade.Recommended Hardware includes SS Ball Bearing Hinges – SS 304 of Size 100mm x 75mm x 3mm. Door Closer – Fire rated & Tower / Flush Bolt and Fire Rate Panic Bar – Push Side Operation & Fire rated Panic Trim – Pull Side Operation.	Sqm	5	1.8		2.4	21.6	1.08	22.68
	PROTO LAB								
A	Auto Sliding Single leaf Fire Rated Doors (120 Minutes) With Vision Panels								
	Auto Sliding Single leaf Fire Rated Doors (120 Minutes), Conforms To Is: 3614 (Part - ii), 1992 & Bs: 476 (Part 20 & 22). This type of door is fabricated from GI of 1.219 mm with overall panel thickness of 42 mm. Mineral Wool is used as an infill material to provide integrity, stability and insulation. This door can be made in Single leaf and it comprises Sliding Rail to guide the panel, fusible link (fire rated at 68 deg.C), wire rope, bottom rollers to guide the panel at the bottom, counter weights etc. This door is always kept into open position and at the time of fire break, fusible link melts which allows the counter weight hung to the wire rope to pull the panel automatically close and to prevent fire from spreading further. Standard accessories are to be included in the supply.The door is primed with Zinc-Phosphate Stoving Primer and finished with two coats of Polyurethane paint as required up to a minimum of 70 microns.	Sqm	3	1.5		2.4	10.8	0.54	11.34

ATHER ENERGY FACTORY - FALSE CEILING & INTERIOR PARTITION FLOW CHART



POLYHOUSE WAREHOUSE, ULUNDAI AND IRUNGATTUKOTTAI

PROJECT INFORMATION:

PROJECT NAME: MRM CONSTRUCTION

PROJECT TYPOLOGY: INDUSTRIAL - WAREHOUSE FOR POLYHOUSE

LOCATION: ULUNDAI & IRUNGATTUKOTTAI, CHENNAI

CLIENT: POLYHOUSE

SERVICE PROVIDED BY EPMCR: CONSTRUCTION PROJECT MANAGEMENT

PROJECT START DATE: DECEMBER 2020

CURRENT STATE OF PROJECT: CONSTRUCTION STAGE

PROJECT EXPECTED CLOSE DATE: MAY 2021

WORK GIVEN TO INTERNS - MRM CONSTRUCTION, CHENNAI:

TO DESCRIBE THE OVERALL BUILDING FEATURES, WORK SCOPE, WORK BREAKDOWN STRUCTURE AND FLOWCHART OF OVERALL SCOPE & WBS FOR POLYHOUSE, WAREHOUSE AT ULUNDAI & IRUNGATTUKOTTAI, CHENNAI.

POLYHOSE WAREHOUSE, THODUKADU & IRUNGATTUKOTTAI

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.

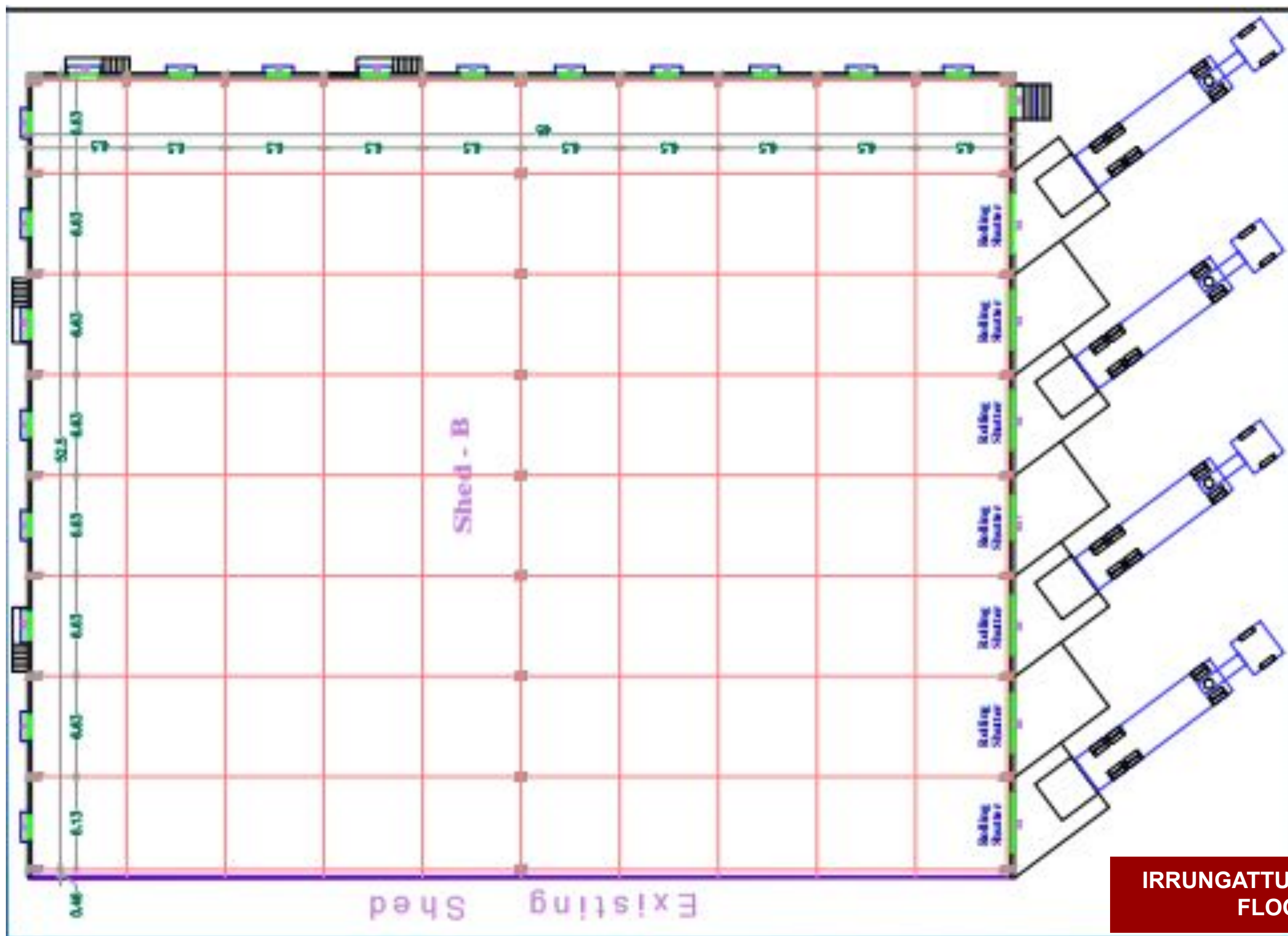
Irungattukottai - Project Information

	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

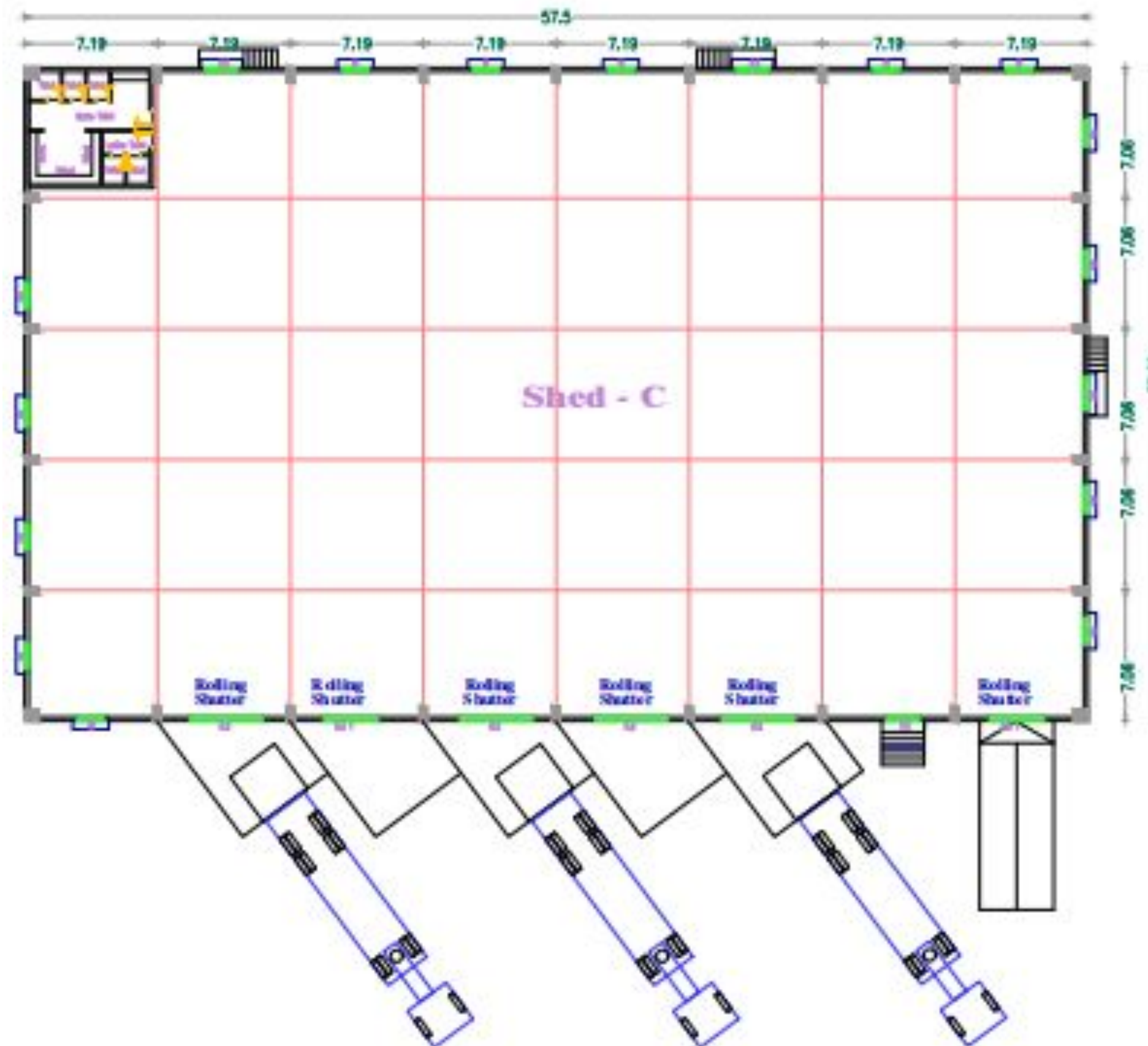
	BLOCK B	BLOCK C	BLOCK D
Column Number	27	26	24
Bays	9- Horizontal, 8- Vertical (2 Brazing)	5- Horizontal, 8- Vertical (2 Brazing)	-
Entry	RS- 7nos (4m x 4m), (3m x 4m) ,EE- 5nos	RS- 6nos (4m x 4m), (3m x 4m), EE- 4nos	Double leaf door- 3m
Number of Dock Parking	4	3	-
Site Entry Dimension	20.97m		
Site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



**IRRUNGATTUKOTTAI - SHED B
FLOOR PLAN**

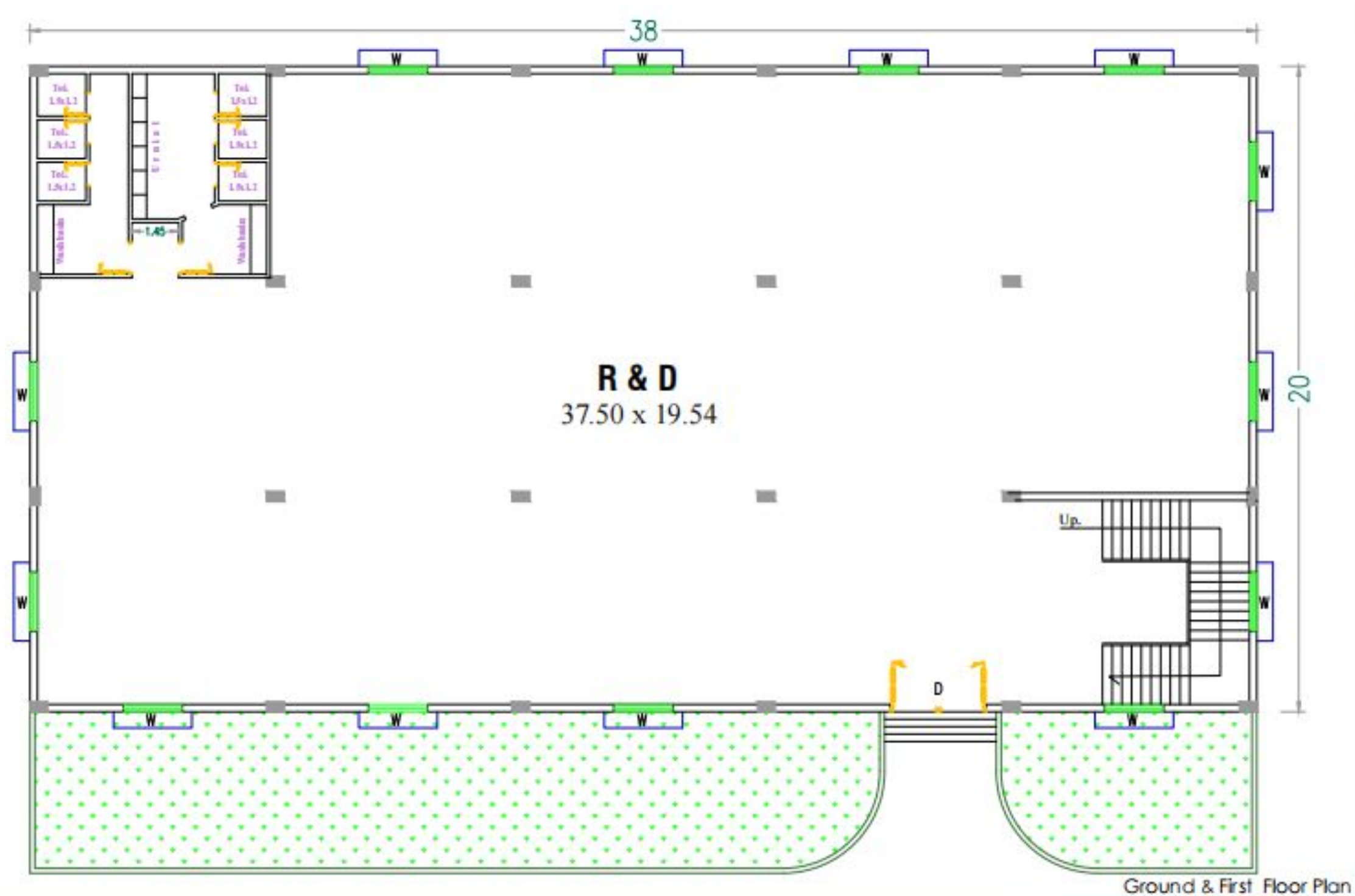
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**IRRUNGATTUKOTTAI - SHED C
FLOOR PLAN**

IRRUNGATTUKOTTAI - RCC BUILDING - DRIVER'S REST ROOM FLOOR PLAN



 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-DRAWING REGISTER - IRUNGATTUKOTAI

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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

Thodukadu - Project Information

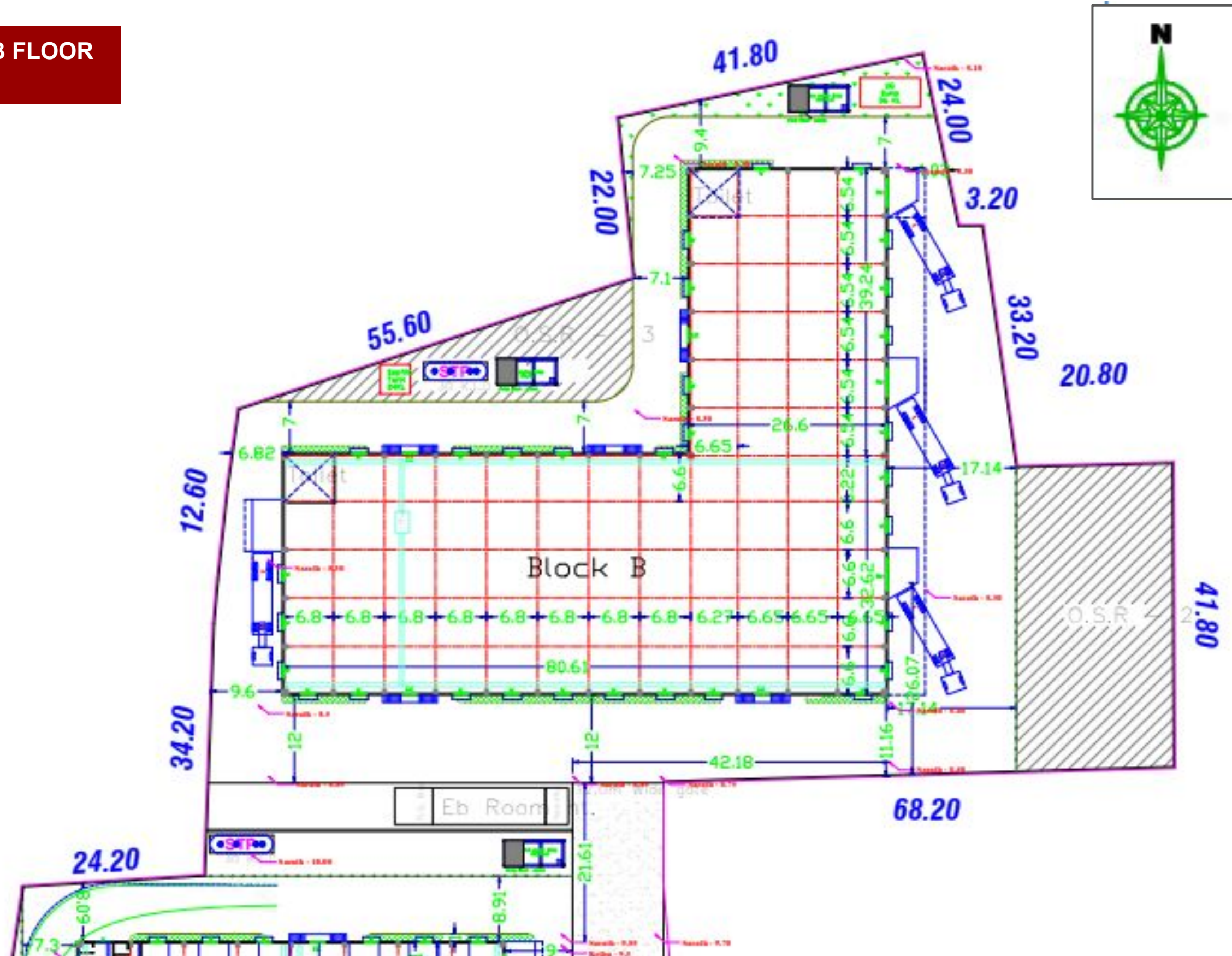
	BLOCK A	BLOCK B
Built up Area	5757 Sq.m	3188 Sq.m
Total Built up Area	8945 Sq.m	
Length of Building	101m (Building), Canopy -106m	71.86 m
Width	57m (Building), Canopy- 5m	80.61m
Clear Height	9 m (Block work-3.123m, Mezzanine-3.5m, Canopy-4.2m)	-
Set Back - North	8.9m	7m
Set Back - South	12.5m	12m
Set 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	

The site plan for Block A is a rectangular plot with a grid of 10 by 10 units. The overall dimensions are 117.79' on the left, 144.04' on the right, and 107.09' on the bottom. The top boundary is 24.20' high. The plan includes a parking area on the left, a road on the right labeled '40'0" WIDE ROAD', and a road on the bottom labeled 'ROAD'. The central area is labeled 'Block A'. The plan also shows various setbacks and dimensions for the building footprint, including a 7.13' setback on the left, a 7.21' setback on the right, and a 7.15' setback on the bottom. The plan is oriented with North at the top.



THODUKADU- BLOCK B FLOOR PLAN



 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- BUILDING FEATURES - THODUKADU

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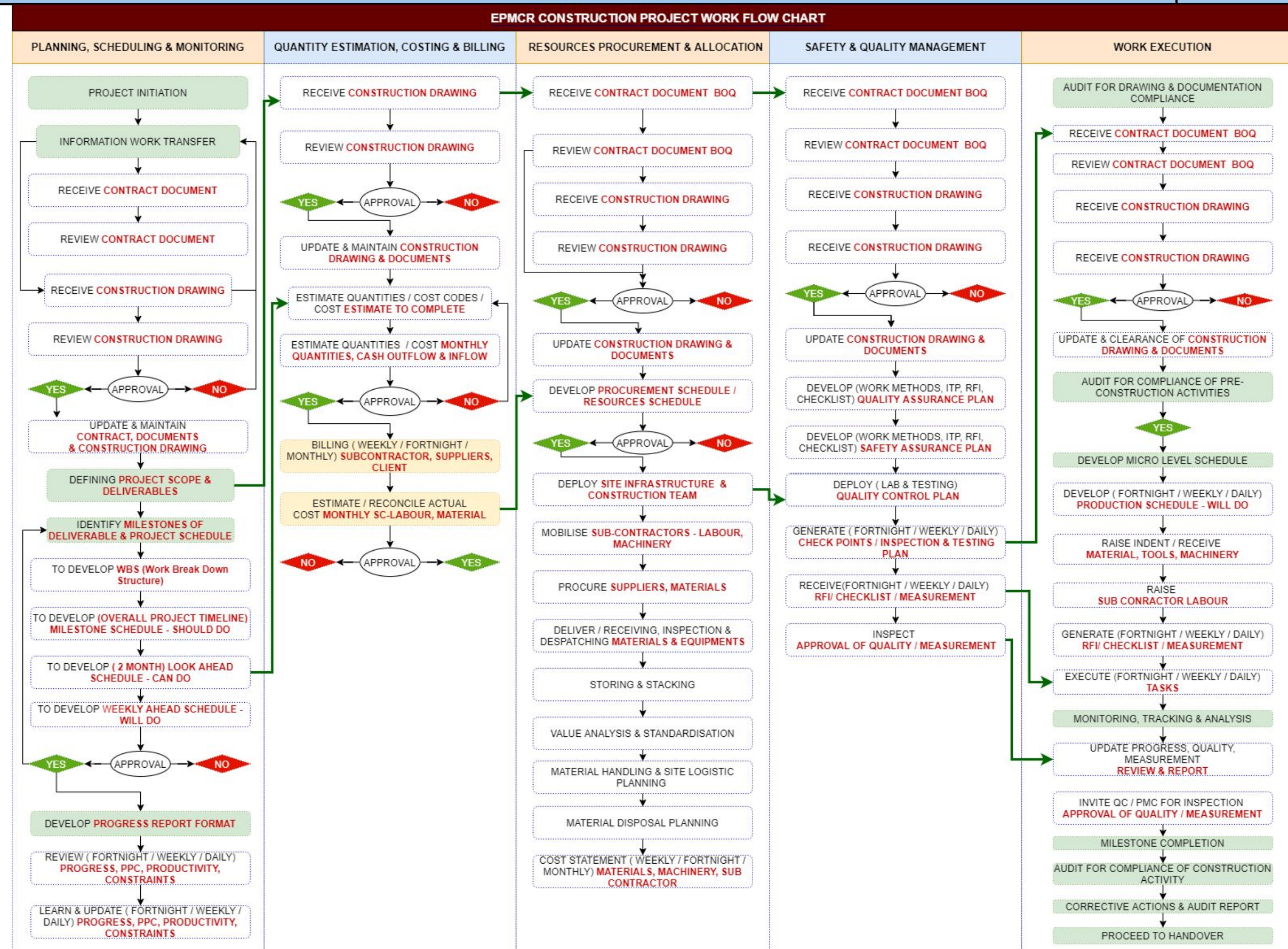
14	G.A Drawings B Block	Cross Section @ GL- 1 to 8			28.11.2020	PDF
15	G.A Drawings B Block	Cross Section @ GL- G,H,J,K & L			28.11.2020	PDF
16	G.A Drawings B Block	Roof Framing Plan			28.11.2020	PDF
17	G.A Drawings B Block	Side Wall Framing Elevation			28.11.2020	PDF
18	G.A Drawings B Block	Side Wall 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

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 - CONSTRUCTION PROJECT MANAGEMENT-WORKFLOW CHART

Page No.: 105



SS LOGISTICS. BANGALORE

PROJECT INFORMATION

PROJECT NAME: SS LOGISTICS

PROJECT TYPOLOGY: INDUSTRIAL - WAREHOUSE FOR FLIPKART

LOCATION: IGGALURU, BANGALORE

CLIENT: FLIPKART

PROJECT AREA: 9952 SQ.M

SERVICE PROVIDED BY EPMCR: PROJECT MANAGEMENT

PROJECT START DATE: DECEMBER 2020

CURRENT STATE OF PROJECT: CONSTRUCTION STAGE

PROJECT EXPECTED CLOSE DATE: MARCH 2021

WORK GIVEN TO INTERNS - SS LOGISTICS, BANGALORE:

TO DESCRIBE THE OVERALL BUILDING FEATURES, WORK SCOPE, WORK BREAKDOWN STRUCTURE, FLOWCHART OF OVERALL SCOPE & WBS, 2 WEEKS LOOK AHEAD SCHEDULE & WEEKLY WORK PRODUCTION PLAN TILL EARTH FILLING & COMPACTION FOR FLIPKART WAREHOUSE, BANGALORE.

HEADING: SS LOGISTICS - PROPOSED WAREHOUSE FEATURES

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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

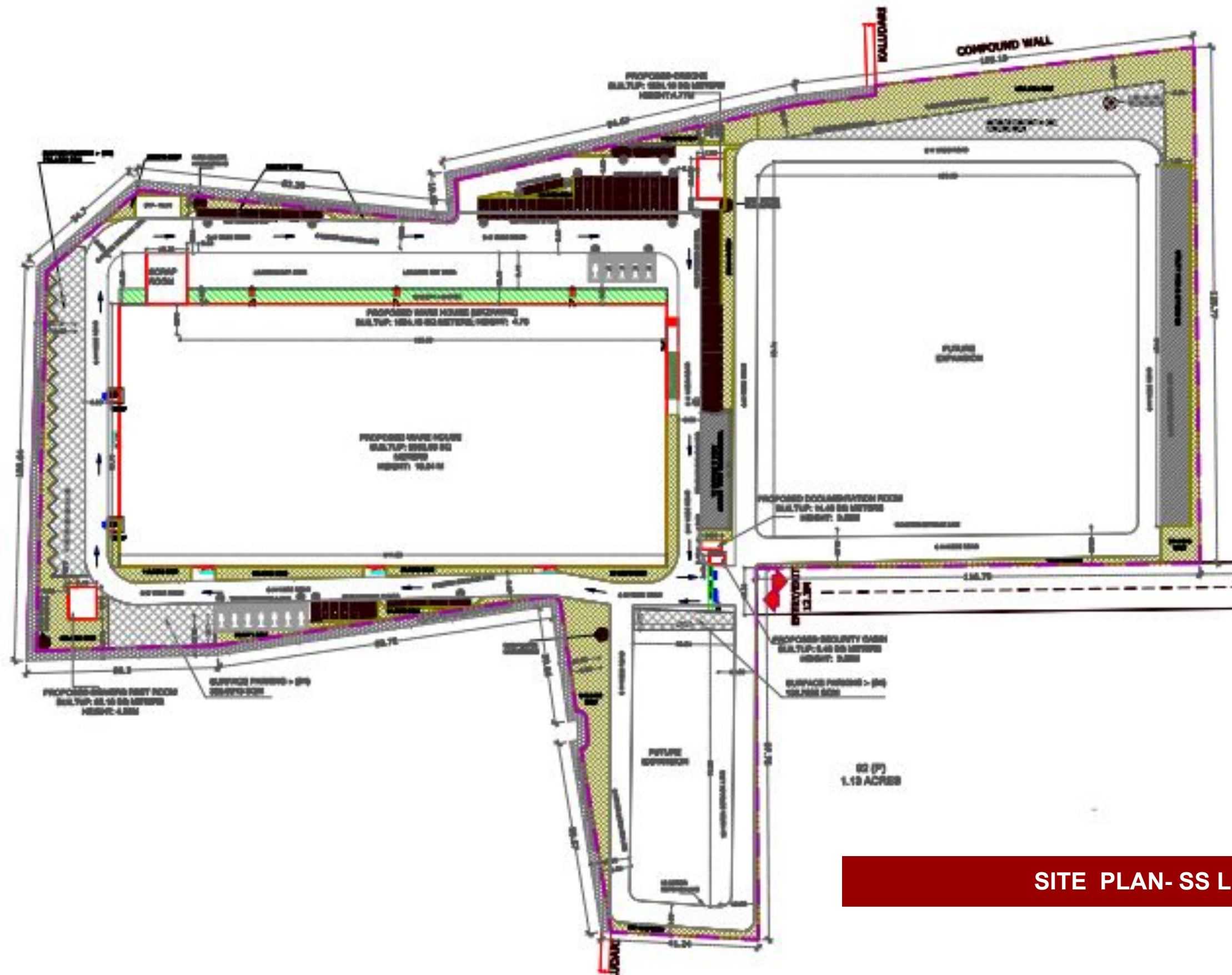
29	Mini Truck Parking	7 Nos; 3.5m x 7.5m
30	Car Parking	75 Nos; 2.5m x 5.5m
31	Bike Parking	257 Nos, 1m x 2m
32	Bus Parking	2.5m x 8.25m; 2 No
33	Ambulance Parking	2.5m x 8.25m; 1 No
34	Dock Leveler	14 Nos.; 2m x 3m
35	Proposed Creche	1024 Sq. m
36	Transformer Yard	6m x 6m
37	Substation	15m x 7m
38	DG 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

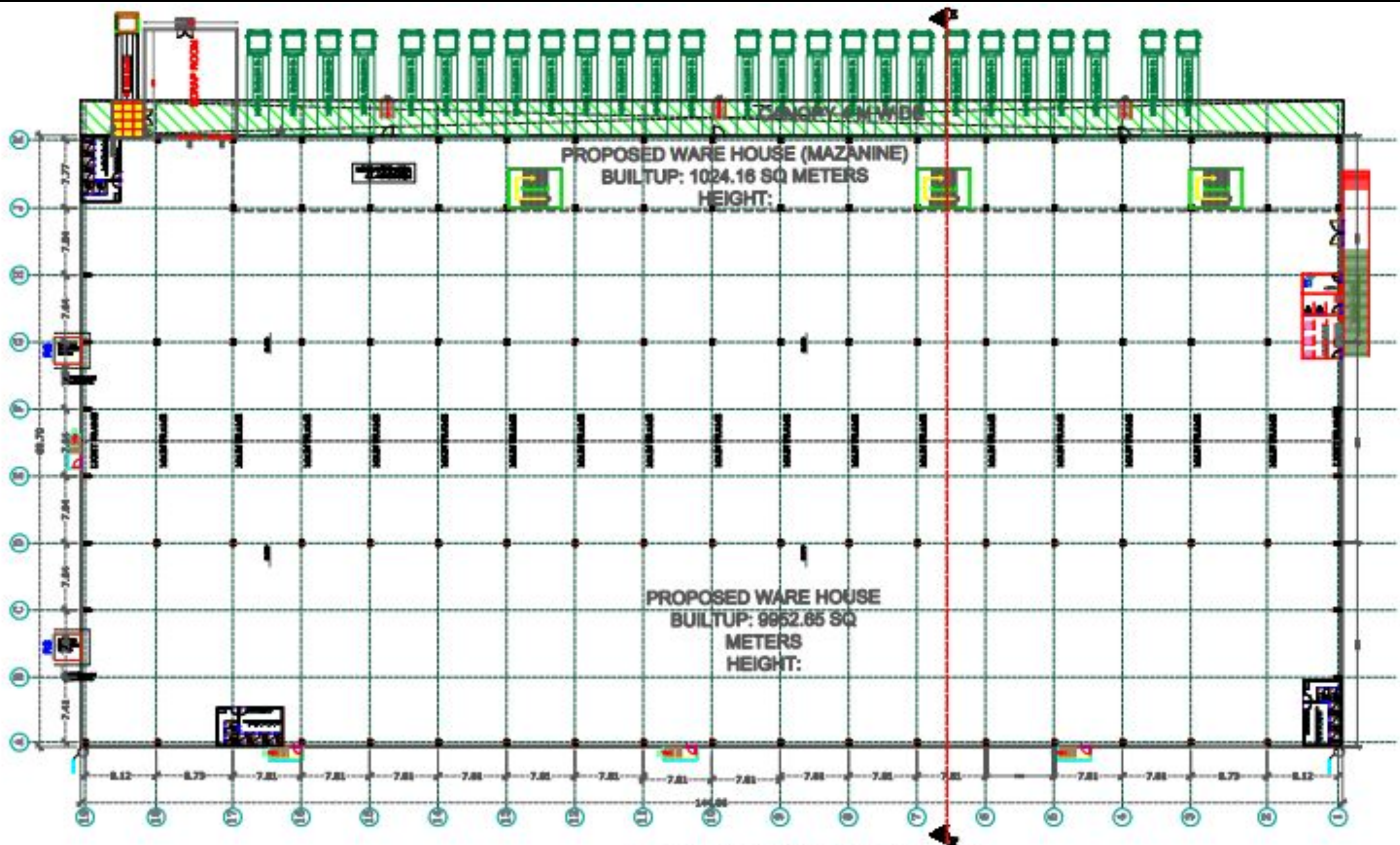
SL. NO.	DESCRIPTION	DIMENSION / NUMBER
1	Site - Future Expansion 01	100m x 99m
2	Site Setback	10 m
3	Site North Road Width	6 m
4	Site South Road Width	6 m
5	Site East Road Width	6 m
6	Site West Road Width	6 m

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



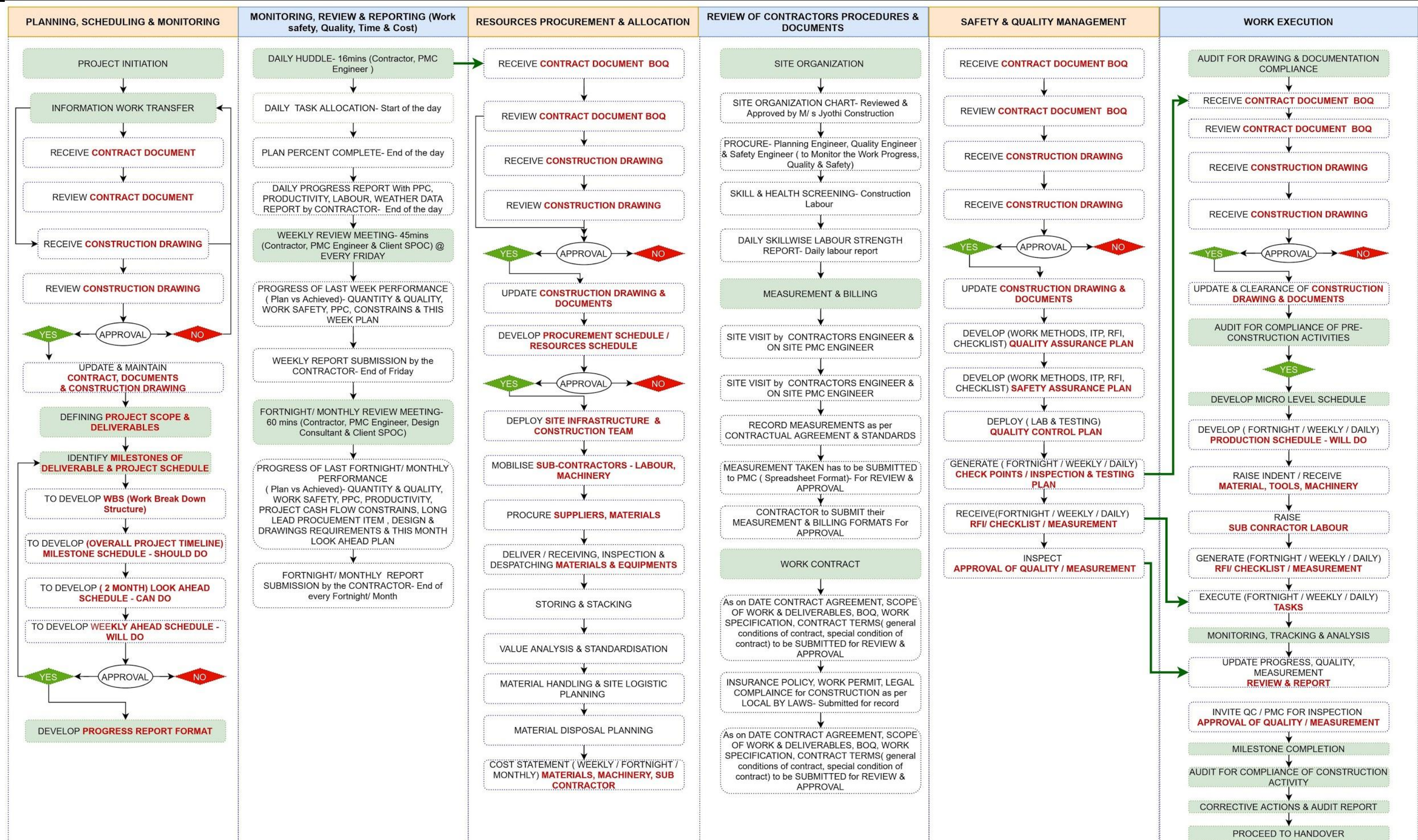
SITE PLAN- SS LOGISTICS



FLOOR PLAN - PROPOSED WAREHOUSE - SS LOGISTICS

HEADING: SS LOGISTICS - PROJECT MANAGEMENT FLOW CHART

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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 Arrester 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: 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

HEADING: 2 WEEKS/ 6 WEEKS LOOK AHEAD SCHEDULE- FORMAT

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FORMAT FOR 2 OR 6 WEEK LOOK AHEAD SCHEEDULE DEVOLOPED BY US BY UNDERSTANDING THE EXISTING 2 OR 6 WEEK LOOK AHEAD SCHEEDULE

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	



HEADING: LOOK AHEAD PLAN- SS LOGISTICS

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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	



HEADING: PRODUCTION PLAN - SS LOGISTICS

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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



HEADING: PRODUCTION PLAN - SS LOGISTICS

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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	
	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)	Civil Work- Footing
	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							
	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- Footing
			Grade Beam	Grade Beam		Grade Beam	Grade Beam	
			SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day		SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	Civil Work- Grading
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		
	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day	SCOPE QTY: 46m / Day		Civil Work- Grade Beam
				Pedestal Reinforcement	Pedestal Reinforcement	Pedestal Reinforcement	Pedestal Reinforcement	



HEADING: PRODUCTION PLAN - SS LOGISTICS

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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					

HEADING: PRODUCTION PLAN - SS LOGISTICS

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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			
	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	Pedestal Column Concreting.	
	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						
	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			
	Shuttering	Shuttering						
	SCOPE QTY: 12 Nos of Column / Day	SCOPE QTY: 12 Nos of Column / Day						
	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		

Civil Works- Stiffener Column

Civil Works- Masonry Up to FFL

Civil Works- Basement Earth Filling & Compacting.

Civil Work- Pedestal

Civil Works- Stiffener Column

Civil Works- Stiffener Column

PROPOSED SCHOOL BUILDING, CHITRAKOOTA, BANGALORE

PROJECT INFORMATION:

PROJECT NAME: PROPOSED SCHOOL BUILDING- CHITRAKOOTA, BANGALORE

PROJECT TYPOLOGY: INSTITUTION - SCHOOL

LOCATION: BANGALORE

CLIENT: CHITRAKOOTA SCHOOL

PROJECT AREA: 9952 SQ.M

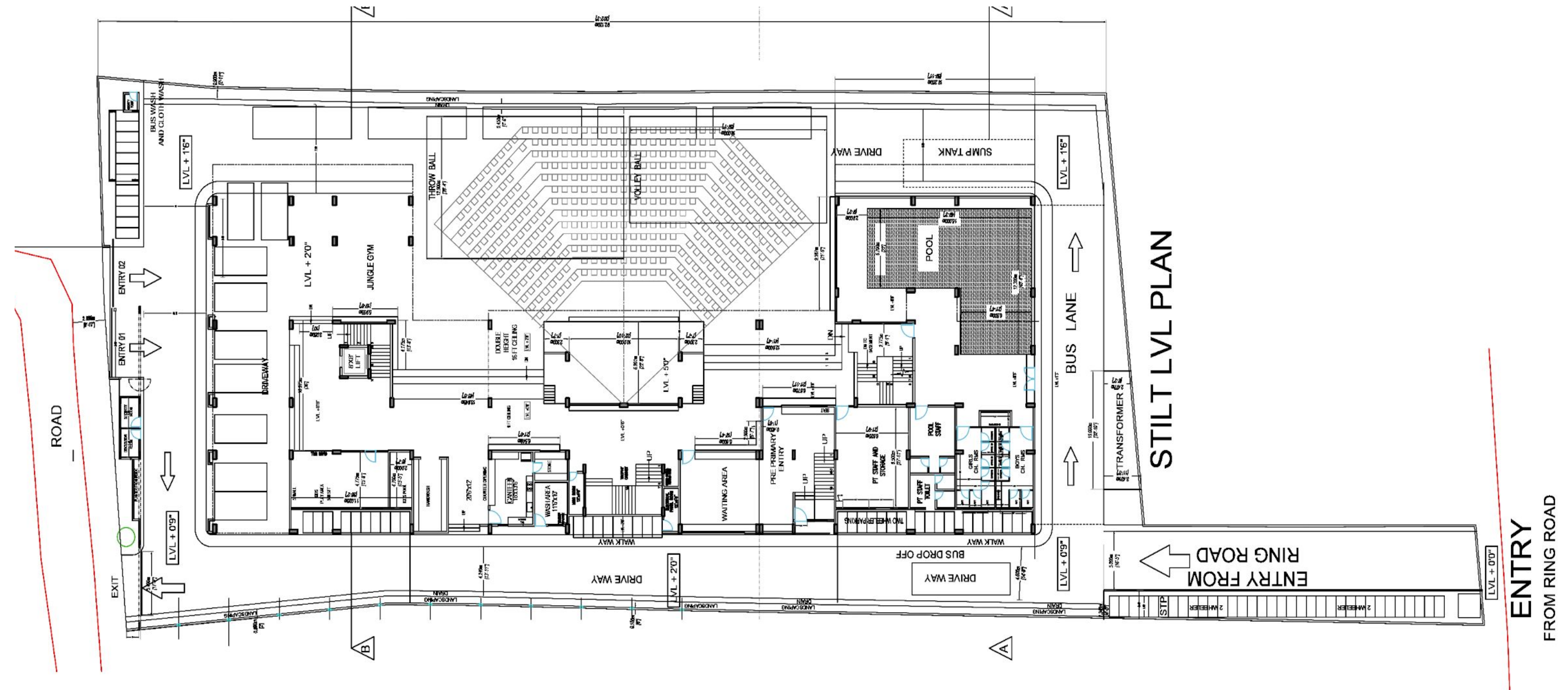
CURRENT STATE OF PROJECT: INITIATION STAGE

SERVICE PROVIDED BY EPMCR: PROJECT MANAGEMENT

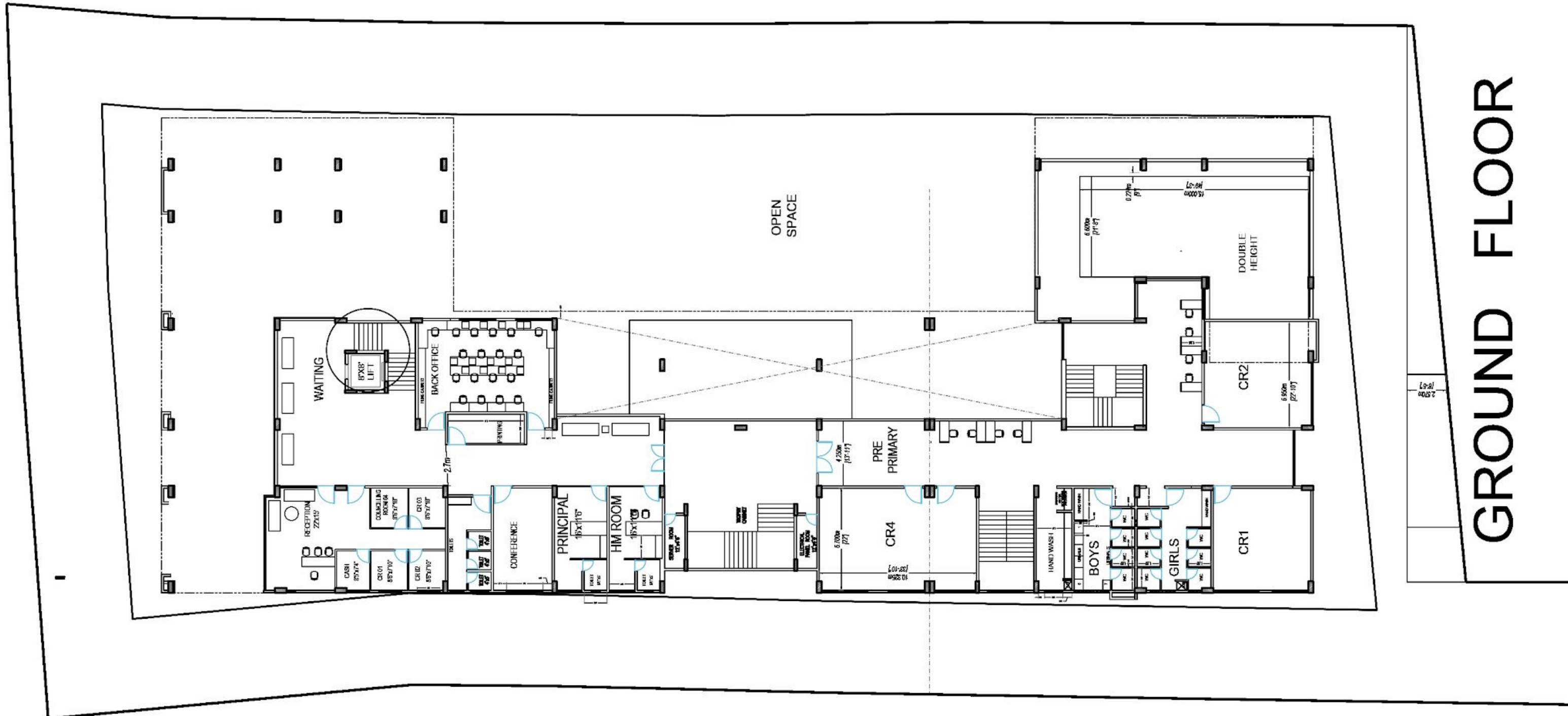
WORK FOR INTERNS - PROPOSED SCHOOL BUILDING, CHITRAKOOTA, BANGALORE:

TO DEVELOP SCOPE DOCUMENT FROM THE GIVEN DRAWINGS FOR THE SCHOOL BUILDING TO GIVE OVERALL IDEA OF PROJECT REQUIREMENT TO THE CLIENT.

STILT FLOOR PLAN - SCHOOL

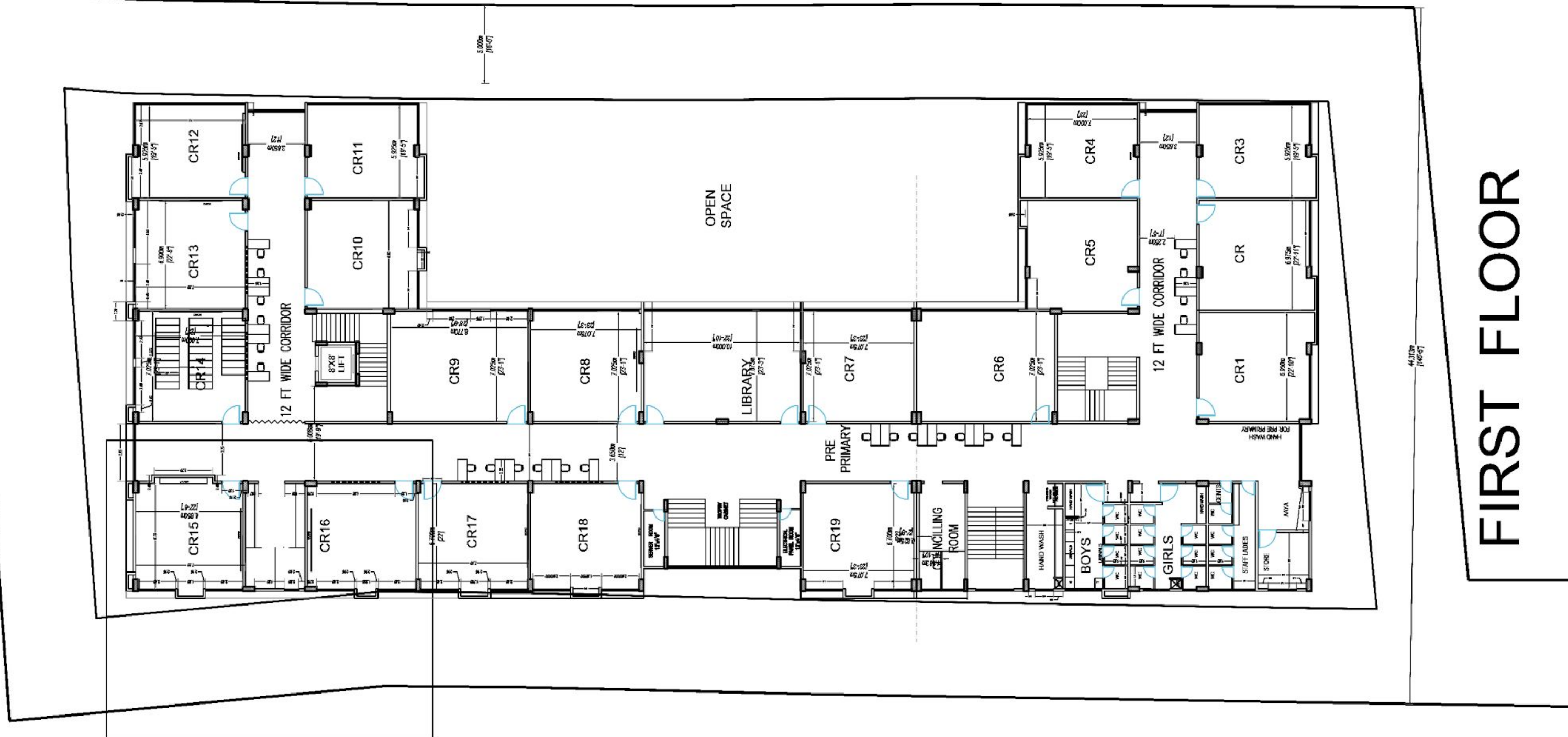


GROUND FLOOR PLAN- SCHOOL



GROUND FLOOR

FIRST FLOOR PLAN- SCHOOL



FIRST 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: CHITRAKOOTA SCHOOL BUILDING - SCOPE DOCUMENT

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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: CHITRAKOOTA SCHOOL BUILDING - SCOPE DOCUMENT

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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		



PLANNING & TRACKING SYSTEM AT SITE - DAILY PROGRESS



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

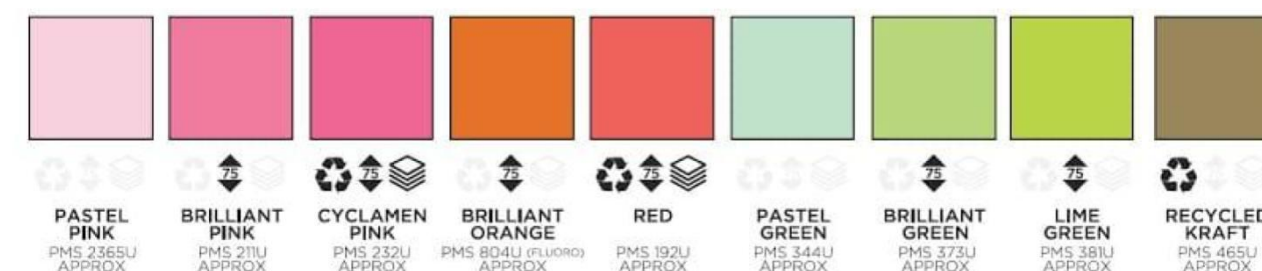
A2/ A3 BOARD FORMAT - 1 WEEK

STICKY NOTE FORMAT

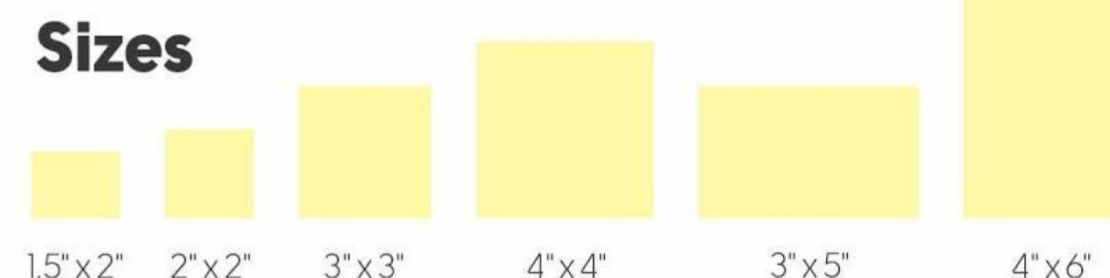
Activity ID	
Activity Name	
Location Id	
Structure Id	
Quantity to complete & Remaining	
Resources	
Resp. Person	
Predecessor	
Successor	

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

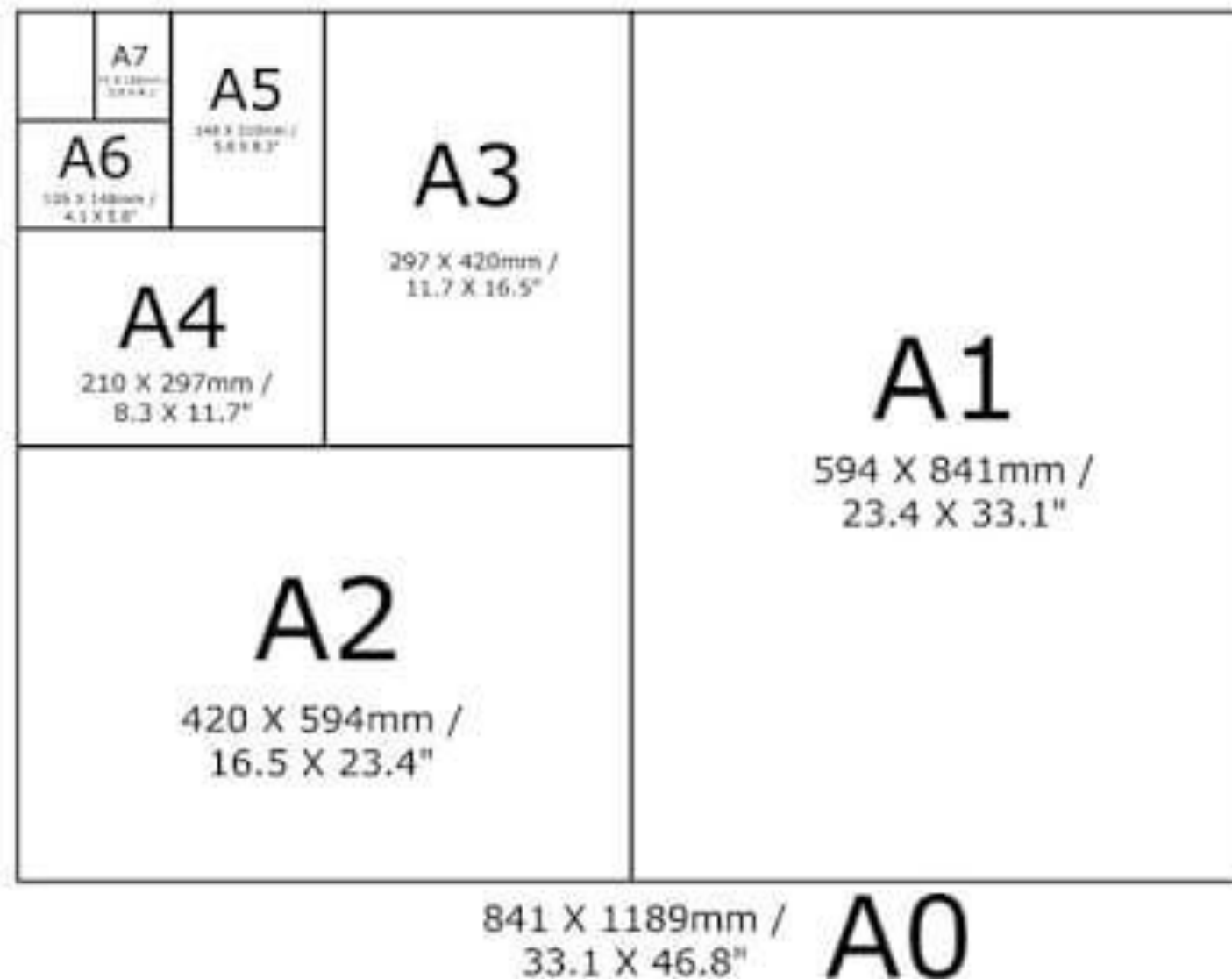


HEADING: FORMAT FOR PLANNING & TRACKING SYSTEM AT SITE

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

WORKABILITY SAMPLE



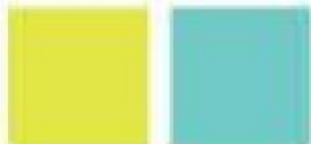
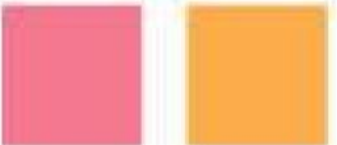
A2 BOARD FORMAT - SCHEDULE COMPOSITION

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

A3 BOARD FORMAT - SCHEDULE COMPOSITION

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

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

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

SHEET SIZE:

A3 (Daily Progress) / A2 (Activity Progress)

STICKY NOTE SIZE:

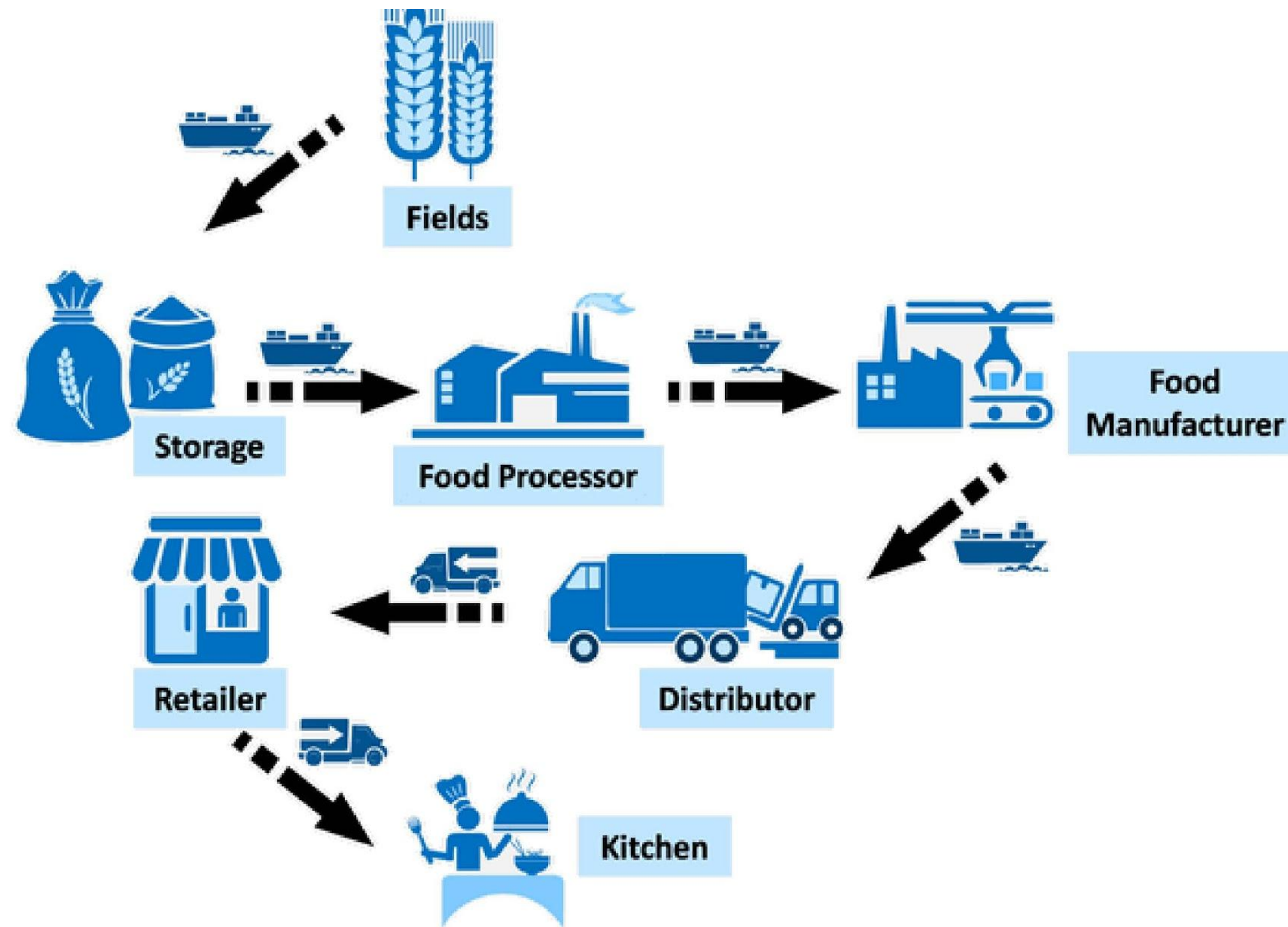
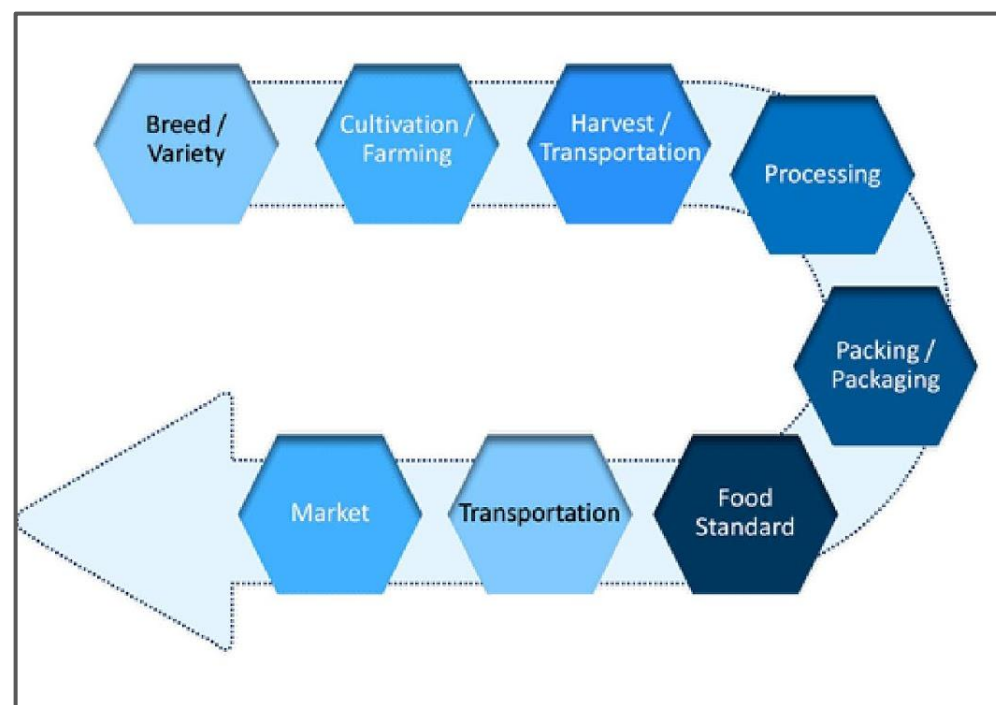
2"x 2" (A3 SHEET) ; 3" x 3" (A2 SHEET)



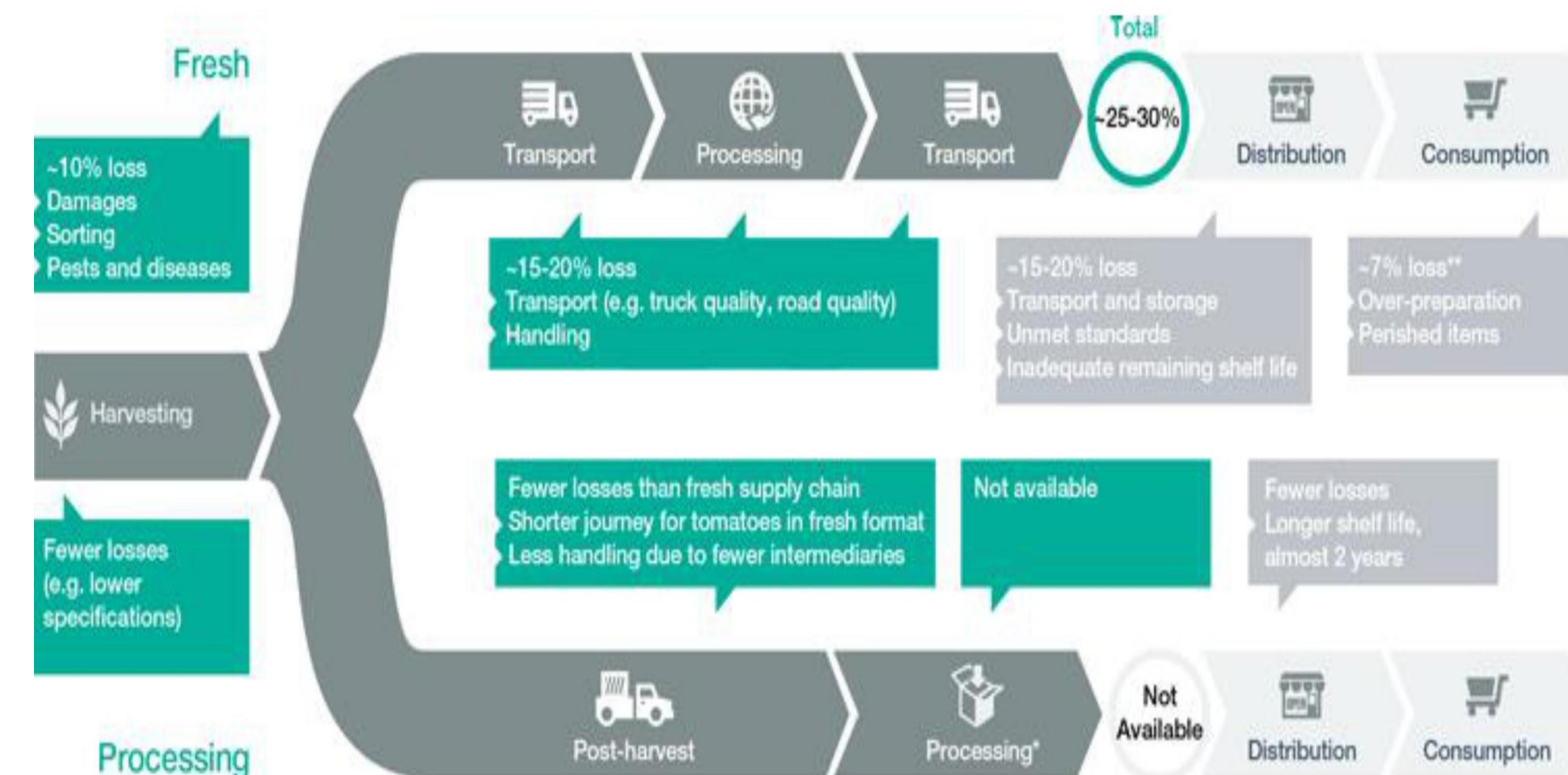
AGRI FOOD SUPPLY SYSTEM

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.



TOMATO FOOD SUPPLY CHAIN



INTERESTING FACTS ABOUT TOMATO FARMING IN INDIA:

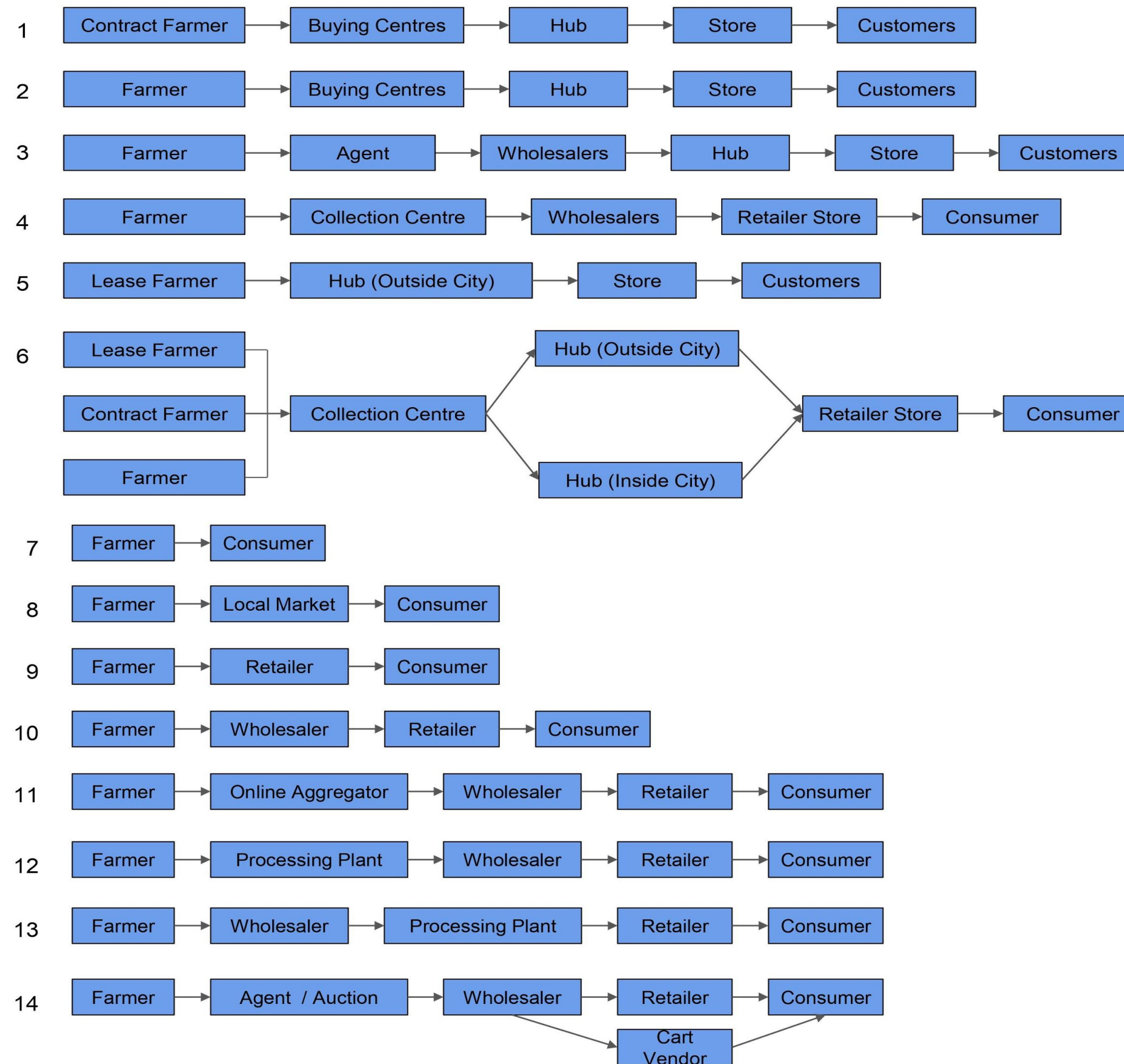
- 2nd most widely grown vegetable in India after potatoes
- 2nd largest tomato producer worldwide is India
- 17 mn tonnes produced in India in 2014-15
- 20 tons/hectare (ha) Low yields
- World average - 33 tons/ha; China average 48 tons/ha
- 10-15% Indian tomatoes exported in 2015
- 1% of the total production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



HEADING: AGRI FOOD SUPPLY CHAIN

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FOOD SUPPLY CHAIN - TYPOLOGY





PROJECT MANAGEMENT SYSTEM & TECHNIQUES



HEADING:

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LEAN PROJECT MANAGEMENT SYSTEM

LEAN CONSTRUCTION MANAGEMENT

“Lean is a philosophical way of working which emphasises on the removal of waste within a process & improve the quality while the production time and cost are reduced.

It identifies three types of waste; **Muda, Mura, And Muri**, also known as the **3Ms**.

➤ **Muda:**

Muda is about getting **rid of waste**, and refers to an activity or process that **does not add value**.

- **Transport:** The movement of product between operations and locations
- **Inventory:** The work in progress (WIP) and stocks of finished goods and raw materials that a company holds.
- **Motion:** The physical movement of a person or machine whilst conducting an operation.
- **Waiting:** The act of waiting for a machine to finish, for a product to arrive, or any other cause.
- **Overproduction:** Over producing product beyond what the customer has ordered.
- **Over-processing:** Conducting operations beyond those that customer requires.
- **Defects:** Product rejects and reworks within your processes.

Mura : Mura is about **eliminating variances in the workflow process** at a scheduling and operation level so that **everything flows evenly**.

Muri : Muri is about **removing overload so that the nothing slows down**.

Five main Lean principles are:

- **Specify the value** desired by the customer
- Identify the steps in the **value stream** providing that value and challenge for all the wasted steps involved.
- Make the **product flow continuously** through the remaining value-added steps
- **Introduce pull** between all steps where continuous flow is possible
- Manage Towards **Removing Unnecessary Steps**.

BENEFITS OF LEAN PRACTICES AND CULTURE

1. Learning from one another helped us help each other
2. Openly discussed and resolved issues
3. Accuracy of model allowed for batching & prefabrication
4. Coordination complete before construction, which meant no additional time needed to create coordination drawings.



LEAN FOCUSES ON:

1. Generate Value: Identify and deliver value to the customer and to eliminate anything that doesn't add value to meet client's objectives.
2. Eliminate rework, minimize waste and optimise as a whole.
3. Increase productivity & safety.
4. Focus on flow: Organise production as continuous flow
5. Respect for people and human centric approach
6. Continuous Improvement
7. Reduce Cost, Time and Effort.
8. Pull Scheduling
9. Just in time

THROUGH BETTER RELIABLE AND FLEXIBLE TOOLS AND TECHNIQUES THAT ARE BASED ON:

- Commitment based approach- in terms of planning
- Target Value Delivery
- Collaborative Culture:
- Common communication and coordination collaborative platform.
- Collaboration of all the stakeholders from the earlier stage of the project till handling over of the project.
- Co-location of stakeholders.
- Shared Risk & Reward.
- Integrated design delivery
- Maintaining Accountability and trust with no compromise.
- 3 P's (People, Product, Processes):
- People - Ensure Their Expectations And Satisfaction Of Both Internal & External Are Met To The Best Of The Abilities
- Process- Continuous Strive To Get Better In All Processes.
- Product - Conforms To Specifications & Requirements Of All Product Characteristics.
- Root Cause Analysis for Problem solving
- Weekly work plan (small milestones based extensive planning, scheduling, monitoring and tracking, that involves part to whole approach).
- Daily meets & Regular reporting - Daily, weekly and monthly basis.
- Balanced design approach between social and technical aspects.
- Transformation, flow and value theory approach for design delivery

HEADING: LEAN PROJECT MANAGEMENT - TOOLS

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CHOOSING BY ADVANTAGES (CBA)

A sound method of decision making method based on the importance of advantages.

- Methods for *conversations about+ making decisions produce decisions.
- Decisions guide actions.
- Actions produce outcomes.

Beneficial difference between attributes of 2 alternatives:

*Canoe C is 10lbs lighter than Canoe A



Examples of Attributes	Examples of Advantages
Eighty inches tall	Two inches taller
A very nice light blue color	Much nicer color
Moderately smooth finish	Slightly smoother finish
With speed control	With <u>versus</u> without speed control

CONTINUOUS FLOW:

UNINTERRUPTED & STANDARDISED INFORMATION FLOW: RFIs, Submittals, Change Requests, Project Reports.

- Clear Requirement & Scope Analysis – All stakeholders
- Clear identification & instructions on deliverables & work flow pattern.
- Change order management with more customer involvement and proactive action to satisfy the customer's Requirement.

PLAN – DO – CHECK – ACT (PDCA):

PDCA / PDSA is an iterative, four-stage approach for continually improving processes, products or services, and for resolving problems. It involves systematically testing possible solutions, assessing the results, and implementing the ones that are shown to work.

The four phases are:

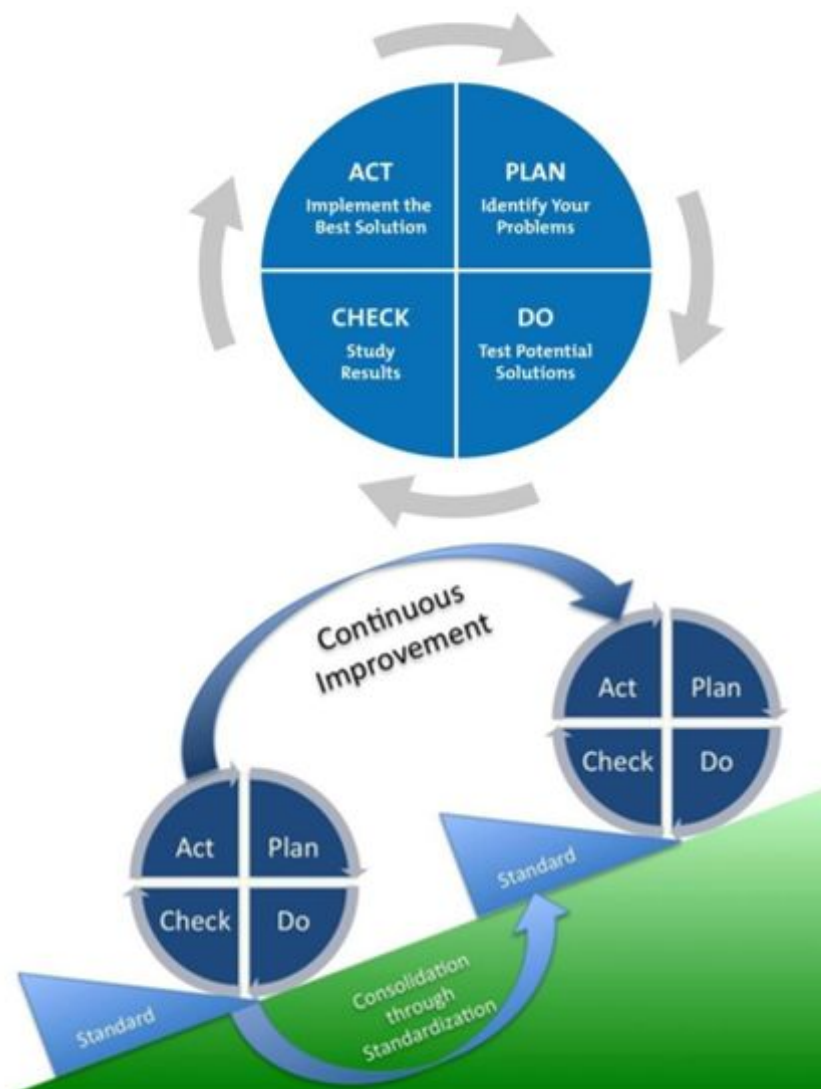
Plan: identify and analyse the problem or opportunity, develop hypotheses about what the issues may be, and decide which one to test.

Do: test the potential solution, ideally on a small scale, and measure the results.

Check/Study: study the result, measure effectiveness, and decide whether the hypothesis is supported or not.

Act: if the solution was successful, implement it.

Figure 1: The Plan-Do-Check-Act Cycle



- Involvement of Client & user effectively & intentionally is mandatory
- Effective engagement of all stakeholders in collaborative approach from beginning
- Avoidance of delay of response / Information flow; and leading to value generation by removing waste.

CO-LOCATION:



Technique of Lean & IPD (Integrated Project Delivery), Which is intended to improve collaboration through greater team integration by physically bringing together designers, builders, users and owner together to work in a single **location**, generally on-site or within close proximity of the project site.

SET – BASED DESIGN:

In practice there are many more than **two parties around the funnel**, Each has a point of **view** that can **contribute to the optimisation** of the project as a **whole & to develop a set of possible solutions to product design** and production design problems and then to decide at the last responsible moment, that **allows the project team time to develop a number of design options in parallel and then choose between them with agreement among stakeholders**. All of which **reduces the need for later rework**.

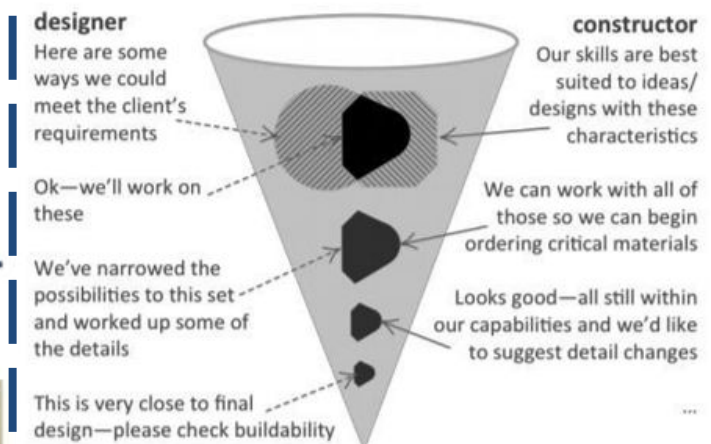
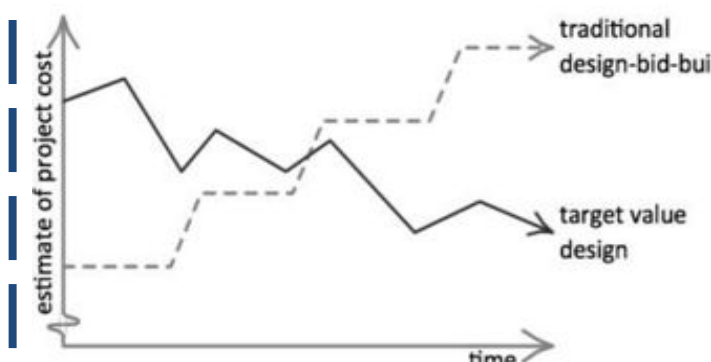


Figure 6: Set-based design dialogue (after Sobek et al 1999)

TVD:

Within the TVD process, design is based on detailed estimates, rather than estimates waiting for a detailed design. This requires new skills, the ability and willingness – to provide estimates on the basis of incomplete & conceptual designs.



HEADING: LEAN PROJECT MANAGEMENT - TOOLS

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ROOT CAUSE ANALYSIS:

Root Cause Analysis (RCA) helps to answer the question of why the problem occurred in the first place. It seeks to identify the origin of a problem using a specific set of steps, with associated tools, to find the primary cause of the problem, to:

- Determine **what happened**.
- Determine **why it happened**.
- Figure out **what to do to reduce the likelihood that it will happen again**.

3 BASIC TYPES OF CAUSES:

Physical causes – Tangible, material items failed in some way

Human causes – People did something wrong, or did not do something that was needed. Human causes typically lead to physical causes

Organizational causes – A system, process, or policy that people use to make decisions or do their work is faulty

Note: RCA reveals more than one root cause.

THE ROOT CAUSE ANALYSIS PROCESS – 5 STEPS:

Step 1: Define the Problem

- What do you see happening?
- What are the specific symptoms?

Step 2: Collect Data

- What proof do you have that the problem exists?
- How long has the problem existed?
- What is the impact of the problem?

Step 3: Identify Possible Causal Factors

- What sequence of events leads to the problem?
- What conditions allow the problem to occur?
- What other problems surround the occurrence of the central problem?

Step 4: Identify the Root Cause(s)

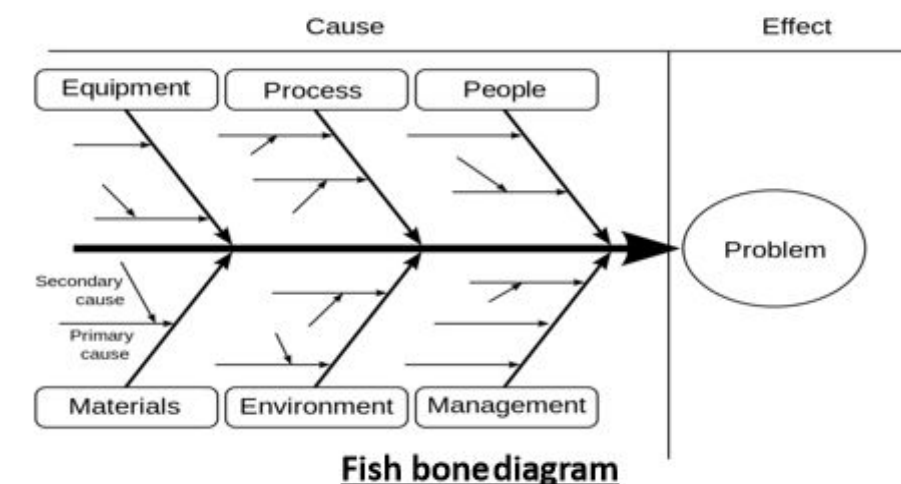
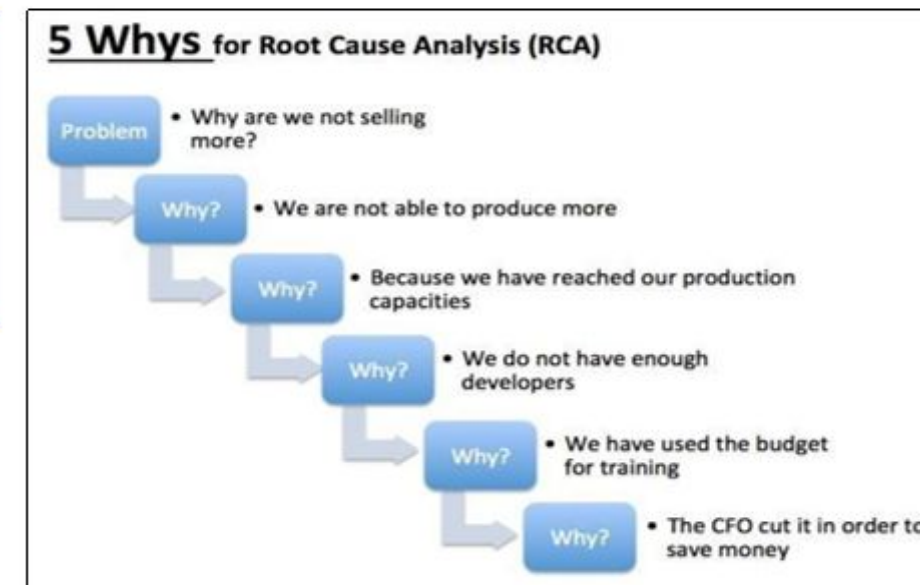
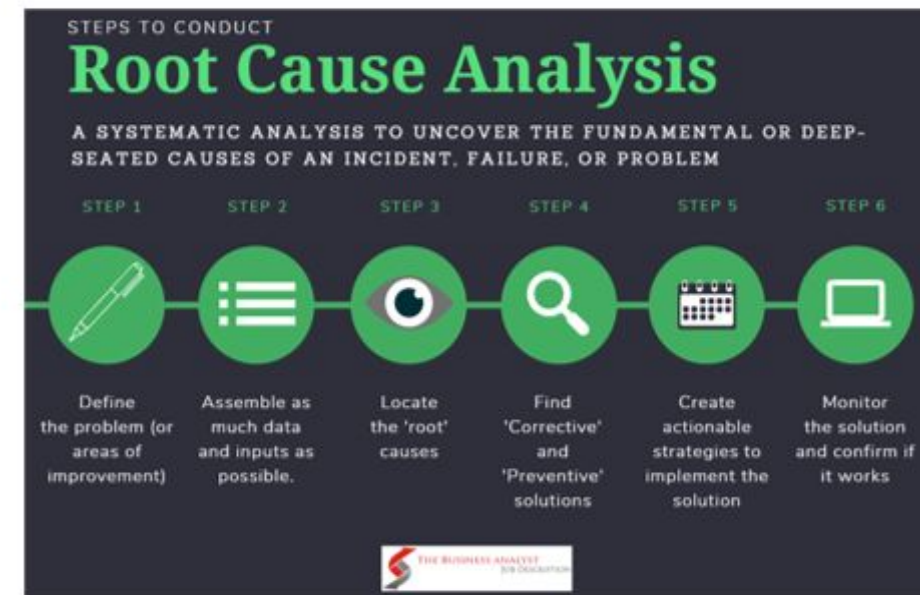
- Why does the causal factor exist?
- What is the real reason the problem occurred?

Step 5: Recommend and Implement Solutions

- What can you do to prevent the problem from happening again?
- How will the solution be implemented?
- Who will be responsible for it?
- What are the risks of implementing the solution?

Use these tools to help identify causal factors:

- **5 Whys** – Ask "Why?" until you get to the root of the problem.
- **Cause and Effect Diagrams** – Create a chart of all of the possible causal factors, to see where the trouble may have begun.



EVIDENCE-BASED DESIGN / RESEARCH-BASED DESIGN.

Supporting set-based design, evidence-based design (EBD) exists to help designers make a connection between design and the outcomes that owners want from their buildings. EBD research seeks to establish relationships between design decisions and desired corporate outcomes. Choosing to use EBD is a commitment to basing design (generating, evaluating, selecting from alternatives) on the best available evidence, and to actively search for and create that evidence.

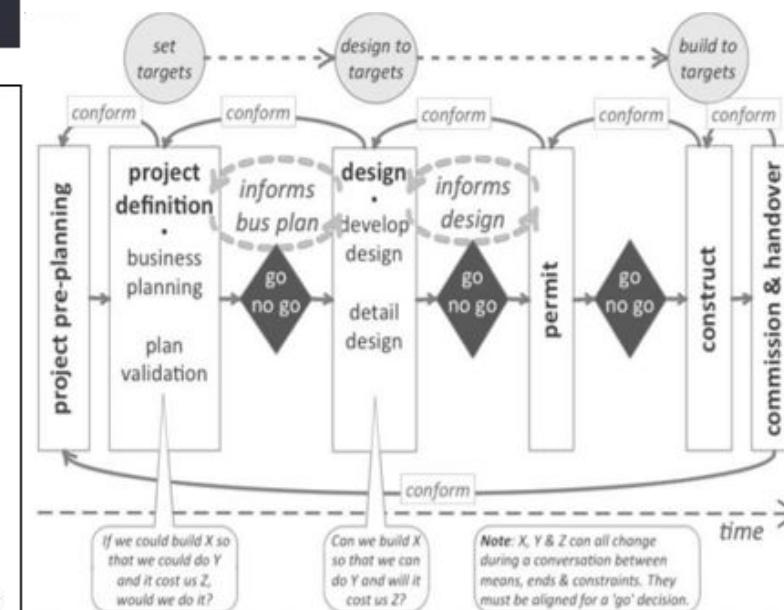
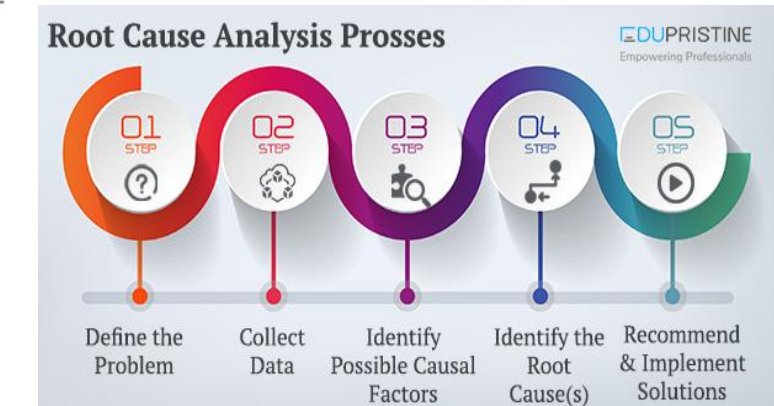


Figure 9: The Target Value Design Process (after Ballard 2009 with additional material from Long et al 2007))



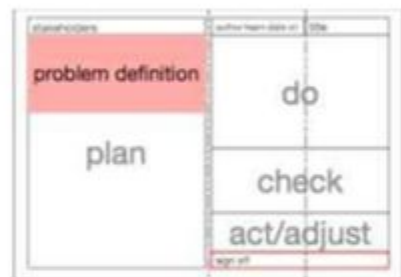
HEADING: LEAN PROJECT MANAGEMENT - TOOLS

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A3 DESIGN THINKING / PROBLEM SOLVER:

There are a number of **different uses of A3s**:

- Problem solving – Through PDCA & Root cause Analysis
- Tracking & Monitoring
- Making proposals
- Status reporting
- Strategic planning
- Documenting decisions

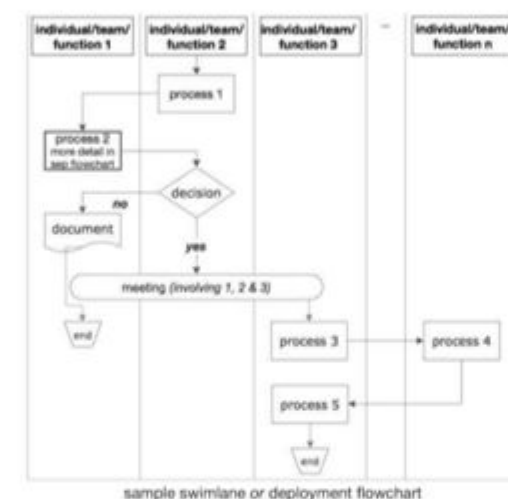
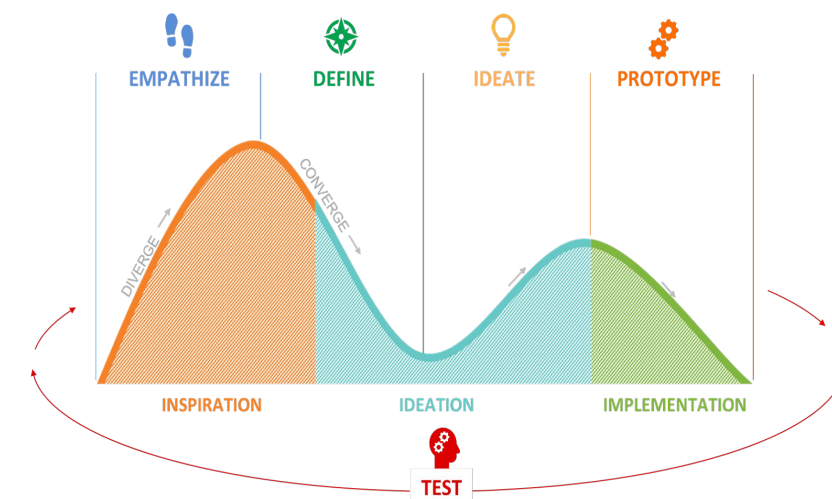
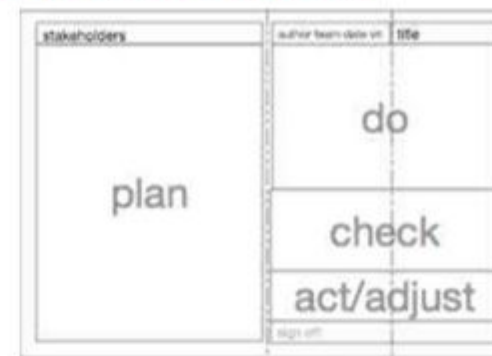
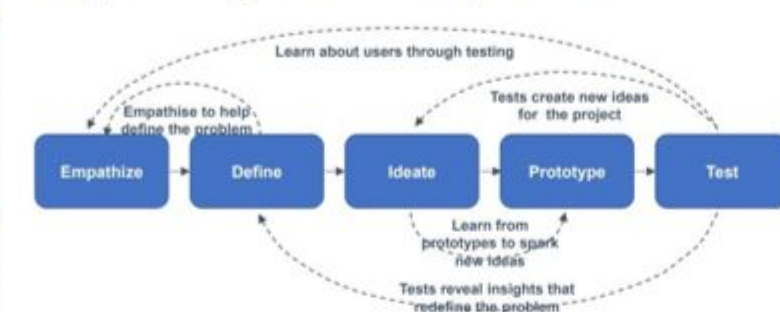


One can employ swimlane diagram for flow chart- to demonstrate current practices involved

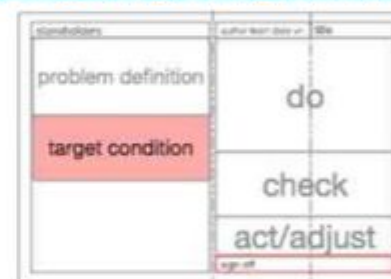
Purpose:

Group of people to agree on a problem definition, study the problem and its causes, agree on one or more countermeasures, implement it/them, & measure from what happened and what they learnt in the process.

Design thinking: A non-linear process



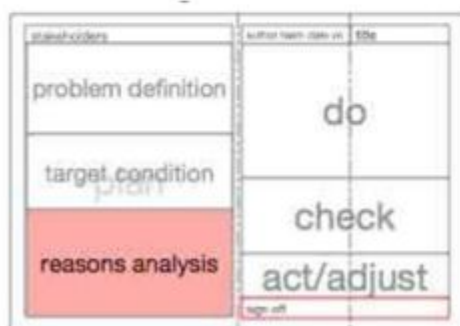
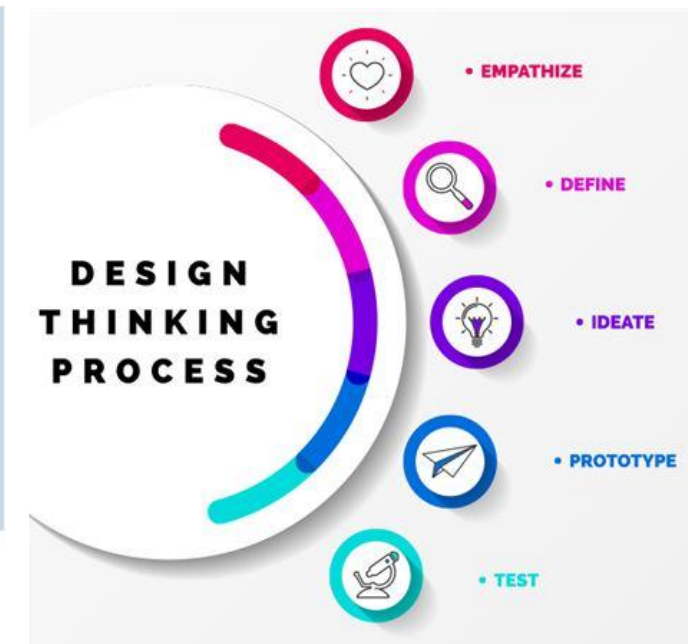
STEP 02: Agreeing the Target Condition-Plan



Describe how you would like the process to be working & What will be happening when you have reached your target condition? what the process will be achieving & ensure quantities are clearly stated.

PDCA has 5 steps **look-ask-model-discuss-act** (LAMDA for short):

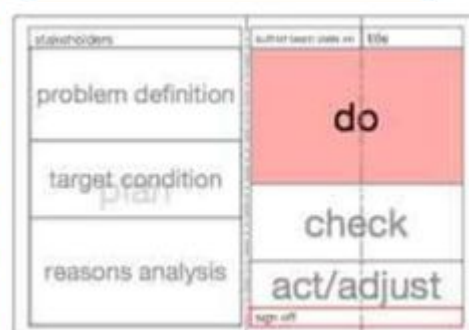
- **Look** = 'go and see' the problem for yourself;
- **Ask** others for their opinions about the problem;
- **establish root causes** and
- **Model the problem** using the information you have;
- **Discuss** what you have learnt with key stakeholders and
- Get agreement so that you can **take action**.



Observe the process (go and see)

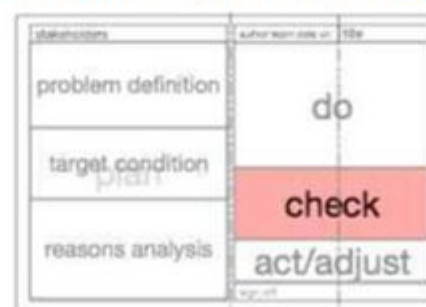
Use: **5 Why** or **fishbone diagram** to identify root causes.- Test (check) causes & analysis – with the benefit of ideas and observations from co-workers

STEP 04: Choosing & Planning what you will do – Counter Measures



2 Sorts Of Countermeasures: **Short-term Countermeasures** (Not based on Root cause). **Longer-term, Systemic Countermeasures**, Based on thoroughly Understanding **Root Cause(s)**. **Implement & Track them.**

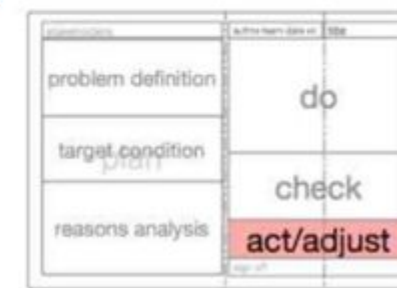
STEP 05: Check – Did your plan work?



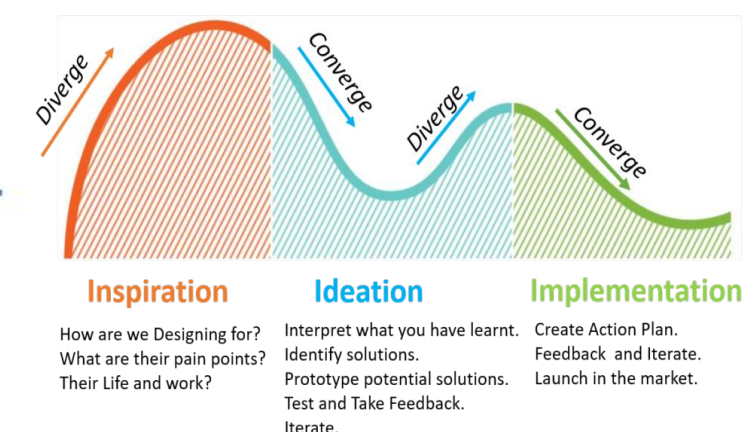
With everyone involved, carefully study:

- What you did
- What results you got
- How these results compare with the results from the process before the change
- To what extent (if any) the change was an improvement
- Note what you have learnt
- About the process
- About the test you have done, process improvement generally & the A3 process.

STEP 06: Act= Adjust, Redesign, Revisit the process or create a new standard, Learn & Record



Human Centered Design



Inspiration How are we Designing for? What are their pain points? Their Life and work?

Ideation Interpret what you have learnt. Identify solutions. Prototype potential solutions. Test and Take Feedback. Iterate.

Implementation Create Action Plan. Feedback and Iterate. Launch in the market.



A3 DESIGN THINKING AT EPMCR

A3 DESIGN THINKING FORMATS CREATED BASED ON UNDERSTANDING THE FORMATS WHICH ARE PRESENT AT EPMCR,CHENNAI THAT WAS CREATED BY Mr.KAVIN KUMAR TO USE A3 SHEETS AS :

1. DESIGN THINKING SHEETS TO UNDERSTAND THE PROJECT & EVOLVE IDEAS / SOLUTION
2. UNDERSTANDING CHALLENGES, THEIR ROOT CAUSE/ PAIN POINT, ,EMPATHIZE & IDEATE TO PROVIDE SOLUTION - PDCA APPROACH
3. IMPLEMENT , REPORT THE PROGRESS / TEST REPORT, DOCUMENT THEM, GET FEEDBACKS & ACT / ADJUST TO UNDERGO CONTINUOUS IMPROVEMENT IN COLLABORATIVE APPROACH OF ALL THE STAKEHOLDERS.

A3 DESIGN THINKING FORMAT THUS INCLUDES FOLLOWING TYPOLOGIES:

1. A3 UNDERSTANDING
2. A3 SITE VISIT TEMPLATE
3. A3 EMPHATHIZE SHEET
4. A3 PROJECT MILESTONE IDENTIFICATION & PROCESS
5. A3 IDEATING SHEET
6. A3 SOLUTION SHEET
7. A3 SOLVER

A3 DESIGN THINKING - A3 SITE VISIT TEMPLATE

COMPANY LOGO		TITLE				COMPANY DESCRIPTION		
DATE		CLIENT NAME		PROJECT CODE		AUTHOR / SURVEYOR NAME		
TIME				PROJECT NAME				
PROJECT DESCRIPTION			INFORMATION (DATA COLLECTION)		CHECKLIST (DRAWING)			REMARKS
REF. NO.	LOCATION	AREA		KEY MAP/MASTER PLAN	LEGEND		DIMENSIONS	GENERAL NOTE
AUTHOR SIGNATURE / ATTESTATION			AUTHOR NAME & DESIGNATION	DATE & TIME	COPYRIGHTS	DECLARATION : (If any)		



HEADING: LEAN PROJECT MANAGEMENT -TOOLS - A3 DESIGN THINKING AT EPMCR

A3 DESIGN THINKING- A3 UNDERSTANDING

**SATHYABAMA INSTITUTE OF
SCIENCE AND TECHNOLOGY**

M.Arch-BUILDING MANAGEMENT- INTERNSHIP REPORT (2019 - 2021)

NAME: Monisha Nageswaran
REG. NO.: 39840021



A3 DESIGN THINKING - A3 EMPHATHIZE SHEET

DESCRIPTION OF PROJECT / WORK / ACTIVIYTY / TASK					AUTHOR:		DATE:	TITLE
							REV.NO:	
INTERNAL STAKEHOLDERS								
STAKEHOLDER NAME	ACTIVITY	ROLES & RESPONSIBILITIES	WHAT DID YOU HEAR	WHAT DID YOU OBSERVE	KEY CHALLENGES / CONSTRAINTS- - "I WONDER IF THAT MEANS"	PROBLEMS	EXPECTATION / ASPIRATIONS	REMARK
EXTERNAL STAKEHOLDERS								
STAKEHOLDER NAME	ACTIVITY	ROLES & RESPONSIBILITIES	WHAT DID YOU HEAR	WHAT DID YOU OBSERVE	KEY CHALLENGES / CONSTRAINTS	PROBLEMS	EXPECTATION / ASPIRATIONS	REMARK
OVER ALL PROBLEM DEFINITION								



A3 DESIGN THINKING - A3 PROJECT MILESTONE IDENTIFICATION & PROCESS

CURRENT - PROJECT MILESTONE & PROCESS AND RESPECTIVE PROBLE IDENTIFICATION

DESCRIPTION OF PROJECT			CLIENT NAME			AUTHOR:	SUPPORT TEAM		DATE:	TITLE		
SL NO.	ACTIVITY	OVERALL TIME LINE	STAKE HOLDER / RESPONSIBLE MANAGER	INPUT / INFORMATIO FLOW - DESIGN, DRAWINGS & COMMUNICATION	INFLOW TIME	TOOLS & TECHNOLOGY - INFLOW	OUT FLOW - DESIGN, DRAWINGS & COMMUNICATION	OUTFLOW TIME	TOOLS & TECHNOLOGY - OUTFLOW	WORK FRONT AVAILABILITY & CONDITIONS	WORK METHOD - QUALITY, SAFETY & PRODUCTIVITY	PROBLEM



A3 DESIGN THINKING - A3 IDEATING SHEET

DESCRIPTION OF PROJECT / WORK / ACTIVIYTY / TASK		AUTHOR:	SUPPORT TEAM		DATE: REV.NO:	TITLE
ACTIVITY NO & NAME		OVERALL PROBLEM STATEMENT				
THE PROBLEM (TO BE SOLVED) HOW MIGHT WE..		THE USERS / STAKEHOLDER THE USERS THAT WE ARE TARGETING ARE				
THE USER PAIN POINTS THE USER PAIN POINTS / NEEDS ARE		THE SOLUTION OUR SOLUTION WORKS LIKE THIS				
THE IMPACT THE BENEFITS OF THE SOLUTION IS	THE ACTORS OUR SOLUTION INVOLVES	THE COST THE SOLUTION NEEDS INVESTMENT FOR		THE REVENUE OUR SOLUTION GENERATES PROFIT BY		
		OVER ALL COST & TIME FRAME		WORK METHOD - QUALITY, SAFETY & PRODUCTIVITY		



A3 DESIGN THINKING - A3 SOLVER

PROJECT TITLE		CLIENT NAME		AUTHOR:		SUPPORT TEAM	
ACTIVITY NAME & NO.				DATE:		TITLE	
STAKEHOLDERS				REV.NO:			
CURRENT CONDITIONS		CHALLENGES / ASPIRATIONS / IDEAS		COUNTER MEASURE	DESCRIPTION	BENEFIT	SUPPORT
PROBLEM							
GOALS / TARGETS		DEPENDENCIES	RESOURCES	DELIVERABLE	TIMELINE	RESPONSIBILITY	REVIEW
		CONSTRAINTS	PRODUCTIVITY				
		CO M MITMENT					
REASON ANALYSIS				CHECK			
				ACT - LEARN - IMPROVE			

HEADING: LEAN PROJECT MANAGEMENT -TOOLS - LPS

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LAST PLANNER SYSTEM

TRADITIONAL CONSTRUCTION MANAGEMENT

- Concentrates on: **what they "should" do**. Project management thereafter monitors and enforce conformance of **"did"** to **"should"**.
- Project management at the beginning of the project is replaced by control during project execution.
- Everything works well until someone causes the delay in his work, which in turn delays the entire chain or work process.
- The supplier fails to return on time, cause delay in activity, and late delivery to site



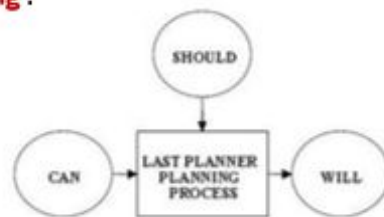
LAST PLANNER SYSTEM(LPS):

It is a technique of lean construction, which gives sequence of work and project variability in construction, That emphasises on collaboration / team work and commitment based approach.

The Last Planner is the person/team assign for operational planning, which facilitates improved sequence of work, completion of individual assigned task at the operational level.

In the last planner system, **the sequences of work include** :

- Master schedule,
- Reverse phase schedules ,
- Six-week look ahead,
- Weekly work plan,
- Percent plan complete,
- Constraint analysis and Variances analysis



Provides **optimized schedule planning through a pull technique**, sequence which matches **work flow and capacity for executing work**.

It will achieve **"Should Can Will"** :

- "Should"** indicates the work required to be done according to planned schedule requirement.
- "Can"** indicates the work with can actually be accomplished on account of various constraints on the field.
- "Will"** reflects the work commitment.

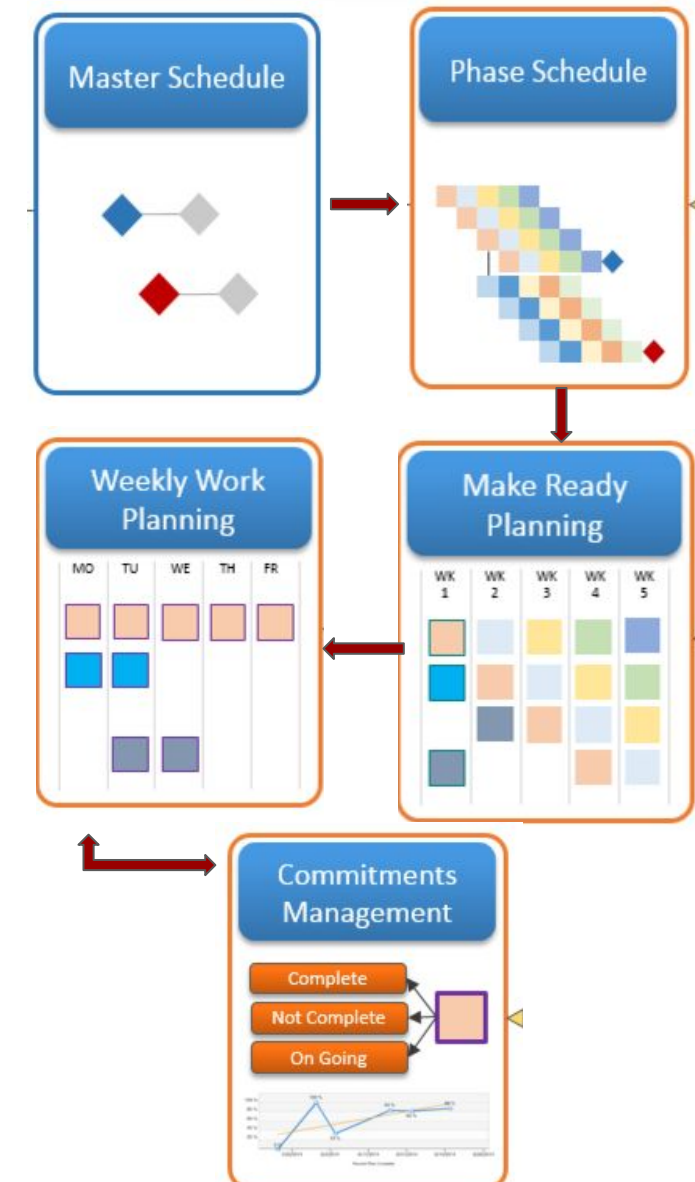
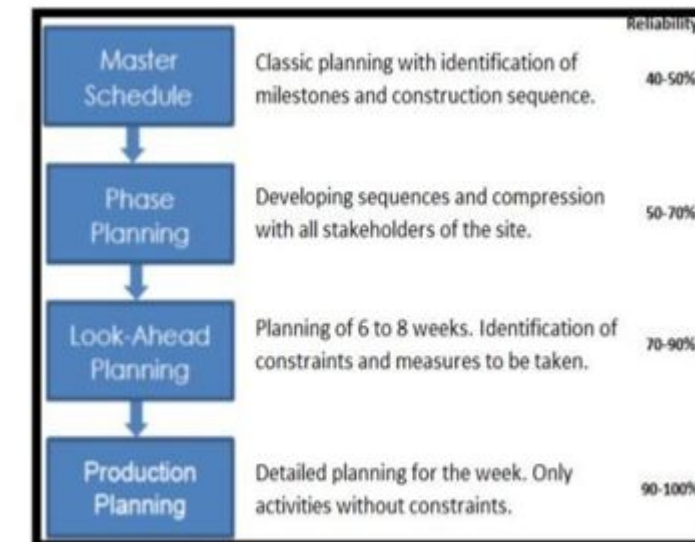
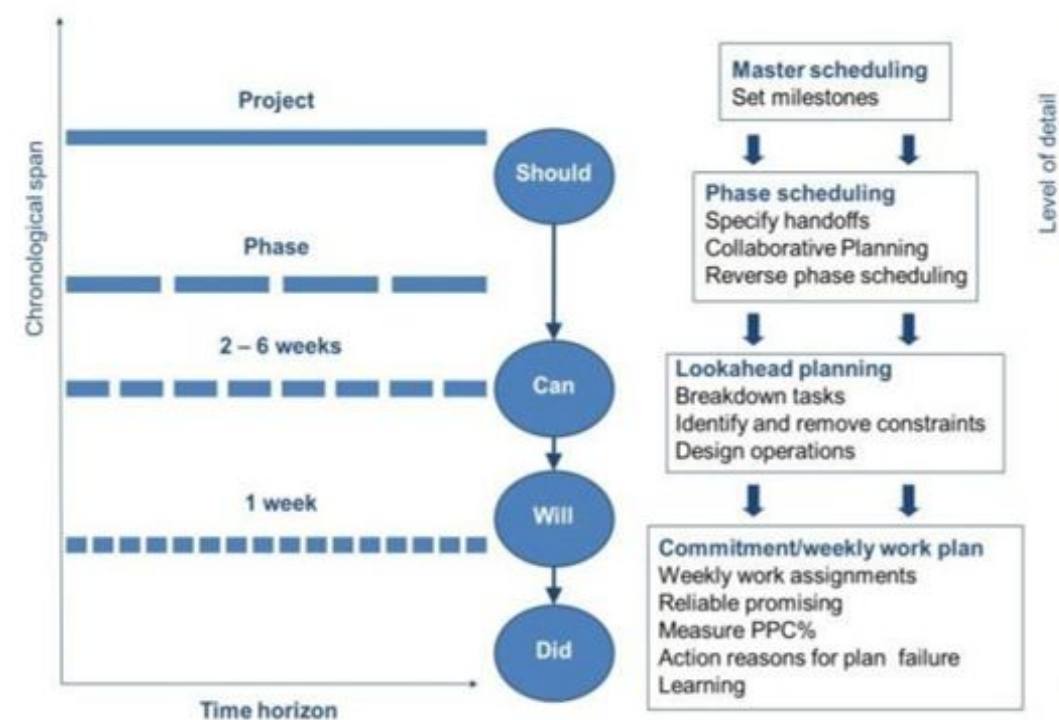
Various **way to improve the work flow are**:

- Two way communication**,
- Constraints analysis process** for **6 week look ahead** before activity are executed,
- The **analysis of reasons for variance after activity are completed**, the efforts of each planner, and the guidance of the project team.

Last Planner System



LPS planning process overview



LAST PLANNER SYSTEM

Difference between CPM & Last Planner System(LPS).

Critical Path Method	Last Planner System
CPM logic embedded in software	Applied common sense
High maintenance	Low maintenance
Managing Critical Path	Managing variability
Focus on managing work dates	Focus on managing work flow
Planning based on contracts	Planning based on interdependencies

BENEFITS OF LAST PLANNER SYSTEM:

- (1) Personal commitment of last decision makers (last planners).
- (2) Coordination of the last planners through regular meetings.
- (3) Use of a basic indicator called planned tasks completed as planned (PPC).
- (4) Obtained weekly results.

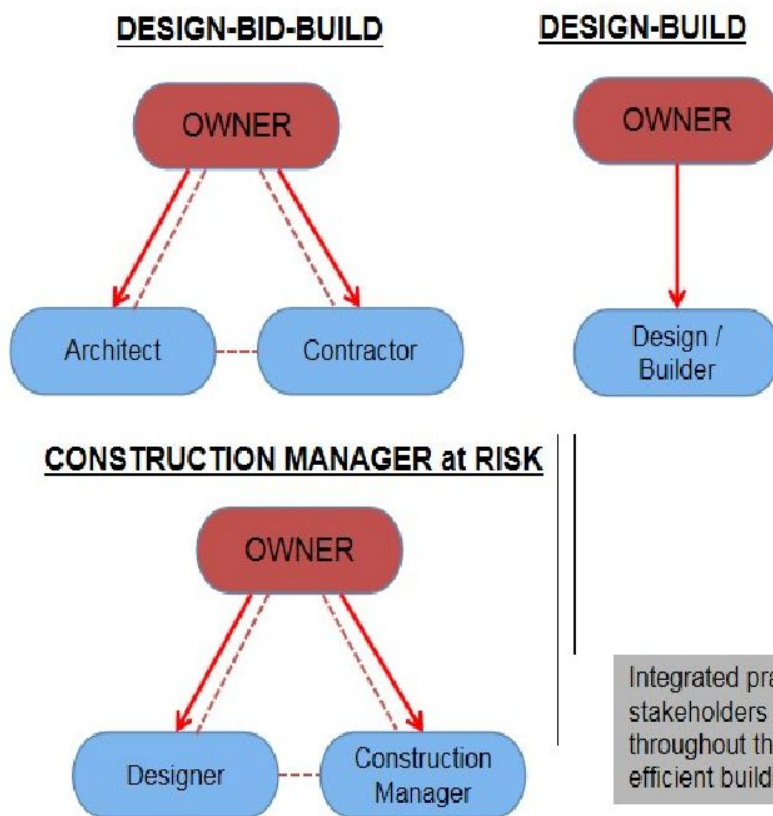
Difference between Traditional Project Management system & Last Planner System (LPS).

SL. NO.	TRADITIONAL PROJECT MANAGEMENT SYSTEM	LAST PLANNER SYSTEM
1	In traditional construction management, the errors between the dependencies of the activities are not considered.	In Lean construction methodology, primarily the errors are taken into account before making the dependencies between the activities.
2	It focus is on increasing the productivity of each activity which results in errors and reduced quality of work resulting in reworks.	In this, main focus is on the proper flow of activities as per dependencies which results in reduced errors and reworks.
3	This method at times does not consider the customer's requirements which results in reduced customer satisfaction.	Due to the consideration of customer's requirement and proper planning, there is surety of customer satisfaction.
4	In the traditional method, customer is not involved in planning stage.	End user/ customer are involved in start to end planning and design.
5	Traditional method relies on variance detection after the completion of tasks.	In lean construction, controlling is practiced during the task performance.
6	Here push techniques manages the release of information and materials.	In the lean approach, pull techniques govern the flow of information and materials.
7	It not tries to mitigate variation in (product quality, rate of work).	It tries to mitigate variation in every aspect (product quality, rate of work) and manage the remaining variation
8	It does not pay attention to continuous improvement.	Lean approach tries to make continuous improvements in the process, sequential workflows
9	In Traditional construction management, decision making is centred to one manager some times.	In lean construction, decision making is distributed in all those who are involved.
10	Traditional construction management does not consider transparency in between the customer, managers, and labours.	Lean construction tries to increase transparency between the customer, managers and labours, in order to know the affect of their work on the whole project
11	Traditional construction management persists on optimizing each activity	Here the system optimises project as a whole.
12	The approach of Traditional construction management is only considers managing a project at the macro level. This is necessary but not sufficient for the success of projects.	Lean Construction approach in Project and Production Management, and formally recognizes that any successful project undertaking will without doubt involve the interaction between project and production management.

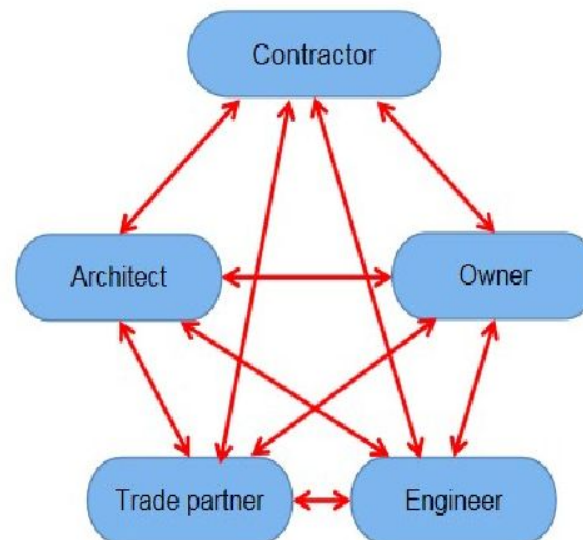
HEADING: LEAN PROJECT MANAGEMENT -TOOLS - LPS

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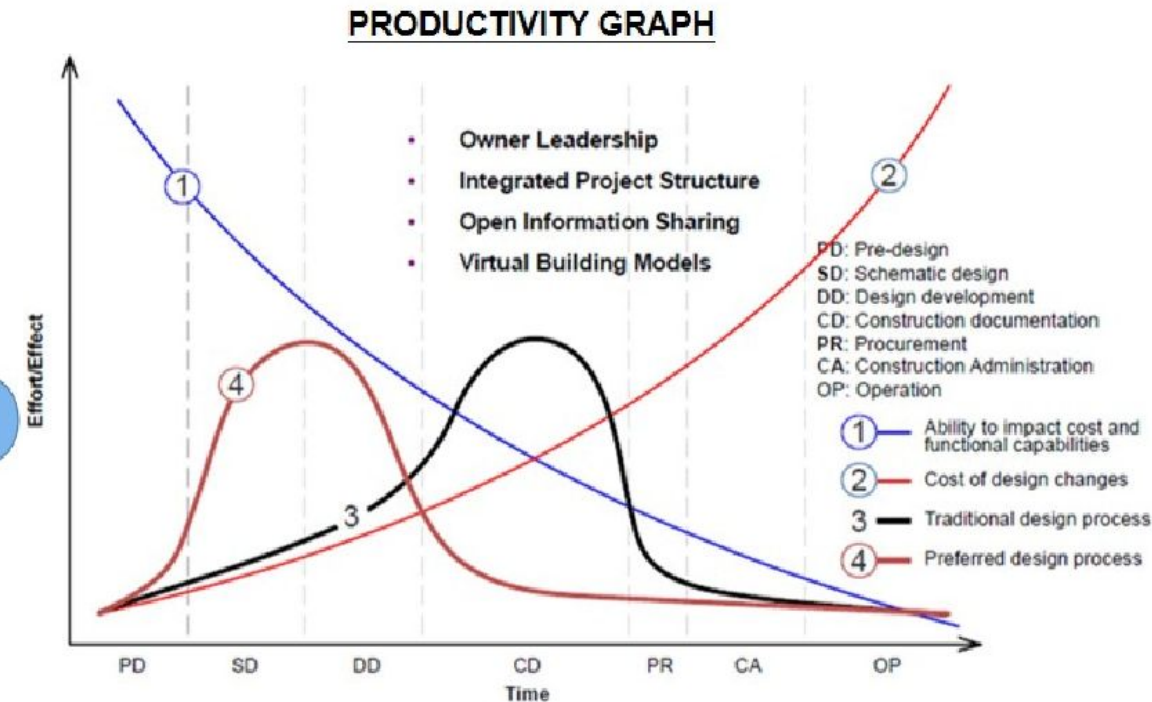
TRADITIONAL PROJECT DELIVERY SYSTEM



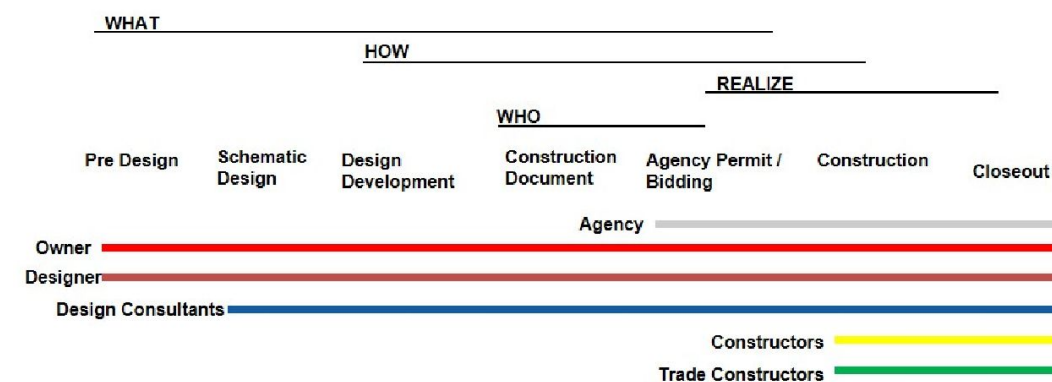
INTEGRATED PROJECT DELIVERY



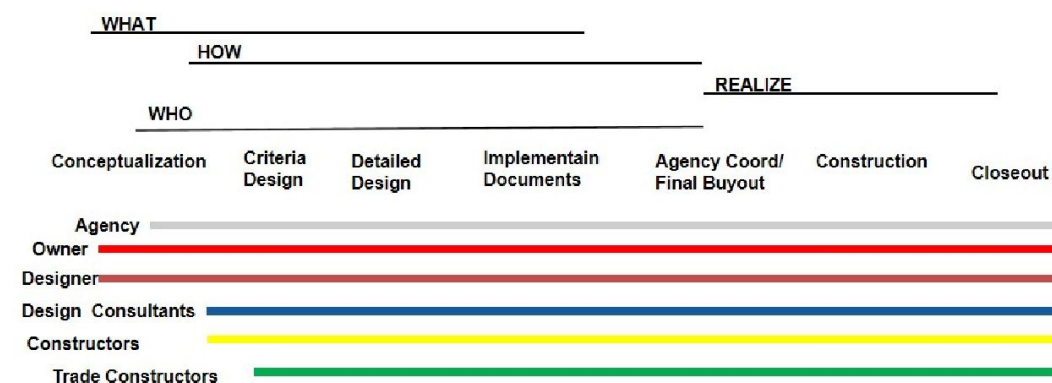
Integrated practice is a holistic approach to building in which all project stakeholders and participants work in highly collaborative relationships throughout the complete facility life cycle to achieve effective and efficient buildings.



TRADITIONAL DESIGN PROCESS



INTEGRATED DESIGN PROCESS



TRADITIONAL PROJECT DELIVERY METHOD
Fragmented, assembled on "just-as-needed" or "minimum necessary" basis, strongly hierarchial, controlled
Linear, distinct, segregated; knowledge gathered "jus-as-needed"; information hoarded
Individually managed, transferred to the greatest extent possible
Individually pursued; minimum effort for maximum return; (usually) first-cost based.
Paper-based , 2 dimensional; Analog
Minimum effort for maximum return; minimize or transfer risk; don't share
Individually fussed, emphasis on composition

INTEGRATED PROJECT DELIVERY METHOD
An integrated team entity composed of all project lifecycle stakeholders, Assembled early in the process, Open, Collaborative
Concurrent, Multi-level, Integrated; Early contributions of knowledge and expertise; information openly shared.
Collectively managed, appropriately shared.
Team success tied to project sucess; value-based.
Digitally based, virtual, 4 dimentional; BIM.
Encourage, foster, promote & support open sharing and collaboration, full integration.
Team-based, integrated, collaborative; technologically inclusive; materials & meths focus in addition to composition.

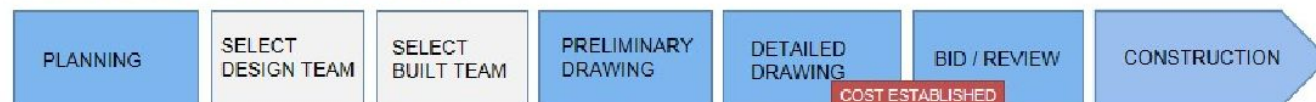
DELIVERY METHODS OF PROJECT

TRADITIONAL DELIVERY METHODS

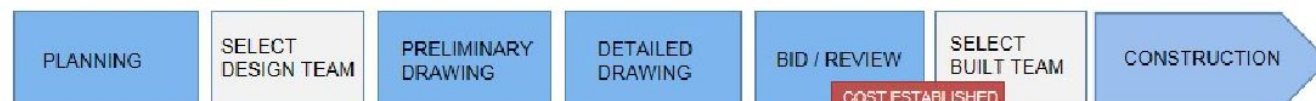
1. DESIGN - BUILD



2. CONSTRUCTION MANAGER AT RISK



3. DESIGN - BID - BUILT





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PROJECT MANAGEMENT SYSTEM - DESIGN THINKING

HEADING: PROJECT MANAGEMENT SYSTEM - DESIGN THINKING

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DESIGN THINKING- PROJECT MANAGEMENT

TRENDS & TECHNOLOGIES:

PROJECT MANAGEMENT TECHNIQUES:

1. Waterfall
2. Agile
3. Kanban
4. Scrum
5. Lean

ASSESSING DURATION:

1. WBS
2. Productivity Data
3. Time Lapse
4. Videographic study
5. Historical data
6. Analogous Estimation / Top down
7. Parametric Estimation
8. Expert Judgement
9. The Delphi Technique

PROJECT SCHEDULING:

1. PERT Method
2. Bar chart & milestone
3. CPM (Critical Path Method)
4. LOB (Line of Balance Technique)
5. Network diagram
6. Q Scheduling / Queue Scheduling

TIME PLANNING TECHNIQUES:

S.No	Work Type	Planning	Scheduling	Monitoring	Display
1.	Simple Project / Sub Project				
a.	Non- Repetitive Works	Bar Chart	Bar Chart	Bar Chart	Bar Chart
b.	Repetitive Works	LOB	LOB	LOB	Bar Chart / LOB
2.	Complex Sub Project				
a.	Deterministic	CPM	Time Scale Network	CPM	Bar Chart

b.	Probabilistic	PERT	Time Scale Network	PERT	Bar Chart
3.	Complex Project				
a.	Non- Repetitive Works	PNA	Bar Chart	PNA	Bar Chart
b.	Repetitive Works	PNA	LOB	LOB	Bar Chart/ LOB
c.	Probabilistic	PERT	Time Scale Network	PERT	Bar Chart
4.	Linear Projects	LPC	LPC	LPC	Bar Chart/ LPC

CPM - Critical Path Method

PERT- Programme Evaluation Review Technique

PNA- Precedence Network Analysis

LOB- Line of Balance Technique

LPC- Linear Programme chart

BC- Bar Chart

TSN- Time Scale Network / Logic Bar chart

AIDING SOFTWARE -

- SAP
- Oracle Primavera
- MSP - Project Management
- Ms Office
- Other ERP Tools

TOOLS & TECHNIQUES USED FOR UNDERGOING PRD THROUGH INTERACTION WITH CLIENT / USER / STAKEHOLDERS:

- Interviews
- Focus Groups
- Workshop
- Group Creative techniques:
 1. Brainstorming
 2. Nominal group technique
 3. Mind-mapping technique
 4. Affinity Diagram
 5. Delphi Technique
 6. Devil's Advocacy
 7. Fishbowling

HEADING: PROJECT MANAGEMENT SYSTEM - DESIGN THINKING

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- Questionnaires & Surveys
- Observation
- Prototypes
- Group Decision - Making Techniques

QUALITY TOOLS:

1. Quality Classic tools
 - a. Cause & Effect Diagram/ fishbone diagram/ Ishikawa diagram
 - b. Check Sheet
 - c. Control Chart
 - d. Flow chart
 - e. Histogram
 - f. Pareto Chart
 - g. Pie chart
 - h. Run chart
 - i. Scatter diagram
 - j. Stratification diagram
 - k. Quality circle
 - l. Benchmarking
2. Managing & Planning tools:
 - a. Activity Network Diagram (Arrow diagram / Critical Path Method)
 - b. Affinity diagram
 - c. Interrelationship / Relationship diagram
 - d. Matrix diagram
 - e. Prioritization matrix
 - f. Process decision program chart
 - g. Tree diagram
3. Process Analysis tools
 - a. Benchmarking
 - b. Cause & Effect
 - c. Cost of quality
 - d. Critical to quality
 - e. Failure mode & effect Analysis (FMEA)
 - f. 5 Why Analysis
 - g. 5 W 2 H
 - h. Process Mapping / Flow charting
4. Process Improvement tools
5. Innovation & Creative tools
6. LEAN :
 - a. Just in time
 - b. The last planner system
 - c. PDCA
 - d. Pull planning
 - e. Toyota Way

- f. Value Stream Mapping
- g. Target value design
- h. Enterprises Resource Planning (ERP) System
- i. 5S
- j. Six sigma
- k. Big Room
- l. A3 Report
- m. Stretch & Flex Meeting
- n. Choosing by Advantages
- o. 6 weeks look ahead schedule
- p. Reports
- q. Daily meetings
- r. BIM
- s. Integrated project delivery system
- t. Constraint Analysis
- u. Root Cause Analysis
- v. Continuous improvement
- w. LCA
- x. LCCA
- y. Prefabrication / Pre Engineered Structure / Precast / Modular Construction
7. Cost of quality
8. Quality function development
9. TRIZ

TECHNICAL TOOLS:

1. Artificial Intelligence
2. Internet of Things (IoT)
3. Block Chain
4. Augmented Reality
5. Digital Ethics
6. Autonomous Things
7. Digital Twins
8. Empowered Edge
9. Smart Spaces
10. Quantum Computer

PROJECT COMMUNICATION:

1. Reporting
2. Record Keeping
 - a. Daily Project logs
 - b. Monthly Project logs
3. Record Keeping
 - a. Photograph

- b. QA Testing Documents
- c. Other Documents
4. Construction Meetings
 - a. Weekly Progress Meeting
 - b. Monthly Progress Meeting
 - c. Final Inspection Meeting
5. Quality Audit
6. Audit Report

STANDARDS & CODES

DRAWINGS & MODELS:

1. AutoCAD
2. STAAD Pro
3. Etabs
4. Candy - Estimation
5. Sketchup
6. 3DSMax
7. Revit
8. BIM
9. Maya (not used much)
10. Photoshop
11. Cost Ex (not used much)
12. Grasshopper
13. Vray
14. I-render
15. Lumion

COLLABORATIVE COMMUNICATION APP:

1. Mail
2. Social network
3. Cloud & Real-time collaboration
4. Internet
5. Mobile technology
6. Drive
7. Whatsapp
8. Skype
9. Zoom
10. Google meet
11. Flock
12. Microsoft team
13. Ayoa
14. I mind map

HEADING: PROJECT MANAGEMENT SYSTEM - DESIGN THINKING

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15. Slack
16. google : Sheet, Slide, Doc
17. Microsoft: Sheet, Slide, Doc

OTHER TRENDS & TECHNOLOGIES:

- Hologram
- Virtual Reality (VR) & Augmentation Reality (AR)
- Wearable AR
- 3D Printing
- Artificial intelligence and machine learning.
- Biometric Scanner
- Sensors (Eg.: Depth Sensor)
- GPS tracking
- Robot Swarms
- Robotics
- Autonomous Construction Vehicle



- Online Ordering & Delivery
- Drones
- Nanotechnology
- Smart Boots
- Connected Hardhats
- Humanoid Labourers
- Lidar Material Advancement
- Eco-friendly Construction Technology
- Electric Truck / Delivery Vans
- 3D Scanning
- Photogrammetry
- Wireless Monitoring & Connected Equipment
- Big Data & Analytics
- Combining IoT(Internet of Things) and Predictive Analysis
- Evolutionary Algorithm Softwares & Apps
- Checklist
- Safety Equipment
- Kinetic Architecture
- photovoltaic Cells / Modules
- Biomimicry

- Bricky-Mould
- Plaster Leveling



- Advanced material:
 - Self-healing concrete
 - Kinetic paving
 - 4D printed structure
 - SMOG - EatingBuilding



- Exo Skeletons



- Armeg Brick Line runner



- IBMS
- Wall Cement Plastering Machine



- Corium brick
- Vibration Screed floor leveling

LIST OF STAKEHOLDERS:

1.INTERNAL STAKEHOLDERS:

- Client / Owner
- User
- Clients Manager
- Investor or Sponsor
- Stockholders
- Board Of Directors
- Architect
- Project Manager
- Accountant
- Human Resource Manager
- Structural Engineer
- Costing Engineer
- Contracts & Claims Engineer
- Project Coordinator
- Design Head
- Material Engineer
- Service Engineer / Engineering Consultant
- Quality surveyors / Engineer
- Health Safety Officer
- Feasibility consultant
- Contractors
- Sub Contractors
- Senior Organisation Manager/ Corporate manager
- Project Tester
- Planning Manager
- Site Office Manager
- Chief Executive Manager
- Work Package Manager
- Functional Manager
- Designer
- Management Contractor
- General Manager
- Labors
- Team Members
- Material / Equipment Suppliers
- Manufacturers
- Vendors

- Security
- TransportFinancier

2. EXTERNAL STAKEHOLDERS:

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

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.

HEADING: PROJECT MANAGEMENT SYSTEM - DESIGN THINKING

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PLACE:

- Clients Office
- Approval Authority (Govt.)
- Site
 - Entry & Exit point
 - Office (Contractor - PM)
 - Project management office
 - Safety induction room
 - Contractor office
 - Conference / Meeting Room
 - Visitor room / space
 - Labour's Accommodation
 - Security Room
 - Testing Lab
 - Processing Unit
 - Loading / Unloading Space & Bay
 - Treatment Area
 - Workshop Space
 - Record Room
 - Material / Sample Lab or Library
 - Location for Equipment Installation
- Design Engineer's Office
- Architect's Office
- Material Sourcing
 - Inventory / Warehouse
 - Manufacturing Unit / Plant
 - Shops / Markets
 - Exhibits
 - Mine / Ores
 - Forest
 - Online Market / E- Commerce
- Transportation
- Knowledge Centres
 - Library
 - Research Centre
 - Online Resources
- Accessibility & Circulation

FACTS:

1. Project management takes into account:
 - Clear goals/objectives
 - Support from senior management
 - Adequate funds/resources
 - Realistic schedule
 - End-user commitment
 - Effective leadership/conflict resolution
 - Flexible approach to change
 - Clear communication channels
 - Taking account of past experience
 - Effective management of risk
2. The project manager is in control of the project throughout the project life cycle
3. Stakeholder influences are greatest toward the beginning of the project.
4. Whenever there is a change request, you should look at the impact on all of the project constraints, not just the schedule.
5. Project cost peaks in the middle of the project as maximum resources are utilized during this phase. Project cost is low at the beginning, peaks midway, and drops rapidly as the project draws to an end.
6. Lack of awareness about current technologies & trends.
7. Lack of accountability & coordination between stakeholders
8. Traditional PM system does not take into account of uncertainties & dynamic nature of construction project leading to failure of project objectives (Scope, Cost, Quality & Safety)
9. Although the industry is growing, there is currently a shortage of construction workers.
10. Women comprise only 9.9 percent of construction workers in the field today.
11. Under today's Scenario of COVID-19, There will be high demand & low supply ratio for labors, Materials & Equipments, Perhaps will lead to an increase in total cost & delay of the project.
12. Also labor's safety becomes a mandatory checklist
13. Instead of conventional scheduling techniques, using lookahead scheduling and lean construction management to achieve milestones for the project has become more effective.
14. Delegating simple problem solving through the root cause.
15. Plan and schedule in a last planner method respecting the dependencies of activities on each other which includes 6 weeks look ahead & phase pull plan method helps to avoid delay due to uncertain situations.
16. Encourage just in time and daily flash meetings (15 to 25 minutes) with all the stakeholders involved in the project for updating progress, identify problems and derive solutions for respective root causes and for motivating & driving the team.
17. In today's scenario there is a need for use of TQM (Total Quality Management), Which includes PDCA (Plan, Do, Check, Act), Continuous assessment/quality check, flexibility, Delegation of daily responsibility, Continuous incremental improvement, Teamwork and one common platform for all stakeholders for communication for planning in the same horizon together with active participation and cooperation for better efficient Project management along with human-centric approach.
18. **IoT in construction** has the potential to vastly reduce all kinds of accidents, using digital solutions
19. **blockchain**-enabled applications that aggregate data into a shared project management dashboard could help to manage workflow. a distributed ledger that keeps an end-to-end chronicle of the **construction** process could record all building inputs and assets
20. **90%** of project management is **Communication**. Project Manager spends 90% of time in Communication.
21. Project Manager can be involved before and after the project.
22. **Artificial intelligence** can help reduce construction costs in many ways.
23. 97% of companies believe that adopting the right project management methodology is crucial to enhance business performance.
24. Choosing the right people for the right job
25. The project manager's main role is to keep all team members aware of these big three - Time, Budget and Quality.



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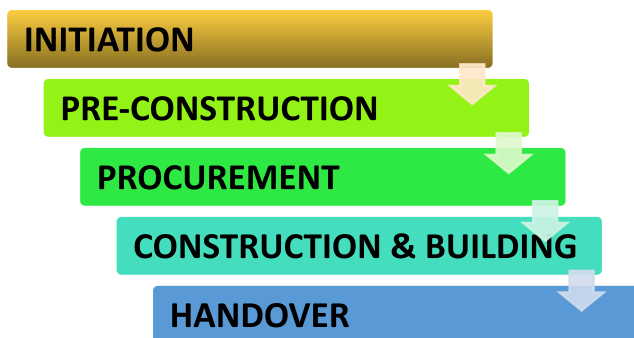
PROJECT LIFECYCLE

PROJECT LIFECYCLE

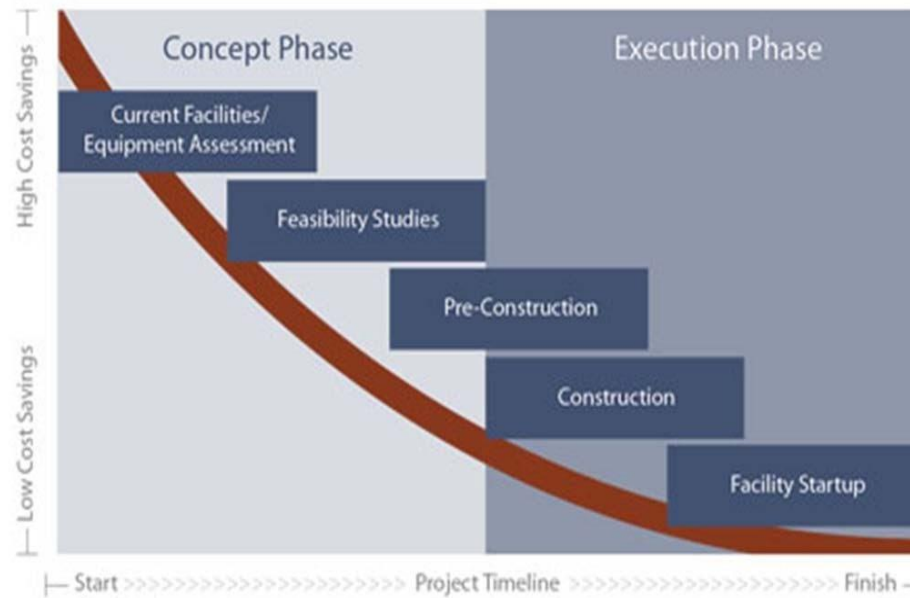
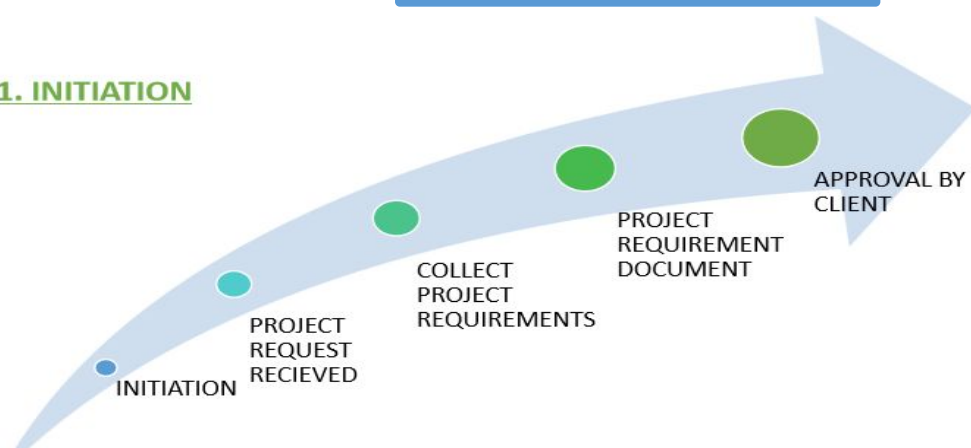
- Formulation stage**
 - Project idea conception
 - Feasibility studies
 - Investment appraisal
 - Project definition
- Mobilization stage**
 - Project preliminary plan
 - Design and Drawings
 - Specifications and contract finalization
 - Resource mobilization and earmarking funds
 - Tendering and Procurement stage
- Construction stage**
 - Planning and controlling execution
 - Inducting resources
 - Construction and commissioning
 - Final handing over to client
- Handing over stage or Post construction**

Project manager is the **key participant** in all these stages and **act as a catalyst** who motivates the participants for achieving the stage objectives

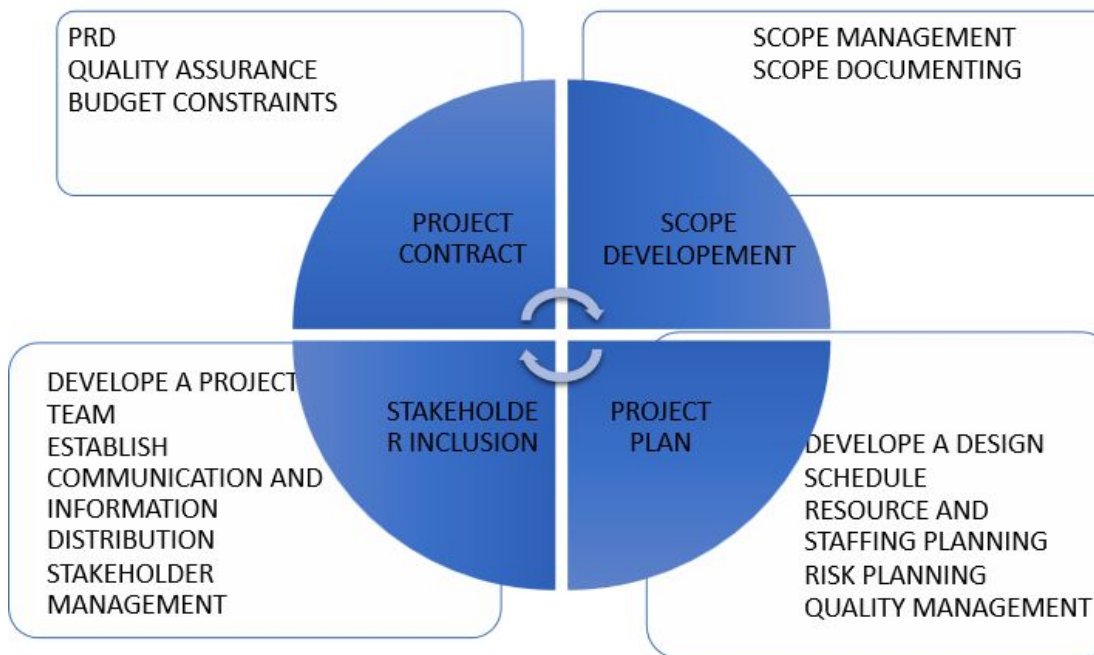
PROJECT LIFE CYCLE



1. INITIATION



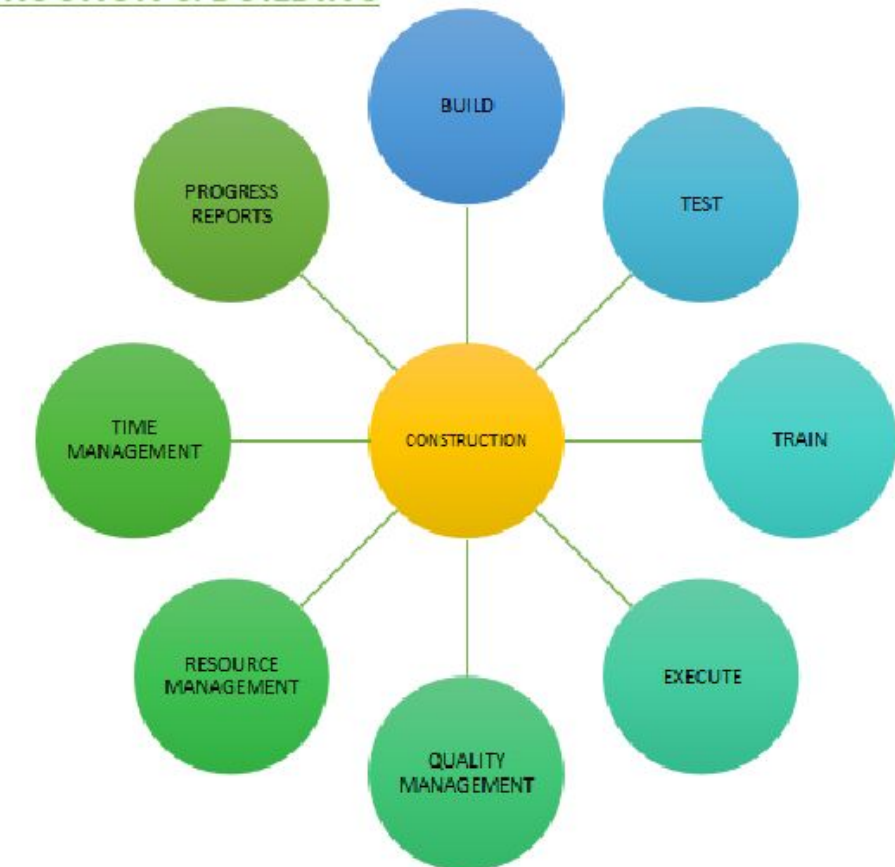
2. PRE- CONSTRUCTION



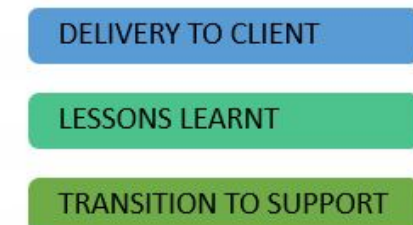
3. PROCUREMENT



4. CONSTRUCTION & BUILDING



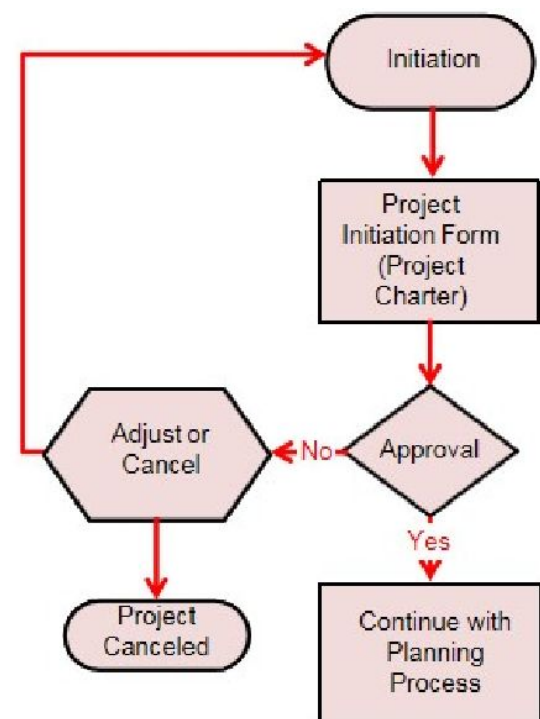
5. HANDOVER



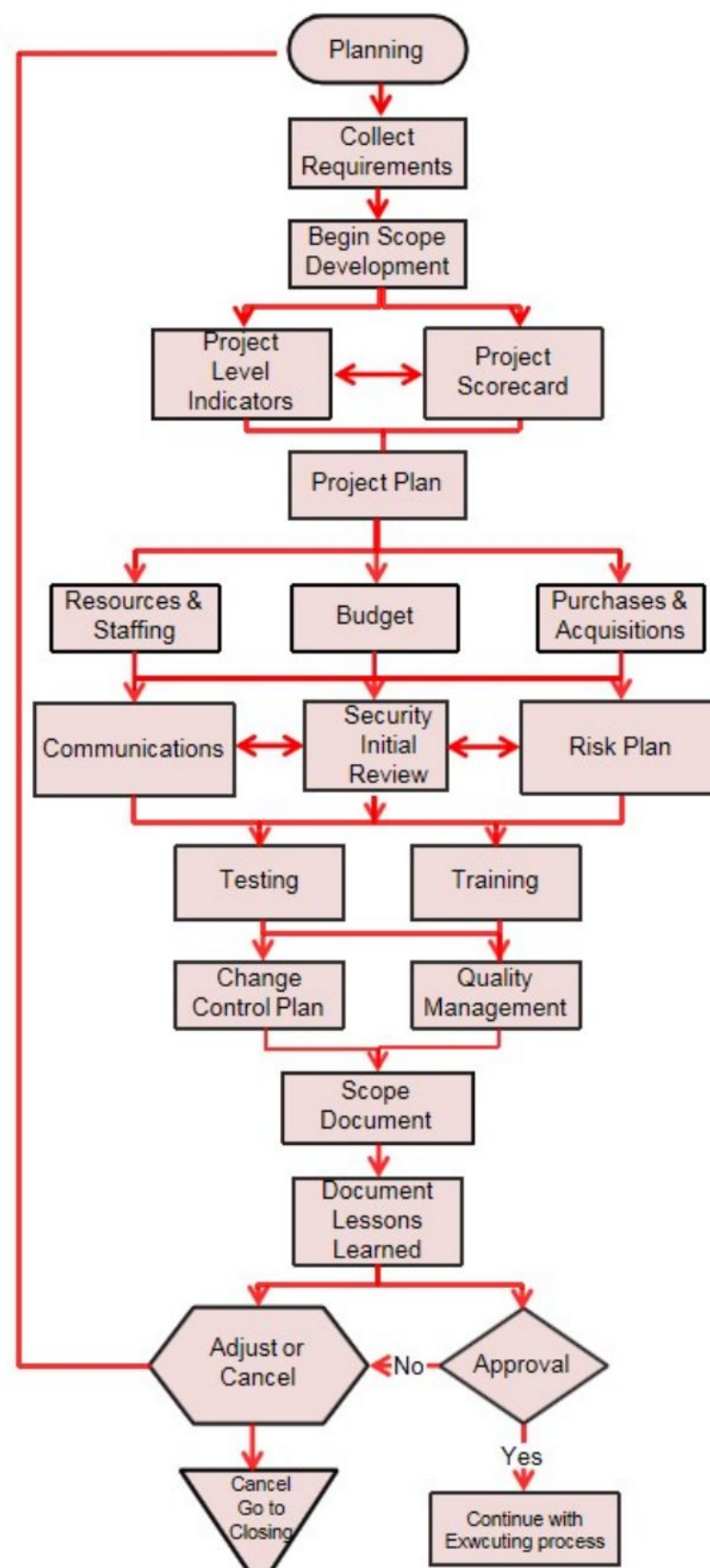
HEADING: PROJECT LIFECYCLE

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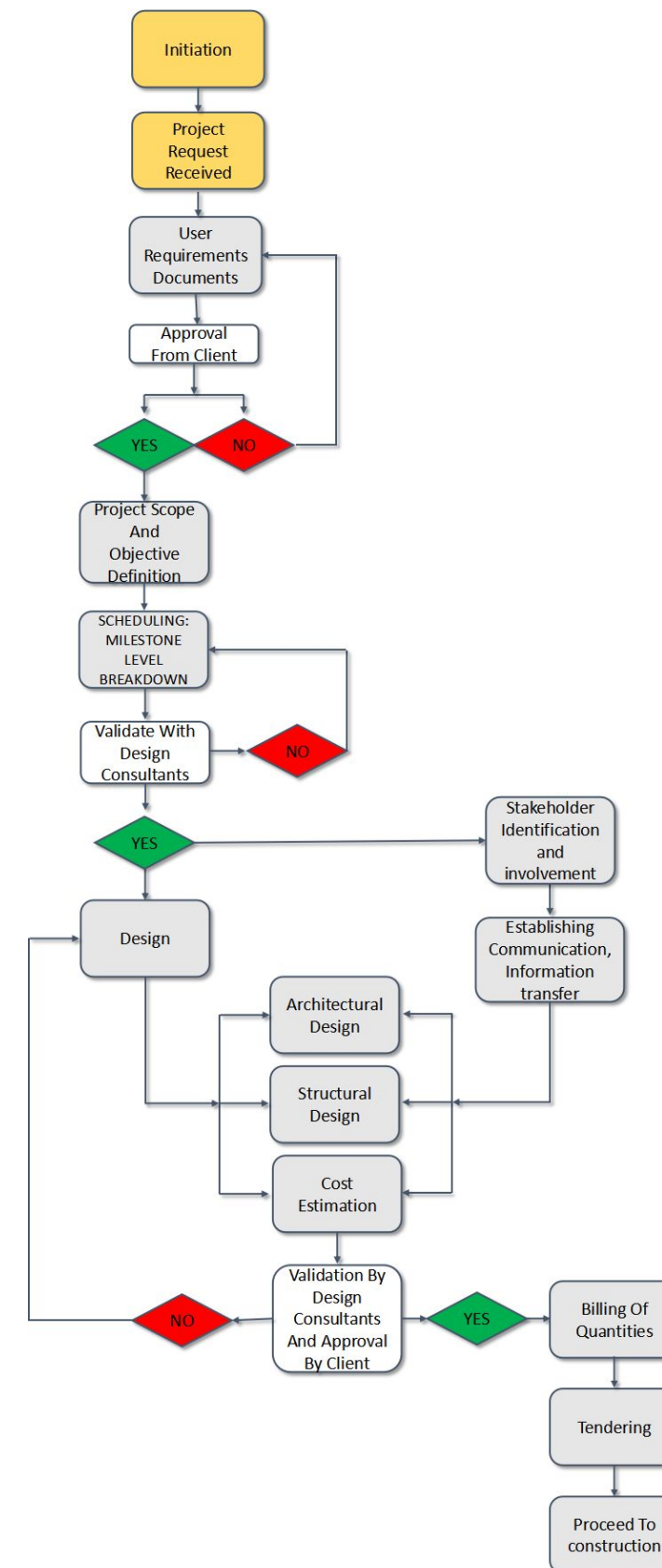
INITIATION PROCESS



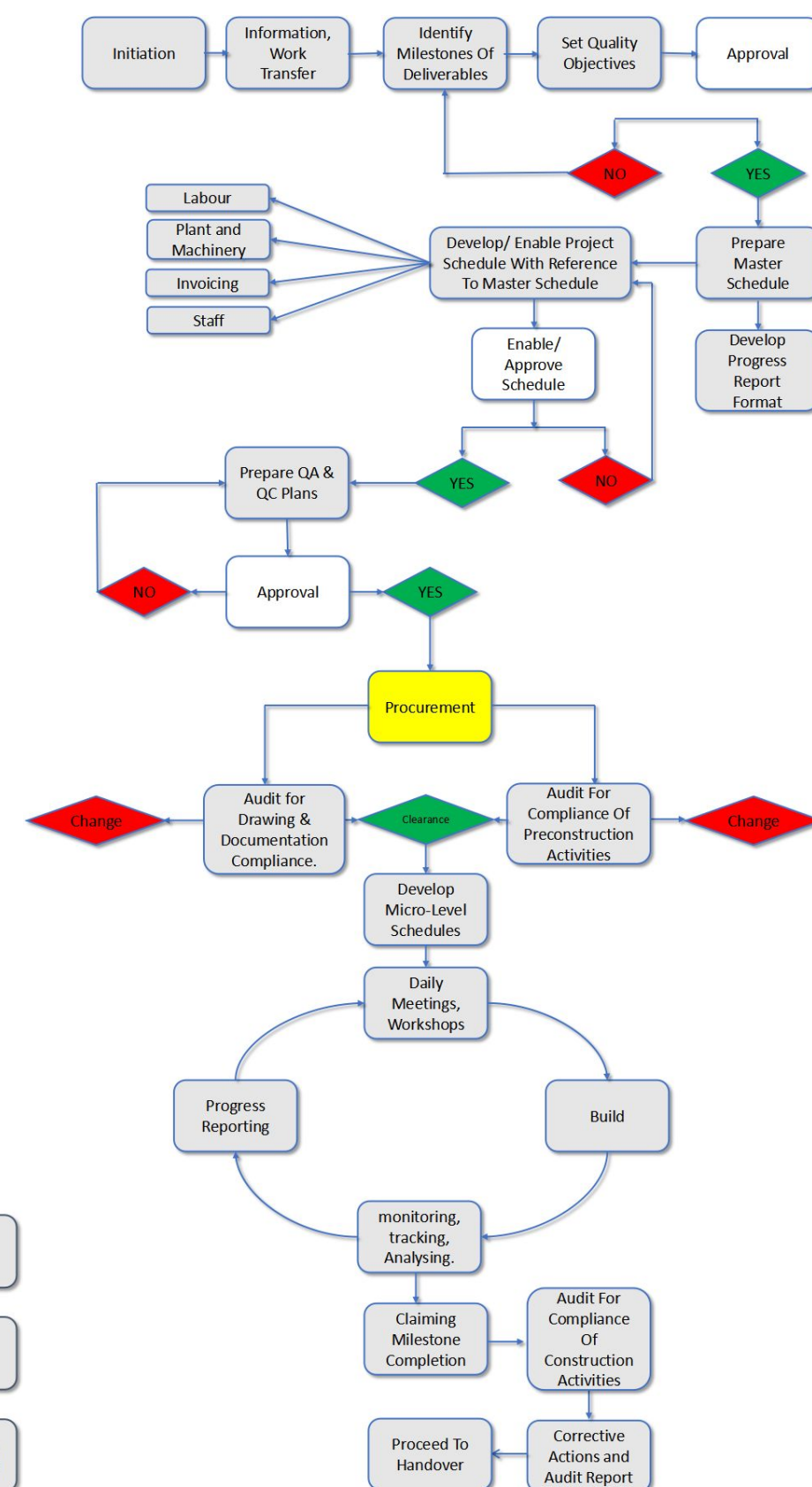
PLANNING PROCESS



PRE CONSTRUCTION PHASE



EXECUTION PHASE





PROJECT MANAGEMENT SYSTEM- PROBLEMS & CHALLENGES FOR INDIVIDUAL STAKEHOLDER

HEADING: PROJECT MANAGEMENT SYSTEM- PROBLEMS & CHALLENGES

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SL. NO.	STAKE HOLDER	INVOLMENT IN PROJECT LIFECYCLE	ROLES	EXPECTATIONS	CONFLICT
1	OWNER / CLIENT	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION, HANDOVER	i) Ensure that suitable management arrangements are made for the project ii) Select & appoint a competent and resourced Principal Designer. iii) Select & appoint a competent and resourced Principal contractor. iv) Notify the relevant enforcing authority of certain projects (notifiable). v) Ensure sufficient time and resources are allowed for all stages of the project. vi) Provide the pre-construction information (PCI) to the designers and contractors. vii) Verify the sufficiency of the construction phase plan (CPP) prior to construction commencement. viii) Verify that suitable welfare facilities are in place prior to construction commencement. ix) Contractor training - Ensure the necessary information, instruction and training is received and appropriate supervision is provided to comply with the regulations. x) Ensure co-operation and co-ordination between the client's employees and client contractors with the project contractors where the client's work activities overlap the construction work and to enable others to perform their duties. xi) Subsequent to receipt of the health and safety file from the Principal Designer, maintain the information up to date and provide access to any person who needs to see it for health and safety purposes	DELIVERY ON TIME, ON BUDGET, QUALITY, SAFETY, COMPLIANCE, TRUST, CLARITY, CONFIDENCE, ACCOUNTABILITY, RISK MANAGEMENT, FLEXIBILITY	Scope / Objective of the project not accomplished as per contract
2	DESIGNERS & OTHER CONSULTANTS	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION, HANDOVER	i) Consultation ii) Investigation of problem iii) Feasibility reports iv) Engineering Design, Drawings, Specification & Calculations v) Construction Supervision (General & Resident) vi) Legal Services	CLEAR INPUT, ON TIME PAYMENT - RECEIVE, COORDINATION, ENVIRONMENTAL FRIENDLY, DELIVERY ON TIME, ON BUDGET, QUALITY, SAFETY, COMPLIANCE, TRUST, CLARITY, ACCOUNTABILITY, CONFIDENCE, RISK MANAGEMENT, COMMUNICATION, CLIENT SATISFACTION	i) Inadequate structural design & Contact document ii) Poor design detail iii) Design & construction errors iv) Workmanship is poor on site v) Poor coordination & communication. vii) Delay, Overcost & poor quality viii) Revision of Drawings & Informations
3	PMC	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION, HANDOVER	i) Leadership ii) Communicator iii) Structuring, Scheduling, Executing, Monitoring & Controlling of iv) Directing, Coach & Guide v) Resource Identifier vi) Mapping the triple constraints	ONTIME PAYMENT - PROVISION, COMFORT, COMMITMENT, SUSPICION, CLEAR INPUT, ON TIME PAYMENT COORDINATION DELIVERY ON TIME, ON BUDGET, QUALITY, SAFETY, COMPLIANCE, TRUST, CLARITY, ACCOUNTABILITY, CONFIDENCE OF CLIENT, RISK MANAGEMENT, COMMUNICATION, CLIENT SATISFACTION	i) Poor coordination & communication. ii) Delay, Overcost, poor quality & safety. iii) Unaccountability iv) Improper report , Upgradation & Meetings v) Lack of Inspection vii) Improper Planning, Organising / Structuring , Scheduling, Executing, Monitoring & Controlling of Activities & Resources. viii) Lack of time payment on different phases

HEADING: PROJECT MANAGEMENT SYSTEM- PROBLEMS & CHALLENGES

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4	LEGAL / GOVERNMENT AUTHORITIES	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION	They are the primary source of Standards, Regulations, Policy programs & Assistance in construction industry and the general public with the respect to occupational safety & health	UNDERSTANDING, FAIRNESS, SAFETY, QUALITY, COMPLIANCE, ENVIRONMENTAL FRIENDLY, COMMITMENT, ACCOUNTABILITY, TRUST	i) Encumbrance ii) Inadequate Quality & Safety iii) Delay of Approvals iv) Non-Compliance v) Corruption vii) Political Issues
5	NEIGHBOURS / GENERAL PUBLIC	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION	They are either directly /Indirectly affected the project. They can influence either positively / Negatively during the course of the project	RESPONSIBILITY, COMMUNITY FRIENDLY, SAFETY, COMFORT, ENVIRONMENTAL FRIENDLY, PROFITABILITY, SECURED, LEGAL, COMPLIANCE, TRUST.	Either directly /Indirectly affected the project (Lack of safety, Comfort, legal compliance, security. Community & Environmental friendliness)
6	CONTRACTORS & VENDORS	FEASIBILITY (CONTRACTOR), PRE-CONSTRUCTION (CONTRACTOR), CONSTRUCTION (BOTH), HANDOVER (CONTRACTOR)	CONTRACTOR: i) Take over the site ii) Mobilisation of Resources iii) Supply materials to the work as per scope. iv) Obtain Mobilisation Advance v) Providing samples of Material for Approval in time / Periodically vi) Get rate variation Approval from employee if there is any variation from what was previously defined. vii) Prepare B.O.Q. For joint measurement, for receiving payment periodically as mentioned in tender document. viii) Project Quality, Duration & Cost monitoring & controlling to accomplish the predetermined scope/ objective of the projection as specified in contract document. ix) Legal & Regulatory. x) Health & Safety Responsibility xi) Removal of materials & machines from site as soon as construction is completed. xii) Obtain completion certificate & Security deposit from employee xiii) Attend defects till the defect liability period & obtain retention money. xiv) Apoint vendors / suppliers , sub-contractor. VENDORS: i) Follow the technical specification & standards as per contract document ii) To accomplish the quality as recommended. iii) Mobilisation of Resources iv) Supply materials to the work as per scope. v) Obtain Mobilisation Advance vi) Providing samples of Material for Approval in time / Periodically vii) Get rate variation Approval from employee if there is any variation from what was previously defined. viii) To maintain Time & Budget as specified.	CLEAR INPUT, CLEAR SPECIFICATION, RESOURCES AVAILABILITY, ENSURE TO GIVE CLEAR & REALITY PICTURE / SITUATION, COMMITMENT ENVIRONMENTAL FRIENDLY, ON TIME PAYMENT - RECEIVE, COORDINATION, DELIVERY ON TIME, ON BUDGET, QUALITY, SAFETY, COMPLIANCE, TRUST, CLARITY, ACCOUNTABILITY, CONFIDENCE, RISK MANAGEMENT, COMMUNICATION, CLIENT SATISFACTION	CONTRACTORS: i) Lack of funds for good purchase ii) Workmanship is poor on site iii) Delay in payment to vendors/ suppliers & labours vi) poor resource management v) Poor coordination & communication. vi) Construction Errors & Deviations vii) Delay, Overcost & poor quality viii) Lack of understanding contractual obligations. VENDORS: i) Not upto the required standards& Quality as per contractual specification. ii) Delay & Over cost. iii) Poor coordination & Communication.
7	FINANCIER	FEASIBILITY, PRE-CONSTRUCTION, CONSTRUCTION, HANDOVER	Provide sufficient funds on time for the project.	SUFFICIENT FUNDS ON TIME, PROFITABILITY, ON TIME PAYMENT, AWARE OF EVERY CASHFLOW, LEGAL, TRUST, COMPLIANCE, COMFORT, ACCOUNTABILITY, CLARITY, SAFETY & SECURE, RISK MANAGEMENT	Unaccountability and Errors, Lack of records, Misunderstandings & Legal issues.

CHALLENGES FACED BY DIFFERENT STAKEHOLDER LEADING TO INEFFECTIVE DESIGN DELIVERY

CHALLENGES

- Knowledge and training
- Collaboration & communication
- Planning ,scheduling & tracking
- Understanding project needs & site conditions
- Material identification
- Design process
- Drawings & specifications
- Constructability
- Preliminary & detailed project cost
- Reporting and documentation
- Problem resolving

ALL STAKEHOLDER'S COMMON CHALLENGES:

- Scope / Objective of the project not accomplished as per contract
- Poor design detail
- Design Error
- construction errors - misinterpretation of drawing
- Corruption
- Revision of Drawings & Information
- Workmanship is poor on site
- Cost of resource is high
- Non-Compliance - Standard design practices
- Non-Compliance - building bylaws
- Poor coordination & communication.
- Delay, Over cost, Poor Quality & Safety.
- Unaccountability

OWNER:

Knowledge And Training

- Challenge for labours to get adapted to new technology
- Incompetency in building construction
- Lack of awareness on construction technologies.
- Lack of awareness on contract
- Lack of knowledge and lack of government initiative about e-tender, online bidding and contracting
- Lack of understanding of design requirements

Collaboration & Communication

- Mode of communication
- Language miscommunication

Planning ,Scheduling & Tracking

- Achieving Milestone
- Payment on different phases

Understanding Project Needs & Site Conditions

- Building Security
- Utility lines with less maintenance
- Building adaptability with modern technologies

Material identification

- Selection of material
- Availability of modern construction materials

Design process

- Inadequate structural design & Contract document
- Design constraints
- Construction methodology
- Comfort
- Aesthetics

Drawings & specifications

- Quality of the project
- Change in the Scope
- Change in the Design (approved prior)

Constructability

- Completion of the project within given time frame
- Delay of Approvals

Preliminary & detailed project cost

- Cost of resource is high
- Available of preliminary costing before design
- Completion of project within the budget

Reporting and documentation

Problem resolving

- Lack of technical facilities
- Inability of contractor to understand drawings
- Lack of awareness of modern construction techniques

Collaboration & communication

- Lack of mentoring
- Information sharing
- Response
- Lack of responsibility
- Non communication of design changes.
- Misunderstandings due to online meetings/phone calls.

Planning, scheduling & tracking

- Improper Planning, Organising / Structuring , Scheduling, Executing, Monitoring & Controlling of Activities & Resources
- Lack of time plan / schedule

Understanding project needs & site conditions

- Misunderstanding of contracts

Material identification

- Lack of awareness of materials

Design process

- Design & construction errors
- Inadequate structural design & Contract document
- Lack of understanding of design requirements

Drawings & specifications

- Revision of Drawings & Information's
- On time delivery of drawings
- Clarity of drawings
- Drawing transmittal
- Revision of drawings
- Format / title of drawings
- Lack of Accountability on project cost
- Lack of detailing in drawings
- Lack of Coordinated drawing
- Frequent changes in drawings
- Drawing management

Constructability

- Lack of design Quality Assurance
- Drawings not received in given time
- Lack of awareness of site conditions

Preliminary & detailed project cost

- Labour employee salary ratio is less

Reporting and documentation

- Absence in review/project meeting
- Missing data
- Authenticity of the documents (from Contractor)

DESIGNERS:

Knowledge and training:

- Clients requirement -functional
- Understanding client inputs
- Lack of knowledge about materials
- Knowledge update on building bylaws
- Knowledge update on construction techniques
- Training
- Lack of awareness about digital technologies.
- Lack of interdisciplinary knowledge
- Conservative nature of firms might be factor which affects the productivity of the employees

Collaboration & communication

- Lack of information
- Lack of proper communication
- Communicating design & drawings
- Communication with all stakeholders
- No responsiveness from vendors / contractors
- Communication from contractors
- Lack of coordination with in the internal team
- Lack of coordination with in the external team
- Lack of coordination with the contractor
- Lack of coordination within the PMC
- Internal & external coordination

Planning ,scheduling & tracking

- Progress Update from co-workers
- Progress update from external design consultants
- Progress update from contractors
- Progress update from PMC
- Lack of planning & scheduling
- Lack of target setting
- Lack of internal review

Understanding project needs & site conditions

- Understanding of site conditions
- Compliance to Building bye laws
- Inputs on site condition - survey drawing
- Inputs on site condition - geotechnical report
- Input on natural hazards
- Input on accidental hazards
- Input on functional processes

Material identification

Design process

- Design & construction errors
- Inputs from other design team - internal design team
- Inputs from other design team - external design consultant

HEADING: PMC - INPUT, PROCESS, OUTPUT

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- Revision of Drawings & Information
- Change request in the drawings by PMC
- Change request in the drawings by Contractors

Drawings & specifications

- Delay in Architectural drawings
- Revision & change management in drawings
- Standard formats for reports & drawings
- Drawing transmittal time delay
- Input from material & machinery vendors

Constructability

- Insufficient time
- Lack of internal approval

Preliminary & detailed project cost

Reporting and documentation

- Improper report
- Design documentation
- Standard formats for reports

Problem resolving

- Mechanism for problem solving / resolving

Approval

- Approval from PMC
- Approval from client
- Approval from contractors
- Time for approval is high

CONTRACTORS:

Collaboration & communication

- Misunderstanding
- Clash with other contractors
- Problem with neighbours

Planning ,scheduling & tracking

- Workability / practical application of the design
- Lack of construction methodology for the execution
- Price escalation
- Reduction of scope quantity
- Addition of new items
- Wrong rate analysis.

Understanding project needs & site conditions

- Lack of equipment to execute design
- Lack of construction methodology for the execution
- Overlapping of utility lines
- Accessibility for utility lines
- Non standard sizes or shapes of structural members
- Omission of work items
- Availability on usage of power and water.
- Lack of security at site.
- Lack of space for labour accommodation
- Lack of space for Site accommodation
- Lack of space for Site Materials
- Rate doesn't include Site establishment
- Lack of constructability review
- Change in site conditions
- Variation of quantities
- Reduction of scope quantity
- Addition of new items
- Limited vendors / supplier availability
- Selection of material / fixtures samples
- Lack of workspace
- Clash with other contractors
- Unsafe working condition
- Problem with neighbours
- Certification of work
- Lack of site visit

Material identification

- Price escalation
- Lack of Material availability
- Poor quality material
- Omission of work items
- Wrong rate analysis.

- Variation of quantities
- Reduction of scope quantity
- Addition of new items
- Limited vendors / supplier availability
- Selection of material / fixtures samples
- High cost of material

Design process

- Workability / practical application of the design
- Lack of skilled labours to execute design
- Lack of equipment to execute design
- Lack of construction methodology for the execution
- Revision of design & drawing during execution of the project
- Lack of constructability review
- Lack of site visit

Drawings & specifications

- Readability of drawing
- Clarity of drawing
- Misunderstanding
- Revision of design & drawing during execution of the project
- Proper execution of the drawing
- Coordination - design & drawing
- Non standard sizes or shapes of structural members
- Unclear Specifications
- Wrong specification
- Omission of work items

Constructability

- Workability / practical application of the design
- Lack of skilled labours to execute design
- Lack of equipment to execute design
- Lack of construction methodology for the execution
- Proper execution of the drawing
- Availability on usage of power and water.
- Lack of security at site.
- Lack of space for labour accommodation
- Lack of space for Site accommodation
- Lack of space for Site Materials
- Rate doesn't include Site establishment
- Lack of constructability review
- Variation of quantities
- Reduction of scope quantity
- Clash with other contractors
- Unsafe working condition
- Certification of work

Preliminary & detailed project cost

- Readability of drawing
- Clarity of drawing
- Misunderstanding
- Price escalation
- Revision of design & drawing during execution of the project
- Stock / high requirement of inventory
- Omission of work items
- Wrong rate analysis.
- Rates does not include enabling work.
- Rates doesn't include cost of Quality
- Rates doesn't include cost of safety
- Rates doesn't include Engineering cost
- Rates don't include overheads.
- Rate doesn't include Site establishment
- Addition of new items
- Selection of material / fixtures samples

Reporting and documentation

- Readability of drawing
- Clarity of drawing
- Price escalation
- Revision of design & drawing during execution of the project
- Lack of Material availability
- Poor quality material
- Stock / high requirement of inventory
- Non standard sizes or shapes of structural members
- Unclear Specifications
- Wrong specification
- Omission of work items
- Change in site conditions
- Variation of quantities
- Certification of work

Problem resolving

- Readability of drawing
- Clarity of drawing
- Misunderstanding
- Workability / practical application of the design
- Clash with other contractors
- Unsafe working condition
- Problem with neighbours
- Certification of work
- Lack of site visit



PMC - PROBLEMS & CHALLENGES

HEADING: PMC - ACTIVITIES INVOLVED AT DESIGN STAGE

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SL. NO.	ACTIVITY	TOOLS	PLACE
1	PROJECT REQUEST RECEIVED FROM CLIENT	MEET IN PERSON, ONLINE, TELEPHONE CONVERSATION	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE
2	MEETING WITH CLIENT FOR INITIATION	MEET IN PERSON, ONLINE, TELEPHONE CONVERSATION	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE
3	PROJECT INFORMATION & DOCUMENTS FROM CLIENT	LAND OWNERSHIP DOCUMENT, OTHER LAND DOCUMENTS, FUNCTIONAL REQUIREMENTS, PROJECT INFORMATION DOCUMENT: MEET IN PERSON, ONLINE, TELEPHONE CONVERSATION	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE
4	INTERNAL TEAM MEET	MEET IN PERSON, ONLINE, TELEPHONE CONVERSATION	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE
5	UNDERSTANDING CLIENT REQUIREMENT	DESIGN THINKING, A3, MINDMAP, GOOGLE SHEETS, MS OFFICE, INTERNAL TEAM MEET - DISCUSSION, MEETING WITH CLIENT, WORKSHOP WITH CLIENT & INTERNAL TEAM, LITERATURE & CASE STUDY: ONLINE MEET, MEETING IN PERSON, TELEPHONE CONVERSATION, MAIL	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE, EMAIL

6	SITE STUDY & SITE TECHNICAL DATA COLLECTION - SITE SURVEYOR, GOVERNMENT	TOPOGRAPHY, HYDROLOGY MAPPING, GEOTECHNICAL INFORMATION, SITE BOUNDARY MAP, LAND USE MAP, LAND OWNERSHIP DOCUMENT, OTHER LAND DOCUMENTS, AUTOCAD, MS OFFICE, GOOGLE DOCUMENT, CLOUD, DRIVE: MEET IN PERSON, SITE VISIT, TELEPHONIC CONVERSATION, MAIL, ONLINE MEETING,	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE, EMAIL
7	LITERATURE & CASE STUDY, FEASIBILITY ANALYSIS	DRAWINGS, MS OFFICE - MEET IN PERSON, SITE VISIT, SITE VISIT- CASE STUDY, TELEPHONIC CONVERSATION, MAIL, ONLINE MEETING,	CLIENTS OFFICE, SITE, SITE - CASE STUDY, PMC OFFICE, ONLINE, EMAIL
8	USER REQUIREMENT DOCUMENT	DRAWINGS, MS OFFICE - MEET IN PERSON, SITE VISIT, TELEPHONIC CONVERSATION, MAIL, ONLINE MEETING,	CLIENTS OFFICE, SITE, PMC OFFICE, ONLINE, EMAIL

9	EXECUTIVE SUMMARY	MS OFFICE, GOOGLE DOCUMENT, AUTOCAD DRAWINGS, 3D SOFTWARES- MEET IN PERSON, TELEPHONIC CONVERSATION, MAIL, ONLINE MEETING,	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL
10	AGENDA FOR MEETING	MS OFFICE, GOOGLE DOCUMENT- MEET IN PERSON, TELEPHONIC CONVERSATION, MAIL, ONLINE MEETING	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL
11	MEETING WITH CLIENT	MS OFFICE, GOOGLE DOCUMENT, AUTOCAD, 3D SOFTWARE, A3 DESIGN THINKING, WORKSHOP, DISCUSSION - MEET IN PERSON, ONLINE MEET, SITE VISIT	CLIENTS OFFICE, PMC OFFICE, ONLINE, SITE VISIT, EMAIL
12	INFORMATION , FEEDBACK & APPROVAL CLIENT - DOCUMENT	MS OFFICE, GOOGLE DOCUMENT- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL
13	INFORMATION , FEEDBACK & APPROVAL CLIENT - DRAWINGS	MS OFFICE, GOOGLE DOCUMENT, AUTOCAD, 3D SOFTWARE- MEET IN PERSON, ONLINE	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL

HEADING: PMC - PMC - ACTIVITIES INVOLVED AT DESIGN STAGE

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		MEET, MAIL, COMMUNICATION SOFTWARES		19	ALLOCATION OF RESOURCES & RESPONSIBILITY	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD, PRIMAVERA, MICROSOFT PROJECT	CONSULTANT OFFICE, OTHER STAKEHOLDER OFFICE, ONLINE		DESIGN CONSULTANTS	IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	
14	MINUTES OF MEETING	MS OFFICE, GOOGLE DOCUMENT- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARE	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL	20	MEETING WITH CLIENT-PLANNING, WBS, SCHEDULING OF ACTIVITIES & ALLOCATION OF RESOURCES & RESPONSIBILITY	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD, PRIMAVERA, MICROSOFT PROJECT	CLIENTS OFFICE, PMC OFFICE, ONLINE EMAIL	25	ARCHITECTURE DETAILED DRAWING WITH STRUCTURED DETAILING AND MEP DRAWINGS & COORDINATION DRAWINGS - TO CLIENT	AUTOCAD, 3D SOFTWARE, MS OFFICE, GOOGLE DOCUMENT, DRIVE, PHOTOSHOP,- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	CLIENT OFFICE, SITE VISIT, PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE
15	MANAGING COMMUNICATION	MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARE, TELEPHONE COMMUNICATION	CLIENTS OFFICE, PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE	21	APPROVAL TO THE WORK FROM OTHER STAKEHOLDERS	AUTOCAD, 3D SOFTWARE, MS OFFICE, GOOGLE DOCUMENT, DRIVE, PHOTOSHOP- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	CLIENT OFFICE, PMC OFFICE, ONLINE EMAIL, OTHER DESIGN CONSULTANT OFFICE	26	DETAILED COSTING, SPECIFICATION & B.O.Q - DOCUMENTS - FROM OTHER DESIGN CONSULTANTS	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE
16	EXTERNAL TEAM MEET	MS OFFICE, GOOGLE DOCUMENT, AUTOCAD, 3D SOFTWARE- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE	22	PRELIMINARY COSTING, SPECIFICATION & B.O.Q OPTIONS - DOCUMENT - FROM COST & ESTIMATION TEAM	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	PMC OFFICE, ONLINE EMAIL, OTHER DESIGN CONSULTANT OFFICE	27	DETAILED COSTING, SPECIFICATION & B.O.Q - DOCUMENTS - TO CLIENT	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	CLIENT OFFICE, PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE
17	ARCHITECTURAL DRAWING WITH STRUCTURAL & MEP LAYOUT OPTIONS FOR CONCEPTUAL DESIGN SUBMISSION	AUTOCAD, 3D SOFTWARE, MS OFFICE, GOOGLE DOCUMENT, DRIVE, PHOTOSHOP- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE	23	PRELIMINARY COSTING, SPECIFICATION & B.O.Q OPTIONS - DOCUMENT - TO CLIENT	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD- MEET IN PERSON, ONLINE MEET, MAIL, COMMUNICATION SOFTWARES	CLIENT OFFICE, PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE				
18	PLANNING, WBS & SCHEDULING OF ACTIVITIES	MS OFFICE, GOOGLE DOCUMENT, DRIVE, CLOUD, PRIMAVERA, MICROSOFT PROJECT	CONSULTANT OFFICE, OTHER STAKEHOLDER OFFICE, ONLINE	24	ARCHITECTURE DETAILED DRAWING WITH STRUCTURED DETAILING AND MEP DRAWINGS & COORDINATION DRAWINGS -FROM OTHER	AUTOCAD, 3D SOFTWARE, MS OFFICE, GOOGLE DOCUMENT, DRIVE, PHOTOSHOP,- MEET	PMC OFFICE, ONLINE, EMAIL, OTHER DESIGN CONSULTANT OFFICE				

INPUT – PROCESS – OUTPUT

INPUT - PROCESS - OUTPUT

PHASES	INPUT	PROCESS	OUTPUT
INITIATION	MEETING WITH CLIENT	UNDERSTANDING CLIENT REQUIREMENT & PROJECT	USER REQUIREMENT DOCUMENT (URD)
	PROJECT REQUEST RECEIVED FROM CLIENT	INTERNAL TEAM MEET	EXECUTIVE SUMMARY & DRAWINGS
	PROJECT INFORMATION & DOCUMENTS FROM CLIENT	DESIGN THINKING & SHARING PROJECT DETAILS & CLIENT REQUIREMENTS - TO THE INTERNAL TEAM	AGENDA FOR MEETING WITH CLIENT
	SITE STUDY & SITE TECHNICAL DATA COLLECTION - SITE SURVEYOR, GOVERNMENT	LITERATURE & CASE STUDY, FEASIBILITY ANALYSIS	MEETING WITH CLIENT
	GOVERNMENT RULES & REGULATIONS - FOR GOVERNMENT APPROVALS	DATA DOCUMENTATION	APPROVAL FROM CLIENT - URD
		INTERNAL TEAM MEET - DATA ANALYSIS , INFERENCE & CONCLUSION	MINUTES OF MEETING
		CREATING USER REQUIREMENT DOCUMENT	INFORMATION & APPROVAL OF USER REQUIREMENT DOCUMENT FROM CLIENT
		MINUTES OF MEETING	

CONCEPTUAL	APPOINTMENT WITH ARCHITECT TEAM, OTHER DESIGN CONSULTANTS & COSTING & ESTIMATION CONSULTANT	EXTERNAL TEAM MEET	CONCEPTUAL ARCHITECTURAL, STRUCTURAL & MEP DRAWINGS
	MEETING WITH DESIGN, COST & ESTIMATION CONSULTANTS AND CLIENT - PROJECT DETAIL & USER REQUIREMENT	DATA ANALYSIS, REVIEW , APPROVAL & CORRECTION - CONCEPTUAL LAYOUTS (ARCHITECTURAL, STRUCTURAL & MEP) BASED ON URD	ASSUMPTION LOG, RISK REGISTER
	INFORMATION & APPROVED USER REQUIREMENT DOCUMENT FROM CLIENT	INTERNAL TEAM MEET - DATA ANALYSIS , INFERENCE & CONCLUSION	ACTIVITY LIST, PROJECT SCHEDULE NETWORK DIAGRAM
	ARCHITECTURAL DRAWING WITH STRUCTURAL & MEP LAYOUT OPTIONS FOR CONCEPTUAL DESIGN	DEFINING THE ACTIVITIES, SEQUENCING	PRELIMINARY SPECIFICATION, COST ESTIMATE, BASIS OF ESTIMATES
	PROJECT ASSUMPTIONS, CONSTRAINTS, BOUNDARIES	DATA ANALYSIS, PMIS	PROJECT DOCUMENT UPDATES
	CONCEPTUAL PRELIMINARY SPECIFICATION, COST ESTIMATE, BASIS OF ESTIMATES FROM COSTING & ESTIMATION TEAM	PLANNING, WBS & SCHEDULING OF ACTIVITIES	RESOURCE BREAKDOWN STRUCTURE, ORGANIZATION CHART
		VENDOR ENQUIRY	
		VENDOR & SUPPLIER DISCUSSION ON MATERIAL SELECTION	
		REVIEW - PRELIMINARY COSTING,	

INPUT – PROCESS – OUTPUT

		SPECIFICATION & B.O.Q OPTIONS	
		PROJECT DOCUMENTATION	
		ALLOCATION OF RESOURCES & RESPONSIBILITY	
		UNDERSTANDING SCOPE,WBS , REQUIREMENTS	
		APPROVAL, AUTHORIZATION	
DETAILING	ARCHITECTURE DETAILED DRAWING WITH STRUCTURED DETAILING AND MEP DRAWINGS & COORDINATION DRAWINGS	INTERNAL TEAM COORDINATION, MEETING WITH CLIENT FOR MORE DETAILING	DETAILED ARCHITECTURE, STRUCTURAL AND MEP DRAWINGS
	DETAILED COSTING, SPECIFICATION & B.O.Q - DOCUMENTS	DETERMINING BUDGET,COST AGGREGATION	COST FORECAST, COST BASELINE
	ESTIMATE DURATION	PMIS, WBS, DATA ANALYSIS, DEPENDENCY DETERMINATION,CPM, PERT	DETAILED DURATION ESTIMATE
	PLAN RISK RESPONSE	STUDYING RISK REGISTER, CONTINGENCY PLANS	RISK RESPONSE DOCUMENT
	COORDINATION AND COMMUNICATION	STAKEHOLDERS ANALYSIS,DATA REPRESENTATION	STAKEHOLDER MANAGEMENT PLAN, COMMUNICATION MANAGEMENT PLAN
	PROJECT PLAN AND DOCUMENT	DATA GATHERING, APPROVAL AND AUTHORIZATION	ACCEPTED DELIVERABLES, PROJECT PLAN AND DOCUMENT UPDATES

APPROVAL	PROJECT WORK APPROVAL	MEETING WITH CLIENT, PMC, IMPORTANT STAKEHOLDER	PROJECT ACCEPTED/DECLINED
	APPROVAL FROM GOVERNMENT	LIASONING CONSULTANT SERVICES FOR GOVERNMENT APPROVAL	PROJECT DOCUMENT APPROVED / DECLINED
	DRAWINGS & DOCUMENTS COMPETENCY AS PER GOVERNMENT APPROVAL BY LIASONING CONSULTANT	REVIEW - DRAWINGS & DOCUMENTS COMPETENCY AS PER GOVERNMENT APPROVAL BY LIASONING CONSULTANT	
		SUBMISSION OF DOCUMENT TO GOVERNMENT AUTHORISED OFFICER	
TENDER & CONTRACT	PLAN PROCUREMENT	DATA ANALYSIS, MEETING WITH DIFFERENT TEAMS , STRATEGY FOR PROCUREMENT	PROCUREMENT STATEMENT OF WORK, BID DOCUMENTS,INDEPENDENT ESTIMATES
	TENDERING	INVITATION TO BID,REQUEST FOR PROPOSALS, ADVERTISEMENT	NOTICE TO TENDER
	REQUEST FOR INFORMATION	BIDDER CONFERENCE	PROPOSED VENDORS/SELLERS
	VENDOR SELECTION	ANALYSIS OF VENDOR, PRICE DETERMINATION	LETTER OF INTENT
	AWARDING CONTRACT	AGREEMENTS, AUDITING	LETTER OF CONTRACT
			APPOINTMENT OF CONTRACTOR

PROBLEMS & CHALLENGES:

PROBLEMS & CHALLENGES

SL. NO.	PROBLEM	CHALLENGES
1	STAKEHOLDERS MANAGEMENT: I wonder if that means: There is no effective stakeholder management for identification & collaboration of key stakeholders from the initial stage of the project lifecycle	- Identifying the important stakeholders, - Unaccountability, - Lack of responsibility, - Inability to communicate efficiently
2	COORDINATING THE PROJECT TEAMS I wonder if that means: There is no common platform for communication & coordination of work There is no effective communication for the transfer of information & transmittals There is no standard format for documenting and sharing them. No proper coordination between internal team itself & the external team	- Keeping team on the same page, - Lack of coordination - internal & external team, - Miscommunication causes conflicts, - Misunderstandings due to online meetings/phone calls, - Challenges of teamwork, - Lack of Coordinated drawing - Virtual teams, - Lack of information transfer.

3	SCOPE DEFINITION I wonder if that means: Improper & unrealistic definition of the goal & objectives. Improper understanding of project need & client requirements, site conditions, and legal requirements. There is no validation of scope No risk management plan Incompetence. There is no decision making ability.	- Poorly defining the goals & objectives - Lack of competency - Lack of planning - Constant change in scope from client & architect and other design consultants - Not having daily check of details - daily meeting - Unaccountability & lack of response from other stakeholders - Lack of Understanding the project needs and requirements. - Poor decision making - Scope creep - Insufficient team skills - Dealing with Risk: - Improper Risk management - Ambiguous Contingency Plans - Understanding project site conditions - Misunderstanding of contracts
4	COMMUNICATION I wonder if that means There is no common platform for communication & coordination of work to keep the team on the same page. There is a delay of information sharing & response Unsuitable project management software for communication transfer. There are misunderstanding & communication related conflicts. There is no standard format for documenting and sharing them. There is no coordination between internal	- Lack of mentoring, Keepin team on the same page - Ineffective Communication - Lack of coordination - internal & external team - Miscommunication causes conflicts - Finding the right project management software - Information sharing - Response From stakeholders - Lack of responsibility - Non communication of design changes. - Misunderstandings due to online meetings/phone calls. - Challenges of teamwork - Revision management

PROBLEMS & CHALLENGES:

	team itself & the external team			
5	PROJECT CONTROL I wonder if that means: There is no performance measurement and reporting of the project. There is no effective project management software for tracking and recording.. No proper WBS , activity & resource planning & scheduling for the design phase of the project management.	1. Lack of Inspection, 2. Improper Auditing, 3. Lack of performance measurement, 4. Lack of project tracking and recording the changes.	COST MANAGEMENT I wonder if that means: No adequate financial availability Ineffective cost performance, tracking & controlling tools & assessment method. Improper budgeting There is no decision making, integration of cost with schedule , budgeting & forecasting. Unclear Payment terms and definition in the initial stage (at the contract document & at the pre bid meeting)	1. Detailing in Cost Estimate 2. Unrealistic Cost Estimate 3. Inadequate Financing 4. Lack of Cost tracking and controlling 5. No contingency plans 6. Cost of quality 7. Cost of non-conformance to quality(repair work, rework) 8. Improper planning for cost 9. Labour employee salary ratio is less 10. Payment terms to be properly discussed in the initial stage or problem will arise in between the project - in contract & pre bid - client & contractor 11. Planning for inflation 12. Budgeting and Forecasting effectively 13. Cost performance analysis 14. Cost Accounting 15. Poor decision making 16. Integrating Cost with Schedule 17. Lack of understanding of the user requirement & client's predetermined budget for the project.
6	TIME MANAGEMENT I wonder if that means: Improper planning , WBS, activity & resource planning & scheduling for the design phase of the project management. And also there is no proper tracking & recording for the same. Unrealistic planning & scheduling. No Effective stakeholder management, from project initial stage There is no decision making ability. There is no proper performance measuring accessing method & tool. - time management	1. Improper planning 2. Unrealistic / Impossible deadlines 3. Improper Scheduling 4. Lack of Monitoring and Controlling 5. Resource Deprivation 6. Lack of stakeholder engagement 7. Execution Difficulties 8. Diffused Decision Making 9. Unaccountability 10. Planning, scheduling & tracking 11. Improper Planning, Organising / Structuring , Scheduling, Executing, Monitoring & Controlling of Activities & Resources 12. Lack of time plan / schedule	COMPETENCY I wonder if that means: There is no proper understanding of project need & client requirements, site conditions, government bylaws, contract document, specification, work methodology for establishing competency of the project Ineffective knowledge sharing, skill transfer & training to the internal & external team. Unawareness about the trends & technologies and their working methodology. Lack of availability of technical facilities that is required to carry out the project effectively.	1. Incompetency with government bylaws 2. Incompetency with the functional requirements of the client/ client requirement Document 3. Incompetency of specification & costing in relation the clients expectation 4. Lack of knowledge on the project work 5. Lack of awareness of site conditions 6. Lack of understanding of design requirements 7. Inability to manage the work 8. Lack of awareness of modern construction techniques 9. Inability to communicate efficiently 10. No Decision making skills 11. Inability to execute the work as per project plan. 12. Knowledge and training : 13. Lack of technical facilities

HEADING: PMC - PROBLEMS & CHALLENGES

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PROBLEMS & CHALLENGES:

	Lack of awareness about construction materials, technologies, trends & equipment. In ability to understand work scope. Unclear drawings & Documents, & hidden clauses / details in transmittals. No Proper planning & management skills Improper execution of work as per planned schedule & determined scope, time, cost & quality - design phase	14. Inability of contractor to understand drawings 15. Lack of awareness of modern construction techniques		
9	MATERIAL IDENTIFICATION I wonder if that means: Lack of effective knowledge sharing, skill transfer & training to the internal & external team. Not being updated on day today trends & technologies and their working methodology. Unavailability of technical facilities that is required to carry out the project effectively. Lack of awareness about construction materials, technologies, trends & equipment. Inability to understand to work scope. Lack of Clear drawings (Architecture, Structural & MEP layouts) & Documents (specification/ B.O.Q/ Estimation / contract/ work scope & methodology/ minutes of meeting/ Executive summary), understandable & no hidden clauses / details in transmittals.	1. Lack of awareness of materials 2. Lack of clarity on clients requirement 3. Lack of clarity of specification 4. Lack of clarity on drawings - Architecture, Structural & MEP layouts 5. Lack of awareness about available trends & technologies 6. Lack of knowledge on work methodology 7. Not being updated 8. Lack of understanding / misunderstanding client requirement 9. Lack of Training on the available technologies.	10	No proper understanding of project need & client requirements, site conditions, government bylaws, contract document, specification, work methodology for establishing competency of the project IMPROPER DESIGN PROCESS I wonder if that means: No proper understanding of project needs & client requirements, site conditions, government bylaws, contract document, specification, work methodology for establishing competency of the project drawing, design & avoid construction error. No prior planning on how to plan & get the deliverables on time from each stakeholders No understanding / knowledge on cycle time for each activity Lack of understanding on interdependency of each activity & stakeholder in terms of deliverables No work breakdown structure for deliverables in design phase and lack of planning & scheduling for milestones of different stages in design phase No proper Data collection from client & other stakeholders on time Getting client approval on time Client no understanding of approval drawing 1. Design & construction errors 2. Inadequate structural design & Contract document 3. Lack of understanding of design requirements

PROBLEMS & CHALLENGES:

11	DRAWINGS & SPECIFICATIONS I wonder if that means: There is no one common platform for communication & coordination of work & transmittal sharing to keep the team on the same page, that can be accessed 24/7. No standard Format for the transmittal letters, documents & drawings There is delay of information sharing, delivering & response No effective changes management No proper maintenance & documentation of revision drawings / documents. No easy accessibility of informations / drawings/ documents No transparency to all the stakeholders There is no right project management software to enhance effective communication, coordination, recording, documentation & maintenance of transmittals (drawing / documents/ letter/ response/ mail/ phone call/ information & revision) No effective document management, transfer of drawing / documents/ letter/ response/ mail/ phone call/ information & revision management. No standard formats for call recording / documentation & sharing the same in a standard format after the online meetings / phone calls.			
12	No Competency to client's objectives - cost, scope, quality, time & work methodology No Competency to government by laws. Lack of Clarity in drawings & Documents and presence of unclear & hidden clauses / details in transmittals. Lack of levels of details in drawings & transmittals causing ineffective understanding & information sharing.			
	CONSTRUCTABILITY I wonder if that means: No effective quality assurance planning Delay in Drawing & document transfer & response time. No Proper understanding & not aware of site conditions and project & client requirement			1. Lack of design Quality Assurance 2. Drawings not received in given time 3. Lack of awareness of site conditions
13	REPORTING AND DOCUMENTATION I wonder if that means: Missing of data, No proper recording, maintaining & documentation of datas (drawings/ documents / letter/ phone call/ mail/information & revision document) No standard Format for the transmittal letters, documents & drawings No effective Recording, documenting & maintaining each meeting & providing minutes of meeting at the end of every meeting / discussion			
				1. Absence in review/project meeting 2. Lack of standard Format for the transmittal letters, documents & drawings 3. Missing data 4. Authenticity of the documents (from Contractor)

1. Revision of Drawings & Information's
2. On time delivery of drawings
3. Clarity of drawings
4. Drawing transmittal
5. Revision of drawings
6. Format / title of drawings
7. Lack of Accountability on project cost
8. Lack of detailing in drawings
9. Lack of Coordinated drawing
10. Frequent changes in drawings.
11. Drawing management

PROBLEMS & CHALLENGES:

Misinterpretation, no clear understanding between all stakeholder Difficulty in reading & interpretation of drawing / document - by different stakeholders No presentation of drawings / deliverables done in particular for each stakeholder's competent level (technical understanding / knowledge level) for readability & effective understanding of the drawings / deliverables. No reference for interdependent drawings / documents No flow / sequence of work flow pattern in collaborative approach of stakeholders for effective coordination & to maintain proper cycle time. Lack / Missing level of details in drawings or document / information which is shared to other stakeholders causing ineffective understanding & information sharing. Too much of information on one sheet		14	DOCUMENT MANAGEMENT I wonder if that means: There is no one common platform for communication & coordination of work & transmittal sharing to keep the team on the same page, that can be accessed 24/7. No standard Format for the transmittal letters, documents & drawings There is delay of information sharing, delivering & response No effective changes management No proper maintenance & documentation of revision drawings / documents. No easy accessibility of informations / drawings/ documents No transparency to all the stakeholders There is no right project management software to enhance effective communication, coordination, recording, documentation & maintenance of transmittals (drawing / documents/ letter/ response/ mail/ phone call/ information & revision) No effective document management, transfer of drawing / documents/ letter/ response/ mail/ phone call/ information & revision management. No standard formats for call recording / documentation & sharing the same in a standard format after the online meetings / phone calls.	1. Timely deliverables. 2. Change Management. 3. To maintain all the stakeholders on the same board regarding changes. 4. Maintaining transparency. 5. Documenting & maintaining records of all the medium of communication such as documents, Mail, letters, recording telephone conversation, social network in a single horizon & standard formats, easy to approach & identify any time later and making them available 24/7 by any stakeholder. 6. Maintaining & documenting all the submittals: a. Transmittals b. Drawings c. B.O.Q d. Good for construction Drawing e. Revision f. Contract documents g. Agenda h. Minutes of meeting
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PROBLEMS & CHALLENGES:

14	DOCUMENT MANAGEMENT I wonder if that means: There is no one common platform for communication & coordination of work & transmittal sharing to keep the team on the same page, that can be accessed 24/7. No standard Format for the transmittal letters, documents & drawings There is delay of information sharing, delivering & response No effective changes management No proper maintenance & documentation of revision drawings / documents. No easy accessibility of informations / drawings/ documents No transparency to all the stakeholders There is no right project management software to enhance effective communication, coordination, recording, documentation & maintenance of transmittals (drawing / documents/ letter/ response/ mail/ phone call/ information & revision) No effective document management, transfer of drawing / documents/ letter/ response/ mail/ phone call/ information & revision management. No standard formats for call recording / documentation & sharing the same in a standard format after the online meetings / phone calls.	1. Timely deliverables. 2. Change Management. 3. To maintain all the stakeholders on the same board regarding changes. 4. Maintaining transparency. 5. Documenting & maintaining records of all the medium of communication such as documents, Mail, letters, recording telephone conversation, social network in a single horizon & standard formats, easy to approach & identify any time later and making them available 24/7 by any stakeholder. 6. Maintaining & documenting all the submittals: a. Transmittals b. Drawings c. B.O.Q d. Good for construction Drawing e. Revision f. Contract documents g. Agenda h. Minutes of meeting	Misinterpretation, no clear understanding between all stakeholder Difficulty in reading & interpretation of drawing / document - by different stakeholders No presentation of drawings /deliverables done in particular for each stakeholder's competent level (technical understanding / knowledge level) for readability & effective understanding of the drawings / deliverables. No reference for interdependent drawings / documents No flow / sequence of work flow pattern in collaborative approach of stakeholders for effective coordination & to maintain proper cycle time. Lack / Missing level of details in drawings or document / information which is shared to other stakeholders causing ineffective understanding & information sharing. Too much of information on one sheet No flow / sequence of work flow pattern in collaborative approach of stakeholders for effective coordination & to maintain proper cycle time.	
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PROBLEMS & CHALLENGES:

PROBLEM DEFINITION:

1. No prior planning on how to plan & get the deliverables on time from each stakeholders - PLANNING & TIME
2. No understanding / knowledge on cycle time for each activity
3. Lack of understanding on interdependency of each activity & stakeholder in terms of deliverables
4. No work breakdown structure for deliverables, activity & resource in design phase and lack of planning & scheduling for milestones of different stages in design phase
5. Not aware of the client's project objective - scope, time, cost & quality.
6. No proper Data collection from client & other stakeholders on time
7. Not Getting client approval on time
8. Client no understanding of approval drawing
9. Misinterpretation, no clear understanding between all stakeholder
10. Difficulty in reading & interpretation of drawing / document - by different stakeholders
11. No presentation of drawings / deliverables done in particular for each stakeholder's competent level (technical understanding / knowledge level) for readability & effective understanding of the drawings / deliverables.
12. No reference for interdependent drawings / documents
13. No flow / sequence of work flow pattern in collaborative approach of stakeholders for effective coordination & to maintain proper cycle time.
14. Junior team not competent enough
15. Lack / Missing level of details in drawings or document / information which is shared to other stakeholders causing ineffective understanding & information sharing.
16. Too much of information on one sheet
17. There is no effective stakeholder management for identification & collaboration of key stakeholders from the initial stage of the project lifecycle
18. There is no effective communication for the transfer of information & transmittals
19. No proper coordination between internal team itself & the external team
20. Improper & unrealistic definition of the goal & objectives.
21. There is no validation of scope
22. No risk management plan
23. There is no decision making ability.
24. There is no performance measurement and reporting of the project.
25. There is no effective project management software for tracking and recording..
26. No adequate financial availability
27. Ineffective cost performance, tracking & controlling tools & assessment method.
28. Improper budgeting
29. There is no decision making, integration of cost with schedule , budgeting & forecasting.
30. Unclear Payment terms and definition in the initial stage (at the contract document & at the pre bid meeting)
31. Improper execution of work as per planned schedule & determined scope, time, cost & quality - design phase
32. No proper understanding of project needs & client requirements, site conditions, government bylaws, contract document, specification, work methodology for establishing competency of the project drawing , design & avoid construction error.
33. No Competency to client's objectives - cost, scope, quality, time & work methodology
34. No Competency to government by laws.
35. Delay in Drawing & document transfer & response time.
36. No Proper understanding & not aware of site conditions and project & client requirement
37. Missing of data, No proper recording, maintaining & documentation of datas (drawings/ documents / letter/ phone call/ mail/information & revision document)
38. No effective Recording, documenting & maintaining each meeting & providing minutes of meeting at the end of every meeting / discussion.
39. There is no one common platform for communication & coordination of work & transmittal sharing to keep the team on the same page, that can be accessed 24/7.
40. No standard Format for the transmittal letters, documents & drawings
41. There is delay of information sharing, delivering & response
42. No effective change management.
43. No proper maintenance & documentation of revision drawings / documents.
44. No easy accessibility of information / drawings/ documents.
45. No transparency to all the stakeholders.
46. There is no right project management software to enhance effective communication, coordination, recording, documentation & maintenance of transmittals (drawing / documents/ letter/ response/ mail/ phone call/ information & revision).
47. No effective document management, transfer of drawing / documents/ letter/ response/ mail/ phone call/ information & revision management.
48. No standard formats for call recording / documentation & sharing the same in a standard format after the online meetings / phone calls.

OVERALL PROBLEM DEFINITION- STATEMENT:

"Developing a system for project management consultants in construction industry to enhance effective project delivery for design phase, Which is in competency with predetermined clients objectives- scope, cost, time & quality through effective :

- Stakeholder management,
- Planning of milestones of activities & deliverables for design stage,
- And identification of appropriate project management software that uses collaboration, efficient management of documentation, revisions & changes in deliverables. And also establishing effective cost and time management with

PROBLEM – IDEAS FOR EACH PHASES OF DESIGN DELIVERY:

PROBLEMS - IDEAS

PROBLEM - SOLUTION : PRE- DESIGN PHASE

PHASE	PROBLEM IDENTIFIED BASED ON CHALLENGES	IDEAS	SOLUTION
PRE-DESIGN PHASE	SCOPE: 1. I wonder if that means there is no proper understanding of client requirements including special design considerations by all stakeholders. 2. I wonder if that means there is no proper documentation and approval process for understanding client needs.	1. Meeting client in person to understand needs 2. Virtual meet with client in case of new project/renovation 3. A3 Design thinking 4. Workshop with client 5. Daily Meeting / Updates / Reporting 6. Minutes of meeting 7. Complete understanding - Study about site & project & Clients requirement - competency 8. Effective document, change, revision, transmittal management 9. Common Communication & Coordination Platform 24/7 Accessible - Flock, Coaspect 10. Hand sketches 11. Bubble diagrams 12. Sketchpad 13. Alarm / trigger - approval / information/ response 14. Standard format for transmittals 15. Bylaws competency 16. stakeholder management 17. Collaborative approach 18. All On Same Page 19. Integrated design approach 20. User requirement documentation	1. Regular / virtual meetings internal & external stakeholder 2. MoM 3. Documentation of user requirements 4. A3 Design Thinking 5. Mind- Mapping platforms 6. Common communication & coordination platform 24/7 accessible - Flock, Coaspect, Drive, cloud 7. Integrated design approach

PROBLEM - SOLUTION : CONCEPTUAL DESIGN & LAYOUT PHASE

PHASE	PROBLEMS IDENTIFIED BASED ON CHALLENGES	IDEAS	SOLUTION
CONCEPTUAL DESIGN, CONCEPTUAL LAYOUT	TIME, DELIVERY, DOCUMENT, CHANGE, REVISION, STANDARD COMMUNICATION & COORDINATION AND SCOPE MANAGEMENT: - I wonder if that means there is no structure to identify and collect information for conceptual design. - I wonder if that means there is no proper work breakdown, planning & scheduling to ideate, discuss, travel, communicate and getting approval from the client. - I wonder if that means there is no proper mechanism for sharing & managing revisions of conceptual documents for review and approval from the client. - I wonder if that means there is no information support from other consultants and vendors. - I wonder if that means there is no information support from other consultants and vendors. - I wonder if that means there is no competency to client's objectives - cost, scope, quality, time & work methodology - I wonder if that means there is no competency to government by laws. - I wonder if that means there is lack of clarity in drawings & documents and presence of unclear & hidden clauses / details in transmittals. - I wonder if that means there is lack of levels of details in drawings & transmittals causing ineffective understanding & information sharing.	- Site visit after discussion with client - A3 Design Thinking - Daily Meeting / Updates / Reporting - Minutes Of Meeting - WBS shall have real-time work schedule - Design phase - Setting Milestones - Design Phase - Effective document, change, revision, transmittal management - Common Communication & Coordination Platform 24/7 Accessible - Flock, Coaspect - Standard Formats - Transmittals - Integrated design approach - collaboration - Submission Alarm / trigger - approval / information/ response - Stakeholder Management - Travel Management - Clear drawing, level of detailing & presentation- stakeholder based - Data collection planning & management - submittals & transmittals - Last Planner System - In Competence With Contract Document, Specification, Work Methodology For Establishing Competency Of The Project - Clear Drawings & Documents, & No Hidden Clauses / Details In Transmittals. - All On Same Page - Cloud platform for scheduling of start-end date & time to get approval from clients & all stakeholders - Weekly meeting with all stakeholders for discussion & coordination - Hand sketches, 3D model, Physical model	- Last Planner System - Regular / virtual meetings internal & external stakeholder - MoM - A3 Design Thinking - Mind-Mapping platforms - Common communication & coordination platform 24/7 accessible - Flock, Coaspect, Drive, cloud - Integrated design approach - Hand sketches / Digital sketchpad. 3D models - Data collection planning & management - submittals & transmittals - WBS & milestones - design phase - Effective presentation, clear drawing, level of detailing & presentation- stakeholder based

PROBLEM - SOLUTION : CONCEPTUAL DESIGN & LAYOUT PHASE

PHASE	PROBLEM IDENTIFIED BASED ON CHALLENGES	IDEAS
CONCEPTUAL DESIGN, CONCEPTUAL LAYOUT	TIME, DELIVERY, DOCUMENT, CHANGE, REVISION, STANDARD COMMUNICATION & COORDINATION AND SCOPE MANAGEMENT: - I wonder if that means there is no structure to identify and collect information for conceptual design. - I wonder if that means there is no proper work breakdown, planning & scheduling to ideate, discuss, travel, communicate and getting approval from the client. - I wonder if that means there is no proper mechanism for sharing & managing revisions of conceptual documents for review and approval from the client. - I wonder if that means there is no information support from other consultants and vendors. - I wonder if that means there is no information support from other consultants and vendors. - I wonder if that means there is No Competency to client's objectives - cost, scope, quality, time & work methodology - I wonder if that means there is No Competency to government by laws. - I wonder if that means there is Lack of Clarity in drawings & Documents and presence of unclear & hidden clauses / details in transmittals. - I wonder if that means there is Lack of levels of details in drawings & transmittals causing ineffective understanding & information sharing. Topic 1- New Technologies of Facades using kinetic Architecture Topic 2- Unmanned Aerial Aircraft Systems for transportation engineering: Current practice and future challenges (In high-rise buildings lifting materials & machines for constructions reducing usage of Towered Cranes) Topic 3- Innovative Diagrid System	- Site visit after discussion with client - A3 Design Thinking - Daily Meeting / Updates / Reporting - Minutes Of Meeting - WBS shall have real-time work schedule - Design phase - Setting Milestones - Design Phase - Effective document, change, revision, transmittal management - Common Communication & Coordination Platform 24/7 Accessible - Flock, Coaspect - Standard Formats - Transmittals - Integrated design approach - collaboration - Submission Alarm / trigger - approval / information/ response - Stakeholder Management - Travel Management - Clear drawing, level of detailing & presentation- stakeholder based - Data collection planning & management - submittals & transmittals - Last Planner System - In Competence With Contract Document, Specification, Work Methodology For Establishing Competency Of The Project - Clear Drawings & Documents, & No Hidden Clauses / Details In Transmittals. - All On Same Page - Cloud platform for scheduling of start-end date & time to get approval from clients & all stakeholders - Weekly meeting with all stakeholders for discussion & coordination - Hand sketches, 3D model, Physical model

PROBLEM - SOLUTION : PRE- DETAILED DESIGN

PHASE	PROBLEM IDENTIFIED BASED ON CHALLENGES	IDEAS
DETAILED DESIGN	TIME, DELIVERY, DOCUMENT, CHANGE, REVISION, STANDARD COMMUNICATION & COORDINATION AND SCOPE MANAGEMENT: 1. I wonder if that means there are changes made by the client, other consultants & material vendors 2. I wonder if that means there are changes made by other consultants due to their design changes 3. I wonder if that means there are changes made by the client due to limitation of boundary conditions. 4. I wonder if that means there are changes made due to site conditions and workability. 5. I wonder if that means there is no structure to identify and collect information for conceptual design. 6. I wonder if that means there is no proper work breakdown, planning & scheduling to ideate, discuss, travel, communicate and getting approval from the client. 7. I wonder if that means there is no proper mechanism for sharing & managing revisions of conceptual documents for review and approval from the client. 8. I wonder if that means there is no information support from other consultants and vendors. 9. I wonder if that means there is no information support from other consultants and vendors. 10. I wonder if that means there is No Competency to client's objectives - cost, scope, quality, time & work methodology 11. I wonder if that means there is No Competency to government by laws. 12. I wonder if that means there is Lack of Clarity in drawings & Documents and presence of unclear & hidden clauses / details in transmittals. 13. I wonder if that means there is Lack of levels of details in drawings & transmittals causing ineffective understanding & information sharing.	1. Prior approval of design from client & stakeholders through email 2. Prior site visit & detailed site study & analysis has to be done 3. Site visit after discussion with client 4. Daily Meeting / Updates / Reporting 5. Minutes Of Meeting 6. WBS shall have real-time work schedule - Design phase 7. setting Milestones - Design Phase 8. Effective document, change, revision, transmittal management 9. Standard Formats - Transmittals 10. Integrated design approach - collaboration 11. Submission Alarm / trigger - approval / information/ response 12. clear drawing, level of detailing & presentation- stakeholder based 13. Data collection planning & management - submittals & transmittals 14. Last Planner System 15. PDCA 16. In Competence With Client requirement, project requirement, government by laws, Specification, Work Methodology For Establishing Competency Of The Project 17. Clear Drawings & Documents, & No Hidden Clauses / Details In Transmittals. 18. All On Same Page 19. Cloud platform for scheduling of start-end date & time to get approval from clients & all stakeholders 20. Drive & Cloud Platform 21. Weekly meeting with all stakeholders for discussion & coordination 22. Hand sketches, 3D model, Physical model 23. 24. Effective Common Communication & Coordination Platform - SOFTWARE / APP - 24/7 Accessible for all stakeholders - Flock, Coaspect a. Planning , scheduling of milestones of activities & deliverables- design phase b. Work & submission - Reminder alarm, c. Data collection planning & management - submittals & transmittals d. Call recording e. Mails f. 2d & 3d softwares accessibility g. Documentation, reference, revision & change management. h. Standard format & checklists - drawing & document - transmittals 1. Cycle time for each activity predetermination - establish flow chart 2. Clear drawings & Documents, & no hidden clauses / details in transmittals.

PROBLEM - SOLUTION : DESIGN DOCUMENTATION PHASE

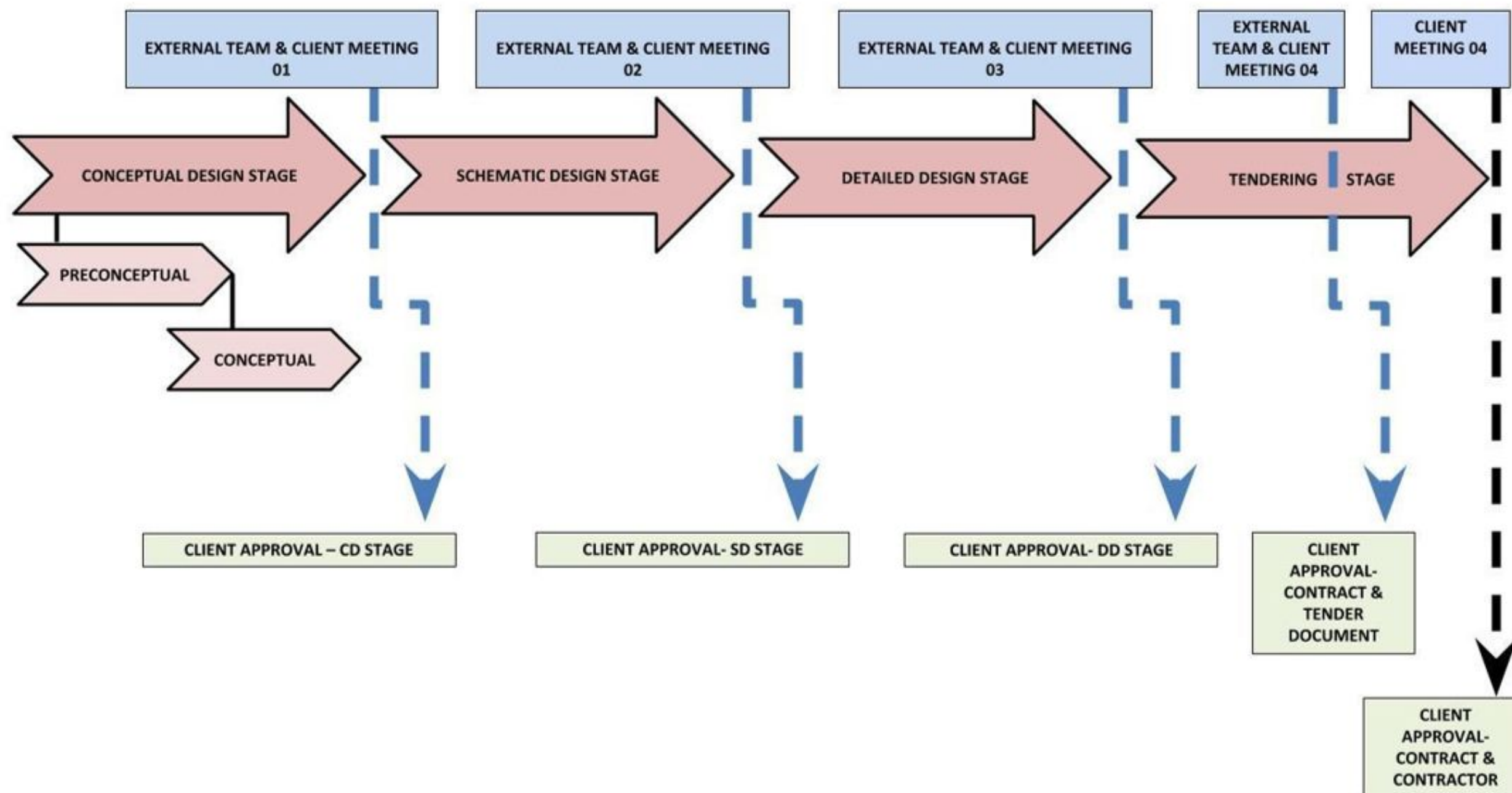
PHASE	PROBLEM IDENTIFIED BASED ON CHALLENGES	IDEAS
DESIGN DOCUMENTATION	DELIVERY, DOCUMENT, CHANGE, REVISION, STANDARD COMMUNICATION & COORDINATION AND SCOPE MANAGEMENT: - I wonder if that means there is no methodology for understanding client needs. - users - form & function process - stakeholders - Safety - comfort - aesthetics - Boundary conditions - time,budget, - government bylaw compliance - sustainable compliance - structural compliance - local cultural compliances - vastu compliance - medium of communication - I wonder if that means there is no methodology for documenting the client's needs and getting approval. - I wonder if that means there is lack of clarity in the documents & drawings provided by clients & various stakeholders respectively. - I wonder if that means the contractors & client mis interpret the drawings and specification due to lack of clarity and readability . - I wonder if that means there are no proper drawings & documents to support building permits.	- A method of detailed checklist- deliverables & parameter - Prior planning of deliverables for each drawing phase - Meeting with clients & various stakeholders for final clarification - Minutes Of Meeting - WBS shall have real-time work schedule - Design phase - setting Milestones - Design Phase - last planner system - Effective document, change, revision, transmittal management - Standard Formats - Transmittals - Integrated design approach - collaboration - Submission Alarm / trigger - approval / information/ response - clear drawing, level of detailing & presentation- stakeholder based - Data collection planning & management - submittals & transmittals - PDCA - In Competence With contract, Client requirement, project requirement, government by laws, Specification, Work Methodology For Establishing Competency Of The Project - Clear Drawings & Documents, & No Hidden Clauses / Details In Transmittals. - All On Same Page - Cloud platform for scheduling of start-end date & time to get approval from clients & all stakeholders - User requirement document & project requirement - by laws - codes - site analysis document - Effective Common Communication & Coordination Platform - SOFTWARE / APP - 24/7 Accessible for all stakeholders - Flock, Coaspect - Planning , scheduling of milestones of activities & deliverables- design phase - Work & submission - Reminder alarm, - Data collection planning & management - submittals & transmittals - Call recording - Mails 2d & 3d softwares accessibility - Documentation, reference, revision & change management. - Standard format & checklists - drawing & document - transmittals - Cycle time for each activity predetermination - establish flow chart - Clear drawings & Documents, & no hidden clauses / details in transmittals.

PROBLEM - SOLUTION : PRE- POST- DESIGN PHASE

PHASE	PROBLEM IDENTIFIED BASED ON CHALLENGES	IDEAS
POST-DESIGN PHASE	COMPETENCY, DELIVERY, PAYMENT, DOCUMENT, CHANGE, REVISION, STANDARD COMMUNICATION & COORDINATION AND SCOPE MANAGEMENT: - I wonder if that means there are repeated changes from clients. - I wonder if that means there are no timely sequential tendering processes. - I wonder if that means there is client payment scheduling is affecting - I wonder if that means the delay in Govt. approvals affect workflow. - I wonder if that means the delay from other consultants approvals. - I wonder if that means lack of effective: - Delay Management - Time Management - Document management - submittal & transmittals - Change management - Communication management - Information & flow management - Needs management	- Prior approval of design from client & stakeholders through email - A timeline can be set prior to the schedule so that work can be efficient - Preparation for Govt approvals shall commence ahead of schedule - Discussion & coordination with PMC - PDCA - A method of detailed checklist- deliverables & parameter - Prior planning of deliverables for each drawing phase - WBS shall have real-time work schedule - Design phase - setting Milestones - Design Phase - Effective document, change, revision, transmittal management - Standard Formats - Transmittals - Integrated design approach - collaboration - Submission Alarm / trigger - approval / information/ response - clear drawing, level of detailing & presentation- stakeholder based - Data collection planning & management - submittals & transmittals - PDCA - In Competence With Contract Document, Specification, Work Methodology For Establishing Competency Of The Project - Clear Drawings & Documents, & No Hidden Clauses / Details In Transmittals. - All On Same Page - Cloud platform for scheduling of start-end date & time to get approval from clients & all stakeholders - Effective Common Communication & Coordination Platform - SOFTWARE / APP - 24/7 Accessible for all stakeholders - Flock, Coaspect: - Planning , scheduling of milestones of activities & deliverables- design phase - Work & submission - Reminder alarm, - Data collection planning & management - submittals & transmittals - Call recording - Mails 2d & 3d softwares accessibility - Documentation, reference, revision & change management. - Standard format & checklists - drawing & document - transmittals - Cycle time for each activity predetermination - establish flow chart - Clear drawings & Documents, & no hidden clauses / details in transmittals.

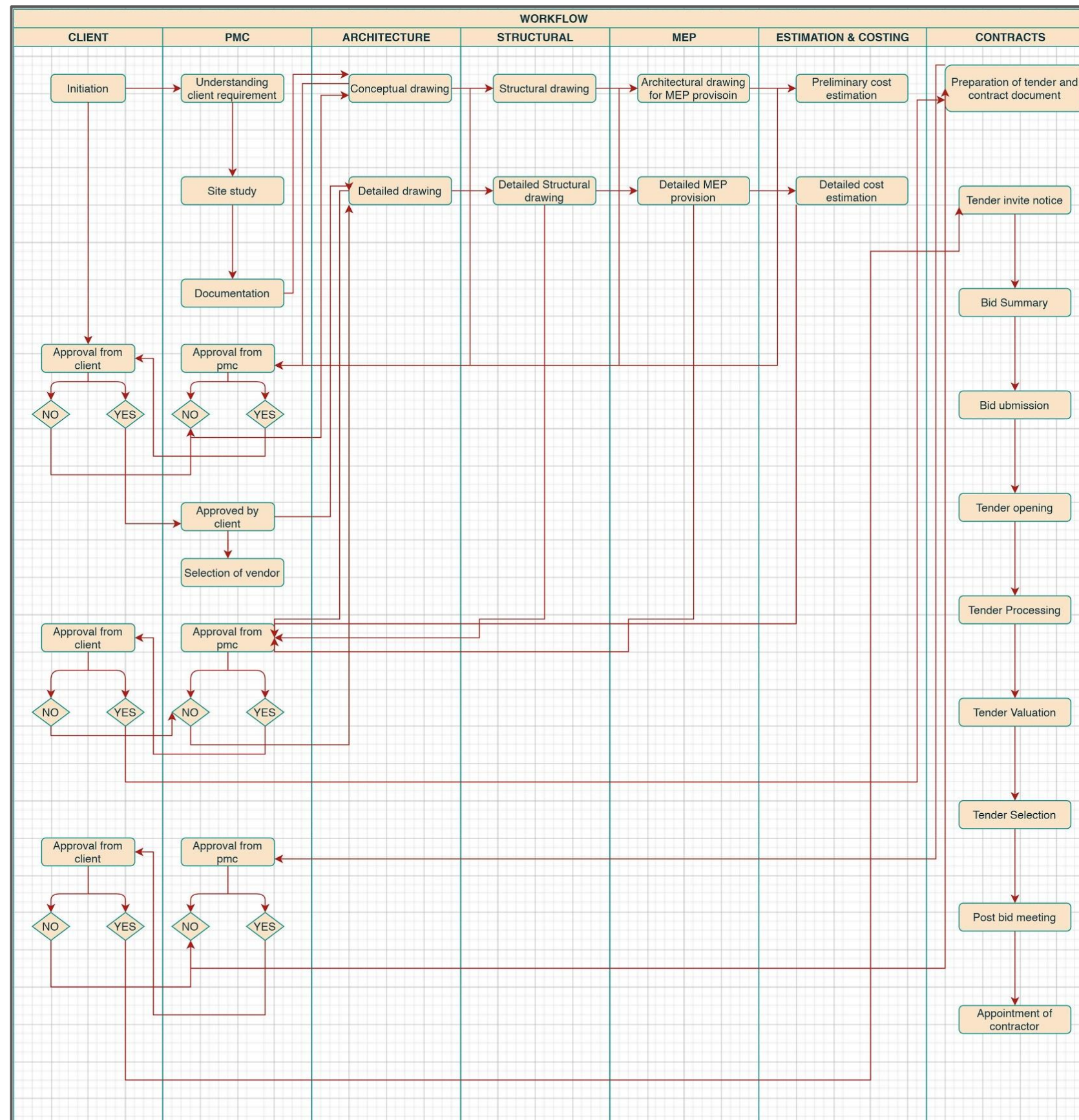
DIFFERENT PHASES OF DESIGN DELIVERY

WORKFLOW OF DELIVERABLES FROM DESIGN CONSULTANTS TO PMC - DESIGN PHASE



HEADING: DIFFERENT PHASES OF DESIGN DELIVERY - SWIMLANE

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HEADING: DELIVERABLES - DIFFERENT PHASES OF DESIGN DELIVERY

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	DESIGN PHASES – CONCEPTUAL & SCHEMATIC STAGE					
PMC – PRE CONCEPTUAL	ARCHITECT TEAM- CONCEPTUAL	STRUCTURE TEAM - CONCEPTUAL	MEP TEAM - CONCEPTUAL	COSTING & ESTIMATION TEAM – CONCEPT		PMC - Conceptual
				PRE CONCEPTUAL	CONCEPTUAL	
1. Client consultation	1. Client consultation	1. Inference from Understanding : - Architecture layout - Purpose of the building - Budget Constraints - Client Specifications w.r.t Materials - Site Layout - Site survey Report - Soil Data / Geological report - Contour mapping - Material Specifications - Local Regulations(CMD A) - Sequencing of Activities	1. Preliminary load calculations	1. Preliminary Cost Estimation - A cost prediction based on size and/or capacity of a proposed project.	1. Technical Specification	1. Client meeting scheduling
2. User requirement document	2. User requirement document		2. MEP Plant Area Calculations	2. Approval & information from PMC	2. B.O.Q	2. Executive summary – URD & Calculations, Drawings
3. Definition: scope, features, purpose, and functionality	3. Definition: scope, features, purpose, and functionality		3. Highlight areas where improvement can be made	3. Approval & information from Client	3. Scope of work	
4. Existing site conditions survey and documentation	4. Existing conditions survey and documentation		4. Define Engineering strategy & Parameters in relation to building structure		4. Detail of measurement – Abstract	
5. Photographs	5. Photographs		5. Concept report		5. Detail of measurement	3. Agenda for meeting with client
6. Measurements	6. Measurements		6. Fee proposal		6. Vendor enquiry	4. Client meeting
7. Compile existing drawings if any	7. Compile existing drawings if any		7. Approval & information from PMC		7. List of Vendors & supplier	5. Minutes of meeting
8. Programming space and use	8. Programming space and use	2. Restrictions to be followed	8. Approval & information from Client		8. Material & Equipment Selection – Vendor & Supplier	6. Approval & information from Client
9. Code review	9. Mind mapping	3. Soil Bearing Capacity			9. Basic Rates	7. Information / supporting documents from client
10. Understanding – client & project requirement, site conditions & bylaws	10. Bubble diagram	4. Foundation typology			10. Unit Price Cost Estimation	
11. Mind mapping	11. Conceptual sketches	5. Defining Loads			11. Assembly or Conceptual Cost Estimation	
12. User requirement document (URD)	12. Prepare base drawings	6. Load calculation - preliminary			12. Approval & information from PMC	
13. Approval & information from Client	13. Statement of probable build/construction cost	7. Preliminary idea about Design, Dimension, location , spacing - Foundation, Excavation, column, plinth beam, lintel & roof beam			13. Approval & information from Client	
	14. Code review	8. Preliminary Material identification & Scope of work				
	15. Approval & information from PMC	9. Comparison & Consolidated Data				
	16. Approval & information from Client	10. Approval & information from PMC				
		11. Approval & information from Client				

HEADING: DELIVERABLES - DIFFERENT PHASES OF DESIGN DELIVERY

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DESIGN PHASES –SCHEMATIC STAGE					
SCHEMATIC DESIGN STAGE	ARCHITECT TEAM - SCHEMATIC DESIGN STAGE	STRUCTURE TEAM – SCHEMATIC DESIGN STAGE	MEP TEAM - SCHEMATIC DESIGN STAGE	COSTING & ESTIMATION - SCHEMATIC DESIGN STAGE	SCHEMATIC DESIGN STAGE
1. Conceptual architectural, structural & MEP drawings & Conceptual Prelim Quantity & Estimation 2. Assumption log, risk register 3. Activity list, project schedule network diagram – DESIGN PHASE 4. Planning, WBS & scheduling of activities – DESIGN PHASE. 5. Approval & information from client	1. Floor plans of all levels with generic openings and plumbing fixtures 2. Site plan 3. Working plan 4. Column layout & centre line 5. Sectional drawing 6. Elevation drawing 7. Exterior building elevations with representative openings and finishes 8. Building cross-section 9. Typical wall section 10. Finishes 11. 3d models , walkthrough 12. Prototype 13. Approval & information from PMC 1. Approval & information from client	1. Defining Loads 2. Load calculation 3. Schematic idea about Design, Dimension, location , spacing - Foundation, Excavation, column, plinth beam, lintel & roof beam 4. Schematic Drawing: • Excavation Drawing represents the footing excavation dimension, column position, footing plan and grid lines of column. • Column Layout This drawing represents the position and orientation of columns and column reinforcement details. • Plinth Beam Layout This drawing represents the dimensions, position and section of plinth beam and the details of reinforcement in plinth beam. • Lintel Beam Layout This drawing represents the dimensions, position and section of lintel beam and the details of reinforcement in lintel beam. • Roof Beam and Shuttering Layout This drawing represents the details of reinforcement of roof beam, its section and shuttering details. 5. Preliminary Material identification & Scope of work 6. Approval & information from PMC 7. Approval & information from client	1. Preliminary engineering design and calculations 2. Location of services – determining 3. Preliminary engineering drawing & Space planning 4. Drawing issue sheets 5. Coordination drawing - preliminary 6. System configuration & equipment selection 7. Value Engineering & Alternative design solutions 8. Schematic design basis report 9. Approval & information from PMC 10. Approval & information from client	1. Technical Specification 2. B.O.Q 3. Scope of work 4. Detail of measurement – Abstract 5. Detail of measurement 6. Basic Rates 7. Unit Price Cost Estimation 8. Assembly or Conceptual Cost Estimation 9. Approval & information from PMC 10. Approval & information from client	1. Schematic architectural, structural & MEP drawings 2. Assumption log, risk register 3. Activity list, project schedule network diagram 4. Preliminary specification, cost estimate, basis of estimates 5. Project document updates 6. Planning, WBS & scheduling of activities – DESIGN PHASE. 7. WBS & Resource breakdown structure, organization chart – Construction 8. Executive summary 9. Agenda for meeting with client 10. Minutes of meeting

HEADING: DELIVERABLES - DIFFERENT PHASES OF DESIGN DELIVERY

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DESIGN PHASES – DETAILED DESIGN PHASE					
PMC - DETAILED DESIGN STAGE	ARCHITECT TEAM- DETAILED DESIGN STAGE	STRUCTURAL TEAM- DETAILED DESIGN STAGE	MEP - DETAILED DESIGN STAGE	COSTING & ESTIMATION - DETAILED DESIGN STAGE	PMC - DETAILED DESIGN STAGE
- Schematic Drawing & Preliminary Costing – Approval & Information From Client - Minutes Of Meeting – Schematic Stage	- Floor plans with a proposed basis of design openings and plumbing fixtures - Site plan - Working plan - Column layout & centre line - Sectional drawing - Elevation drawing - Approval drawing - Overall dimensions - Structural grid dimensions - Interior wall dimensions - Exterior elevations with a proposed basis of design openings and finishes - Additional building sections - Wall sections at all typical conditions - Typical details & general note - Finishes 3d models , walkthrough - Prototype - Additional details to establish a basis for design products - Good for construction drawing - Approval & Information from PMC - Approval & information from client	- Defining Loads - detailed - Detailed Load calculation - Detailed idea about Design, Dimension, location , spacing - Foundation, Excavation, column, plinth beam, lintel & roof beam - Detailed Drawing: - Excavation Drawing - Column Layout - Plinth Beam Layout - Lintel Beam Layout - Roof Beam and Shuttering Layout - Approval & Information from PMC - Approval & information from client	- Load distribution schedule - Local authority standards & regulation - Quality assurance plan & procedure - Finalized design criteria - Detailed drawings with all floor & external layouts: - Plumbing plans, schedules, details, and notes - HVAC plans, schedules, details, and notes - Electrical power and lighting plans, schedules, details, and notes - IBMS System - Coordination detailed drawing - Coordination with other stakeholders - Building Information modelling - Vendor & supplier – list - Material & Equipment selection - Final design report - Approval & Information from PMC - Approval & information from client	- BOQ template - Finalised rates - Detailed or Definitive Cost Estimation - Detailed B.O.Q - Approval & Information from PMC - Approval & information from client	- Cost forecast, cost baseline - Detailed duration estimate - Risk response document - Detailed or definitive cost estimation - Detailed B.O.Q - Executive summary agenda for meeting with client - Minutes of meeting

MEP DELIVERABLES

MECHANICAL (HVAC):

- Heat load calculation
- Project Scheme Design
- Equipment Selection
- Air distribution Scheme & piping design
- Ventilation systems
- Staircase / lift well pressurisation system
- Control system

ELECTRICAL:

- Project Scheme Design
- Details of electrical fixtures,
- Location of switches, fan, light and others.
- HT / LT Distribution system
- Electrical load calculation
- Back-up Power Arrangement
- Cabling & Bus Riser System
- Panel & Cable schedule
- Lighting & Power Scheme design
- Earthing & Lightning
- Lighting & Renewable

PHE

- Location Of Sanitary, Piping For Water Supply System, Fixture, And The Process To Connect Every Fixture.
- Project Scheme Design
- Water Demand Calculation
- Water Storage & Distribution
- Drainage System
- Rain Water Harvesting
- Sewage Treatment Plant
- Fire Hydrant & Sprinkler System

IBMS:

- Fire Alarm System
- Public Address system
- Access Control system
- Integrated building management system
- Tele-communication system
- CCTV System
- Parking management system

HEADING: DELIVERABLES - DIFFERENT PHASES OF DESIGN DELIVERY

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DESIGN PHASES – TENDER DOCUMENT					
PMC TEAM - TENDER DOCUMENT	ARCHITECT TEAM – TENDER DOCUMENT	STRUCTURAL TEAM - TENDER DOCUMENT	STRUCTURAL TEAM - TENDER DOCUMENT	COSTING & SCHEDULING TENDER DOCUMENT	PMC TEAM - TENDER DOCUMENT
- Detailed Architecture, Structural And MEP Drawings & Detailed Quantity, Estimation & B.O.Q– Approval & Information From Client - Minutes Of Meeting – Detailed Stage	- Floor plans fully annotated - All dimensions - Room, wall, door, and window identification - Section and detail indicators - General notes and detailed notes - Exterior elevations fully annotated - All building sections required for construction - Wall sections at all conditions - Good for construction drawing - Approval & Information from PMC - Approval & information from client	- Tender drawing: - Excavation Drawing - Column Layout - Plinth Beam Layout - Lintel Beam Layout - Roof Beam and Shuttering Layout - Specification - Approval & Information from PMC - Approval & information from client	- Tender - Detailed drawings with all floor & external layouts: - Plumbing plans, schedules, details, and notes - HVAC plans, schedules, details, and notes - Electrical power and lighting plans, schedules, details, and notes - IBMS System - Technical Specification - Approval & Information from PMC - Approval & information from client	- Detailed or Definitive Cost Estimation - Detailed B.O.Q - Approval & Information from PMC - Approval & information from client	- Tender & contract document - Detailed architecture, structural and MEP drawings - Good for construction drawing - Detailed or definitive cost estimation - Detailed B.O.Q - Tender & contract document - Executive summary – CLIENT Meeting - Agenda for meeting with client - Minutes of meeting – to client - Approval & information from client - List of contractors - Tender invite notice - List of contractors – selected - Executive summary – CLIENT Meeting - Agenda for meeting with client - Minutes of meeting – to client - Approval & information from client - Appointment letter / offer letter

LESSONS LEARNT:

1. WBS for RCC Building & PEB Building
2. Preparing Schedule - Master Schedule, Last Planner, 6 Weeks or 2 Weeks Look Ahead Schedule, Weekly Work Plan / Production Plan
3. Project Co-ordination during design stage
4. Stakeholder Management
5. A3 Problem Solver
6. A3 Design Thinking
7. A3 Big Picture
8. Lean PM System, its Principles and Tools and their Practical Implementation
9. Hazardous Cell Storage Building- Bylaws and Project Requirements
10. Work Flow Process for:
 - a. Design Delivery
 - b. Project Management
 - c. Construction Project Management
11. Swimlane Diagram
12. False Ceiling & Partition - Material and Work Methodology
13. Project/ User Requirement Document
14. Scope Documentation
15. Agri Food Supply Chain
16. Method to track Site Activity- Weekly / Forthright
17. Formats for:
 - a. Kick off Meeting
 - b. M.o.M
 - c. Agenda
 - d. Questionnaire
 - e. A3 Design Thinking
 - f. A3 Problem Solver
 - g. A3 Big Picture
 - h. PRD/ URD
18. Methods of Documentation

CRITICAL OVERVIEW

The Internship training for 111 days out of 123 days of 4 Months (19 May 2020 to 21st August 2020 & December 2020) was overall an enriching experience. I am very grateful to be given chance to undergo my training at four of the challenging project Management firm of Engineering Project Management Consultancy and Research (EPMCR). I tried my level best to go through all the departments and understand their roles and responsibilities and also learn the lean project management system. The training made me understand the importance of time, cost, scope, quality and safety for a project success along with the importance of value added activity and a needs to avoid and the methods to avoid nonvalue added activity by using lean thinking, principles and tools. This perhaps thought me smaller milestone planning by removing the constraints prior executing the activity and continuous learning along with the requirement for human centric Design approach and equal importance to transform, value generation and flow management for the successful & uninterrupted outcome.

An internship at this stage helped me practically understand how to coordinate the various work between different departments like MEP, Architectural, structural, costing and management, understand how to implement Lean PM System and Project Planning for PEB Building. Hence I had a good amalgamation of technical as well as managerial skills which made these 4 Months of training a memorable experience and will carry all my learnings for my future endeavours. I thank all, the board of directors, staffs of EPMCR who provided their assistance during my internship.

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THANKYOU